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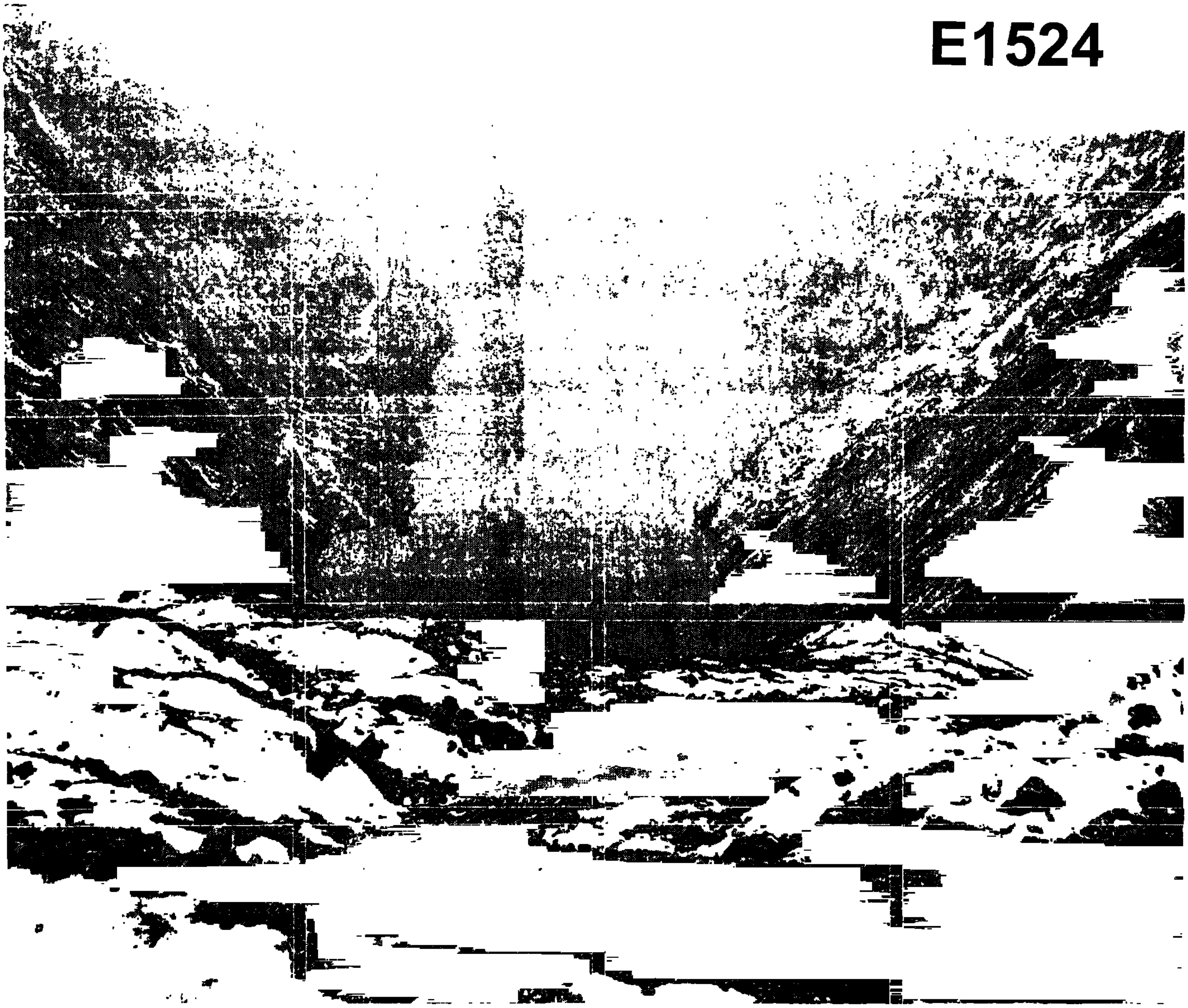

Environmental Assessment of RTB Bor Operations - Final Report

August 2006

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Environmental Assessment of RTB Bor Operations - Final Report

11 August 2006

Reference 0041869

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CONTENTS

EXECUTIVE SUMMARY

BACKGROUND AND METHODOLOGY

The Consortium led by Environmental Resource Management (ERM) Ltd and supported by Fideco d.o.o. and CSA Group Ltd was commissioned by the Privatisation Agency of the Republic of Serbia (PA), to undertake the "Environmental Assessment of the Environmental Damages from Past Operations of RTB Bor" in November 2005.

The Project is aimed at the preparation of an Environmental Assessment for RTB Bor operations including an assessment of environmental damages from past operations, determining the environmental issues and the required clean-up measures.

This document represents the Final Environmental Assessment Report for the study and presents the work undertaken in the frame of the Project by the Consultants, focusing on the description of Environmental Baseline, identification of Environmental Impacts deriving from Past and Current activities undertaken at the Complex and the proposed Environmental Management Plan (EMP).

The EMP includes an Action Plan with Mitigation Measures description and an Environmental Monitoring Plan. In addition, a list of Recommendations for the Institutional Strenghtening and Legal Framework development is included in the report as part of the Legislative and Institutional Framework review reported in Annex C. Finally, the two steps consultation process is described by means of the two reports from the First and Final Local Consultation Meetings, reported in Annex E.

Adopted methodology for the environmental assessment included:

1. *description of the environmental baseline through data collection and elaboration with regard to environmental setting and available monitoring data related to air, water, soil, public health, flora, fauna, rare or endangered species and sensitive habitats. The environmental baseline has been defined relying on data supplied by site management, municipalities, universities and other entities; no additional monitoring has been undertaken;*
2. *identification of pressure factors – in particular, analysis of the RTB Bor Complex through general data collection, site inspections, interviews with site management and local consultation process;*
3. *impact assessment through comparison of environmental data with Serbian regulatory requirements and WB/EU standards and gap analysis with regard to existing international standards of good practice management; an analysis of privatisation options/alternatives was undertaken to ascertain relation of the proposed privatisation/restructuring plan with the environment;*
4. *preparation of an Environmental Management Plan including: a) preliminary mitigation measures to be undertaken; mitigation measures have been qualitatively prioritised based on an "urgency criterion"; b) preparation of an Environmental Monitoring Plan with the aim of completing environmental data collection and of verifying effectiveness of mitigation measures.*

Site Description

RTB Bor Complex includes:

- *RBB copper mines in Bor, comprising:*
  - *Bor Mines (open pit and Jama underground mine) and Concentrator;*
  - *Veliki Krivelj Mines and Concentrator;*
  - *Cerovo Mine and Mill;*
- *RBM Copper Mine in Majdanpek;*
- *TIR Copper Smelter and Refinery Bor.*

RBB Bor and TIR smelter complex are located in the Bor District around the municipality of Bor, approximately 160 km far from Belgrade and 20 km from Zajecar. RBM Copper Mine is located close to the Bulgarian and Romanian borders, approximately 210 km far from Belgrade and about 40 km north-east of Bor settlement, south of Majdanpek village and at a distance of about 15 km from the Danube.

The sites were first developed at the beginning of 1900 for copper ore exploitation. The site is presently involved in copper ore drilling, crushing, milling and flotation (at Bor, Veliki Krivelj and Majdanpek) for subsequent smelting and refinery of copper in the TIR plant of Bor. Activities are currently decreasing due to reduced content of copper in the ore and lack of investments and maintenance due to economic difficulties of the Complex.

Privatisation and Restructuring of RTB Bor

It is currently ongoing a Project "Restructuring and Privatization of RTB Bor" which encompasses RTB Bor (Parent Company), RB Bor (RBB), RB Majdanpek (RBM) and Smelter and Refinery (TIR). The consortium in charge of the Project on behalf of the Privatization Agency of the Republic of Serbia ("PA") is constituted by CA IB, Deloitte, Harrisons Solicitors and the subcontracted IMC.
After thorough consideration of various options, Sale of Assets has been recommended as the most appropriate privatization/restructuring method. The subject recommendation was made upon the cross-assessment of the social, financial and legal implications, as well as the expressed market interest. Special consideration was given to the required time for the implementation of each possible option, and the Sale of Assets is obviously the fastest method.

The Consortium anticipates that the assets will be sold as part of the following groups:

- *RBB core assets;*
- *Veliki Krivelj, flotation and Cerovo assets; Jama assets (including Borska Reka deposit) and flotation;*
- *TIR core assets;*
- *RBM core assets.*

The structure and time frame of the sale process will be presented in the Action plan, which will encompass specific activities, responsible parties and define project implementation deadlines. The outputs of the EA will be incorporated in the Action plan to include environmental liabilities in the Sale process.

ENVIRONMENTAL IMPACTS

Main environmental issues identified at the sites are reported in the following paragraphs grouped by impacted media (air, wastewater, waste, soil and groundwater).

Meteorology and Air Quality

Bor and its surroundings are characterised by continental climate. Prevailing winds are from WNW but also from east. Winds from North and South are practically absent.

With regard to air quality, current monitoring is undertaken by means of four stations: Gradski-Park, approximately 500 m E from the smelter stack; Copper Institute, about 1 km SW from the smelter complex; Electroistok Yugopetrol, about 2 km SE of the smelter and Brezonik, a community about 2.5 km N of the smelter. Key data with regard to air quality are reported in the following Table:

Table E.1 ***Air Quality in Bor (2004)***

Parameter	Location of sampling point	Emission detected* (μg/m^3)	Serbian limits* (μg/m^3)
particulate	Copper Institute	10 (max 63)	50
sulphur dioxide	Electroistok Yugopetrol	126 (max 1,508)	50
arsenic	all stations	ranging between 4,5-224	6

* annual average

Also Majdanpek climate is of continental type. Prevailing winds are from ENE and W.

With regard to air quality in Majdanpek, no recent monitoring data are available. In the past, air quality in the region was found to have been mainly affected by particulate.

Air emissions

Major emission sources in Bor area are recognised to consist of stacks from the TIR smelting complex which have high emissions of sulphur dioxide (annual average concentrations in 2004 up to 16,000 mg/Nm^3 against a limit of 2,000 mg/Nm^3) and particulate (annual average concentrations in 2004 up to 1,200 mg/Nm^3 against a limit of 20 mg/Nm^3). Additional sources of emissions to air include: sulphur dioxide and particulate from power plants, particulate from mining activities both underground and crushing/milling processes, wind blown particulate from tailing ponds and spoil heaps.

Major emission sources in Majdanpek are recognised to consist of particulate from RBM mining activities due to crushing/milling processes and wind blown particulate from tailing ponds and spoil heaps.

Surface Water Quality

Monitoring activities in the vicinity of Bor Complex in Timok, Bor, Kriveliska and Bela rivers have been carried out in recent years. Several exceedings of Serbian for heavy metals (mainly copper and nickel) and suspended solids were recorded in Bor, Kriveliska and Bela rivers (copper concentrations up to 16 mg/l against a limit of 0.1 mg/l). Also in Majdanpek were carried out analysis of Mali Pek and Veliki Pek rivers and exceedings of suspended particles, iron and copper were recorded.

This situation is mainly derived b y the leaching of waste and overburden heaps located in the Bor area and by RBB and TIR liquid effluents discharge.

Wastewater Discharges

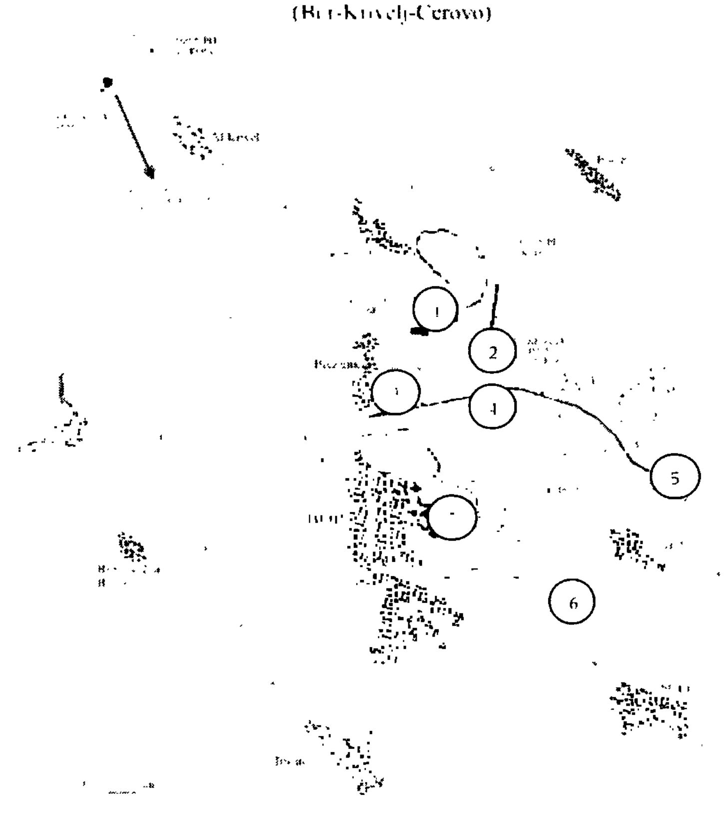
With regard to wastewater effluents generated at Bor, main sources of wastewaters include effluents from underground mine (blue waters) and drainage waters collected at the bottom of open pits (Bor, Veliki Krivelj and Cerovo), wastewaters from the smelting complex comprising sulphuric acid plant WW, spent electrolyte solutions and blowdowns; runoff from overburden disposal sites and waste heaps leaching.

Major effluents generated are reported in the following Figure:

Figure E.1 ***Wastewater Effluents Generated at Bor***

THE BOR COPPER MINES

(Bor-Krivelj-Cerovo)



Legend

1: Effluents from open pit Veliki Krivelj

2: Run-off from overburden storage discharged in to the water stream Saraka

3: Effluents from Jama underground mine (blue water)
4: Drainage waters from the tailing dam 1A
5. Drainage waters from the tailing dam 3A
6. Wastewater from lake Robule, collecting stormwater runoff from overburden disposal sites
7. Mixed effluents including drainage water from open pit Bor and from smelter

Based on analytical results of monitoring undertaken on the generated effluents in 2005, presence of concentrations above Serbian limits of heavy metals (Cu, As, Zn, Fe and Ni above Serbian limits) and highly acidic pH are detected.

With regard to wastewater effluents generated at Majdanpek, main sources of wastewaters are limited to mining activities – drainage waters collected in open pits (North and South) and runoff from overburden disposal sites and waste heaps leaching which are currently not monitored. Minor effluents include water from filtration of tailings and wastewater from the light workshop and heavy service.

Waste Management

Main waste generated at Bor include overburden and tailings from mining activities, slags from blast furnace and insulating materials from the smelting process and other wastes including waste tyres, scrap metals, lubricating oils and spent accumulators. Waste generated at Bor are currently mainly open dumped.

Major open dumps are recognised to be present at Bor site, close to the tailing pond RTH and in the old open pit Bor. In addition, an open dump for municipal waste is located on the premises.

Main waste generated at Majdanpek are overburden and tailings from mining activities and other wastes including waste tyres, scrap metals, lubricating oils and spent accumulators.

Waste are stored at different locations throughout the sites. No formal waste management procedures are in place at the sites and waste generated are generally on site temporarily stored waiting to be re-used or sold out or on site dumped.

Based on available information and interviews conducted at the site, waste have historically been on site abandoned/dumped and the same procedure is currently in place with the exception of secondary raw materials that can be sold or reused at the site (metal scraps, redundant equipment, spent batteries, exhausted oils). Waste are generally placed directly on the ground, without any soil protection devices and any mitigation measures to avoid stormwater runoff contamination and fugitive emissions to air of dusts and vapours.

Soil, Groundwater and River Sediments

Quality of soil, groundwater and river sediments

Controls have been carried out on drinking water wells and no significant quality problem was identified so far. On the contrary, no sufficient information is available about the quality of first aquifer: further monitoring is needed. Only few soil quality measurements have been undertaken in Bor vicinity. Only copper resulted in some samples above Serbian limits. River sediments taken from the Bor and Kriveliska *rivers resulted to be highly polluted: copper concentration was found to reach 3,000 mg/kg and arsenic concentration up to 300 mg/kg.*

Sources of Contamination

Key identified sources of soil and groundwater contamination at Bor include:

- *wet/dry deposition of air pollutants deriving from the smelter and dusts from tailing ponds, open dumps and waste heaps;*
- *historical and current waste dumping and contaminated stormwater infiltration into the ground and leakage from the underground pipeline connecting Cerovo open pit to Bor;*
- *historical and current discharge of contaminated effluents into surface watercourses and consequent sediments contamination.*

Key identified sources of soil and groundwater contamination at Majdanpek include:

- *wet/dry deposition of particulate from tailing ponds;*
- *historical and current discharge of contaminated effluents into surface watercourses and consequent sediments contamination.*

ENVIRONMENTAL MANAGEMENT PLAN

Mitigation Measures

Air Quality and Emission to Atmosphere

With regard to Bor, main recommended mitigation measures include smelter modernisation plan or closure (as recommended also by the specific SNC Lavalin study), power plant to be equipped with electrofilters rather than with cyclones, revegetation of tailing ponds to abate particulate dispersion and crushing/milling plants to be fitted with ventilation/particulate abatement devices.

With regard to Majdanpek, main recommended mitigation measures include revegetation of tailing ponds to abate particulate dispersion and crushing/milling plant to be fitted with ventilation/particulate abatement devices.

Wastewater effluents

With regard to Bor, major mitigation measures to be implemented include:

- *chemical-physical wastewater treatment to be provided prior to discharge into surface water of effluents from Jama and from the smelter;*
- *treatment of drainage water collected in the open pits and final rehabilitation of the pits; and*
- *treatment of leachates from spoil heaps and overburden and final requalification of waste heaps.*

With regard to Majdanpek, proposed mitigation measures are limited to the evaluation of the opportunity of recycling the effluents from the filtration process and crushing into the flotation. This option has to be ascertained, since provision of a dedicated treatment plant is considered not economically sustainable. Based on results of monitoring of drainage water collected in the open pits and of leachates from spoil *heaps and overburden (to be analysed for acidity, heavy metals including arsenic), need of treatment should be assessed.*

Waste Management

Recommended Mitigation Measures at both sites consist of:

- *Future Waste Generation - open dumping of waste must be stopped and an adequate temporary storage area should be provided;*
- *Existing solid waste - open dumps have to be immediately secured; an inventory of dumped waste and related risk assessment must be undertaken; waste capping/removal to be carried out.*

Soil and Groundwater Contamination

Due to the lack of detailed geological and hydrogeological data and comprehensive soil and groundwater quality information, no soil remediation can be recommended at this stage except for the replacement/repair of Cerovo-Bor underground pipeline.

The environmental setting has been severely influenced by historical mining activities which deeply impacted geology, hydrogeology and hydrology. This aspect makes very complicated any identification of environmental impact with specific regard to soil and groundwater aspects. In addition, many environmental data are available, but there is a lack of some key data e.g. adequate topographical maps, geological and hydrogeological sections. In summary, although some soil and presumable shallow groundwater contamination is likely to have been occurred, the high level of uncertainty does not allow at this stage to propose any soil remediation before appropriate soil monitoring is undertaken.

Prioritisation of Mitigation Measures

The Privatisation and Restructuring Program poses a number of technical issues but also a high level of uncertainty in the environmental data of which the assessment had to take into account in the process of issues description and mitigation measures/clean up interventions identification in one of the most polluted areas in this part of Europe.

From a qualitative point of view, it can be pointed out that the key issues at the complex are the very bad quality of air, which need urgently an intervention (closure of air polluting sources – mainly identified in the smelting complex – or modernisation of this plant) and the discharge of untreated effluents from mining activities, characterised by acidic pH and high content of heavy metals, into surface watercourses, which requires installation of adequate wastewater treatment plants and/or prevention of generation of these effluents by means of modelling and revegetation of open pits and overburden heaps. In addition to these two aspects, it is anticipated that soil and groundwater contamination may pose an additional, severe risk, that can not be quantified at this stage due to a general lack of data.

Due to the fact that the situation is so complex, a phased approach is proposed by the Consultants focusing on realistic, gradual interventions to be prioritised by means of an urgency criterion. In particular, identified environmental issues have been classified as immediate or chronical high risk issues both with regard to the people and the environment.

According to this approach, the following criteria have been adopted for prioritisation:

- *Immediate, high risk issues both with regard to the people and the environment have been classified as priority 1.*
- *Chronical high risk issues have been classified as priority 1, 2 or 3 based on gravity of consequences:*

    Priority 1 - Immediate, high risk issues both with regard to the people and the environment and chronical high risk issues that pose a real, actual threat with regard to the people;
    Priority 2 - Chronical high risk issues with regard to the environment;
    Priority 3 - Chronical high risk issues mainly related to environmental liabilities

A summary of main proposed Mitigation Measures with assigned priority is reported in the following table.

Table E.2 Prioritisation of Proposed Mitigation Measures

Issue	Mitigation Measure	Priority
Air Quality	**Bor**	
	smelter modernisation plan (different options) or closure	1
	revegetation of tailing ponds and spoil heaps	1
	crushing/milling plants to be fitted with ventilation&particulate abatement devices	2
	power plant to be equipped with electrofilters	2
	Majdanpek	
	crushing/milling plants to be fitted with ventilation&particulate abatement devices	2
	revegetation of tailing ponds and spoil heaps	1
Waste water effluents	**Bor**	
	chemical-physical wastewater treatment to be provided prior to discharge into surface water courses of effluents from Jama and from the smelter	2*
	treatment of drainage water collected in the open pits and final rehabilitation of the pits	2*
	treatment of leachates from spoil heaps and overburden and final requalification of waste heaps	2*
	Majdanpek	
	the opportunity of recycling the effluents from the filtration process and crushing into the flotation should be ascertained since provision of a dedicated treatment plant is considered not economically sustainable.	2*
	based on results of monitoring of drainage water collected in the open pits and of leachates from spoil heaps and overburden (to be analysed for acidity, heavy metals including arsenic), need of treatment should be assessed	2*
Waste	**Bor**	
	Future Waste Generation - open dumping of waste must be stopped and an adequate temporary storage area should be provided	3**
	Existing solid waste - Open dumps have to be immediately secured; an inventory of dumped waste and related risk assessment must be undertaken; waste capping/removal to be carried out	3**
	Majdanpek	
	Future Waste Generation - open dumping of waste must be stopped and an adequate temporary storage area should be provided	3**
	Existing solid waste - Open dumps have to be immediately secured; an inventory of dumped waste and related risk assessment must be undertaken; waste removal to be carried out	3**
Soil Quality	**Bor**	
	A site specific survey should be undertaken at all open pits including data review, monitoring wells and boreholes drilling, corelogs preparation, freatimetry elaboration and reporting	1
	Surface soil sampling in an area of 5 km around the smelter - 80 sampling points individuated by concentric rings and radial vectors.	1
	Soil monitoring plan in the open dumps area with a 20*20 grid.	1
	River sediments' sampling every 250 m on the two banks	1
	Urgent replacement of the underground pipeline from Cerovo to Bor	1
	Majdanpek	
	A site specific survey should be undertaken at all open pits including data review, monitoring wells and boreholes drilling, corelogs preparation, freatimetry elaboration and reporting	1
	Surface soil sampling in an area of 2 km downwind the tailing ponds in the prevailing wind direction – about 40 sampling points individuated by radial vectors	1
	River sediments' sampling upstream and downstream discharge points	1
Tailing ponds	Stability analysis to be performed at all tailing ponds in Bor and Majdanpek including geotechnical investigation, new piezometers installations and stability evaluation	1
	Urgent measures e.g. seepage containment and silt wash containment	1
	Final rehabilitation of tailing ponds including side slopes and flat surface and revegetation	1
	Underground collector beneath Veliki Krivelj tailing ponds needs urgently intervention as already stated in a number of studies	1
	Bor collector needs remedial work analysis and design of potential options for intervention	1

** Assuming there is no connection with drinking water network*

*** Assuming that risk assessment results will not evidence any threat with regard to the environment or human health*

Environmental Monitoring Plan

A proposed Environmental Monitoring Plan (EMP) for the RTB Bor Complex has been developed with the aim to:

- *acquire new elements to complete the environmental data collection;*
- *provide an outline of a tool which will help to monitor the environmental data and the implementation and the efficiency of the proposed environmental mitigation measures.*

To achieve the above specified objectives, it is proposed to appoint an Environmental Advisory Committee (EAC), gathering a group of highly qualified experts, which will have the duty to guarantee the implementation of the proposed mitigation measures and monitoring activities, interpret monitoring results and suggest possible corrective measures.

The EAC could be formed by:

- *one representative of the Municipality;*
- *one representative of the Privatisation Agency;*
- *the new owner(s);*
- *one representative of the Ministry for the Environment;*
- *one representative of NGOs;*
- *representatives of local communities.*

The need for two separate EACs for Bor and Majdanpek should be considered. Environmental problems are quite different at the two sites and new owners might have different attitudes and environmental sensitivity.

One of the tasks of the EAC will be also to review the authority and capability of institutions at local, provincial/regional and national levels and recommend steps to strengthen or expand them so that the monitoring plan can be implemented. The recommendations may extend to new laws and regulations, new agencies or agency functions, intersectional arrangements, management procedures and training, staffing, operation and maintenance training, budgeting, and financial support.

Upon being formed, the EAC will begin an environmental monitoring training program for institutions, population and stakeholders on how to convey the importance of the monitoring plan, its goals and how their contribution and commitment could improve the success of the plan itself. Once a year, the EAC will arrange a public conference and present results and progress. Finally, the EAC will be responsible of public access to environmental data.

Monitoring Program

A 5 year monitoring program is to be developed and implemented, starting from the privatization process. This will allow for the establishment of background data and comparison of impacts before and after mitigation measures implementation.

The following monitoring activities are proposed:

Air Quality

- *continuous monitoring of air emissions from main stacks. Emissions of SO_2, particulate (including PM_{10}) and NO_x from the four main stacks (roasting furnace, smelting furnace, sulphuric acid plant and power plant) should be monitored on a continuous basis;*
- *spot sampling of air emissions. Quarterly monitoring is proposed at the four main stacks to investigate the chemical composition of particulate for heavy metals contents. In addition, emissions of SO_2, particulate (also for heavy metals) and NO_x from the other RBB, TIR and RBM stacks will be monitored every three months;*
- *air quality in the Bor District. An integral ambient air quality monitoring system is foreseen for SO_2, particulate (including fine particulate - PM_{10}) and NO_x. Pollutants concentration will be monitored on a continuous basis and every three months the chemical composition of particulate will be also investigated for heavy metals contents. With regard to the Bor Municipality, since four monitoring stations are already present, it is proposed to install 1-2 new ones. In addition, equipment for all the stations (existing and new) with fine particulate (PM_{10}) monitoring devices is recommended. With regard to the Majdanpek Municipality, since no monitoring stations are present, it is proposed to install at least one for particulate monitoring.*
- *air immissions in Bor and Majdanpek, up wind and down wind from tailing ponds and reclamation areas. Immissions of particulate (including PM_{10}) will be monitored on a continuous basis by means of dedicated monitoring stations to be installed upwind and downwind to each tailing pond, along the prevailing wind direction. Once a month, the chemical composition of particulate will be also investigated for heavy metals. Periodic reports will be issued (comparing the results with legislative limits) and sent to the Municipalities. A minimum of 8 monitoring stations are foreseen.*

Wastewater

- *flow rates monitoring. Flow rates of process water discharged will be monitored on a periodical/continuous basis in order to have reliable data for preliminary design of WWTP; the proposed survey will require close cooperation of water specialists with site personnel who should give specific input with regard to representativeness of data to be collected;*
- *effluents generated at Bor will be analysed before and after treatment to ascertain quality of effluents discharged and to monitor efficiency of WWTPs installed. Monitoring will be undertaken every three months, to ensure that all recorded parameters are in compliance with the legislative limits in force. The analysed parameters should be the following: pH, COD, TSS, metals including - as a minimum – Cu, Fe, Zn, As, Cd, Pb, Cr, Ni; standard water sampling equipment and laboratories are required;*
- *existing monitoring procedures in Majdanpek (quarterly) should be continued; in addition, it is suggested to monitor quality of water drainage from open pits and rainwater runoff from overburden disposal sites. Based on results of additional monitoring, (effluents to be analysed for acidity, heavy metals including arsenic), need of treatment should be assessed.*

Soil, Groundwater and River sediments

- *geology and hydrogeology. To complete the environmental baseline, a number of new piezometers are proposed (about 10 at every site) to have more site-specific information. In particular, the aim is to further investigate on geological sections, stratigraphy, depth of shallow aquifer and flow direction. Specific studies will have to be developed for Cerovo, Veliki Krivelj, Majdanpek northern and southern pit and a more extensive study for Bor;*
- *groundwater general quality with particular regard to the impact from the open pits. To verify the influence of the open pit mine on groundwater quality, two piezometers are foreseen, one upstream and one down stream in flow direction; monitoring should be undertaken on a periodical basis (quarterly for the first two years then the frequency might be annual in case no impact is detected);*
- *river sediments characterisation at Bor. Contaminated sediments along river banks (Bor river and Kriveljska river) will be analysed for pH, organic matter, mineral oil, hydrocarbons and heavy metals. The foreseen samples are approximately 200 (one every 250 m on the two banks, for an estimated linear extension of 25,000 m). Monitoring should be repeated once a year to ascertain the self-treatment of the river and to monitor eventual further impacts deriving from the RTB Bor Complex;*
- *river sediments characterisation at Majdanpek. Due to the lack of available data with regard to river sediments quality, a first screening is proposed to ascertain whether any impact is detected prior to proceeding with a comprehensive monitoring campaign. River sediments sampling from Mali Pek and Veliki Pek rivers) should be undertaken one point upstream of the outlet and two points downstream on the two banks (approximately 20 samples are foreseen at this stage). Sediment samples should be analyzed for: pH, organic matter, mineral oil, hydrocarbons and heavy metals.*
- *superficial soils quality. With regard to the Bor area, some samples of contaminated soils will be taken in an area (considered the most critical) of 5 km radius from the smelter, once a year. Eighty superficial soil samples will be collected and analyzed for pH, organic matter, mineral oil, hydrocarbons and heavy metals. With regard to Majdanpek, a surface soil sampling program is proposed in an area of 2 km from the tailing ponds. A total of 40 samples are foreseen to be analysed for pH, organic matter, mineral oil, hydrocarbons and heavy metals.*
- *soil quality at waste open dumps. Some samples of soils will be analysed for pH, organic matter, mineral oil, hydrocarbons and heavy metals. Grid sampling, based on a specified pattern with sample collection at regular intervals along that defined pattern is proposed. The foreseen samples are approximately 100 (on a sampling grid 20 x 20 m).*

Legal and Institutional Framework

With regard to the Legal and Institutional review undertaken in the frame of the project, it is highlighted that the legal framework for environmental management has gone through an important phase of development over the past few years. Four key new environmental laws have been adopted including a new Environmental Protection Law which sets out the overarching structure for a modern environmental management system. The new SEA and EIA laws are starting to work as a powerful *tool for working towards more sustainable development and the IPPC law sets out a framework for a modern environmental permitting system.*

A number of the necessary implementing regulations have been developed as well and more key regulations are expected to be adopted during 2006 including laws on air, waste, water and nature protection. They are all being developed according to EU standards and methodologies and aim to harmonise with EC Directives as much as possible.

The legal framework that is thus being built is of great significance as it provides for the establishment of an integral management system for natural resources, the introduction of the concept of sustainable development, prevention and control of pollution, informing the public and providing for participation in decision-making. These developments are addressing the previous problems related to the legal framework such as too many and conflicting laws, lack of regulation (e.g. for environmental permitting, environmental Fund, environmental management system), lack of public participation in decision-making, lack of clarity in terms of institutional responsibility etc.

In addition, autonomous province and local government are gaining more authority and a new and more important role in environmental management. There are still some problems connected to conflicts between the new environmental legislation and other laws such as the urban planning law which currently doesn't mention the need for EIA as part of the permitting process.

However, implementation and enforcement of this emerging modern legal framework is a great challenge and much remains to be done to make an impact on the ground.

Institutions at the local level cope with a lack of financial and human resources. They move towards creating greater financial independence such as through the set up of local environmental funds are a key step forward. Even though the funds expected to be collected are not nearly enough in comparison to the environmental infrastructure investment needed, they do provide a first step in the right direction and can serve as co-financing for attracting international funds. Much remains to be done in terms of training staff at the local level, set up stable coordination and cooperation mechanisms between different authorities and different levels of government, awareness raising on environment (outside as well as inside government), development of tools and guidance for the implementation of environmental laws, strengthening of the environmental inspectorate through training etc.

The following indications are given with regard to the legislative and institutional framework:

Legislation

- *Further development of the legal framework in line with EC directives as planned;*
- *Identification and removal of conflicts between new environmental legislation and other laws;*

- *Adoption of the new regulation on the environmental fund within the Bor municipality, as soon as possible.*

Institutional strengthening

EIA and Permitting

- *Development of further tools and guidance documents to help better implementation of the EIA law.*
- *Training on implementation of the EIA law and IPPC permitting system at all levels.*
- *Strengthening of the local municipality environmental office (additional experts, additional trainings and necessary equipment, better coordination between the environmental secretariat and other offices in relevant sectoral policies and between environmental secretariat and local and republican inspections).*
- *Established Local Environmental Fund and training of the experts.*

Inspection

- *Creation of coordination mechanism between the republican inspectorate and the municipal environmental secretariats.*
- *Development of a strategic approach to inspection through the development of inspection plans at all levels.*
- *Further training for environmental inspectors.*

Monitoring

- *Further development of the monitoring system (clarify the role of certain elements in system and obligations of relevant subjects);*
- *Strengthening institutions relevant for monitoring system (especially the Agency for environmental protection);*
- *Solving the problem of further financing of the existing air monitoring system in Bor (guarantee will soon expire);*
- *Improvement of the self monitoring system in companies and coordination with local monitoring system.*

1 INTRODUCTION

The Consortium led by *Environmental Resource Management (ERM) Ltd* and supported by Fideco d.o.o. and CSA Group Ltd was commissioned by the Privatisation Agency of the Republic of Serbia (PA), to undertake the "Environmental Assessment of the Environmental Damages from Past Operations of RTB Bor" in November 2005.

The Project is aimed to the preparation of an Environmental Assessment for RTB Bor operations including an assessment of environmental damages from past operations, determining the environmental issues and the required clean-up measures.

This document represents the Final Environmental Assessment Report for the study and presents the work undertaken in the frame of the Project by the Consultants, focusing on the description of Environmental Baseline, identification of Environmental Impacts deriving from Past and Current activities undertaken at the Complex and the proposed Environmental Management Plan (EMP). The EMP includes an Action Plan with Mitigation Measures description and an Environmental Monitoring Plan. In addition, a list of Recommendations for the Institutional Strenghtening and Legal Framework development is included in the report as part of the Legislative and Institutional Framework review section. Finally, the two steps consultation process is described by means of the two reports from the First and Final Local Consultation Meetings.

1.1 BACKGROUND AND OBJECTIVES

As stated in the Terms of Reference (ToR), the main objectives of this project are to:

- prepare an Environmental Assessment of the RTB Bor operations, including an assessment of environmental damages from past operations, determining the environmental issues and the required clean-up measures;
- describe in detail the major (potential) environmental impacts associated with the existing assets and activities of RTB Bor and after implementation of the restructuring and privatization program;
- carry out public consultations and coordination with government agencies on the environmental impacts and proposed mitigation measures;
- assess the preferred technical design standards, and site-specific preliminary designs to mitigate environmental risks;
- prepare a prioritized environmental management plan for the clean-up/closure activities and upgrading/privatization activities; and
- ensure compliance to the environmental guidelines of all relevant agencies and institutions.

The Environmental Assessment process was structured in three steps:

- a first phase mainly focused on the description of the environmental baseline of the area including environmental setting, hydrology, geological and hydrogeological data, meteoclimatic information, natural and sensitive receptors data, etc. and of the RTB Bor Complex, including activities ongoing and undertaken in the past, site history, current status of mining activities, preliminary identification of main impacts generated by the RTB Bor Complex in terms of emission to air, wastewater discharge, waste generated. The First Draft Environmental Assessment Report was submitted at completion of this first stage.
- a second phase, focused on the completion of the Environmental Assessment, which included the legal and institutional framework review, a specific analysis of tailing ponds stability issues and a more detailed assessment of environmental impacts generated by the Complex. A preliminary identification of recommended clean-up/mitigation measures required was outlined at that stage. The Second Draft Environmental Assessment Report was submitted at completion of the second stage.
- a third phase, focusing on the preparation of the environmental management plan, including environmental monitoring plan, institutional strengthening and legislative framework development and mitigation measures prioritisation, which is detailed in the present Final Environmental Assessment Report.

As anticipated in the First Draft Environmental Report, it was agreed during the meeting held at the Privatisation Agency on Monday 30th January 2006, impact deriving from the proposed restructuring program for RTB Bor was limited to a general description of current alternatives and the Environmental Assessment was focused on past damages deriving from activities undertaken at RTB Bor.

In addition, the report structure was designed in order to have the description of activities and related impacts per each facility of RTB Bor Complex (e.g. RBB Mining sites, smelter, etc.) in order to facilitate eventual fractioning of the report per site.

Finally, it is pointed out that a huge amount of data is available with regard to the environmental situation at RTB Bor Complex and that these data took a long time to be collected and reviewed and analysed in depth. A complete review of available data and related gap analysis is presented in the following *Section 1.2*.

1.2 *DATA COLLECTION PROCESS*

Since the RTB Bor Group has been in operation for many decades, there is a substantial volume of technical information available. However, it is only in relatively recently times that the RTB Bor has undertaken studies focused on environmental issues and their management aspects.

Furthermore, in last years many studies have been carried out by institutions/entities in charge for monitoring of environmental and health issues and environmental NGOs with regard to the potential impacts on the surrounding communities and the environment associated with the RTB Bor's operational activities.

A preliminary list of data and documents needed for the assessment was prepared by the Consultants and submitted to the RTB Bor management in December 2005 following the first site mission; subsequent requests of data were submitted by the Consultants to the site management both via telephone/e-mail/fax contacts with Fideco and during the second and third on-site missions. Site surveys and interviews were undertaken in December, January and February by the Consultants in order to complete the information gathered and to confirm enironmental findings with the site representatives. Photografic documentation was openly collected during site inspections.

Reportedly, existing and easily available documents were delivered by the RTB Bor management to the Consultants.

In particular, the following cathegories of documents were provided by RTB Bor management and reviewed by the Consultants:

- Technical reports/documents related to each site;
- Environmental monitoring data (waste waters, surface water, air emissions and air quality data);
- Production data (production charts, raw materials consumption, water and energy supply data, waste quantity, etc.);
- Geological and hydro-geological data.

A literature review of technical papers dealing with the RTB Bor's mining and processing activities, with particular regard to management aspects of environmental issues and associated impacts, was also undertaken. This was drawn from the following sources:

- Environmental baseline data for the Municipalities of Bor and Majdanpek;
- Serbian and EU environmental regulation and WB standards and international guidelines for environmental management;
- Relevant studies prepared by international organization and entities (UNEP, UNOPS, etc.);
- Monitoring data (ambient air quality data, soil quality, surface waters) from local entities/institutions in charge for environmental control;
- General information on geological and hydro-geological setting.

Key documents reviewed in the frame of the project are listed in *Table 1.1.*

Table 1.1 ***List of Key Documents Reviewed***

Document Title	Author	Date
General description of RBB - copper mines and floatation unit	RTB Bor	n.a.
General description of sulphuric acid production in Bor	TIR	n.a.
Smelting unit - production scheme	TIR	n.a.
Power plant	TIR	n.a.
"LEAP Municipality Bor"	LEAP office, Bor	2003
Repair of Collector underneath Tailings Field Veliki Krivelj	DHV	2004
Environmental project ideas for Bor and Majdanpek	DHV	2004
Risk Assessment of Dump site Bor Mining Complex	UNOPS	2002
Assessment of Environmental Monitoring Capacities in Bor	UNEP	2002
Impacts of the industry complex RTB Bor on the environment and public health on the territory of Bor municipality - Industrial complex impacts on soil.	Centre for agriculture and technological research, Zajecar	1997
Report on air quality in Bor	Copper Institute RTB	2003, 2004, 2005
Municipality Majdanpek Spatial Plan	Institute for Urbanism and Communal Issues, Belgrade	1986
Industrial Wastewaters treatment technologies	RTB Bor	2005

A complete list of reports and studies collected and reviewed in the frame of the Project is enclosed to this report (*Annex B*).

As above mentioned, a huge amount of data was available for review. It has to be highlighted that environmental data are generally not properly organized and fully structured. In particular, with regard to geology and hydrogeology, a lack of site-specific information has been identified being available only a general review of geological and hydrogeological characteristics of the area. Only a limited number of geological sections are available and absence of a detailed, updated topographic map further complicates the reconstruction of local geology. No wells corelogs and stratigraphy were available for review except for a limited information drawn from available environmental studies (LEAP, UNEP reports, etc) mainly focusing on surface layers (up to 1-2 metres of depth). From an hydrogeological point of view, no detailed data with regard to the depth of the shallow aquifer is available. The situation is made further complicated due to mining activities, which have deeply influenced the water table original characteristics due to drainage/dewatering processes as a consequence of the gravitational draw wielded by the depression created by open pits that intercept deep acquifers. No hydrogeological cross-sections are available for the area of Cerovo open pit.

A geological and hydrogeological survey per each site is strongly recommended as pointed out in *Section 6.2*.

No detailed hydrological map was readily available and data regarding surface watercourses flow rates and seasonal modifications are missing. Mining activities have deeply influenced surface water courses network both in terms of original bedding (a number of deviations were constructed) and in terms of current flow rates of wastewater effluents discharged into the rivers. With regard to soil and groundwater quality, only limited data are available (mainly the Study carried out by the Centre for agriculture and technological research in 1997 and the UNEP study dating back to 2002). Soil sampling was limited to surface soil and parameters analysed included metals and acidity only. Groundwater monitoring is undertaken on a regular basis by the Bor Medical Centre, but only a limited range of parameters is screened. Groundwater quality data were taken from the UNEP of 2002. River sediments characterisation was drawn from the same report. Surface water data were taken both from 1 Maj monitoring campaign of 2005 and from the UNEP report of 2002. Soil and groundwater quality monitoring is recommended.

Waste water effluents are monitored once a year at RBB Bor and TIR by 1 Maj, while for RBM, quarterly monitoring is undertaken by the Public Health Institute of Timok. These data were made available by the site representatives and are generally complete except for monitoring of Arsenic which is often missing. In addition, reliable data with regard to water flow rates are not available and these should therefore be estimated prior to proceeding with a detailed design of WWTPs.

Climate and meteorology data are available for Bor (where a meteorological station is installed near the Copper Insitute). Based on collected data, no meteorological station is installed at Majdanpek. Wind roses are available both for Majdanpek and for Bor.

Regarding ambient air quality, monitoring is undertaken at Bor by means of 4 monitoring points (Gradski-Park, Copper Institute, Electroistok Yugopetrol and Brezonik). Sulphur dioxide concentrations at three of these locations are monitored daily, with measurements at 15-minutes intervals. Concentrations of particulate are measured daily at the Copper Institute, but less frequently at other locations. Collected samples of particulate are analysed for heavy metals: arsenic, lead, cadmium, manganese and mercury. Reports are issued monthly and annually. Characterisation of air quality is completed with the measurements of atmospheric particulate and heavy metals deposition rate, performed using standard deposit gauge methodology at 15 locations in the Bor region. Screened parameters include pH, sulphate, calcium, magnesium, dried residue, insoluble material, organic material, ash, lead, cadmium and zinc. Available data with regard to air quality are considered not to be sufficient to give a complete picture of the situation since a wider range of parameters should be monitored (e.g. ozone, NO_x and PM_{10}).

Air monitoring has not been undertaken at Majdanpek since 1995 and no updated data are therefore available. Air monitoring recommendations are reported under *Section 6.2*. Finally, it should be noticed that, being the first phase of the Environmental Assessment (during which the key site inspections were performed) undertaken during winter time, site surveys findings with regard to external areas were affected by the presence of snow and ice on the ground.

1.3 *CONTENTS AND STRUCTURE OF REPORT*

The remainder of this Report is structured as follows:
Section 2 - Environmental Setting - describing environmental setting for Bor and Majdanpek and socio-economical baseline;
Section 3 - RTB Bor Complex - detailing sites activities and related environmental issues;
Section 4 - Analysis of Proposed Restructuring and Privatisation Options - summarising proposed options for the privatisation and restructuring;
Section 5 - Environmental Issues - identifying and analysing environmental impacts deriving from current and past activities from RTB Bor;
Section 6 - Environmental Management Plan - summarising the main environmental findings and recommended mitigation measures and clean-up interventions and presenting the proposed monitoring plan.

Annexes to the report include:

Annex A - Figures

- A.1 Location of Cross-Sections of Veliki Krivelj and Bor Mines
- A.2 Bor Mining Complex Location;
- A.3 Veliki Krivelj Mining Complex Location;
- A.4 Cerovo Mining Complex Location;
- A.5 Majdanpek Mining Complex;
- A.6 Smelter and Refining Complex Layout;
- A.7 Groundwater, Rivers and River Sediments Samples Location;
- A.8 Waste Dumps at RBB Bor;
- A.9 Monitoring Plan at Bor;
- A.10 Monitoring Plan at Majdanpek.

Annex B - Complete List of Data Collected/Reviewed

Annex C - Regulatory and Institutional Framework - outlining environmental regulatory background and institutional framework and giving a list of recommendations;

Annex D - Tailing Ponds - describing characteristics of tailing ponds and identifying and analysing related risks and potential critical aspects;

Annex E - Local Consultation Process - including reports from the first (*Annex E1*) and final local consultation meetings (*Annex E2*).

2 ENVIRONMENTAL SETTING

2.1 TOPOGRAPHY

RTB Bor Complex includes:

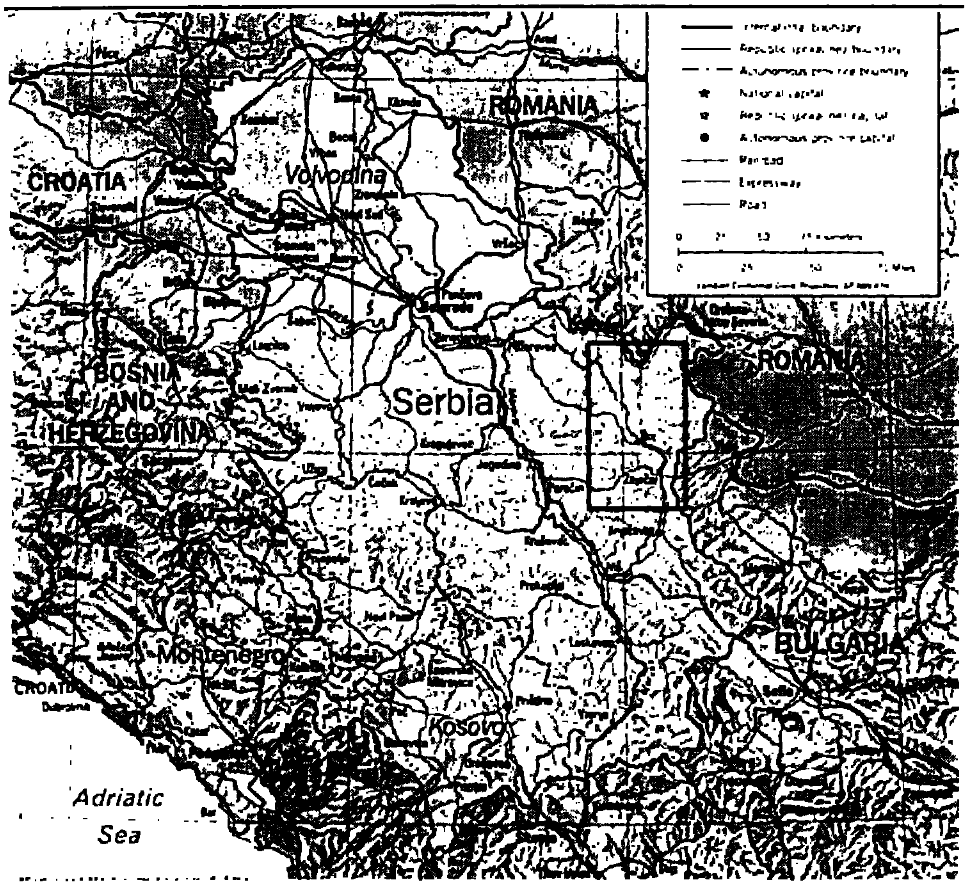
- RBB copper mines in Bor, comprising:
  - Bor Mines (open pit and Jama underground mine) and Concentrator;
  - Veliki Krivelj Mines and Concentrator;
  - Cerovo Mine and Mill;
- RBM Copper Mine in Majdanpek;
- TIR Copper Smelter and Refinery Bor.

RBB Bor and TIR smelter complex are located in the Bor District around the municipality of Bor, approximately 160 far from Belgrade and 20 from Zajecar.

RBM Copper Mine is located close to the Bulgarian and Romanian borders, approximately 210 km far from Belgrade and about 40 km north-east of Bor settlement, south of Majdanpek village and at a distance of about 15 km from the Danube.

Figure 2.1 shows the locations of these operations within Serbia.

Figure 2.1 *RTB Bor Complex Location*



2.1.1 *Bor*

The Bor complex (RBB and TIR) is located in a predominantly hilly to mountainous area, with elevations of 400-600 m above sea level. Bor is located in the valley of the homonym river at elevation of 360m asl.

Bor open pit mine is located on the northern boundary of Bor, approximately 300 m deep and over 1 km at the widest point. Mining activities are not ongoing and the pit is presently used for storage of waste rock, delivered by overland conveyor from Veliki Krivelj mine together with waste slag from the smelter. No further topography profile modifications are scheduled for Bor open pit. Progressing Jama underground mining does not influence local topography.

Excavation of Veliki Krivelj open pit mine started in 1979, and it came into production in 1982. Since then, some 150 million tonnes of ore have been mined. Production continues at an annual rate of around 4,8 million tonnes per year (Mpta).

Cerovo mine is approximately 14 km north west of Bor in hilly, wooded countryside forming the headwaters of the Kriveljska stream.

The open pit is located between two streams, the Cerovo river to the east and the Valja Mare river to the south west. These confluence to form the Kriveljska river, approximately 2 km south east of the mine, in correspondence of the village of Mali Krivelj. Cerovo open pit is presently not operational. Production took place from 1991 to 2002, when 1,17 million tonnes of ore were mined at a grade of 0.35%Cu.

Due to mining works that took place during last century, the morphology has been changed significantly from its original setting; current elevations are reported in the following *Table 2.1* and *Table 2.2*.

Table 2.1 ***Bor Complex Pits' Elevations***

Bor	Ground Elevation at Perimeter (m asl)	Ground Elevation at Bottom (m asl)	Top Pit Dimensions (km^2)
Open pit Cerovo 1	530	370	App. 0.5x0.5
Open pit Bor	370 town-455	-5	App. 1.7x1.2
Open pit Veliki Krivelj	300-400	95	App 2.0 x1.7

Table 2.2 ***Veliki Krivelj Tailings' Elevations***

	Elevation m Dam(s) crown	Elevation m Water Level/Tailings	Original Ground Elevation
Tailings Veliki Krivelj	Designed 375	Designed 370	260-280
Field 1, phase 1	Current 363,353	Current 340	
Tailings Veliki Krivelj	Designed 350	Designed 345	260-240
Field 2	Current 350	Current app. 340	

2.1.2 *Majdanpek*

Majdanpek mining complex is situated in a predominantly hilly to mountainous area, with elevations ranging from 400 to 600 m above sea level. A 57% (1) of the total municipal territory present slopes steeper than 20 degrees and only 8% of the municipal territory is plain. Main river valleys are those of rivers Mali Pek, Veliki Pek, Saska reka, Crnajka I Porecka reka.

The Majdanpek deposit was explored extensively (two open pits) over three decades, by approximately 25,000 m of surface drilling, 41,778 m of horizontal development, a shaft of 965 m and 28,905 m of underground drilling. Actual elevations are reported in following *Table 2.3*.

Table 2.3 ***Mining Elevations***

Majdanpek	Ground Elevation m at Perimeter	Ground Elevation m at Bottom	Top Pit Dimensions km^2
Southern Pit	350 -430	110	App 2.5 x 1.3
Northern Pit	455-500	360	App. 2.0x 1.0

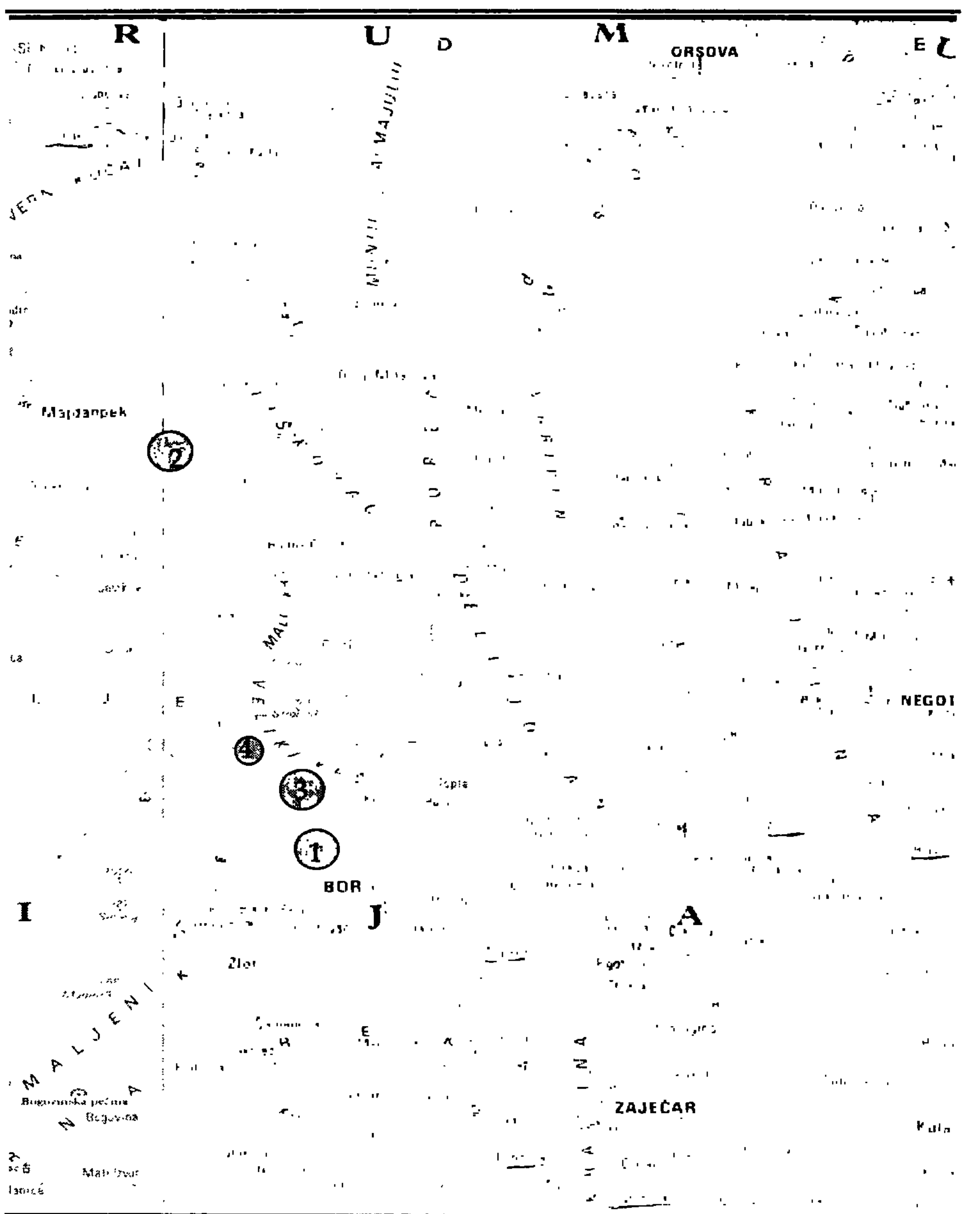
(1) Municipality Majdanpek Spatial Plan, Institute for Urbanism and Communal Issues, Belgrade,1986

Table 2.4 ***Tailing Elevations***

Tailings	Elevation m Dam (s) Crown	Elevation m Pond Water/Tailings
Valja fundata	550	521- 525-530
Saski potok	531,530,521	515

Location of the mining complexes are shown in *Figure 2.2.*

Figure 2.2 ***Location of RTB Copper Mines: 1-Bor, 2 –Majdanpek, 3-Veliki Krivelj ,4-Cerovo***

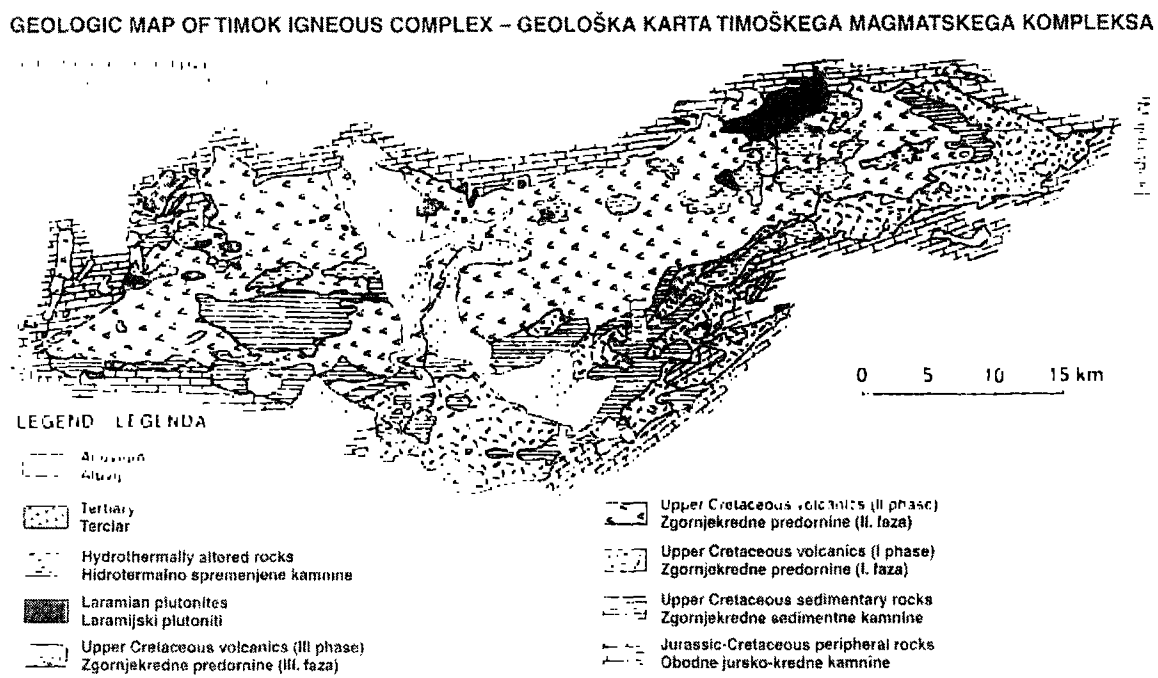


2.2 *REGIONAL GEOLOGY AND HYDROLOGY*

Eastern Serbia geology is significant for its ore deposits. The ore deposits are spread in a wider region of eastern Serbia within Carpathian-Balkanod orogenic zone and more precisely within eastern Serbia Timok eruptive massive. This massive spreads from Majdanpek in the north to Knjazevac (village Bucje) in the South.

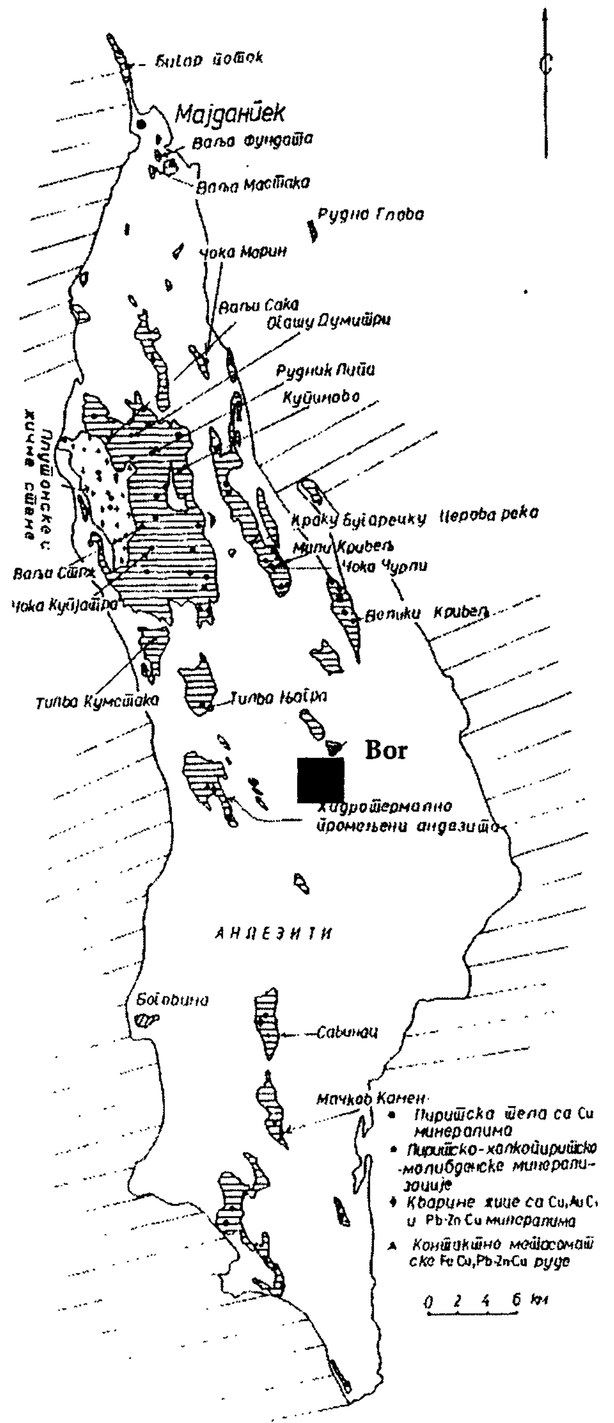
Majdanpek, Bor (Jama) and Veliki Krivelj are mainly porphyry type copper /gold deposits within the Upper Cretaceous Timok Magmatic Complex (see following *Figure 2.3*) of the Carpatho-Balkan Metallogenic province of the Tethyan Euroasian Metallogenic Belt. The belt hosts the Panagyurishte ore district, Elatsite and Chelopeck deposits in Bulgaria, the Banat region of Romania and the Resck deposit in Bulgaria. Eastward the belt traverses Turkey into Asia and contains some giant porphyry copper deposits including Sar Cheshmeh and Songoon in Iran and Saindak in Pakistan.

Figure 2.3 Geological Map of Timok Region



The Timok massif is about 80 km long and up to 20 km wide. The layout of ore deposits in the *Figure 2.4*.

Figure 2.4 *Layout of Ore Deposits in Eastern Serbia*



Legend:

■ Pyrite bodies with Cu minerals

▲Ores Fe,Cu,Pb,Zn,Cu

•Pyrite - halcopyrite- molibden mineralization

♦Quartz with Cu,Au,in Pb-Zn-Cu minerals

The massif consists of three volcanic episodes, each with related sub-volcanic intrusives, and zoned from oldest (east) to youngest (west). The Bor Metallogenic zone is a corridor within the Timok massif, 50 km long and 5 km wide which extends from Bor to Majdanpek.

The form of the intrusives related to mineralisation in the Bor Metallogenic zone is interpreted as a volcanic dyke-like structure intruded along a rift. The main regional ore control is the NNW fault system, which is cut by a later EW post ore fault system. The main Bor fault trending NW, which extends for 30-40 km from the Bor mine, separates andesites from conglomerates and, to the NE, the Krivelj fault separates andesites from sandstones and limestones. At the Veliki Krivelj deposit these two systems appear to converge and may continue to the north at the Majdanpek deposit.

In the Bor ore district all deposits are referred to Upper Cretaceous. Supergene enrichment has been recognised at the Majdanpek mine with a thickness of 10 m and is recorded as being 25 m thick. A chalcocite blanket is present and covellite is reported to a depth of approximately 500 m in the porphyry at the top of the primary sulphide zone.
Platinum group metals have been reported as minor phases accompanying the copper mineralisation in Majdanpek deposit.

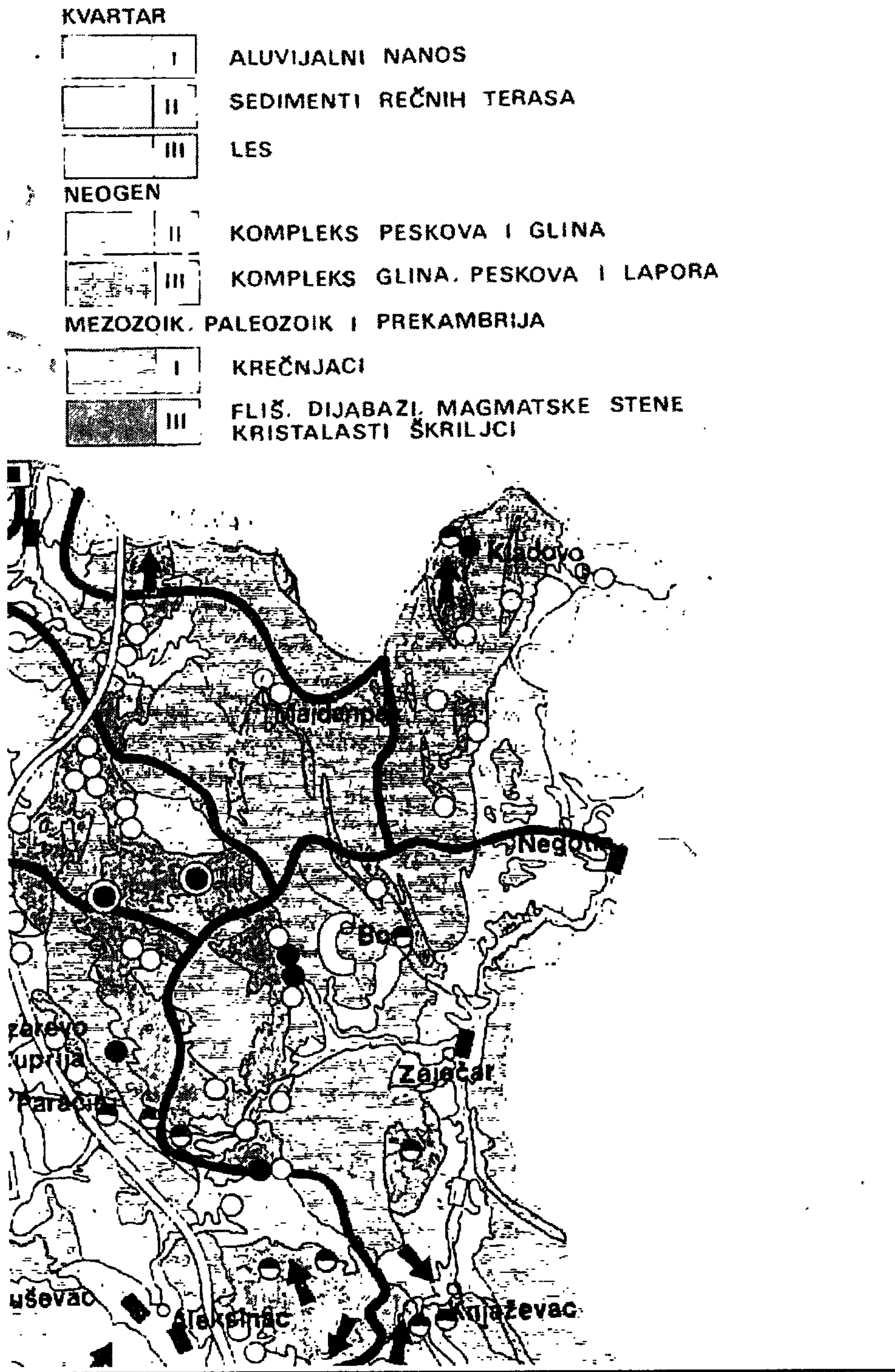
Timok eruptive zone belongs to the catchment area of the Danube and Black sea. The disposition of the hydrographical network is dependent on the geological composition and tectonic features of the region.

The most important water streams are set in north, north west to south, south east direction which complies with main dislocations (faults) in the region.

Due to complex geological setting and tectonic conditions, the region is characterized by aquifers in hard rocks which are conditionally called "dry " aquifers.

The Bor region and Timok eruptive zone is well known for its deposits and springs of thermal and thermal-mineral waters, such as springs in Gamzigrad, Nikolic, Brestovac, Sarbanovac, and Sumrakovac S.p.A. and were used even in ancient Roman times. *Figure 2.5* indicates principal aquifers both in Bor and in Majdanpek area and the underground watersheds. Bor and Majdanpek areas are divided by two watersheds oriented N-S and E-W and Bor area general underground water flow direction is to the Timok river, while Majdanpek area water flow direction is to the Danube river.

Figure 2.5 Hydrogeological Map of Timok River Basin (Source: LEAP)



2.2.1 *Bor*

Geology

Bor region represents one of the most interesting regions in Serbia for its geodiversity. North-Eastern Serbia and Carpathobalkanides consist of rocks and complex tectonic structures. In the mountains, valleys and tectonic pits and horsts of these parts of earth's crust appear various types of sedimentary, volcanic and metamorphic rocks which are interconnected.

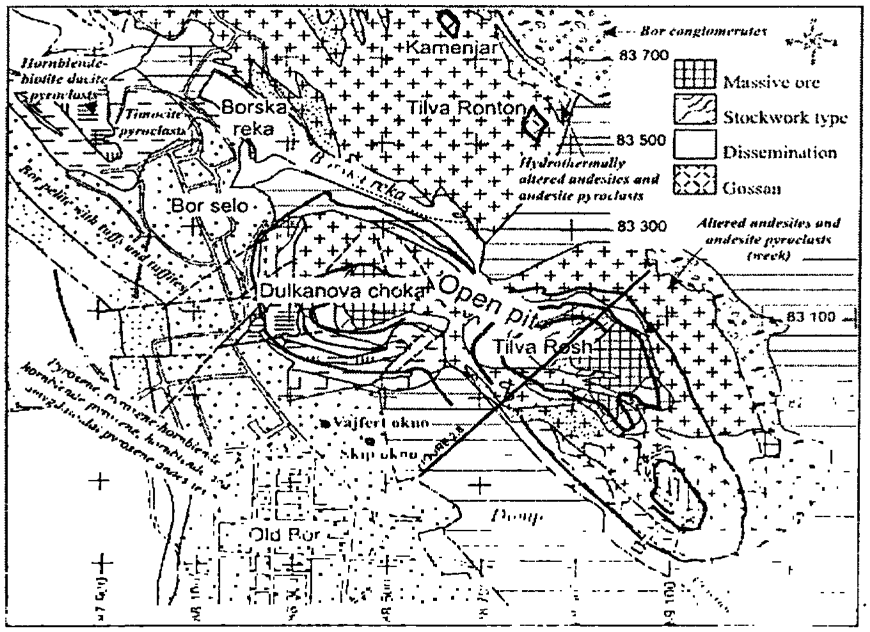
The western part of the Municipality of Bor belongs to the mountainous complex Juzni Kucaj. The karst plateau Dubasnica, spread over 70 km^2, is famous for its diversity of geological structure, morphology both ground and underground. Mountains, valleys and depressions within the region of Bor and its surroundings have been created during long geological history.

North of Bor, in the valleys of Crna and Porecka rivers geologists discovered rocks which, on the base of fossil remainders, were classified as the oldest rocks in Serbia. The existing area of municipality of Bor was in the past under the sea, lakes and swamps. During that period, sedimentary rocks formed that were subsequently hydro-thermally altered due to pressure and heat from movement of earth's crust, to magmatic and eruptive rocks rich in copper, silver, platinum, gold and other metals. There are ten thermal and mineral sources within the area of Brestovac resort 7 km from Bor (towards the south-west), in the foothill of Tilva Njagra.

The Bor deposit is defined as a sub cropping massive sulphide ore body above a transitional stockwork, which overlies porphyry copper type mineralisation at depth. It is hosted by porphyritic hornblende-biotite andesites with minor dacites and their equivalent pyroclastic rocks, limited to the W by the Bor fault (5 to 15 m wide mylonitic zone) where it is in contact with barren conglomerates. It consists of more than 25 ore bodies in complex geological setting and represents most significant ore deposit most of which are already mined out. The remaining minor resources or smaller undeveloped resources are in the central part.
At Jama underground mine, the Brezanic ore body, situated in the south east, is described as a stockwork and massive sulphide body with chlorite, kaolin, silica and gypsum-anhydrite alteration. The mineralisation consists of pyrite, chalcopyrite, enargite, bornite, chalcocite and covellite

The geological map of the Bor region is given in *Figure 2.3*. Geologic map of Bor ore deposits is reported in *Figure 2.6*. The open pit in Bor is located at the town perimeter and mining operations are finished.

Figure 2.6 *Geological Map of Bor Ore Deposits*



60.- Прегледна геолошка карта Централног дела Борског лежишта бакра и злат
Fig. 60.- Summary geological map of Central part of Bor copper and gold deposit.

Figure A1 in Annex A indicates the location of representative geological cross sections that are reported on the following figures as follows:

- *Figure 2.7*- Geological cross section of Bor deposit area;
- *Figure 2.8*- Geological cross section of Tilva Ros ore bodies;
- *Figure 2.9*- Geological cross section of Veliki Krivelj ore deposit.

Figure 2.7 *Geological Cross Section of Bor Deposit Area*

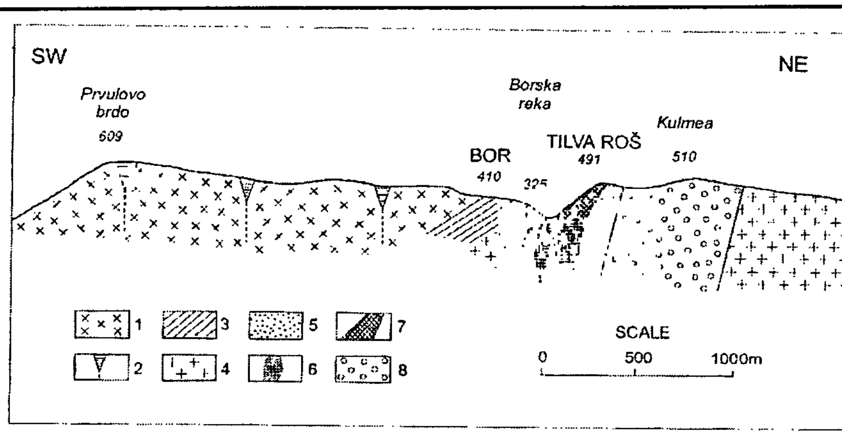


Fig. 1. Schematic geologic cross section trough the Bor copper deposit area. 1 Hornblende andesite agglomerate, 2 Andesite-basalt dike, 3 Tuff, tuffite and marl, 4 Timocite, 5 Hydrothermally altered timocite, 6 Orebody, 7 Gossan, 8 Conglomerate. (F. Drovenik & M. Drovenik 1956).

Bor copper deposit area cross section is oriented in the direction NE-SW and indicates the position of the main ore bodies Borska reka and Tilva Ros within tuff -tuffite and marl (legend n. 6). As represented in the cross section, the geology of Bor copper deposit area is mainly characterised by the presence of ore bodies from elevations of 360 m a.s.l. to 5 m, within hydrothermally altered timocite. Towards north-east, there are massive conglomerate and timocite zones and to the south-west andesite zone (legend 2) with basalt bodies (legend 2) settled over higher elevations.

Figure 2.8 *Geological Cross Section of Tilva Ros Ore Bodies*

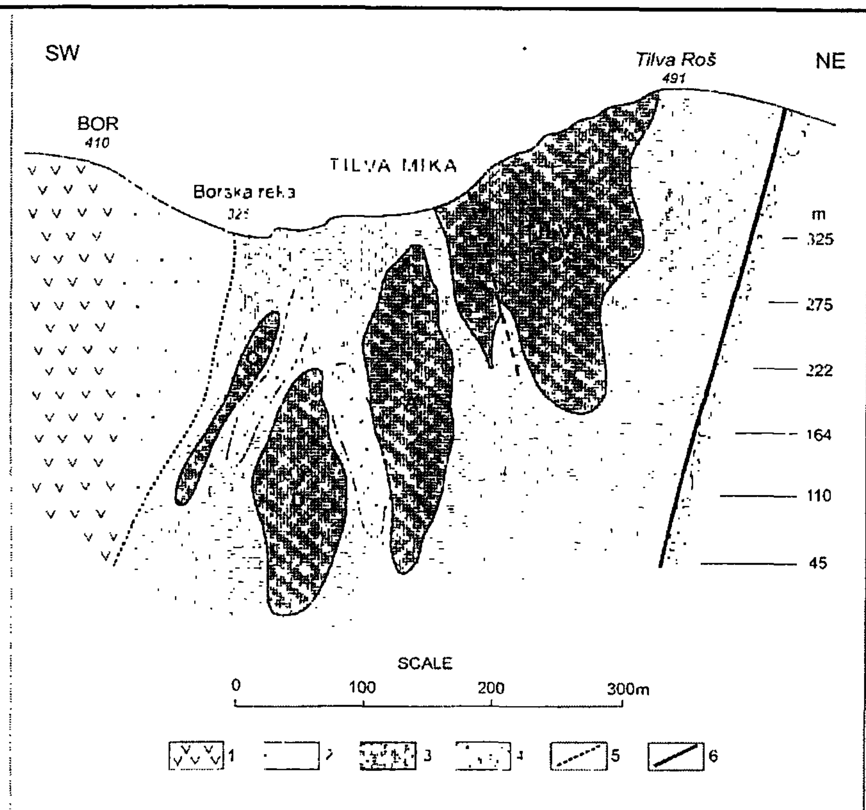


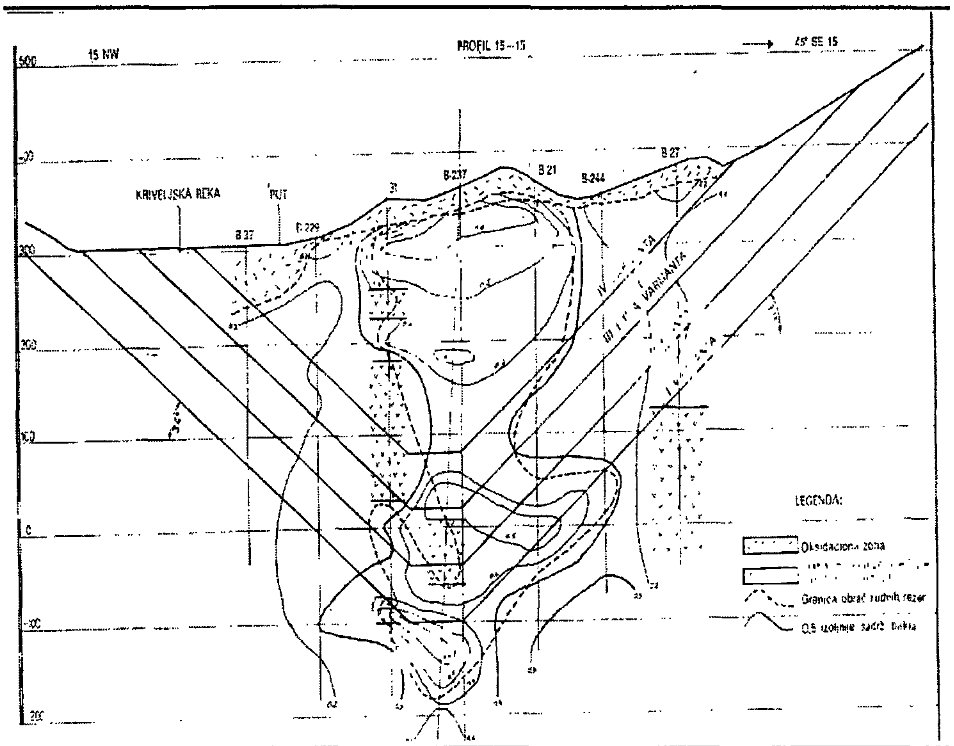
Fig. 4. Schematic geologic cross section through Tilva Mika and Tilva Roš orebodies. 1 Timocite, 2 Hydrothermally altered timocite, 3 Orebody, 4 Conglomerate, 5 Supposed boundary, 6 Bor fault (F. DROVENIK & M. DROVENIK 1956, simplified).

The Tilva Ros ore bodies are presented in the *Figure 2.8* in larger scale. The ore bodies marked as 1,A, C and D represented rich ore bodies, exploited mostly before the World War II, and some of remained columns and ceilings were excavated by open mine exploitation during 1970's and 1980's. The Tilva Ros ore body has central position in the Bor deposit and represents somewhat poorer deposit, which was mostly excavated by the open mining. The dot line (legend 5) represents the assumed boundary between rich and poorer ore body.

Veliki Krivelj is defined as a porphyry copper deposit hosted by altered andesites, pyroclastics and related sedimentary rocks.

The mineralogy of the deposit is characterized by chalcopyrite, pyrite, pyrrhotite, magnetite, rare molybdenite and traces of enargite, galena and sphalerite. The deposit is limited to the E by the NNW trending Veliki Krivelj fault, which puts sedimentary rocks (sandstone and limestone) in fault contact with the mineralisation. Cross section is reported in following *Figure 2.9.*

Figure 2.9 ***Geological Cross Section of Veliki Krivelj Ore***



Legend : - - - - - - - ore deposit boundary for calculation of the ore reserves.

Geological cross section, from elevation 350 to -200 m, of Veliki Krivelj is taken from the design documentation. The figure shows the position of investigation boreholes and the boundary of the ore deposit (dashed line) that was used for calculation of the ore reserves (estimated as 440 Mt within the contour line 0.43 % of copper in the ore). Inclined lines (I to IV varijanta) represent the four different slopes and bottoms of the open pit at different mining stages. At present pit cross section is the IV varijanta and mining advance reached the Kriveljska river that actually runs along pit edge.

Cerovo Complex consists of a porphyry copper deposit hosted in altered andesites.

Hydrogeology

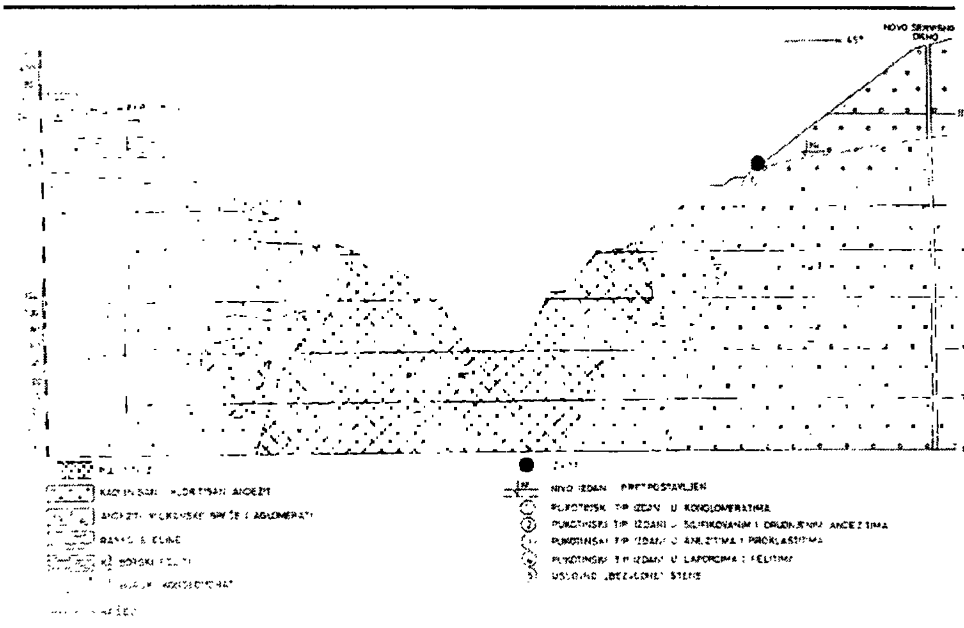
As previously introduced, Timok eruptive zone belongs to the catchment area of the Danube and Black sea. The disposition of the hydrographical network is dependent on the geological composition and tectonic features of the region.

The terrain where the exploited ore bodies are located belongs to the catchment area of the Borska river. The river valley was cutting the ore body itself. The original terrain was characterized by the diverse relief, with two distinguished hills, Tilva Ros (489 m a.s.l.) and Coka Dukljan (388 m a.s.l.) and numerous tributaries to the Borska river, most of them chute/ditch type which together with the Borska river drained and dewatered the terrain.

Original hills Tilva Ros, Tilva Mika and Coka Dulkan have been mined, and open mine pit reached bottom elevation of 40m a.s.l.. Drainage/dewatering of the whole zone have been significantly influenced by mining activity with respect to original hydrogeological setting. As a matter of fact, underground waters moved gravitationally towards depression created by open mine pits (see following *Figure 2.10*).

The Bor municipality water supply system uses water from the wells in villages Surdup, Zlot and Bogovina, located 10-25 km south-west from RTB Bor.

Figure 2.10 ***Hydrogeological Cross Section of Bor Copper Ore Deposit (Source: Dragisic, 1992)***



Sl. 19. Hidrogeološki profil kroz ležište bakra Bor

Legend: 1,2,3,4- aquifer in fractured hard rocks 5-impervious rock ,

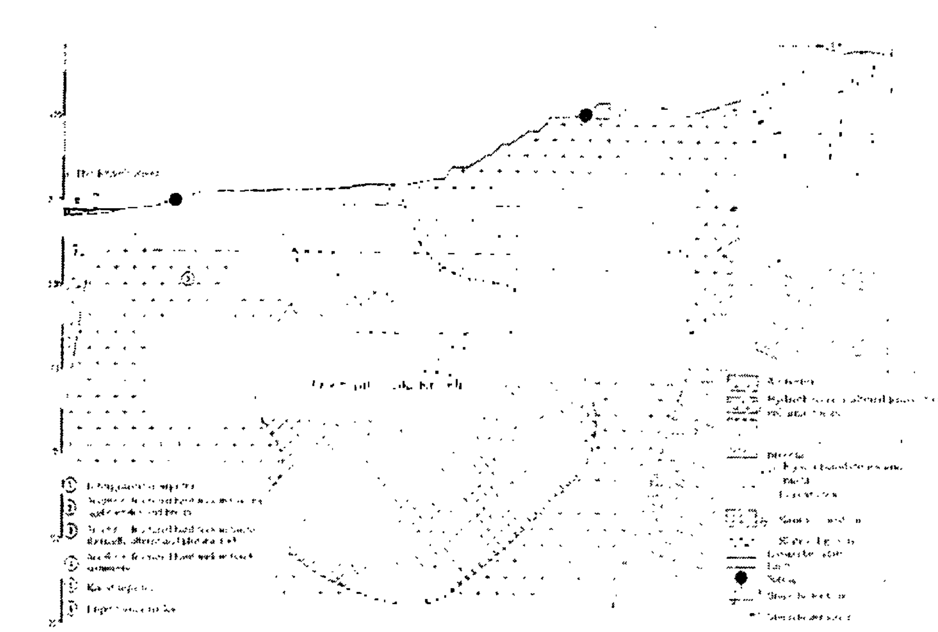
- *Spring , - - - - - GWT –ground water table*

As represented in the cross section, a water spring located at elevation of about 260 m a.s.l. (right hand side of the figure) was identified in correspondence of the tectonic contact between conglomerate and andesites. The water spring elevation indicates the ground water table level (marked with dashed line) of the conglomerate aquifer.

Original hills Tilva Ros, Tilva Mika and Coka Dulkan have been mined and open pit with is actually presenting its deeper elevation of 40 m. Drainage/dewatering of the whole zone became simplified compared to original hydrogeological setting as a consequence of the gravitational draw wielded by the depression created by open mine pits that intercept deep aquifers.

Figure 2.11 contains the hydrogeological cross section of the Veliki Krivelj ore deposit and the original underground water circulation in both volcanic and sedimentary rocks.

Figure 2.11 Hydrogeological Cross Section of Veliki Krively Ore Deposit (Source: Ibid)



A water spring indicates the original water table level and the groundwater flux from the karst acquifer to the one present in the fracturated roks that contain the copper deposit. This groundwater circulation has been increased by the creation of the open pit that eliminated the slates (right top part of the figure) that divided the volcanic and flysch sediments aquifers. Groundwater is now gravitationally driven from the sandstones of the flysch sediments (aquifer 4) to the fractured hard rock (aquifer 3).

No hydrogeological cross-sections are available for Cerovo open pit. It was evident from the visit that the present abandoned open pit mine (bottom at an elevation of about 370 m asl and rims at an lavation of abut 500 m asl) drains water from surrounding aquifer which in turn are reportedly connected with the two creeks Cerovo and Valja Mare flowing at the sides of the open pit mine.

Notes of Outcropping Rocks Permeability

Bor area is caracterized mainly by hornblende andesite agglomerate and conglomerates that present low permeability.In Tilva Ros area hydrotermally altered timocite outcroppings represent impermeable surfaces. Intergranular aquifer of higher permeability is represented by alluvial deposits of Bor River.

Mining activities at the open pit mine of the ore body resulted in covering the abovementioned sediments, decreasing the relevance of these sediments.

Intergranular aquifer of lower permeability has the broad occurrence within the flotation and mining tailings, as well as within eluvial sediments. These deposits are clayey by the composition, and are deposited in large quantities and in irregular manner. Water seeps through these deposits at a very low rate. Although the intrinsic vulnerability of the dump site of Bor area is low, it must be stressed that flotation tailings, smelter slag and other waste materials are cumulated directly on bedrock with no specific protective covering.

In Veliki Krivelj area, outcropping sandstones present low permeability and hydrotermally altered volcanic rocks that are impermeable and host fissured acquifer. With available information no vulnerability of the area can be estimated.

Hydrology

Based on available information, there is no significant hydro potential in the municipality Bor. Most of the streams and rivers belong to Timok catchment area shown in *Figure 2.12*. Terrains in the north- west belong to the catchment area of river Mlava, in the north to the catchmnet area of river Pek, and in north-east to the area of Veliki Timok (mostly investigated is Crni Timok catchmenet). Mountain massive Crni Vrh (1,027 m) is the watershed of these catchments.

Natural disposition of hydrographical network is conditioned by geological setting and tectonics of the region. The majority of main river streams are positioned in the north-northwest to south-southeast direction, what coincides with directions of the major tectonic dislocations (faults) in Timok eruptive zone, such as Zlot, Bor- Tupiznica and Bucijan fault.

Water streams are characterized by small flow rates and unsteady water levels. Most important rivers are Zlotska reka, Borski potok which after inflow of RTB Bor industrial waste waters becomes Borska reka, Kriveljska reka, Ravna reka and Timok. In 1959 the dam was constructed on tributaries of the Brestovacka river and reservoir Bor lake was accumulated, total area 30 ha.

In Cerovo pit area two principal rivers are present: Valja Mare, south-east of the open pit and Cerovo river west of it. These two courses join in correspondence of Mali Krivelj to form the Kriveliska river that runs in its natural basin up to the Veliki Krivelj open pit area.

Mining activity strongly influenced in past years natural river courses. In particular, Borska reka, that was originally flowing north-west to south- east and next to Bor settlement, has been deviated by a pipeline builted north of Bor open pit and is now flowing into Kriveljska river deviation before the underground collector placed under the Veliki Krivelj tailig ponds (see *Figure A2/A3* in *Annex A*).

South to the tailing pond "RTH", the natural river basin does not recive any river water, but water discharges that flow into the kriveljska river south-east of Slatina settlement.

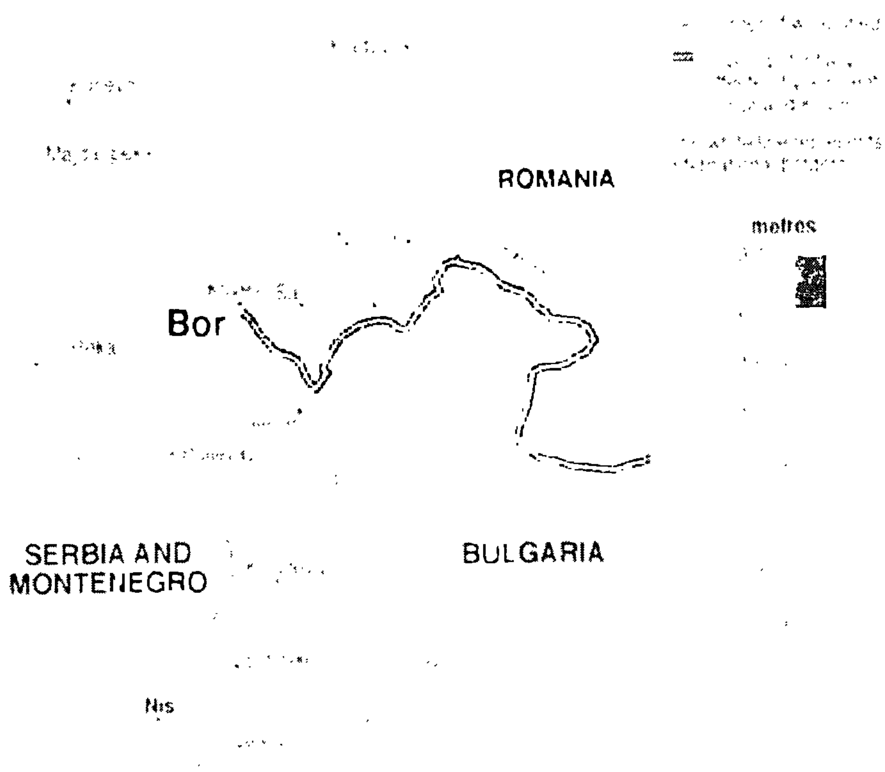
Also Kriveljska river course has been modified from the original course both in correspondence of Veliki Krivelj open pit where it now borders the pit and in correspondence of the Veliki Krivelj tailig ponds, where it is deviated into ad underground collector running under the eastern tailing pond.

Kriveljska river inflows in Timok river that flows into the Danube as shown in *Figure 2.12*.

Hydrological data of Timok river are summarized as follows:

- Mouth at Danube km: 846;
- Length in km: 180;
- Size of Sub-basin in km^2 (larger than 4,000 km^2): 4,600;
- Average Flow - m^3/sec: 15.

Figure 2.12 Timok River Basin



The hydrological situation in the Bor mining region is complex due to the number of waste water discharge points from the three mines and the metallurgical complex combined with sanitary waste water from Bor town and several villages. The whole complex impacts on water streams as, with the exception of settlement of suspended solids at Cerovo mine, at the metallurgical complex there is no treatment of any waste water stream. Borska reka and Kriveljska reka are final destination of effluents of the Jama and Veliki Krivelj drilling activities and of wastewaters from flotation process undertaken in Veliki Krivelj waters from the smelting/refining complex and of untreated municipal wastewater. This resulted in extremly polluted and degraded surface water with respect of pH, suspended solids, copper and iron.

Contamination of Borska river is clearly visible between Bor and the community of Slatina and the riverbanks have deposits of tailings from previous incidents at the Bor tailings pond. The Borska water is still acidic and contains elevated levels of suspended solids and copper concentrations as far as 10km from the metallurgical complex. The Kriveljska stream south of the Veliki Krivelj mine and tailings ponds is acidic and contains high levels of suspended solids, iron, copper and zinc.

2.2.2 *Majdanpek*

Geology and Hydrogeology

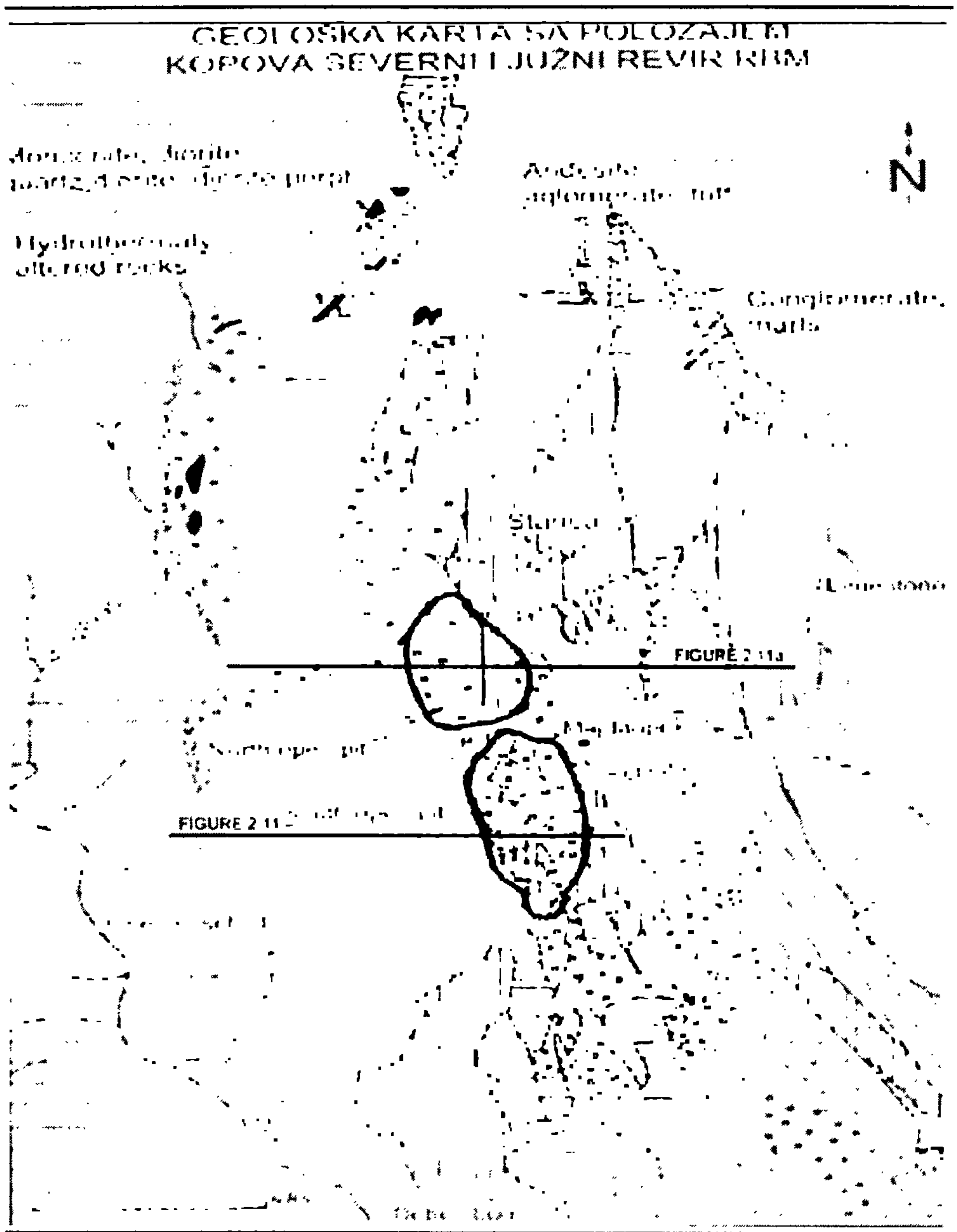
The geological setting is complex. The ore deposit is located in the northern boundary of Timok magmatic complex. The type of mineralization is porphyritic with prevailing copper mineral and chalcopyrithe.
The mineralization is characterized with higher gold content compared to other ore deposits.

The Majdanpek deposit is classed as porphyry copper-gold style, with Cu, Au and minor Ag, Bi, and Te and copper molybdenum mineralisation; Cu, Mo, with minor W, U, and Re. Mineralisation is related to sparse and thin, north-south trending andesite dykes, along a north-south trending fault zone, cutting Proterozoic, Palaeozoic, and possibly Cambrian metamorphic rocks and Jurassic limestones, dated at 83 (78 +/- 4)Ma. It is typically developed as stockworks, the bulk of which are actually within the metamorphic aureole of the andesitic dykes.

There are also numerous skarns and replacement bodies (Au, Cu, Pb, Zn, Ag, W, Mo, Sn, Fe) flanking the intrusives, while more distal replacement (Pb, Zn) bodies are found in the Jurassic limestone. The mineralogy consists of enargite, pyrite, chalcopyrite, bornite, chalcocite, covellite, molybdenite, magnetite, pyrrhotite, galena, sphalerite and tenantite-tetrahedrite. Gold is present, with an average grade of 0.2 g/t. Hydrothermal alteration consists of silica, adularia, sericite, argillite, and chlorite. The highest copper grades relate to K-silicate alteration and zones of strong silicification.

The geological map of the Majdanpek region is reported in *Figure 2.13*.

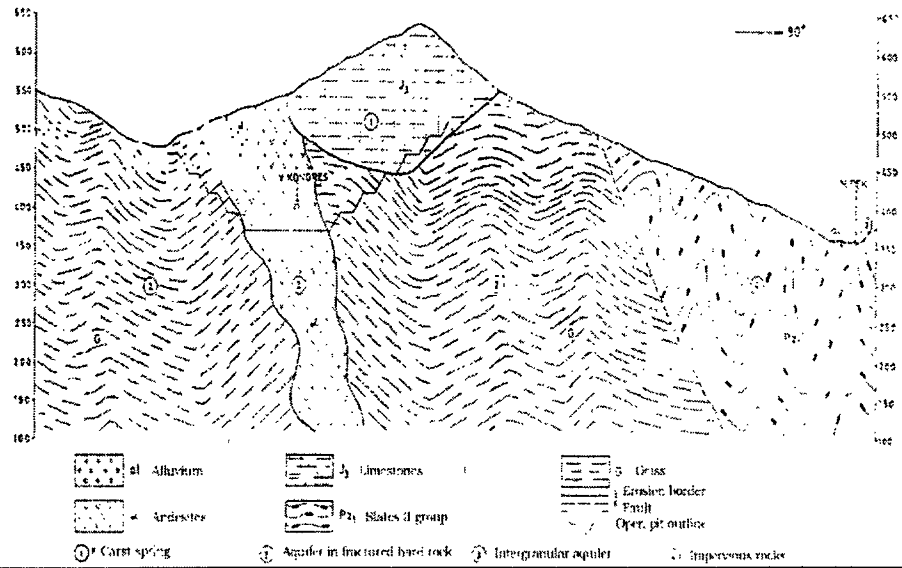
Figure 2.13 ***Majdanpek Geological Map with Southern and Northern Pit***



As represented in the cross section, the geology of the area is mainly characterised by the presence of hydro thermally altered rocks.

Hydrogeological cross section of northern pit is shown in the following Figure:

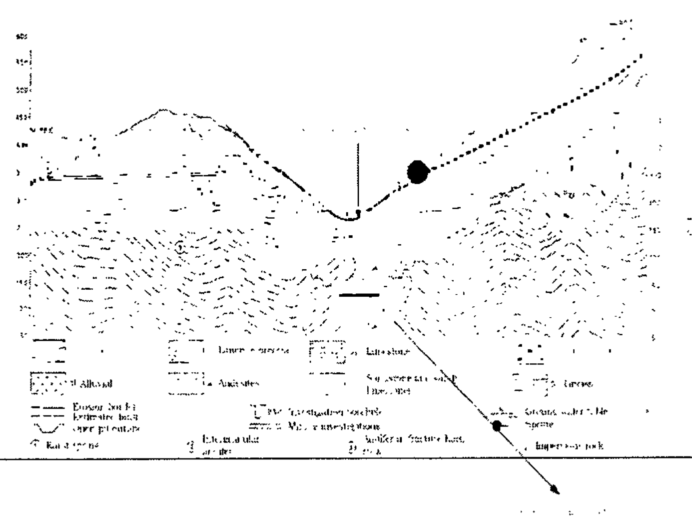
Figure 2.14 ***Hydrogeolgical Cross Section of Northern Pit (Source: Ibid)***



Although not indicated on the cross-section, it can be assumed that an aquifer was originally hosted in the top limestone. As mining excavation proceeded, all limestone were excavated and the original first aquifer is no longer existing. Actually, main aquifers are in fractured hard rocks (legend 1,2 and 3).

Hydrogeological cross section of southern pit shown in the following Figure:

Figure 2.15 *Hydrogeological Cross Section of Southern Pit (Source: Ibid)*



Legend: 1,2,3 aquifer in fractured hard rocks, -----NI-GWT assumed

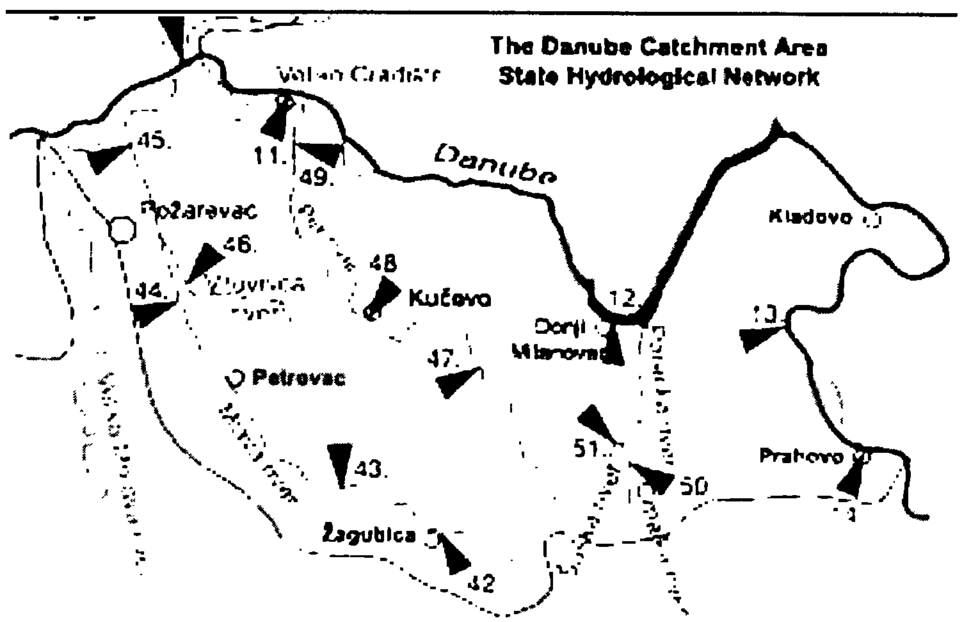
As represented in the cross section, the hydrogeological structure of Majdanpek copper deposit before mining activity was mainly characterised by the aquifers in limestone which level was indicated by the natural spring located at elevation 370 m a.s.l. As mining work proceeded almost all limestone and underlying sandstone and sandy limestone were excavated. Actually, main aquifers are in fractured hard rocks (legend 1,2 and 3).

Hydrology

There is no significant hydro-potential in the municipality Majdanpek. The most important rivers are Porecka reka, tributary of the Danube, Saska reka, running east to the Majdenpek mining complex and flowing into the Porecka river downstream the complex Mali and Veliki Pek, flowing west of the mining complex. There are numerous creeks and springs in the mountainous area. The flow rates are small and water level unsteady.

The flow rates are small and water level unsteady. The catchmnet area of Veliki Pek is approximately 1,236 km^2, river length 129.0 km. Hydrological network for monitoring of surface water status in the catchmnet area of the Pek and Porec rivers is presented in *Figure 2.16.*

Figure 2.16 ***Danube Catchment Area Refferred to Pek and Porec River Area***



2.3 *SEISMICITY OF THE REGION*

The region of Bor (both towns of Bor and Majdanpek) belongs to the zones of seismic intensity I=VII^0 MCS scale for return period Tr =100 years and I = VIII^0 MCS scale for return period Tr =1,000 years, according to the state seismic maps (Zavod za seizmologiju SFRJ, 1987).

2.4 SOIL AND GROUNDWATER QUALITY

2.4.1 *Evaluation Methodology*

A comprehensive review of Serbian Legislation concerning soil and groundwater quality is reported in *Annex C*. Key local legislative requirements are summarized below. In particular, *Table 2.5* presents selected national soil quality standards while groundwater quality standards are reported in *Table 2.6*. It is pointed out that no EU guidelines are present with regard to soil and groundwater standards. This results in different approaches chosen by the EU countries such as UK and Germany, who have adopted a risk-based approach with consequent definition of different quality standards to be achived at each contaminated site to be defined case by case based on site vulnberability and sensitivity and to hazard of detected contaminants. On the other side, the Italian and/or Dutch approaches give specific soil and groundwater standards to be achieved after the remediation in the two cases – residential land use or industrial landuse.

Since no information was available for RTB Bor with regard to geology and hydrogeology and only limited assumptions could be therefore made for vulnerability and sensitivity of the site, it has been decided to follow the Italian approach (relevant standards are reported in section 5.7, Table 5.40) and the soil and groundwater standards have been taken as a reference since the well known Dutch standards are referred to a more specific morphological/ geological/hydrogeological context.

Soil

Soil quality standards are set by **Regulations on permitted amounts of hazardous and harmful substances in soil and water for irrigation and methods of their testing** ("Off. Jour. of RS", No. 23/94), which prescribes maximum permitted quantities of hazardous and harmful substances in soil and water for irrigation that can deteriorate or change production capacities (fertility) of agricultural land and quality of water for irrigation. As hazardous substances are considered cadmium, lead, mercury, arsenic, chromium, nickel and fluor, and harmful substances are copper, zinc and boracium. Maximum permitted quantities of hazardous and harmful substances are listed in the following table.

Table 2.5 ***Soil Standards set by Serbian Regulation (Off. Jour. Of RS n. 23/94)***

Parameter	unit	Concentration
Cadmium	mg/kg	3
Lead	mg/kg	100
Mercury	mg/kg	2
Arsenic	mg/kg	25
Chromium	mg/kg	100
Nickel	mg/kg	50
Fluorine	mg/kg	300
Copper	mg/kg	100
Zinc	mg/kg	300

Parameter	unit	Concentration
Boron	mg/kg	50

No information was drawn by the consultant with regard to soil standards for industrial development.

Groundwater

As already presented in the previous section, both surface and groundwater quality standards are defined, according to Serbian regulation, based on water pollution level and use. Limits are summarized in *Table 2.6* as presented in Order on Water Classification, official Gazette of Social Republic of Serbia, No. 5/68 (ecological parameters) and official Gazette of Social Republic of Serbia, No. 31/82 (chemical quality parameters). A selection of most representative parameters is presented in the following table.

Table 2.6 ***Groundwater Quality Standards per Class****

Indicator	Class I	Class II	Sub-class IIa	Sub-class IIb	Class III	Class IV
Suspended solids in dry weather conditions [mg/l]	10	30	30	40	80	-
Total dissolved substances in dry weather conditions [mg/l]	800	1000	1000	1000	1500	
pH	6.8 - 8.5	6.8 - 8.5	6.8 - 8.5	6.5 - 8.5	6.0 - 9.0	-
BOD_5 [mg/l]	2	4	4	6	7	-
Most probable number of coliform germs in 100 ml of water, up to	200	6000	6000	10000	-	-
Noticeable waste materials	none	none	none	None	none	none
Colour	none	none	none	None	-	-
Smell	none	none	none	None	-	-
Cyanides	0.1	0.1	0.1	0.1	0.1	0.1
Iron (mg/l)	0.3	0.3	0.3	0.3	1.0	1.0
Copper (mg/l)	0.1 (0.01)	0.1 (0.01)	0.1 (0.01)	0.1 (0.01)	0.1	0.1
Nikel (mg/l)	0.05	0.05	0.05	0.05	0.1	0.1
Cadmium (mg/l)	0.005	0.005	0.005	0.005	0.01	0.01
Zinc (mg/l)	0.2	0.2	0.2	0.2	1	1
Arsenic	0.05	0.05	0.05	0.05	0.05	0.05

*Indicated classes are:

- Class I: water that, in natural state or after disinfection, can be used for drinking water supply, food industry and fine fish (salmonidae) breeding.

- Class II: water appropriate for bathing, recreation, water sports, less fine fish (cyprinidae) breeding, including water that, after basic treatment methods (coagulation, filtration and disinfection), can be used for drinking water supply and food industry. Class II is then divided in two further subclasses: sub-class IIa and sub-class IIb.
- Class III: water that can be used for irrigation and industries except food industry.
- Class IV: water that can be used only after special treatment.

2.4.2 *Soil Quality*

Based on available information mining of non-ferrous metals, copper and other, degraded an area of 1,110 ha in Bor and 12,060 ha in Majdanpek. Total degraded area by mining of non-ferrous metals in Serbia is 13,479 ha and represents 53% of total areas degraded by this activity in Serbia. Majdanpek and Bor mining industry have major participation in this share.

The area of damaged and degraded agricultural land in Municipality Bor is estimated to be about 60.6%[1] of total agricultural land. The main causes of land degradation are mining and metallurgy, mine pits, landfills for overburden disposal and flotation tailings ponds.

Smelting of ore copper produces SO_2 emissions which lead to soil acidity, dust with high contents of heavy metals and arsenic, destroying vegetation and consequently caused soil erosion.

Mining degraded agricultural, arable soil in Bor, Slatina, Ostrelj, Krivelj, Bucje and Donja Bela Reka.

Waste water disposal from flotation plant and tailings destroyed soil in inundation zones in cadastre municipalities Slatina, Rgotina, Vrazogrnci and numerous villages in Veliki Timok valley.

Gas emission from smelter plant, damaged soils in almost all villages in Bor municipality, to a lesser or bigger extent. Present and future emissions are the most significant for soil degradation.

The "Centre for agriculture and technological research ", Zajecar, 1997, carried out the project Impacts of the industry complex RTB Bor on the environment and public health on the territory of Bor municipality, subproject Industrial complex impacts on soil. In the frame of this project, soil samples were taken and submitted for chemical analyses to ascertain potential soil impact. The samples were taken from 10 different sites in the municipality of Bor. Results of that study are reported in the following *Figure 2.17*, *Figure* 2.18, *Figure 2.19* and *Figure 2.20.*

The below reported graphs show the results of heavy metal content in the soil samples taken from 10 different sites in the municipality of Bor (Bor, Krivelj, Ostrelj, Slatina, Bucje, Gornjane, Metovnica, Brestovac, Sarbanovac and Zlot).

(1) The Report on the State of Environment in municipality Bor for period I-XII 2004 to I-VI 2005, Department for Social and industrial activities, Municipality Bor, June 2005

Figure 2.17 Acidity of Soil (Source: Centre for Agricultural Research, 1997)

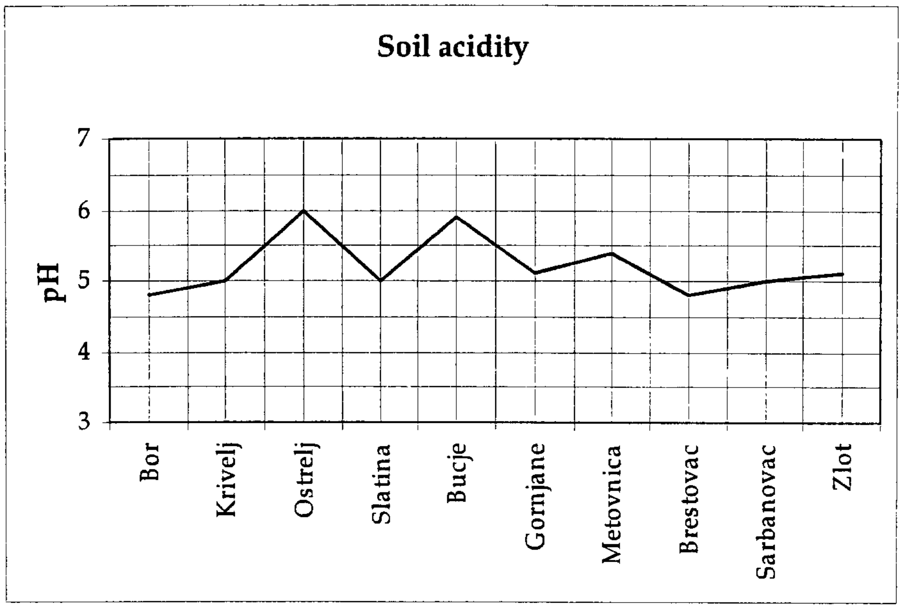


Figure 2.18 Heavy Metals Content in Soil (Source: Centre for Agricultural Research, 1997)

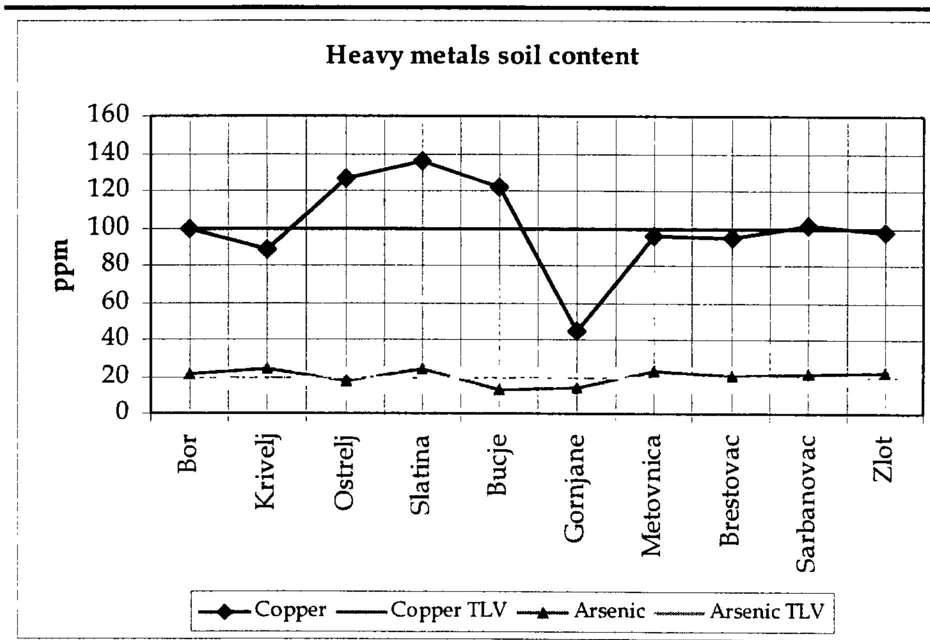


Figure 2.19 *Zinc Content in Soil (Source: Centre for Agricultural Research, 1997)*

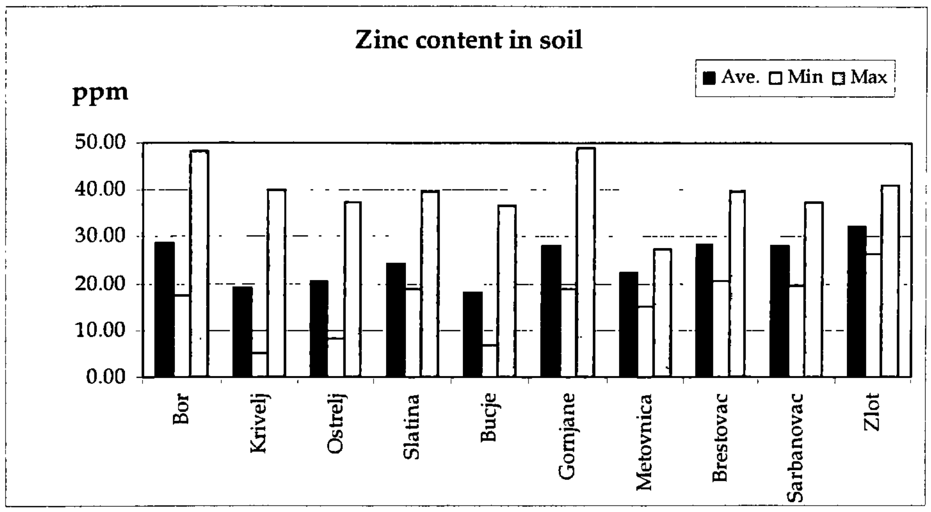
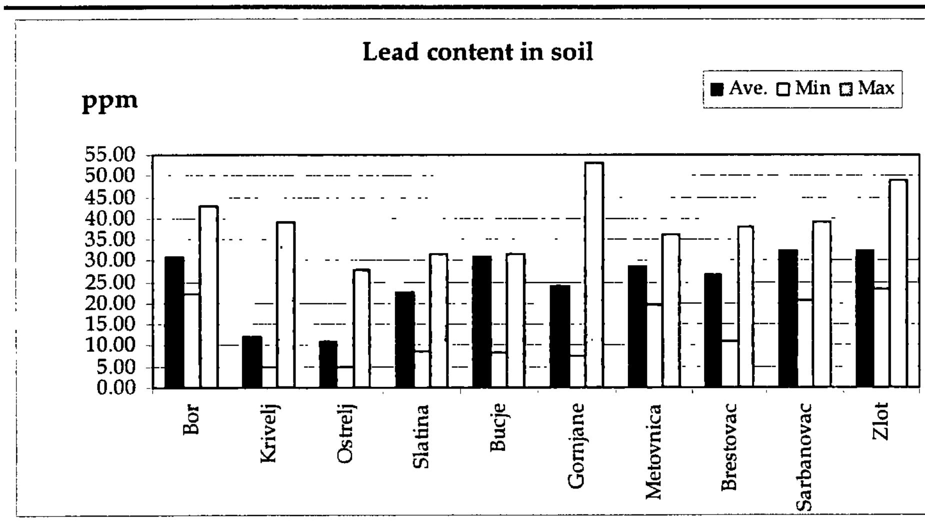


Figure 2.20 *Lead Content in Soil (Source: Centre for Agricultural Research, 1997)*



Recorded values of arsenic and copper is below Serbian soil quality standards both in Bor and Veliki Krivelj. Copper content resulted above the Serbian limits in Ostrelj, Slatina nad Bucje (respectively 125 mg/kg, 135 mg/kg and 120 mg/kg, against a limit of 100 mg/kg). Arsenic close to the maximum permitted concentration of 25 mg/kg was detected at Kriveli, Slatina and Metovnica. Zinc and Lead average content is always below Serbian limits.

Soil acidity appeared a common problem in the whole investigated area. In particular, a pH below 5 was detected in Bor and Brestovac while at the other locations pH values are below 6.

Monitoring results of annual average values of deposition rates are reported in the following *Section 2.7.*

In 2002, soil analyses have been carried out in trhe frame of the project Assessment of Environmental Monitoring Capacities in Bor, September 2002. The following concentrations for heavy metals were detected in the Bor area:

- Zn: 62-126 ppm;
- Ni: 6-17 ppm;
- As: 2-45 ppm;
- Hg: < 0.15 ppm;
- Cu: 84-408 ppm;
- Cr: 6-15 ppm;
- Pb: 6-58 ppm;
- Cd: < 1.2 ppm.

Serbian standard values are exceeded only for Copper.

River Sediments

River sediments characterisation was undertaken in the frame of the project UNEP Assessment of Environmental Monitoring Capacities in Bor in September 2002 at the following locations:

- Bor River sediments, before the conjunction with the Kriveljska River (sample ID 10-33);
- Kriveljska River sediments, at the conjunction with the Bor River (sample ID 10-34);
- Bor River sediments, after the conjunction with the Kriveljska River (sample ID 10-33).

Analytical results are reported in the following *Table 2.7.*

Table 2.7 ***Analytical Results of River Sediments in Bor Area (Source: UNEP Assessment of Environmental Monitoring Capacities in Bor in September 2002)***

Parameters/Sample ID	**10/33**	**10/34**	**10/35**	**Serbian standards (mg/kg)**
pH	7.69	4.56	6.39	n.a.
Moisture (%)	43.90	45.70	40.18	n.a.
Total organic materials (mg/kg)	167.1	634.8	190.9	n.a.
Total hydrocarbons (mg/kg)	2.8	5.0	3.8	n.a.
Cyanide (mg/kg) CN	0.14	0.12	0.12	n.a.
Heavy metals (mg/kg)				n.a.
Lead (mg/kg) Pb	38.3	105	41.2	100
Cadmium (mg/kg) Cd	<1.25	<1.25	<1.25	3
Zink (mg/kg) Zn	133.5	92	101.2	300
Copper (mg/kg) Cu	2937	3257	2688	100
Chromium (mg/kg) Cr	8.9	9.2	9.2	100
Nickel (mg/kg) Ni	8.9	9.2	9.0	50
Arsenic (mg/kg) As	315	291	310	25
Mercury (mg/kg) Hg	0.472	<0.15	0.406	2
Polyaromatic Hydrocarbons (PAH) total (mg/kg)	<0.01	<0.01	<0.01	n.a.
PCB total (mg/kg)	<0.01	<0.01	<0.01	n.a.
Pesticides total (mg/kg)	<0.01	<0.01	<0.01	n.a.
Volatility Organic Compounds (BTEX) (mg/kg)	<0.01	<0.01	<0.01	n.a.
Chlorinated Hydrocarbons (CHC) (mg/kg)	<0.01	<0.01	<0.01	n.a.

Groundwater

Wells located in the city of Bor are used by the public especially in the dry season, like the public drinking fountain "Hajducka cesma". In the nearby settlements, the Trnavac well serves as a source of drinking water and the Slatina well as a source for watering of agricultural areas. A lot of wells are also used as private drinking water wells or for irrigation. These wells are regularly monitored by the Bor Medical Centre according to their bacteriological status, but only a limited number of parameters are examined

The following *Table 2.8* reports the results of the sampling and monitoring programme carried out by the IPH Belgrade in year 2002 (UNEP Assessment of Environmental Monitoring Capacities in Bor) on wells and public drinking fountains in Bor area with comparison with most restrictive Class I standards.

Sampling locations are reported in *Figure A.7* in *Annex A* and are:

- 03-364 Hajducka Cesma - Bor (public fountain);
- 03-365 Trnavac - well;
- 03-366 Slatina - well.

Table 2.8 ***Results of Analytical Groundwater Sampling for Bor Area (UNEP Assessment of Environmental Monitoring Capacities in Bor, September 2002)***

Parameters/Sample ID Number	03-364	03-365	03-366	Threshold limits for Class I
Temperature (°C)	12.8	11.9	9.1	
Colour-platinum cobald method	<5	<5	<5	
Odour	Without	Without	Without	
Turbidity NTU	0.1	0.1	0.1	
pH	7.2	6.8	7.1	6.8-8.5
Oxidability (mg/L) $KMnO_4$	2.8	4.0	5.3	
Residue 105°C	850	1050	1030	
Conductivity (μS/cm)	1270	1570	1540	
Chlorine (residual) (mg/L) Cl_2	<0.05	<0.05	<0.05	
Ammonia (mg/L) NH_4	<0.05	<0.05	<0.05	
Nitrite (mg/L) NO_2	<0.006	<0.006	<0.006	
Nitrate (mg/L) NO_3	90	100	90	
Chloride (mg/L) Cl	11.3	104.2	90.0	
Sulfate (mg/L) SO_4^{2-}	556.8	235.2	432.0	
TOC (mg/L)	1.78	2.48	2.95	
Metals (mg/L) method AAS				
Arsenic (mg/L) As	<0.002	<0.002	0.004	0.05
Copper (mg/L) Cu	0.005	<0.005	0.025	0.1
Zinc (mg/L) Zn	0.010	0.070	0.15	0.2
Iron (total) (mg/L) Fe	<0.05	<0.05	<0.05	0.3
Chromium (total) (mg/L) Cr	<0.010	<0.010	<0.010	
Cadmium (mg/L) Cd	<0.002	<0.002	<0.002	0.005
Nickel (mg/L) Ni	<0.010	<0.010	<0.010	0.5
Manganese (mg/L) Mn	<0.05	<0.05	<0.05	

Parameters/Sample ID Number	03-364	03-365	03-366	Threshold limits for Class I
Lead (mg/L) Pb	<0.010	<0.0.10	<0.010	
Mercury (mg/L) Hg	<0.0005	<0.0005	<0.0005	
Methanes (THN) (μg/L) - method GC/ECD				
Potential of THM*	36.9	66.4	94.2	
Chloroform	22.9	19.4	39.2	
Dichlorbrommenthane	10.5	24.6	33.3	
Dibromchlormethane	3.1	17.6	18.3	
Bromofom	0.4	4.8	3.4	
By products of disinfection (μg/L) method GC/ECD				
Dibromacetonitrile	<0.1	<0.1	<0.1	
Dichloracetonitrile	<0.1	<0.1	<0.1	
Trichloracetonitrile	<0.1	<0.1	<0.1	
Chlor Alkanes (μg/L) method GC/ECD				
1,1 dichlorethane	<0.1	<0.1	<0.1	
1,2 dichlorethane	<0.1	<0.1	<0.1	
Dichlormethane	2.6	3.2	2.0	
1,1,1 trichlorethane	<0.1	<0.1	<0.1	
Carbon tetrachloride	<0.1	<0.1	0.1	
Chlor ethenes (μg/L) method GC/ECD				
1,1 dichlorethene	<01	<0.1	<0.1	
1,2 dichlorethene	<0.1	<0.1	<0,1	
Trichlorethene	<0.1	<0.1	<0.1	
Tetrachloretene	<0.1	<0.1	0.1	
Chlor Benzene (μg/L) method GC/ECD				
1,2 - dichlorbenzene	<1	<1	<1	
1,3 - dichlrobenzene	<1	<1	<1	
1,4 - dichlorbenzene	<1	<1	<1	
Volatility aromatic hydrocarbons (μg/l) method GC/FID				
Benzene	<1	<1	<1	
Ethylbenzene	<1	<1	<1	
Xylene	<1	<1	<1	
Styrene	<1	<1	<1	
Toluene	<1	<1	<1	

*The potential of THM is measured after reaction with chlorine in the Laboratory

According to the Serbian regulation and the EU regulation, no relevant quality problem was identified in groundwater analized by the Institute of Public Health of Belgrade.

2.5 *SURFACE WATER USES AND QUALITY*

2.5.1 *Evaluation Methodology*

Serbian regulation points out the legal framework for protection of surface water by means of classification in four classes according to water pollution level and use. Limits are summarized in Table 2.9 as presented in Order on water classification, official Gazette of Social Republic of Serbia, No. 5/68 (ecological quality parameters) and official Gazette of Social Republic of Serbia, No. 31/82 (chemical quality parameters). With regards to chemical quality paramenters, a selection of most representative is presented in the table.

As a matter of facts, iron, copper, nickel, cadmium, zinc, arsenic and cyanides are most frequently found in waterstreams in concentrations above threshold values.

Indicated classes are:

- Class I: water that, in natural state or after disinfection, can be used for drinking water supply, food industry and fine fish (salmonidae) breeding.
- Class II: water appropriate for bathing, recreation, water sports, less fine fish (cyprinidae) breeding, including water that, after basic treatment methods (coagulation, filtration and disinfection), can be used for drinking water supply and food industry. Class II is then divided in two further subclasses: sub-class IIa and sub-class IIb.
- Class III: water that can be used for irrigation and industries except food industry.
- Class IV: water that can be used only after special treatment.

Table 2.9 ***Surface Water Quality Standards***

Indicator	**Class I**	**Class II**	**Sub-class IIa**	**Sub-class IIb**	**Class III**	**Class IV**
Suspended solids in dry weather conditions [mg/l]	10	30	30	40	80	-
Total dissolved substances in dry weather conditions [mg/l]	350	1,000	1,000	1,000	1,500	-
pH	6.8 - 8.5	6.8 - 8.5	6.8 - 8.5	6.5 - 8.5	6.0 - 9.0	-
Dissolved oxygen [mg/l] (not for groundwater and lakes)	8	6	6	5	4	0.5
BOD_5 [mg/l]	2	4	4	6	7	-
Saprobic level according to Libman (not for groundwater and lakes)	oligo-saprobe	beta-meso-saprobe	beta-meso-saprobe	beta-alfa-meso-saprobe	alfa-meso-saprobe	-
Level of biological productivity (applicable only for lakes)	oligo-trophic	eutrophic	eutrophic	-	-	-
Most probable number of coliform germs in 100 ml of water, up to	200	6,000	6,000	10,000	-	-
Noticeable waste materials	none	none	none	none	none	none
Colour	none	none	none	none	-	-
Smell	none	none	none	none	-	-
Cyanides	0.1	0.1	0.1	0.1	0.1	0.1
Iron (mg/l)	0.3	0.3	0.3	0.3	1.0	1.0
Copper (mg/l)	0.1 (0.01)	0.1 (0.01)	0.1 (0.01)	0.1 (0.01)	0.1	0.1
Nikel (mg/l)	0.05	0.05	0.05	0.05	0.1	0.1
Cadmium (mg/l)	0.005	0.005	0.005	0.005	0.01	0.01
Zinc (mg/l)	0.2	0.2	0.2	0.2	1	1
Arsenic	0.05	0.05	0.05	0.05	0.05	0.05

2.5.2 *Bor*

Bor potable water supply is abstracted from Zlotska river basin/catchment and from water wells near Crni Timok river since 2000.

The water from villages near mining facilities and along Borska river and Kriveljska river banks are contaminated and can not be used either for drinking or irrigation. Problem was partly solved when some of the villages (Slatina, Brestovac, Ostrelj, Krivelj and Donja Bela Reka) were connected to Bor water supply system.

Rivers Borska and Kriveljska represent an open waste water collector (both for industrial and for municipal effluents), completely degraded and not classifiable by the regulation requirements. After the inflow of Borska reka in Kriveljska, Bela river is formed. After Bela river inflow to Veliki Timok river, the latter becomes useless for the population settled in its valley. In general, rivers located downstream from the RTB Bor and inflow of Borska river are contaminated and their inflow influence the quality of the Danube. In their inundation zones, the flotation tailings sediments are settled. This represents an environmental trans boundary problem.

In the second half of 20^{th} century, flotation tailings spilled into the Borska river and damaged more than 2,500 ha of inundation zones of the Borska and Veliki Timok rivers.

The following *Table 2.10* report the analyses carried out by 1-Maj in August 2005 on the rivers of the area that are located in *Figure 2.21*. Concentration detected are referred to Serbian legal framework for protection of surface and groundwater by means of classification in four classes according to water pollution level and use. Limits are summarized in *Table 2.10* as presented in Order on water classification, official Gazette of Social Republic of Serbia, No. 5/68. Threshold limit values are referred to Class III: water that can be used for irrigation and industries except food industry.

Figure 2.21 Location of Samples taken from the Rivers of the Bor Copper Mines (Source: LEAP)

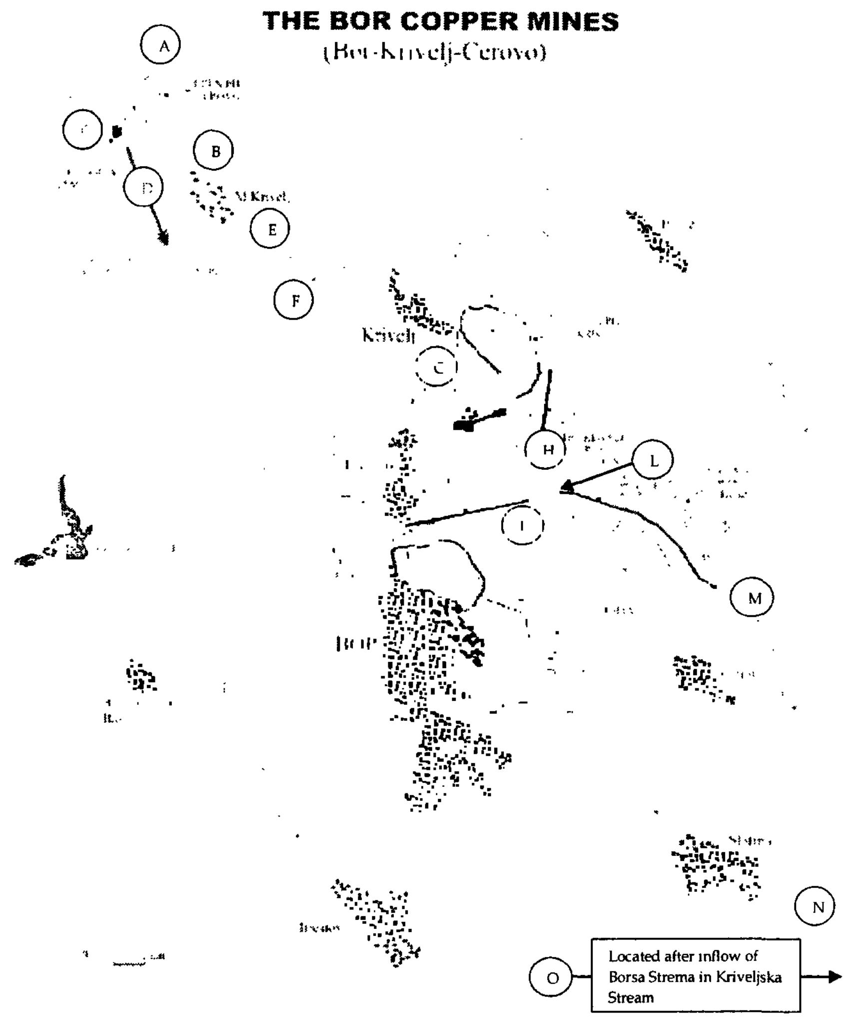


Table 2.10 ***Surface Water Monitoring Results (August 2005) (Source: 1 Maj, August 2005)***

Parameters	Unit	A	B	C	D	E	F	H	I	L	M	N	O	Threshold Limit Value for Class III (conc.)
Water temperature	°C	15/19	14/19	16/19	17/19	/	20/19	21/19	24/22	20/19	20/19	/	/	< 28
Water colour	/	No	Light green	No	No	/	muddy	No	Light brown	Light brown	Light brown	/	/	No
Water smell	/	No	No	No	No	/	No	No	No	No	No	/	/	No
Floating matter	/	No	No	No	No	/	No	No	No	No	No	/	/	No
pH	/	7.5	6.1	7.0	7.2	7.3	7.5	6.0	2.9	3.7	3.5	5.1	4.6	6-9
Sedimentation for 2h	ml/l	0.2	0.4	0.2	0.5	/	0.6	0.9	1.7	16	15	/	/	/
Suspended matter on 105 °C	mg/l	51	72	47	59.5	60	66	78	186	383	595	383	407	80
Dry residual	mg/l	869	905	554	620	/	751	820	874	1,383	1,227	/	/	1,500
$KMnO_4$ Consumption	mg/l	11.2	16.6	10.3	16.9	/	18.4	19.7	32.9	34.7	122.6	/	/	20
BOD 5	mg O_2/l	5.9	4.0	5.1	4.9	/	8.5	10.3*	22.3*	22.3	108.3	/	/	7.0
COD (COD from $K_2Cr_2O_7$)	mg O_2/l	/	/	/	/	/	/	/	111	91.2	512	/	/	/
Nitrates (as N)	mg/l	nd	0.20	nd	0.09	/	0.26	0.34	2.77	0.5	1.27	/	/	15
Nitrites (as N)	mg/l	nd	nd	0.05	nd	/	nd	nd	nd	nd	nd	/	/	0.5
Ammonia ion salts (NH_4)	mg/l	0.08	0.06	nd	nd	/	nd	nd	1.36	0.85	2.16	/	/	10
Chlorides (Cl)	mg/l	11.0	52.3	12.1	24.6	/	27.2	30.8	516	41.0	41	/	/	/
Sulphates (SO_4)	mg/l	75	261	32	70	/	316	297	373	369	383	/	/	/
Sulphites (SO_3)	mg/l	/	/	/	/	/	/	/	/	/	/	/	/	/
Sulphides (S)	mg/l	/	/	/	/	/	/	/	/	/	/	/	/	/
Cyanides (CN)	mg/l	/	/	/	/	/	/	/	/	nd	/	/	/	nd
Phosphates (PO_4)	mg/l	nd	nd	nd	nd	/	0.20	0.25	nd	0.55	0.98	/	/	/
Phenol	mg/l	nd	nd	nd	nd	/	nd	nd	nd	nd	nd	/	/	0.3
Detergents (ABS)	mg/l	nd	nd	nd	nd	/	nd	nd	nd	nd	nd	/	/	0.3
Oils and lubricants	mg/l	nd	nd	nd	nd	/	nd	nd	nd	nd	nd	/	/	1
Iron (Fe)	mg/l	nd0	0.828	nd0	nd	nd	nd0	nd0	1,364.3	3.211	7.257	nd	0.087	10
Chromium (Cr^{6+}/Cr^{3+})	mg/l	nd0	nd0	nd0	nd	/	nd0	nd0	nd	nd0	nd0	/	/	1
Copper (Cu)	mg/l	0.035	1.360	0.061	0.089	0.737	0.289	3.867	460.8	20.663	21.406	1.53	1.29	0.5
Nickel (Ni)	mg/l	nd0	0.037	nd0	nd0	/	nd0	nd0	0.062	nd2	nd0	/	/	0.1
Cadmium (Cd)	mg/l	nd0	0.011	nd0	nd0	/	nd0	nd0	0.082	nd0	nd0	/	/	0.1
Zinc (Zn)	mg/l	0.076	0.519	0.040	0.715	0.055	nd0	0.388	40.448	0.848	1.467	0.883	0.912	0.05
Lead (Pb)	mg/l	nd0	nd0	nd0	nd0	/	nd0	nd0	nd	nd0	nd0	/	/	1
Dissolved oxygen	mg/l	6.6	6.7	6.1	6.5	/	6.9	6.5	4.98	6.22	7.4	/	/	0.1
														min. 4

No analytical results are available for sampling point G; * = BOD5 is not relevant as the concentration of heavy metals concentration is too high

The table evidences a sharp variation in surface water quality at sampling point I (detected values at upstream sampling points - from A to H - do not show evidence of contamination). Low values of pH and dissolved oxygen, high levels of suspended matter, COD and of $KMnO_4$ consumption and concentrations of Sulphates, chlorides, iron, copper and zinc above Class III threshold limit values are detected with a maximum in correspondence of I sampling point and, although in a less evident way, at the downstream sampling locations (from L to O). This fact could be addressed to the discharge of wastewaters deriving from Jama mine and from the smelter complex.

The only exception is represented by copper concentration that is high at all locations and above threshold limits almost everywhere. Only Cerovo stream, upstream the open pit (sampling point A) and Valja Mare stream (sampling points C and D) are not affected by high copper concentration.

It is evident that contaminant concentrations decrease proceeding from sampling location I to L, M, N and O (although N and O analyses do not include the complete screen of parameters monitored at other locations) due to natural attenuation processes occurring in rivers.

Further information with regard to analytical results are available from the UNEP Assessment of Environmental Monitoring Capacities in Bor and refer to the following sampling points reported in *Figure A.7* in *Annex A* with the exception of points 03-358, 03-359 and 03-360 that are located downstream:

- 03-355: Timok river upstream the conjunction with the Bela river;
- 03-356: Bela river before the conjunction with the Timok river;
- 03-357: Timok river, downstream the inflow of Bela river;
- 03-358: Bor river, upstream the inflow in the Kriveljska river;
- 03-359: Kriveljska river, upstream the inflow of the Bor river;
- 03-360: Bela river, downstream the conjunction of Bor and Kriveljska rivers.

Results are reported in following *Table 2.11*. Threshold limits of Class III are also reported to be considered as an average concentration limit for the various parameters as sampling locations refer to different rivers.

Table 2.11 ***Analytical Results of Surface Water in Bor Area (Source: UNEP Assessment of Environmental Monitoring Capacities, 2002)***

Parmeters/Sample ID Number	**03-355**	**03-356**	**0-357**	**03-358**	**03-359**	**03-360**	**Theshold Limit Value for Class III**
Air Temperatur (°C)	20.7	19.3	19.4	19.6	19.6	19.7	
Water Temperatur (°C)	13.2	12.3	12.9	19.2	13.2	17.2	< 28
pH	8.4	6.1	7.3	6.7	4.8	4.9	6-9
Dissolved Oxygen (mg/L) O_2	7.2	9.0	8.8	7.9	9.9	7.8	
Saturation %O_2	68.0	84.0	83.0	84.0	93.0	80.0	
BOD_5	3.8	7.8	4.9	14.1	1.1	8.3	7.0
Oxidability (mg/L) $KMnO_4$	12.4	14.3	13.2	54.2	6.2	43.7	20
COD (mg/L)	3.1	3.6	3.3	13.6	1.6	10.9	
Residue 105 (°C)	246.0	1567	340.0	1953	1398	1934	
Suspended matter (mg/L)	137.0	752.0	218.0	1993	349.0	1570	80
Phosphate total (mg/L) P	0.09	<0.02	0.04	<0.02	<0.02	0.02	
Ortho phosphate (mg/L) $PO4^3$	0.06	<0.02	<0.02	<0.02	<0.02	<0.02	
Conductivity (µS/cm)	430.0	1670	570.0	1970	1640	1880	
Alcalinity ml $O_2$1N HC1/L	36.7	4.9	31.7	4.0	1.0	1.0	
Hardness total (°dH)	10.9	58.0	16.2	65.0	111.3	69.9	
Iron (mg/L)	0.6	5.02	1.16	6.00	3.20	4.40	1
Ammonia (mg/OL) NH^+_4	0.33	4.11	0.71	8.71	1.65	6.73	10
Nitrite (mg/L) NO_2	0.043	0.062	0.053	0.137	0.016	0.034	0.5
Nitrate (mg/L) NO_3	1.4	1.1	1.3	1.4	1.8	1.7	15
TOC (mg/L)	2.82	3.21	2.95	15.93	0.95	8.60	
Chloride (mg/L) C1	35.4	14.2	28.9	15.6	23.4	18.4	
Surfactant anionic MBAS (mg/L)	<0.02	<0.02	<0.02	0.04	<0.02	0.03	
Cyanide (mg/L) CN	<0.010	0.026	<0.010	0.040	0.026	0.029	
Total hydrocarbons (µg/L)	4.4	9.1	6.8	151.5	28.0	131.7	
Metals (mg/l)							
Copper	0.119	15.7	1.29	14.0	16.2	15.0	0.1
Zinc	0.013	2.1	0.15	2.4	0.26	2.0	1
Lead	<0.010	0.100	<0.01	0.100	<0.01	0.90	0.1
Cadmium	<0.002	0.009	<0.002	0.011	0.003	0.09	0.05
Nickel	<0.010	0.270	0.030	0.261	0.020	0.243	0.1
Chromium (total)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	
Arsenic	<0.002	0.008	0.005	0.021	<0.002	0.018	
Mercury	$<5x10^{-3}$	$<5x10^{-3}$	$<5x10^{-3}$	$<5x10^{-3}$	$<5x10^{-3}$	$<5x10^{-3}$	
Mineral oil and grease (µg/l)	**<0.010**	**0.035**	**0.010**	**0.048**	**<0.005**	**0.025**	**10**
Total pesticide	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Volatility aromatics hydrocarbons	<1	<1	<1	<1	<1	<1	
Total PCB	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Total PAH	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Chlorinated hydrocarbons	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	

At all sampling point locations suspended matter was found high. In Bor river both upstream and downstream the inflow in the Kriveljska river and before the conjunction to the Timok river, in the Kriveljska river, upstream the inflow of the Bor river and in the Timok river, downstream the inflow of Bor river iron and copper concentrations are high compared to Class III limits.

Bor, Kriveljska and Bela rivers presents high concentrations of nickel at all sampling locations. Zinc is present in high concentrations both in Bor and Bela rivers.

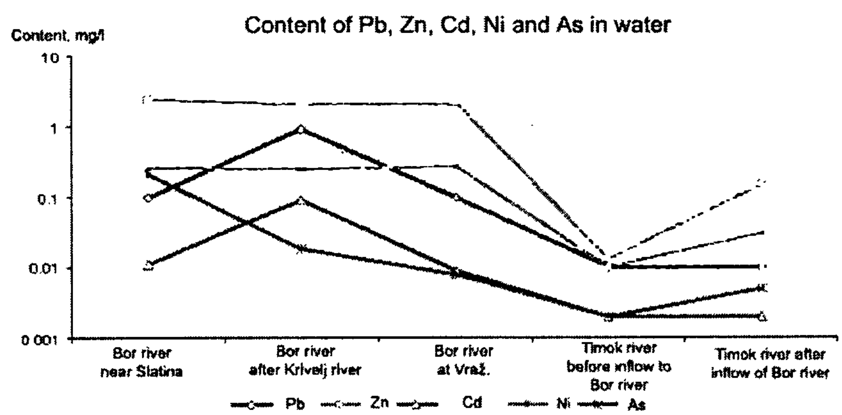
Both Kriveljska river and Bela river are characterized by very low pH (<5). Bela river sampling location (03-360) presents high concentrations of lead and cadmium.

It is also evident that the inflow of Bor river into Kriveljska river decreases pH values and increases BOD_5, COD, suspended matter, iron, ammonia, TOC total hydrocarbons, copper, lead, zinc, nickel and mineral oils.

The inflow of Bela river into Timok river decreases ph values and increase BOD_5, COD, suspended matter, iron, total hydrocarbons, copper, zinc, nickel and arsenic.

The Institute of Health Protection Timok Zajecar carried out an analysis campaign on metals concentration in Borska river. Results are presented in following *Figure 2.22* and clearly show the influence of Bela river on Timok water quality. As a matter of fact, Timok water quality decrease abruptly after the inflow of Bela river.

Figure 2.22 ***Metals Content in Borska River (Source: LEAP)***



Source: Institute for Health Protection "Timok Zaječar"

River Classification

In year 2002, Bor River is, from its source to the Bor settlement, classified as IIa category water flow. Downstream, from the Bor settlement to its confluence with Kriveljska river, as class IV. Kriveljska river has not been categorized at all while Bela river is class IV. The Timok River is, from the settlement of Zajecar to its confluence with Bela River, categorized as Class IIb water. From that point on, to its confluence with the Danube it is categorized as III category water flow.

The water quality from Bor reservoir in 2003 and 2004 referring to samples taken from all measuring points is summarized as follows:

- Values of dissolved oxygen O_2 and percentage of O_2 saturation were decreasing, proportionally to depth increase, from class I to IV
- Recorded concentrations of nitrites (SN) corresponded to class III / IV
- In some samples (no indication about which are these samples), hazardous substances measured as S^{2-} and Mn corresponded to class III/IV.

2.5.3 *Majdanpek*

Majdanpek potable water is abstracted from the reservoir "Pustinjac" (dam constructed in 1973, volume 150,000 m^3, average depth 3m, length 500 m) located near the bank of Veliki Pek river and from reservoir "Veliki zaton" on Mali Pek river (constructed 30 years ago). Both reservoirs are filled up with alluvium.

Waste waters from Majdanpek copper mine flotation contaminate Veliki Pek, whilst waste waters from crushing plants and service shop for heavy vehicles contaminate river Mali Pek. Saski potok is jeopardized by seepage from tailings ponds. The accident on tailings dam Valja Fundata, in 1974, when tailings spilled, caused contamination of rivers Mali and Veliki Pek, their inundation zones, and 5-10 ha of agricultural land.

Water streams are affected by mining as discharge of mine water and run-off water from waste are routed to Saska and Mali Pek streams without previous treatment. Discharge of filtrate from the concentrate filtration plant is discharged to the Veliki Pek river.

The following *Table 2.12* report the analyses undertaken by the Institute for Health protection on behalf of RBM copper mines in June 2005.

Table 2.12 ***Majdanpek Surface Water Analyses (Source Institute of Health Protection, June 2005)***

Stream	**Sample Location**	**pH**	**Mg/litre**				
			Suspended solids	Iron	Copper	Zinc	Arsenic
Saska		8.3	0	0.159	0.004	0.007	0.001
Maximum permitted concentration (Category I/II)		6.8-8.5	30	0.30	0.10	0.20	0.05
Mali Pek	Before waste water from RBM	8.38	69.0	0.854	0.021	0.053	<0.001
Mali Pek	After waste water from RBM	7.84	95.4	12.31	9.953	1.08	0.002
Veliki Pek	Before filtration water RBM	8.51	6.0	0.424	0.006	0.012	<0.001
Veliki Pek	After filtration water RBM	8.56	1.8	0.568	0.014	0.016	0.001
Maximum permietted concentration (Category III/IV)	6-9	80	0.5	0.1	1.0	0.05	

Concentrations of suspended solids, iron, copper and zinc in the Mali Pek stream exceed the criteria for Category III/IV waters after inflow of waste waters from RBM's mining and crushing operations (see *Annex C* for details on regulatory framework).

However natural dilution after confluence with the Veliki Pek, approximately 2 km from the mine, reduces these concentrations below category III/IV standards.

Discharge of filtrate from the concentrate filtration plant has some impact on the Veliki Pek raising the iron concentration above the Category III/IV standard.

River Classification

Saska river (upstream to the site) is classified as Class I/II quality, while Mali Pek and Veliki Pek are categorized as Class III/IV water flow.

2.6 *CLIMATE AND METEOROLOGY*

2.6.1 *Bor*

Bor and its surroundings are characterized by continental climate. Owing to its position which is widely open to Vlaska depression, very strong are climate influences from the east. Therefore, climate characteristics in Bor and its surroundings are often quite different from those prevailing in central Serbia. The mountains Crni vrh and Cestobrodica are special climate boundaries. The climate is temperate continental climate, which in the highest mountain zones is transformed in mild mountain climate. The features of such climate are warm and sunny summers and cold winters with a lot of snow. The seasons are clearly recognized, the autumns being somewhat warmer, drier, with more sunny days than the springs. The summers are characterized by rather stable weather circumstances, comprising long sunny and short rainy periods. In winter, weather circumstances are characterized by low temperatures and intense snowing.

Meteorological data for the territory of Bor are continuously recorded in the meteorological station near the Copper Institute, on the mountain Crni Vrh. Annual results for meteorological parameters for the year 2003 are shown in *Table 2.13*.

In particular, for year 2003:

- the average monthly temperature values were within the range from -4.2°C in February to 24.5°C in August;
- the average annual temperature for the territory of the town Bor was 10.6°C;
- the values of relative humidity were within the range of 52% in August to 88% in January;
- the lowest atmospheric pressure was recorded in July - 970.3 mbar, and the highest in November - 977.2 mbar; the average annual value was 973.2 mbar.

Table 2.13 *Meteorological Parameters, 2003*

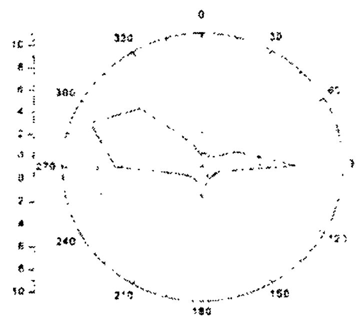
Months	**Air temperature Average monthly value (°C)**	**Air humidity Average monthly value (%)**	**Atm. pressure Average monthly value (mbar)**	**Wind**	
				Average monthly velocity (m/sec)	**Max velocity (m/sec)**
Jan	-1.2	88	970.8	0.3	23.6
Feb	- 4.2	80	974.9	0.6	12.4
Mar	4.6	65	975.7	0.7	12.9
Apr	9.4	65	971.0	0.7	12.9
May	19.2	62	972.5	0.3	13.4
Jun	22.2	62	971.7	0.3	9.3
Jul	21.7	63	970.3	0.6	21.1
Aug	24.5	52	971,9	0.3	13.3
Sep	15.4	71	975.5	0.3	14.9
Oct	8.8	81	970.4	0.3	14.9
Nov	6,5	83	977.2	0.2	11.8
Dec	0.5	84	976.2	0.6	16.5
Average	10.6	71	973.2	0.4	Max 23.6

Source: Annual Report on Meteorological Observations, Bor, 2003

The wind-rose is shown in *Figure 2.23*. The prevailing wind was from WNW direction. The average monthly wind intensities were within the range from 0.2 m/sec in November to 0.7 m/sec in March and April. Maximum blow of wind of 23.6m/sec was recorded in January.

It can be also noted that there is a small percentage of winds blowing southward. In these occasions Ostrelj village can be affected by significant particulate emission from Veliki Krivelj tailing ponds.

Figure 2.23 Wind Rose for Bor, 2003



Wind directions and intensities recorded during 2004 and partly 2005 are similar to the showed ones. There is a significant percentage of winds blowing westwards thus pushing smelter facility emissions and particulate towards Bor town. In particular there are several dwellings close to the western boundary of the old tailing ponds that can be affected by significant particulate emissions.

2.6.2 *Majdanpek*

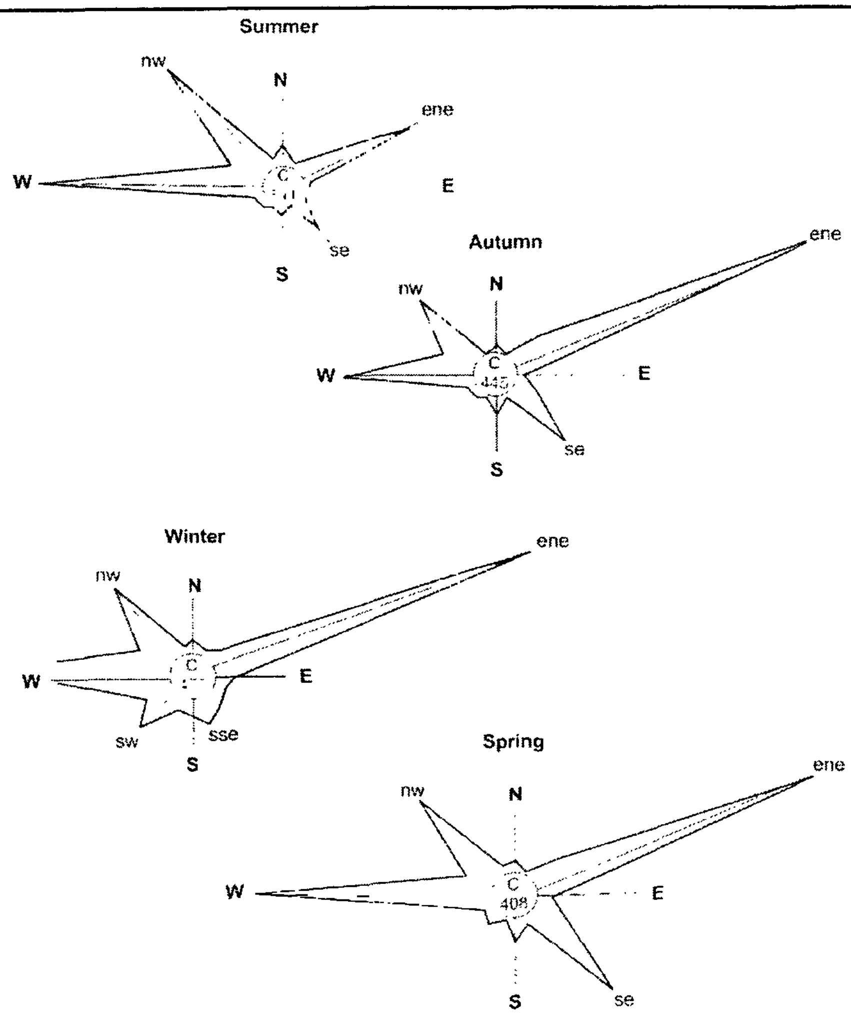
The area of Majdanpek municipality has a continental type of climate, within which there are 3 different subtypes in the zones of:

a) river Danube banks, Djerdap reservoir and Porecki bay;
b) terrains of the river valleys Porecka reka, Saska reka, Mali and Veliki Pek;
c) hills and mountains where ore deposits and forests are.

There is no meteorological station in Majdanpek.

In Majdanpek town and its vicinity climate subtypes b) and c) are relevant. Wind roses for 4 seasons are presented in *Figure 2.24*.

Figure 2.24 *Wind Roses Majdanpek*



2.7 AMBIENT AIR QUALITY

2.7.1 Evaluation Methodology

A comprehensive review of Serbian Legislation concerning air pollution is reported in *Annex C*. Key local legislative requirements are summarized below. In particular, *Table 2.14* presents a comparison of ambient air quality guidelines/standards for selected parameters, at national and international (EU and WB) level.

Table 2.14 Ambient Air Quality ($\mu g/m^3$)

Parameter	Serbia	EU Legislation	WB (1)	WB (2)
Particulate Matter - PM_{10} - soot				
Annual Average	30/50 (13)	40 (3)	100	50
Maximum 1-hour	-/150 (13)			
Maximum 24-hour Average	40/50 (13)	50 (4)	500	70
98 percentile	50/150 (13)			
Total Suspended Particules				
Annual Average	40/70 (13)			
Maximum 24-hour Average	70/120 (13)			
98 percentile	100/200 (13)			
Nitrogen Oxides, as NO_2				
Annual Average	50/60 (13)	40 (5)	100	-
Maximum 1-hour	85/150 (13)	200 (6)		
Maximum 24-hour Average	70/85 (13)		200	150
98 percentile	85/150 (13)			
Sulfur Dioxide				
Annual Average	30/50 (13)		100	50
Maximum 1-hour	150/350 (13)	350 (7)		
Maximum 24-hour Average	100/150 (13)	125 (8)	500	125
98 percentile	150/350 (13)			
Lead - Annual average	1 (14)	0.5 (9)		
Benzene - Annual average	5	5 (11)		
Manganese - Annual average	1 (14)			
Chromium - Annual average	0.3 ng/m^3 (14)			
Cadmium - Annual average	10 ng/m^3 (14)	5 ng/m^3 (12)		
Arsenic - Annual average	6 ng/m^3	6 ng/m^3 (12)		
Nickel - Annual average	20 ng/m^3	20 ng/m^3 (12)		
Benzo(a)pyrene - Annual average	1 ng/m^3	1 ng/m^3 (12)		

(1) WB Environment, Health and Safety Guidelines Mining and Milling - Open Pit, and WB Environment, Health and Safety Guidelines Mining and Milling – Underground.
(2) WB General Environmental Guidelines.
(3) Directive 1999/30/EC.
(4) Directive 1999/30/EC. Not to be exceeded more than 35 times per calendar year.
(5) Directive 1999/30/EC. A limit of 60 µg/m3 (50%) must be met on the 19 July 1999, reducing on 1 January 2001 and every 12 months thereafter by equal annual percentages to reach 0% (40 µg/m3) by 1 January 2010.
(6) Directive 1999/30/EC. Not to be exceeded more than 18 times per calendar year. A limit of 300 µg/m3 (50%) must be met on the 19 July 1999, reducing on 1 January 2001 and every 12 months thereafter by equal annual percentages to reach 0% (200 µg/m3) by 1 January 2010.
(7) Directive 1999/30/EC. Not to be exceeded more than 24 times per calendar year.
(8) Directive 1999/30/EC. Not to be exceeded more than 3 times per calendar year.
(9) Directive 1999/30/EC. The limit is applicable since the 1st January 2005. The application can be postponed up to 2010 for areas in the vicinity of specific point sources.
(10) Directive 1999/30/EC.
(11) Directive 2000/69/EC.
(12) Directive 2004/107/EC sets "target values" for Arsenic, Cadmium, Nickel and benzo(a)pyrene. Target values are set on the total content in the PM10 fraction averaged over a calendar year. Target values shall be met by 31 December 2012
(13) Regulation on ambient air quality, criteria for sampling points and recordkeeping (Official Gazette of the Republic of Serbia, No. 54/92): Rural and recreation areas/Urban areas.
(14) Limit immission values for heavy metals in suspended particles.

Serbian legislation states also limits for particulate deposition and for the maximum heavy metal content in the deposited matter. These standards are reported in *Table 2.15*.

Table 2.15 ***Maximum Particulate and Heavy Metals Deposition Values (According to Official Gazette of Serbia, N. 54/99)***

Pollutant	Unit	Measuring time	Rural and recreational areas (average annual value)	Urban areas (average annual value)
Total suspended	mg/m²/day	1 month	300	450
matter		1 year	100	200
Lead	µg/m²/day	1 month	100	250
Cadmium	µg/m²/day	1 month	2	5
Zinc	µg/m²/day	1 month	200	400

2.7.2 *Bor*

The Copper Institute, together with the Institute of Public Health, Zajecar are responsible for air monitoring in the Bor area.

The Copper Institute monitors ambient air at four locations in Bor town and in the vicinity:

- in Bor town, approximately 500 m from the smelter stack (monitoring point "Gradski-Park");
- at the Copper Institute in Bor town, approximately 1 km from the smelter complex (monitoring point "Copper Institute");
- at a site approximately 2 km SE of the smelter complex on the outskirts of Bor (monitoring point "Electroistok Yugopetrol");
- in Brezonik, a community about 2.5 km N of the smelter complex (monitoring point "Brezonik").

Sulphur dioxide concentrations at the first three locations are monitored daily, with measurements at 15-minutes intervals. Concentrations of particulate are measured daily at the Copper Institute, but less frequently at other locations. Collected samples of particulate are analysed for heavy metals: arsenic, lead, cadmium, manganese and mercury. Reports are issued monthly and annually.

As pointed out in the previous paragraph, prevailing wind direction is from WNW for approximately 28% of the year while calm is for about 50% of the year. As a consequence, Bor town is upwind the industrial area for a significant part of the year.

Monitored data indicate that average sulphur dioxide and arsenic levels in the old town ambient air exceeded Serbian, World Bank and EU air quality standards for the period 1996-2001.

The results of ambient air monitoring for sulphur dioxide, particulate matter and heavy metals in 2004 are given in *Table 2.16*, *Table 2.17* and *Table 2.18*.

In two locations the daily average sulphur dioxide concentration exceeded the daily air quality standard (150 µg/m³) frequently (67 days in Gradski-Park and 84 days in Electroistok) and reached a maximum of approximately 10 times above the limit (in Electroistok). At Brezonik the maximum daily concentration recorded was in excess of the limit by a factor of approximately 30.

The present air quality conditions are probably worse than these data suggest. In fact Bor Smelter Factory processed in 2004 the lowest quantity of copper concentrate of the last 10 years with the smelter operating for approximately 125 days. Therefore, the air quality standard for sulphur dioxide was exceeded in Bor for half of the days the smelter operated in 2004.

Table 2.16 ***Sulphur Dioxide Concentration in Ambient Air, 2004***

Monitoring point	Days sampled	Concentration (µg/m³) Max.	Annual average*	Limit	50 Perc.	98 Perc.	Days above daily limit*
Gradski-Park	352	914	91	150	82	266	67
Copper Institute	366	214	19	150	5	83	9
Electroistok Yugopetrol	356	1508	126	150	89	400	84
Brezonik	214	4444	46	150	9	367	5

* Serbian limit: annual average =50; daily average = 150; 98 percentile = 350

The daily average concentration of particulate matter was within the Serbian air quality standard (50 µg/m³) at all monitoring positions except at the Copper Institute, where it was exceeded on 3 days; the maximum recorded concentration exceeded the limit by a factor of 1.25.

Table 2.17 ***Particulate Matter Concentration in Ambient Air, 2004***

Monitoring point	Days sampled	Concentration (µg/m³) Max.	Annual average*	Limit	50 Perc.	98 Perc.	Days above daily limit*
Gradski-Park	91	40	11	50	11	17	0
Copper Institute	366	63	10	50	9	22	3
Electroistok Yugopetrol	50	12	8	50	7	10	0
Brezonik	214	29	10	50	7	19	0

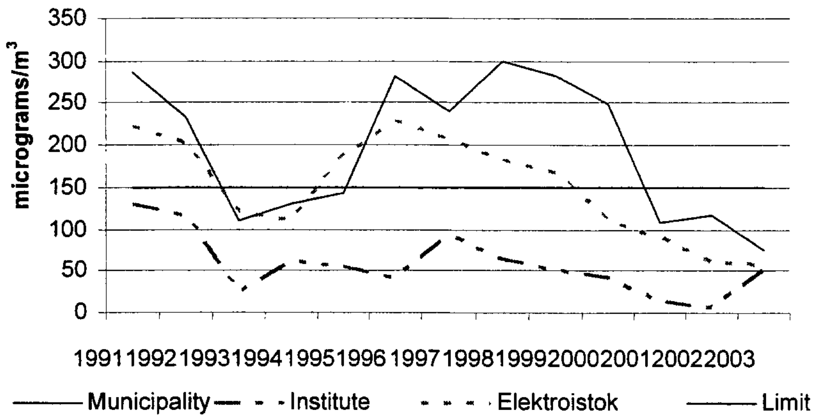
* Serbian limit: annual average =50; daily average = 50; 98 percentile = 150

These data seem, in any case optimistic: particulate concentration surely should exceed the reported values in windy dry summer days. Furthermore secondary particulate (derived from the condensation of sulphur dioxide and nitrogen oxides) should largely exceed the reported values. This is also confirmed by the high arsenic concentration (see below) mainly present in PM_{10} and by the deposition rate recorded in other monitoring stations (see below for discussion). New instrumentation to measure PM_{10} would be useful to have more reliable particulate concentration data.

Annual average concentrations of arsenic exceeded the Serbian and EU air quality standards (both equal to 6 ng/m³).

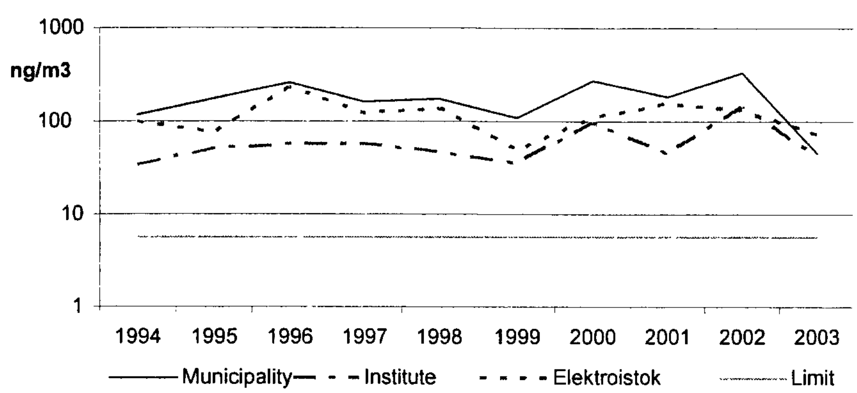
Figure 2.25 and *Figure 2.26* show the average annual concentrations respectively of sulphur dioxide and arsenic in the three monitoring points mentioned above (Gradski-Park, Copper Institute and Electroistok Yugopetrol) in the period 1991-2003.

Figure 2.25 ***Daily Average Annual Concentrations of SO_2 in Bor***



Source: Copper Institute, Bor

Figure 2.26 ***Average Annual Concentrations of Arsenic in Bor***



Source: Copper Institute, Bor

The presence of significant arsenic concentration (70 to 100 times higher than the standard) is confirmed also in other sampling stations (see *Table 2.18* where concentrations of heavy metals is reported), with a maximum recorded at Bolnica (which is approximately 1.5 km NW of the smelter complex on the outskirts of Bor).

Table 2.18 ***Annual Average Concentrations of Heavy Metals in Air, 2004***

Monitoring point	N. days sampled	Pb (µg/m³)	Cd (µg/m³)	Mn (µg/m³)	Cu (µg/m³)	Hg (µg/m³)	Ni (ng/m³)	As (ng/m³)
Gradski-Park	9	0.1	0.004	/	0.2	0.01	/	46.5
Copper Institute	11	0.2	0.005	/	0.7	0.009	0.1	95.4
Electroistok Yugopetrol	8	0.3	0.009	/	0.2	/	0.1	64.4
Bolnica	2	1.0	0.028	/	0.7	0.05	22.8	224
Ostrelj	3	0.2	0.002	/	/	/	/	83.6
Krivelj	1	0.1	0.03	/	1.1	0.1	/	6.7
NGC	1	0.3	/	/	/	/	/	179
Brigade	1	/	/	/	/	/	/	4.5
Jezero	1	0.01	0.01	/	/	/	/	34.9
Limit		1.0	0.01	/	0.2	1.0	20	6

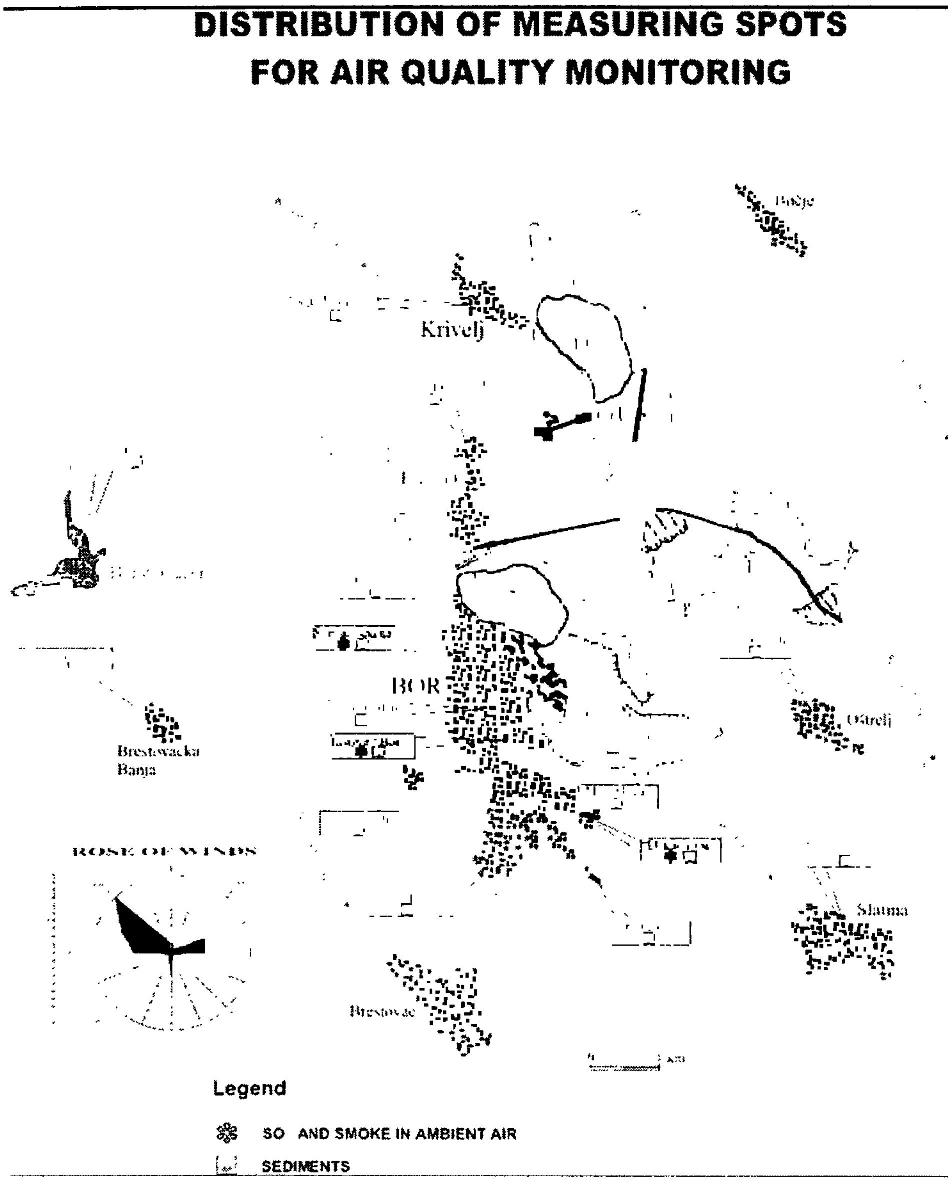
Source: Copper Institute, Bor

Based on available documentation, Bor represents one of the places with highest air pollution in Serbia due to operation of RTB Bor, as identified in the State of the Environment report for 2000.

Characterisation of air quality is completed with the measurements of atmospheric particulate and heavy metals deposition rate, performed using standard deposit gauge methodology at 15 locations in the Bor region (see *Figure 2.27* for exact location). The monitoring includes analysis for pH, sulphate, calcium, magnesium, dried residue, insoluble material, organic material, ash, lead, cadmium and zinc; *Table 2.19* shows the results of air sampling in 2004.

The Table represents annual average values and does not show arsenic, poly-aromatic hydrocarbons and other important pollutants. Annual average values higher than the allowed limit indicate peak situation when dust concentration could be as high as 500 mg/m^2/d and therefore should be considered not easily bearable according to most of the international standards.

Figure 2.27 *Air Quality Monitoring in Bor Area*



Source: Analytical laboratory within the RTB – Bor complex

Table 2.19 *Annual Average Depositions, 2004*

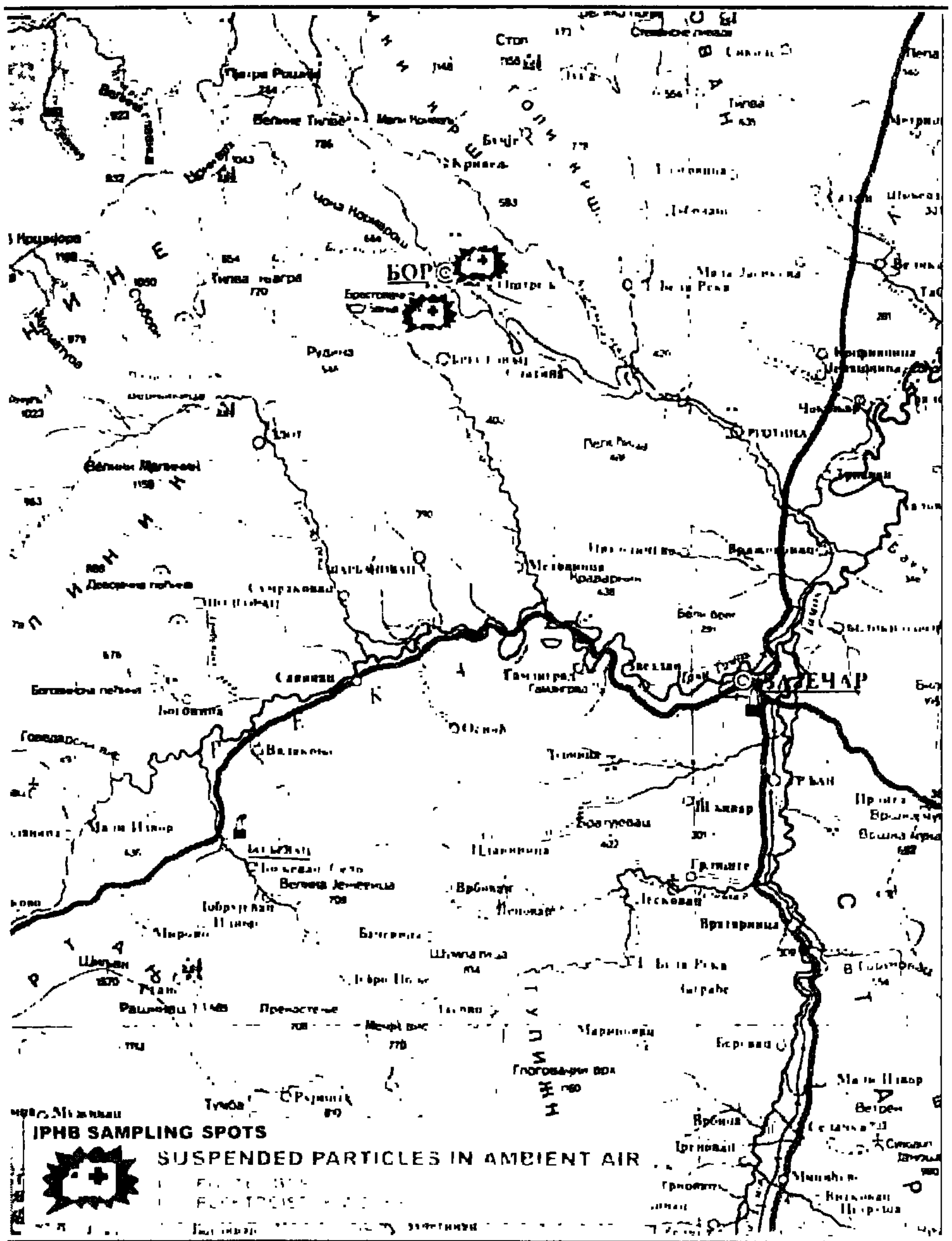
Sampling point	pH	Non soluble (mg/m²/d)	Ash (mg/m²/d)	Combustible matter (mg/m²/d)	Soluble matter (mg/m²/d)	SO_4 (mg/m²/d)	Pb (µg/m²/d)	Cd (µg/m²/d)	Zn (µg/m²/d)	Deposition rate (mg/m²/d)
Bolnica	6.5	35.4	18.4	16.9	62.3	17.2	/	0.1	40.5	100
Sumska Sekcija	6.4	36.2	17.1	19.0	73.9	12.6	/	/	39.0	113
Osn. skola SUB	6.4	37.2	25.8	11.4	29.3	12.2	/	/	47.1	68.9
Institut "Bor"	6.2	25.8	16.5	9.3	33.3	13.5	/	/	32.9	60.0
Naselje Metalurg	6.5	31.4	23.6	7.8	20.0	11.8	/	/	21.2	53.6
Brest. Banja	6.5	21.9	11.4	10.6	28.8	6.7	/	/	28.0	52.3
Elektroistok	6.1	25.8	14.8	11.0	23.9	7.8	/	/	40.2	50.9
Fabrika Folija	6.0	20.3	15.4	4.9	30.8	10.4	/	/	36.1	53.4
Naselje Bor II	6.6	22.9	12.1	10.8	13.9	4.8	/	/	22.4	37.6
Borsko Jezero	6.3	18.8	5.6	13.2	19.6	5.7	/	/	27.0	39.0
Selo Slatina	6.1	38.1	24.8	13.3	25.6	7.0	/	/	24.3	64.5
Naselje Brezanik	6.1	36.8	17.5	18.9	32.6	12.5	/	/	24.7	66.2
Selo V. Krivelj	6.3	34.5	8.1	26.4	23.6	6.9	/	/	20.4	60.4
Selo Ostrelj	6.3	34.2	16.8	17.4	22.6	9.1	/	/	61.6	59.3
MZ "Sloga"	6.2	16.9	15.7	6.6	23.6	7.7	/	/	35.0	41.2
Limit	Rural and recreational areas						100*	2*	200*	100**
	Urban areas						250*	5*	400*	200**

* Sampling frequency: 1 month; ** Sampling frequency: 1 year

Source: Copper Institute Bor

In 2002 UNEP/UNOPS clean-up programme contacted Institute of Public Health - Belgrade to undertake sampling and analysis of suspended particles in ambient air[1] in two locations in Bor: one south west and the other north east of the town (see *Figure 2.28*); *Table 2.20* shows the results of 24 hours measurements.

Figure 2.28 ***Sampling Locations for Suspended Particles in Ambient Air***



Source: UNEP/UNOPS

(1) *"Assessment of environmental monitoring capacities in Bor"*, UNEP, 2002

Table 2.20 *Chemical Analysis of Total Suspended Particles in Ambient Air, 2002*

Parameters / Sample	L1: 22-23/04	L1: 23-24/04	L2: 23-24/04	Limit
Total suspended particulate (μg/m³)	104.1	98.9	70.0	120.0
Heavy metals (ng/m³):				
Lead - Pb	208.2	267.4	220.0	1,000
Cadmium - Cd	7.8	28.0	22.7	10
Zinc - Zn	1822	4651.2	7000	-
Chromium - Cr	<5	<5	<5	0.3
Nickel - Ni	5.2	11.6	11.3	20
Arsenic - As	223.8	645.3	380.0	6
Manganese - Mn	31.2	34.9	33.3	1,000
PAH (μg/m³):				
Benzo(a)pyrene	<0.01	<0.01	<0.01	1
Source: UNEP/UNOPS				

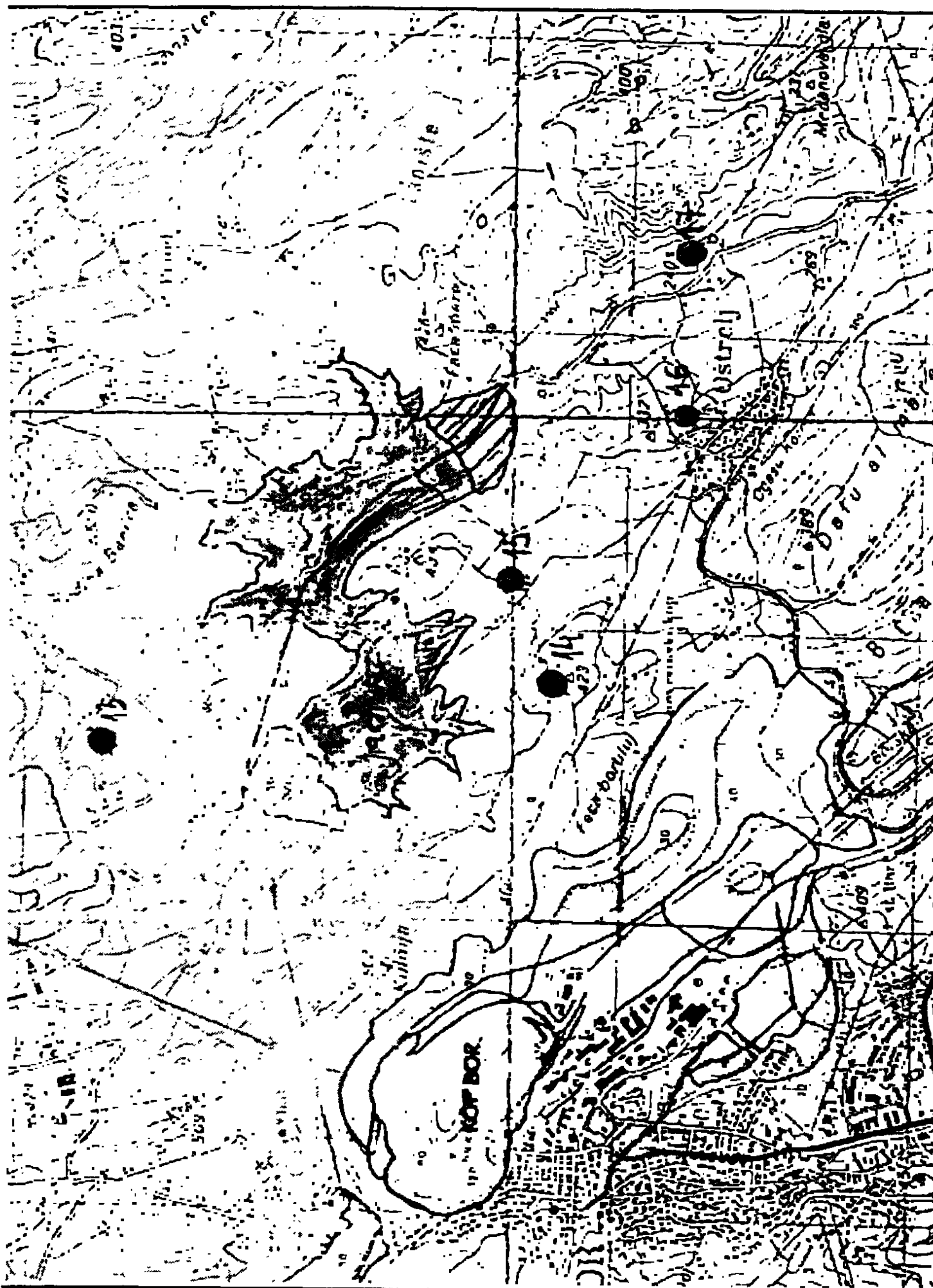
In both the locations the value of arsenic exceeded the air quality standard (6 ng/m³), reaching (in Bor – Poste) a maximum of over 100 times above the limit. Also the values of cadmium and nickel were in excess of the limits, but by undoubtedly lower factors.

In general the equipment used in the Bor area is very limited and does not target the real problems, in particular short-term sulphur dioxide exposure and toxic breathable particulate. Transitory concentrations of sulphur dioxide can cause serious respiratory problems. Based on data provided by the Copper Institute, metallic components in the particulate may be another concern for health; in particular, arsenic was highlighted in the data as a toxic component present in significant concentrations in the settleable matter. The equipment used in the Bor area is capable of measuring only 24-hour average concentrations, meaning that peak concentrations are not measured and it is not possible to take direct action in the event of a serious incident since the data is retrospective.

Other measurements have been carried out by the Copper Institute Bor on particulate deposition mainly close to Ostrelj village, located south east of the Veliki Krivelj tailing ponds and therefore impacted by the dust coming from the tailing pond dams in windy days. The location of the sampling points closest to Ostrelj village is shown in *Figure 2.29*. *Table 2.21* shows the results of such measurements.

As discussed above, the annual average values do not fully represent the problem. It is a matter of fact that, reportedly, many houses near the tailing ponds and near the roads connecting Veliki Krivelj open pit mine with Bor smelting facility were abandoned and a program of relocation launched. This was due mainly to particulate air pollution caused not only by the tailing pond dams but also by the traffic of trucks transporting concentrate from Veliki Krivelj flotation plant to Bor.

Figure 2.29 Location of the Receptors Closest to Ostrelj Village



Source: Copper Institute (received by RTB Bor)

Table 2.21 ***Annual Average Depositions Mainly Due to Veliki Krivelj Tailing Ponds, 2004***

Sampling point	pH*	SO_4* (mg/m²/d)	Soluble matter* (mg/m²/d)	Non soluble matter (mg/m²/d)	Combustable matter (mg/m²/d)	Ash (mg/m²/d)	Deposition rate (mg/m²/d)	Pb (µg/m²/d)	Cd (µg/m²/d)	Zn (µg/m²/d)
2	6.3	4.7	33.6	19.6	9.7	9.9	64.0	0	0	25.3
3	6.4	5.2	58.8	12.9	5.1	7.8	71.7	0	0	19.0
4	6.5	5.4	23.1	19.5	8.8	10.7	42.6	0	0	28.7
5	6.5	6,2	35,0	38,9	14,9	24,0	73,9	0	0	20,5
6	6.5	4,8	22,6	25,1	7,3	17,8	47,7	0	0	26,1
7	6.5	6,6	32,7	27,7	9,9	14,8	57,4	0	0	23,0
8	6.7	4,8	17,9	14,9	6,0	8,9	32,8	0	0	20,9
9	6.6	6,7	23,0	18,2	9,7	8,5	41,2	0	0	29,0
10	6.1	6,6	27,5	33,1	21,5	11,6	60,6	0	0	33,8
11	6.3	6,2	21,8	24,8	10,6	14,2	46,6	0	0	21,5
12	6.5	5,9	25,9	40,2	13,3	26,9	66,1	0	0	50,7
13	6.3	6,7	61,4	22,2	11,9	10,3	83,6	0	0	21,0
14	6.3	7,1	29,6	38,2	11,0	27,2	67,8	0	0	88,7
15	6.4	6,3	19,0	19,8	7,9	11,9	38,8	0	0	31,9
16	6.1	8,1	17,8	21,3	13,2	8,1	39,1	0	0	15,2
17	6.8	3,8	21,2	64,7	15,1	49,6	85,9	0	0	16,1
18	6.5	8,0	33,6	75,4	41,2	34,2	109,7	0	0	52,1
19	5.7	17,1	66,9	94,6	39,7	54,9	162,0	0	0	36,2
Limit							200**	250***	5***	400***

* Liquid phase; ** Sampling frequency: 1 year ; *** Sampling frequency: 1 month

Source: Copper Institute Bor

2.7.3 *Majdanpek*

Air quality in Majdanpek is mostly affected by operation of RBM and also by other industries. The southern and western town zones are occupied by the RBM.

As reported in the General Urban Plan of Majdanpek, in the period 1978-1981 air quality in the region was mainly affected by particulate: at different sampling points the recorded deposition rate was in the range 268-389 mg/m^2/day (compared with a limit of 100 mg/ m^2/day), with maximum values of 630-1.300 mg/m^2/day.
Particulate was present both in winter and summer (92.1% of days with presence annually); in winter, the concentration recorded was up to 161 mg/m^3.

Concentrations of SO_2 were, on the contrary, low.

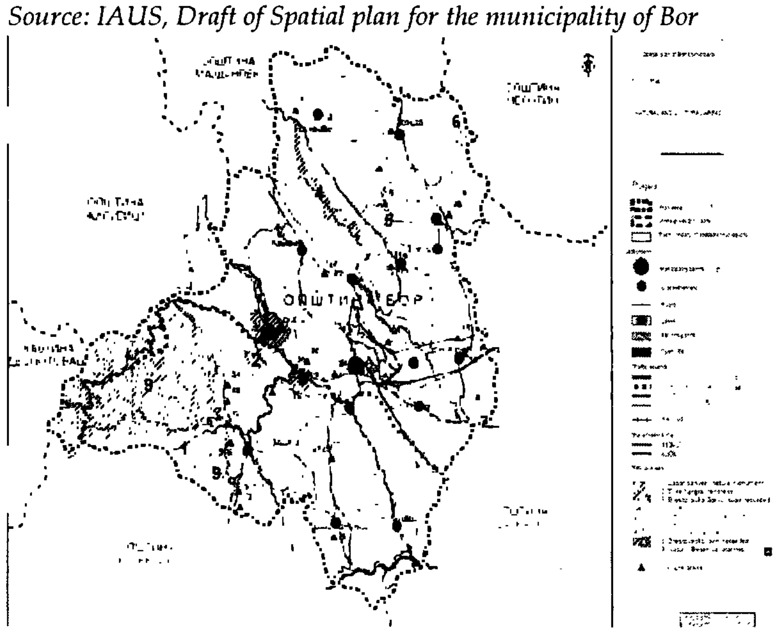
Air monitoring has not been carried out at Majdanpek since 1995, so no updated data are available.

2.8 *BIOLOGICAL ENVIRONMENT*

According to the available documentation, (Local environmental Action Plan of Municipality of Bor, UNEP), as far as biological environmental is concerned, the surroundings areas of Bor Municipality are very important, due to the presence of protected area (Lazar's Canyon) and to the need of protection required, with respect to the use of the land (caves and mines) as shown in following *Figure* 2.30.

Figure 2.30 ***Distribution of Natural and Cultural Area in Bor***

Source: IAUS, Draft of Spatial plan for the municipality of Bor



2.8.1 *Flora*

The Lazar's Canyon is one of the most important centre of plant and tree diversity on Balkan. There are 720 kinds of plants registered in it, which represent 20% of Flora in Serbia and 11% of Flora on Balkan. It is an habitat of 57 endemic species and 50 relict species with their origin form different geological periods. Lazar's Canyon is the only habitat on Balkan where live the adventive plant Pearly Everlasting (Anaphalis margaritacea).

2.8.2 *Fauna*

Fauna living in the surroundings areas of Bor Municipality is characterized by the presence of many species of insect, mollusc, birds and mammals. In particular:

- Insects: there are 205 species of Sirfide (wasp like flies) registered and most of them are of big significance for preserving the biodiversity of Serbia and Balkan Peninsula. At the entrance of Lazar's Canyon a new species was found in 1996, the Merodon Albonigrum; there are 115 registered species of daily butterflies, and these species are endangered by air pollution from metallurgy;
- Mollusc: there are 37 species of snails, and of special significance is Bulgarica Stolensis, which was discovered for the first time on the mountain Stol;
- Birds: there are 140 species of birds, and special significance has Mali and Veliki Krs as habitat of sorts of birds of prey, which are an endangered species in Europe;
- Mammals: there are 47 species of mammals living in Bor area;
- On south Kucaj and Deli Jovan all big beasts of Balken live: wolf, jackal, wild cat, linx, dark bear and other rare and endangered species, like dormouse, stone marten, pine marten, weasel, rabbit, wild boar, roe deer.
- Chamois has been reintroduced into Lazar's canyon;
- Inside the closed hunting area Dubasnica live mouflon and fallow deer;
- Caves and forest of this area are ideal habitat for bats. They represent the connection between live world of caves and outside, bringing organic substances in ecosystems of caves. Many of the species of bats living on Balkan are included on the European red list of global endangered species. In terms of protection of these mammals, Serbia Montenegro did not agree at Eurobats, the Agreement on the Conservation of Population of European Bats;
- Underground Fauna: there are 20 species of invertebrates living in the caves around Bor, rich with waters which carry organic substances. These caves take the first place in Serbia and also on Balkan by species which live there. In Lazar's Canyon there are 50 new species discovered.

2.8.3 *Natural and Sensitive Habitats*

Out of the total surface of municipality Bor, 86% is under extensive anthropologic influence, and 14% is a surface of preserved nature, of which forests cover the 75% of all preserved nature surface.

The municipality Bor is surrounded by natural and different habitats. The western part belongs to the mountain complex of South Kucaj, characterized by the presence of karst terrain of Dubasnica with 70 km^2, with its beauty and with its diversity in surface and underground shapes. The region is very attractive due to its diversity: numerous depressions, dry rivers valleys and canyons. Especially the canyons of Cemizlok, of Mikulj, of Pojen and of Zlot rivers stand out. Underground relief shapes are even more attractive, and two caves are prepared for tourist visits: Lazar's Canyon and Vernjikica cave. Eastern part is mountainous, with major reliefs Stol, Mali and Veliki Krs, Deli Jovan and plateau of Gornjanc, with a surface of 50 km^2.

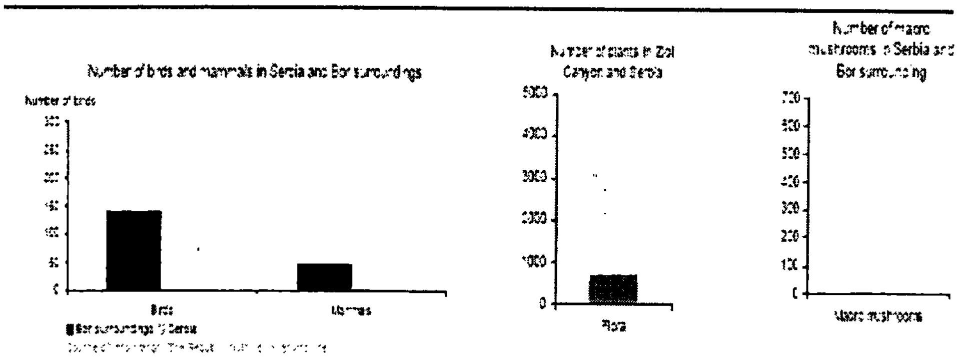
According to Birdlife International, Zlot canyon-Dubasnica is included in the list of important ornithological areas of Europe, and two of the bird species living there, the Wood Lark (Lullula Arborea) and the Common Redstart (Phoenicurus phoenicurus) are categorized, by Birdlife International, as species with an unfavorable conservation status in Europe and inserted in the IUCN (International Union for the Conservation of Nature) Red List of Endangered Species.

Bor

In Bor municipality, Lazar's Canyon is protected as natural good of national value, that correspond, with respect to IUCN classification, to a Natural Monument, a nationally level significant natural area because of its special interest or unique characteristics.

Lazar's Canyon is one of the most important centres of plants and trees diversity in the Balkans. As presented in following *Figure 2.31,* 720 plants have been found here, representing 20% of flora in Serbia and 11% of flora in the Balkans. On the Malinik, a mountain on the edge of canyon, a 180-years-old forest community of beech, ferns and yew with largest wood pulp in Serbia exists. 174 species of mushrooms have been registered here, some having direct economic importance.

Figure 2.31 *Richness of Biodiversity in Bor Surroundings*



Majdanpek

In Majdanpek municipality, according to the LEAP for Bor region (ECBP 2003) and Spatial Plan of municipality Majdanpek, there are 10 natural assets under protection regime. Mainly they are nature reserves and nature assets spread on total area of 1,046 ha with a variety of flora and fauna species. Five of them belong to National park Djerdap and engage 506 ha. Northern part of municipality Majdanpek is within wider protection zone of the National Park Djerdap (IUCN classification) and western of Majdanpek at 7-8 km south west from the National park there is extremely degraded environment due to mine operations engaging app. 1/3 of total municipal area.

The renewable natural resources and rich biodiversity are great potentials for sustainable development and preservation of this region. Development of new economic branches by sustainable use of these resources is a challenge and chance of survival for the population in this region.

2.9 *PUBLIC HEALTH*

Mining and metallurgy activity strongly affect air, water and soil quality and, as a consequence, may influence health of people who may come into contact with the dangerous substances emitted by the industrial activity.

Air is certainly the most effective *environmental pathway* (i.e. the environmental route by which contaminant from the site can reach receptors) : emission from smelter, dust from tailing pond and landfill are transported by wind and may be inhaled by population leaving around and affect ifs health.

An other important pathway is the ground water and the soil where contaminants may accumulate and through food chain may be absorbed by population.

In the following we mainly focus on consequences of air quality variation we can be considered as the most immediate path.

As already pointed out in *Paragraph* 2.7 . "Ambient Air Quality" contaminant concentration in Bor area is quite high.

Air in Bor contains in particular:

- sulphur dioxide, which, at high concentration, may cause skin and mucous membrane diseases Through inhalation, the sulphur dioxide reaches the respiratory system and causes frequent and numerous diseases; it dissolves in saliva, reaches the digestive system and may cause other diseases; moreover, it reaches blood and is transmitted to other organs and affects them in negative way;
- arsenic and its compounds constantly exceeding the law limits which may cause danger for public health increasing cancer risk;
- concentrations of heavy metals and their compounds, which can have too harmful effects on health.

Studies have been carried out in the last years devoted to identify possible consequences of the presence of the above cited contaminants in air, water and soil.

Some of these studies report very negative conclusions about status of public health of Bor population.

Nevertheless, no information about research methodology is reported in the cited literature and it is known that it is very difficult to find a clearly defined relationship among disease and pollutant concentration. In summary the reliability of the above cited data has to be verified and carefully checked.

For this reason in the following we will give a short description of the possible effect of the main pollutant present in the Bor air and some comments will be given about a potential higher health risk due to the presence of these contaminants with particular reference to arsenic concentration.

2.9.1 *Effects of Selected Pollutants on Health*

In the following main health effects of the pollutant present in the Bor area are reported and discussed. Particular attention is devoted to arsenic not only because is an airborne pollutant common in all the areas near smelters unit but also because data are available to draw some comments.

The pollutants considered are the following:

- sulphur dioxide
- smoke, dust and particulate;
- arsenic;
- PCBs.

Sulphur Dioxide

Assessment of the acute short-term effects of sulphur dioxide has been carried out using test chambers and volunteers. Studies have indicated that exercising asthmatics were affected at concentrations from about 0.4 ppm (1144 ug/m^3). It was noted that effects occurred within minutes with wheezing and shortness of breath being symptomatic. Exercise increased effects because heavy breathing resulted in increased penetration of the lungs.

Smoke and particulate are nearly always associated with sulphur dioxide and can cause difficulties in data interpretation and health risk assessments. There is therefore uncertainty concerning long term (24 hours plus) epidemiological studies. There is a possibility that the adverse effects of sulphur dioxide are really the effects of particulate or other associated substances.

Studies of effects over a 24 hour period have demonstrated that sensitive persons are seriously affected by sulphur dioxide concentrations exceeding 0.087 ppm (250 ug/m^3) in the presence of particulate matter. More recent studies have demonstrated that effects on mortality and hospital admissions can occur with daily mean concentrations of 125 ug/m^3.

Long term assessments using data on respiratory illness frequencies and lung function values have shown that exposure to annual mean sulphur dioxide concentrations of 100 ug/m^3 in the presence of fine particulate has a significant effect.

In European urban areas the typical annual mean concentration range is 20-60 $\mu g/m^3$ with daily means not exceeding 125 $\mu g/m^3$. However, where coal is still used for domestic heating, and there are industrial sources in the area, concentrations can reach 1,000-2,000 $\mu g/m^3$ over a 10-minute averaging time [(1)]. The situation in Bor is described in the following.

SO_2 in Bor

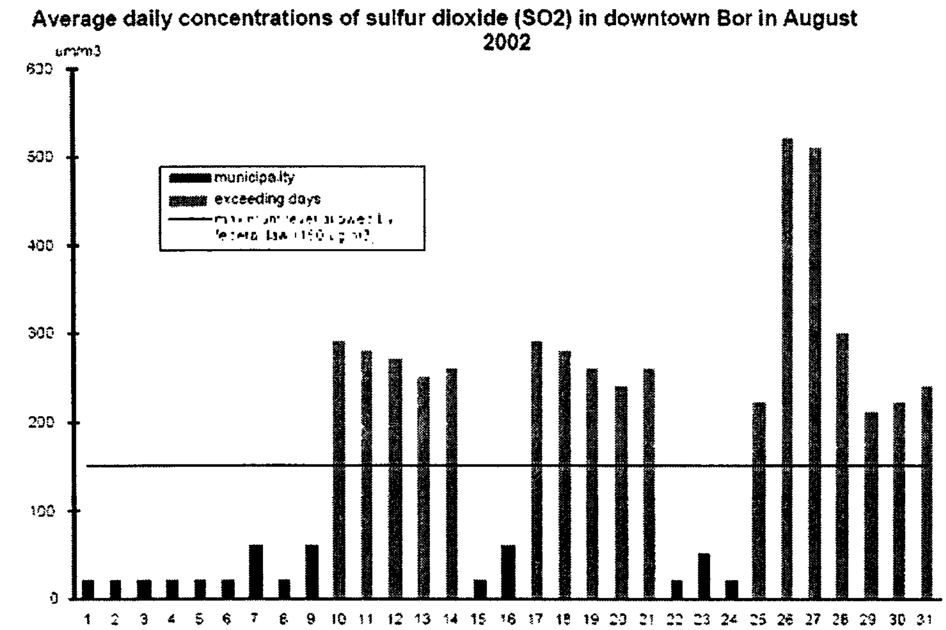
According to data for March 2002 provided by the Copper Institute Bor, both the Serbian 24 hour limit (150 $\mu g/m^3$) and the EU 24 hour limit (125 $\mu g/m^3$) were exceeded during most days investigated [(2)].

As a recent example, the average concentration of sulphur dioxide in the centre of Bor in August 2002 was 175 ug/m^3 (see *Figure* 2.32). The allowed level of concentration was exceeded on 17 days, more than half of the time. The maximum daily mean was above 500 ug/m^3 (source: EkoBor bulletin).

(1) Air Quality Guidelines for Europe. WHO (Second edition)

(2) During the period 1977-2001, sulphur dioxide maximum values of several thousand $\mu g/m^3$ (up to 6501 at sampling spot "Stari Centar") have been measured, Bor, May 2002. Municipal Assembly Bor

Figure 2.32 *SO_2 Average Daily Concentrations in Downtown Bor (August 2002)*



Source: EkoBor Bulletin, Copper Institute

Smoke, Dust and Particulate

Work is still continuing on the distribution of airborne particulate matter in Europe. There is evidence that average winter concentrations as PM_{10} in northern Europe are no greater than 20-30 ug/m^3 with western Europe concentrations slightly higher (40-50 ug/m^3). There appears to be little difference between urban and other areas. Limited data from central and eastern Europe show slightly higher concentrations. However, 24 hour average concentrations can exceed 100 ug/m^3 in many industrial or city locations, particularly when an atmospheric inversion is present. Work is also continuing on the effects of particulate constituents eg sulphate, metals, organic species. It is possible that fine dusts can absorb and concentrate harmful constituents such as benzene (a known carcinogen and a prevalent contaminant in traffic fumes). It is likely that these studies will have a significant effect on guidelines and limits. Most studies are based on measurement of PM_{10} though some studies use $PM_{2.5}$ data. The effect of exposures in the range 0 - 100 ug/m^3 PM_{10} appears to form a straight line relationship. Above 100 ug/m^3 PM_{10} the response to increases in exposure appears to curve. Extrapolation of effects data at lower concentrations is therefore not recommended.

Short term effects of pollution episodes have been assessed by measuring mortality, hospital admissions for respiratory difficulties, breathing performance indicators and broncho inhaler use. Effectively a doubling of the particulate (in the range 0 - 100 ug/m^3) doubles the observed effects.

Studies have indicated that there are injurious effects from long term exposure to particulate at low concentrations. There appears to be demonstrated effects on mortality, hospital admissions etc for all airborne particulate matter concentrations above background.

The following *Table 2.22* summarises many studies so far carried out.

Table 2.22 ***Summary of short term exposure-response-relationship of PM10 with different health effect indicators***

Health effect indicator	**Estimated change in daily average PM_{10} concentration needed for a given effect (in $\mu g/m^3$)***
Daily mortality:	
5% change	50
0% change	100
20% change	200
Hospital admissions for respiratory conditions:	
5% change	25
10% change	50
20% change	100
Numbers of asthmatic patients using extra bronchodilators:	
5% change	7
10% change	14
20% change	29
Numbers of asthmatic patients noting exacerbation of symptoms:	
5% change	10
10% change	20
20% change	40

(**Source**. UK. Department of the Environment, Transport and the Regions
http://www.defra.gov.uk/environment/airquality/aqs/particle/7.htm

For this reason EU fixed limits for particulate 40 ug/m^3 PM_{10} as annual average and 50 ug/m^3 PM_{10} (as daily average not to be exceeded more than 35 times per year).

PM10 is not measured in the Bor area but it is evident that high particulate deposition, high SO_2 concentration indicate PM10 concentration likely well above the above cited EC limits.

Arsenic

Arsenic is a common element in the environment. Typical airborne concentrations range from 0.001 - 0.01 ug/m^3 (1-10 ng/m^3) in rural areas and up to 0.03 ug/m^3 in urban areas (*Air Quality Guidelines for Europe, WHO, second edition*).

The major hazard associated with inhalation of arsenic compounds is lung cancer. Risk assessments have been based mainly on studies around US smelters.

The data indicate a linear lifetime risk level vs arsenic exposure. Because of this linear relationship the WHO cannot assign a safe level of arsenic in the atmosphere.

Some of the studies carried out on arsenic effects (by inhalation) are reported below (from IRIS Database for Risk Assessment http://www.epa.gov/iris/)

"Studies of smelter worker populations (Tacoma, WA; Magma, UT; Anaconda, MT; Ronnskar, Sweden; Saganoseki-Machii, Japan) have all found an association between occupational arsenic exposure and lung cancer mortality (Enterline and Marsh, 1982; Lee-Feldstein, 1983; Axelson et al., 1978; Tokudome and Kuratsune, 1976; Rencher et al., 1977). Both proportionate mortality and cohort studies of pesticide manufacturing workers have shown an excess of lung cancer deaths among exposed persons (Ott et al., 1974; Mabuchi et al., 1979). One study of a population residing near a pesticide manufacturing plant revealed that these residents were also at an excess risk of lung cancer (Matanoski et al., 1981). Case reports of arsenical pesticide applicators have also corroborated an association between arsenic exposure and lung cancer (Roth, 1958)".

The same cited source reports association between arsenic exposure in drinking water and development of skin cancer and skin lesions although this association is not fully proven.

A retrospective case-control study showed a significant association between duration of consuming high-arsenic well water and cancers of the liver, lung and bladder (Chen et al., 1986,1992).

A rough estimate of potential risk of arsenic on public health in Bor is presented in the following. Please note that arsenic has been chosen among the pollutants present in Bor because high arsenic concentrations are the greatest problem for the population in Bor since they can have a long lasting negative effect on health of people.

Estimate of Arsenic Potential Risk on Public Health in Bor

As outlined above, both cancer and non-cancer outcomes are associated with exposure to arsenic. Studies have demonstrated that ingestion of arsenic is associated with an increased risk of skin cancer, and inhalation of arsenic is associated with an increased risk of lung cancer. Long term chronic ingestion of arsenic has been associated with skin changes including skin cancer and is reported to increase the risk of cancer of the liver, bladder, kidney and lung (ATSDR). Non-cancer risks from the ingestion of arsenic include skin hyper pigmentation and skin keratoses. At higher exposure levels, other possible non cancer effects include vascular, neurological, and gastrointestinal disorders. Death from exposure to high environmental levels of arsenic has been documented.

The health risk analysis is generally carried out considering the *Reference Dose* (RfD) for toxic substances and the *Carcinogenic Power Factor* (CPF) as suggested by the U.S. Environmental Protection Agency (EPA) for the evaluation of sanitary risk connected to toxic and carcinogenic substances.

The Reference Dose for chronic oral exposure (RfD) is based on the assumption that thresholds exist for certain toxic effects such as cellular necrosis; it is expressed in units of mg/kg-day. In general, the RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

The RfD is connected to the *Acceptable Daily Intake* (ADI), which is commonly defined as the amount of a chemical to which a person can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect.

The No Observed Adverse Effect Level (NOAEL) is an experimentally determined dose at which there was no statistically or biologically significant indication of the toxic effect of concern; in cases in which a NOAEL has not been demonstrated experimentally, the term *Lowest Observed Adverse Effect Level* (LOAEL) is used. The ADI (and therefore the RfD) is derived by dividing the NOAEL by a safety factor (SF).

The *Carcinogenic Power Factor* (CPF) is the gradient of the dose-response curve for the analysed carcinogenic substance. Such curve (commonly built with experimental data on animals) relates the increase of the number of cancers (compared with a natural rate of such diseases in control sample population) to the assumption of a daily dose of the toxic substance (in mg/kg/day).

As reported in a ERM publication[1] of 1994 : the RfD for inorganic arsenic is 3×10^{-4} mg/kg-day and the CPF is 50 mg/kg-day.

The RfD is used to calculate the Hazard Index, which evaluates the acceptability of an extended exposure: the hazard risk is therefore a number derived dividing the dose potentially absorbed by the exposed inhabitant for the RfD.

The CPF is used to calculate the carcinogenic risk, which is the increase of the probability to get ill of cancer compared with the average probability; the carcinogenic risk is there fore a number, derived multiplying the CPF for the average daily dose of the absorbed substance, and expresses a probability.

At present EPA has defined acceptable risks:

(1) [1] Hazardous Waste Management (MD. LaGrega,P L. Buckingham,J.CEvans McGraw-Hill,Inc 1994)9

- for carcinogens a carcinogenic index s the range of 10^{-4} to 10^{-6}. For EPA an excess life time cancer risk higher than 10-6 may be deemed acceptable only if there were special extenuating circumstances
- for non carcinogens as hazard index of less than 1.

The evaluation of the average daily intake absorbed by the potential inhabitant is carried out using the following expression:

Intake = C x CR x (EF x ED) x RR x ABS/ (BW x AT)

in which:

- C = annual average Concentration at exposure point in Bor 68,8 x 10^{-6} mg/m^3)
- CR = Contact Rate, average quantity of air breathed daily (in normal conditions: 0.83 m^3/h, equal to more or less 20 m^3/day);
- EF = Exposure Frequency (in our example: 365 days/year);
- ED = Exposure Duration (conservatively considered as average lifetime, therefore 70 years);
- AT = Averaging Time, time of exposure (conservatively considered from birth for 70 years, therefore 365x70 days);
- RR = Retention Rate in the body (conservatively 1);
- BW = Body Weight (70 kg);
- ABS = Absorption into Bloodstream (conservatively 1).

As shown in *Paragraph 2.7 - Table 2.18*, average concentrations of arsenic in Bor area in 2004 exceeded the Serbian air quality standard (2.5 ng/m^3) at all sampling stations in Bor and surroundings. The average of the values recorded in the three monitoring points in Bor (Gradski-Park, Copper Institute and Electroistok Yugopetrol) was equal to 68.8 ng/m^3 i.e. 0,069 µg/m^3.

With the described values, average intake would result 19.66 x 10^{-6} mg/kg day. Therefore, the Toxic Risk Index amounts to 0.065 and the Carcinogenic **Risk Index to 9,5 x 10^{-4}**. Toxic index is very low, on the contrary carcinogenic risk would result above what is recommended as a safe value from EPA.

This evaluation is confirmed also by the last publication of he Integrated Risk Information System (IRIS) of the U.S. EPA. IRIS gathers health assessment information on chemical substances and monthly updates the relevant information.

Values given by IRIS for the evaluation of carcinogenic risk for arsenic inhalation are shown in the following *Table 2.23* and are based on the evaluation of the value of 4,29 E-03 for the unit risk (i.e risk increase for a concentration of 1 µg/m^3 in ambient air).

Table 2.23 ***Risk Level as a Function of Arsenic Air Concentration***

Risk level	Air concentration (µg/m^3)
10-4 (1 in 10000)	0,02
10-5 (1 in 100000)	0,002
10-6 (1 in 1000000	0,0002

Source *IRIS Database for Risk Assessment http://www.epa.gov/iris/*

These values hold up to an air concentration of 0,2 µg/m^3.

This would imply a **risk level between 10^{-3} and 10^{-4}** in agreement with the above described calculation. This value indicates an excess risk generally not considered acceptable although present in most of surrounding of copper smelter facilities.

PCBs

Polychlorinated biphenyls (PCBs) are organochlorines (substances based on carbon and chlorine) that were manufactured until the mid-1980s after which they were banned due to their toxicity and persistence. PCBs were widely used in electrical equipment. Presently they are still found in old electrical equipment and releases into the environment continue from waste dump leakages. PCBs are very persistent in the environment taking years to degrade. In rivers they become bound to sediments. They are fat-soluble and build up (bioaccumulate) in the tissues of animals where they become stored in fat for many years. PCBs are highly toxic. PCBs cause toxic effects on the nervous system, immune system, reproductive system, and development of experimental animals. PCBs are classified as probable human carcinogens. There is concern that current body levels in some individuals of the general population are sufficient to cause subtle adverse effects on the nervous system and immune systems of developing young in the womb and infants.

The situation in Bor is described in the following.

PCB in Bor

In Bor, during the 1999 bombing, the transformer station TS3 was destroyed. The PCB-contaminated materials and equipment removed by RTB Bor workers from transformer station TS3, as well as other hazardous wastes are improperly stored at the open dump site within RTB Bor and can cause further risks to the environment and the health of workers.

The potential risks and health effects of these hazardous components have not been measured in a systematic and regular manner by the competent authorities [(1)].

2.10 *SOCIO-ECONOMIC BASELINE*

This section provides a general overview of the socio-economic background of the area. The main topics are:

- the distribution of residential and occupational population in the area;
- the social and educational status;
- the predominant economical activities in the area.

(1) A new transformer station was constructed and completed in September 2002 on the location of the previous station with the assistance of the UNEP clean-up project.

2.10.1 *Demographic and Social Status of the Area*

General relevant data on the demographic and social situation of the area are summarized in the following Table [1].

Table 2.24 ***General Data***

General data	Bor Municipality (*)	Majdanpek Municipality
Municipal area, km^2	856	932
% of agriculture	47.9	21.9
land/agriculture area (ha)	41,000	20,353
No of settlements	14	14
Average settlement area (km^2)	61.1	66.6
Population	144,478	23,142
Population density inhabitants/km^2 31 June 2003(**)	41	25
Employed, 2003	15,935	6,658
No of registered Local Communities	26	14
No of cadastre municipalities	19	14

(*) Data referred to the entire municipality
(**) Figure on population has been estimated

Population

The main municipalities of the area are Bor and Majdanpek. The city of Bor is located in the Bor District area, in the southern Serbia, while the city of Majdanpek is located close to the Bulgarian and Romanian borders.

Majority of local population is concentrated in urban areas, especially in the city of Bor, and smaller administrative centers.

Population data for the Bor and Majdanpek municipalities are reported in *Table 2.25*, referred to 1991 census and most recent 2002 census.

Table 2.25 ***Population Data (Source 1991 and 2002 census)***

Population		Bor Municipality	Majdanpek Municipality
Total population	1991	59,424	26,952
	2002	55,817	23,703
Increase / decrease of	Total	- 3,607	- 3,249
population (1991-2002)	Annual average	- 328	- 295
	% growth rate	- 6%	- 12%

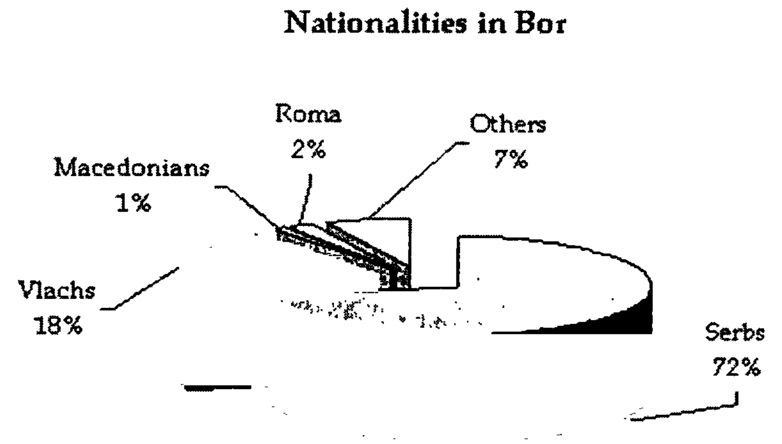
As it can be noticed from the above Table, human population in Bor and Majdanpek in the last years is gradually and constantly decreasing. This negative trend, with a growth rate of -6% in Bor and -12% in Majdanpek, is mainly due to the negative economic situation of the area, which caused a migration from the two cities. In addiction, the recorded number of births is

(1) Municipalities in Serbia, 2004, Statistical Institute of the Republic of Serbia.

lower than the number of deaths (565 against 780 in Bor, and 202 against 320 in Majdanpek).

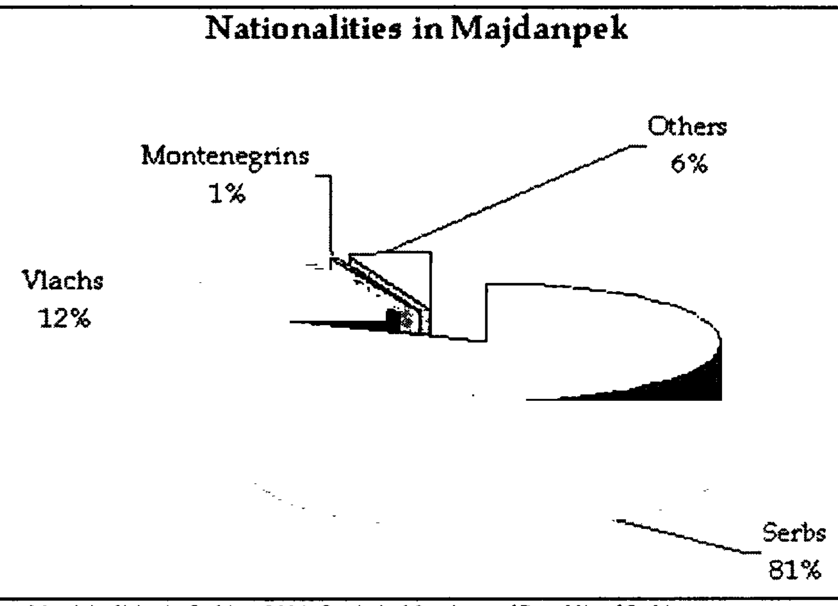
As far as the distribution of nationalities is concerned, data referred to the 2002 census showed that the majority of the population in Bor are composed of Serbs and Vlachs (see *Figure 2.32*), while in Majdenpek are Serbs, Vlachs and Montenegrins (see *Figure 2.33*).

Figure 2.32 ***Distribution of Nationalities in Bor***



Source: Municipalities in Serbia – 2004, Statistical Institute of Republic of Serbia

Figure 2.33 ***Distribution of Nationalities in Majdanpek***



Source: Municipalities in Serbia – 2004, Statistical Institute of Republic of Serbia

The distribution of population by age for the Bor and Majdanpek municipalities according to the 2002 census is shown in *Figure 2.34* and *Figure 2.35* respectively.

Figure 2.34 ***Distribution of Population by Age in Bor (Source: Ibid)***

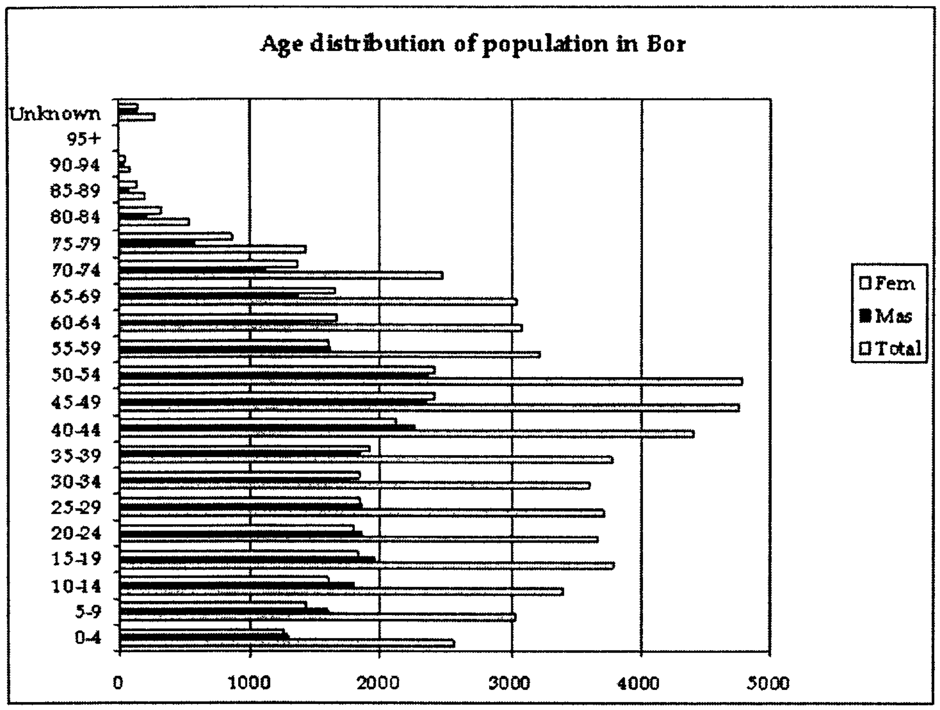
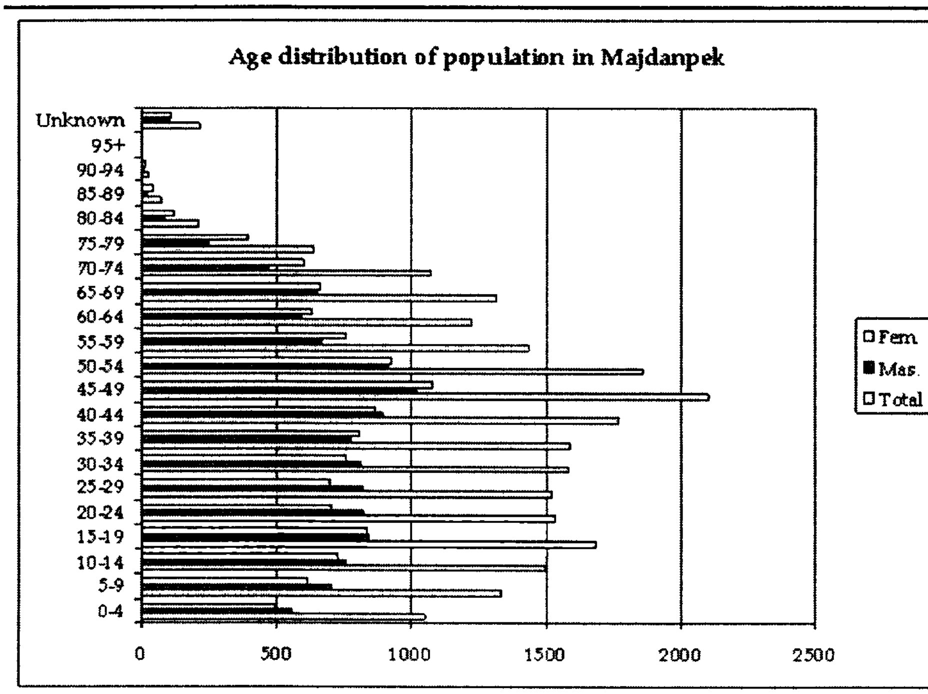


Figure 2.35 ***Distribution of Population by Age in Majdanpek (Source: Ibid)***



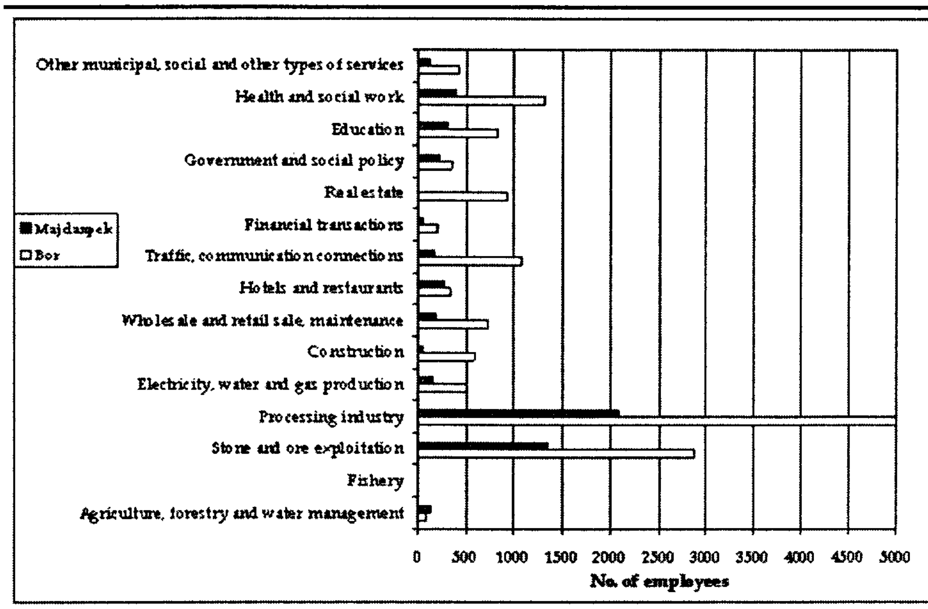
Occupational Status [1]

According to the 2003 census for employment, in Bor there were 290 employees per 1000 inhabitants, of which 95.9% work in private enterprises and public entities/institutions. Women participate with 38.3% of total employees. The average monthly income in 2003 was 7,940 CSD (approximately 122 EUR [2]), which is considerably lower than the national average monthly income of 11,500 CSD (177 EUR).

According to the 2003 census for employment, in Majdanpek there were 288 employees per 1000 inhabitants, of which 82.8% work in private enterprises and public entities/institutions. Women participate with 42% of total employees. The average monthly income in 2003 was 7,528 CSD (approximately 116 EUR [2]).

The majority of employees in Bor and Majdanpek are employed in mining and processing industry (see *Figure 2.36*).

Figure 2.36 ***Employment Distribution in Bor and in Majdanpek (Source: Ibid)***



Social and Educational Status

With regard to the educational status, there are 20 elementary schools in Majdanpek and 23 in Bor, 4 secondary schools and 3 special schools (for children education) in Majdanpek, while only 4 secondary schools and 2 special schools in Bor. There is a Technical faculty in Bor that is a part of the Belgrade University.

(1) Source Statistical Office of the Republic of Serbia, www.webrzs.sr.gov.yu,databases

(2) Average exchange rate for 2003 was 65.

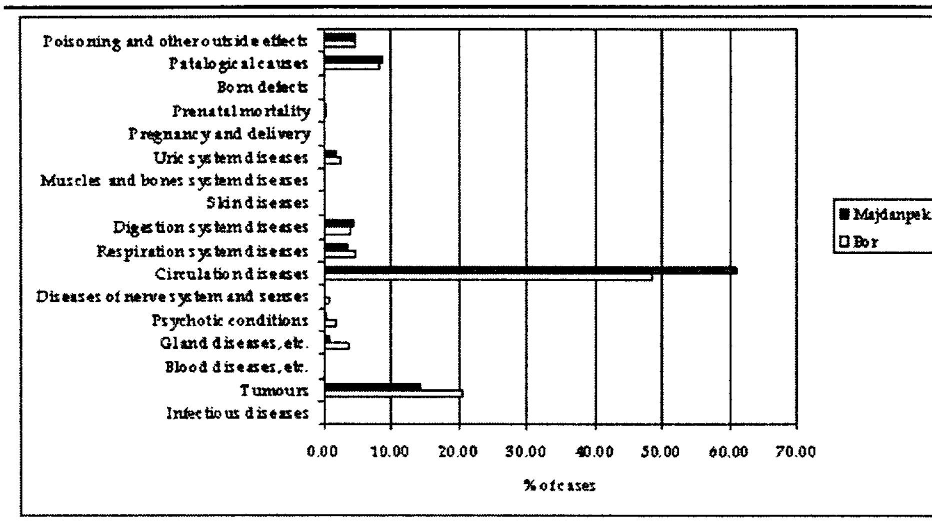
The town of Bor is a commercial and cultural centre in the region. The city has one sport-hall, called "Mladost, a museum, Museum of Mining and Metallurgy, and a Historical archive of the town.
There are two museums in Majdanpek (Lepenski Vir and Museum of Majdanpek town). In each town there is a library.

Several associations are present, 17 are in Bor and 9 in Majdanpek (singing, ethnic singing, local craftsmanship, arts, etc), and some NGOs.

With regard to public health issues, there were 780 deaths in Bor and 320 in Majdanpek. The major cause of mortality is related to blood circulation diseases (see *Figure 2.37*).

A number of public health institutions are in operation in both municipalities. There are 169 of doctors employed in Bor and 43 in Majdanpek[1].
Public health and related issues is being monitored by the Institute for Health Protection in Zajecar.

Figure 2.37 *Causes of Mortality (Source: Ibid)*



2.10.2 *Economy Structure*

The predominant economic activities in both the two cities are mining and industry. At the beginning of last century, the city of Bor was a small and very poor village in the Bor river valley. Discovery of copper ore deposits and starting of ore exploitation in 1903 lead to a quick economical development of the city, which became one of the main industrial and urban centre of the Republic of Serbia.

The development and economic progress was significant from 1960ies to 1990, when copper production reached its peak (e.g. 151,395 t of cathode copper

(1) [1] The dentists are included but not the specialists.

representing 1.5% of world production, 344,655 t of sulphur acid, 4703 t of gold). The person employed at the RTB Bor was about 14,000. After 1990, due to political situation and economic sanctions in Serbia introduced by the international community, mining and metallurgy industry progressively decreased its production and lead to economic decline and poverty. In 2002, the production was only 19% of the production in 1990. Nowadays, approximately 8,800 people work in the RTB and approximately 7,200 people are unemployed, facing economic problems.

A number of supporting metal processing industries were developed in Bor and Majdanpek, e.g. Gold factory in Majdanpek, factory of copper pipes, sulphuric acid factory in Bor, chemical complex in Prahovo.

Forest exploitation is being conducted by public enterprise "Srbijasume".

Development of the region was mainly based on exploitation of non-renewable natural resource and predominantly ore copper. A hundred years of mining caused significant environmental degradation and pollution, with over than 11,000 t of waste per capita.

The economy based on use of renewable natural resources (agriculture, forests, waters, biodiversity, etc.) was neglected. Although there are exquisite geo and biodiversity features in the region, protected areas and assets of nature, and National park Djerdap (park borderline is only 7-8 km from open mine pits in Majdanpek) and favourable conditions for development of tourism, this sector is not developed.

2.10.3 Conclusions

As detailed in section 6 of this report, a list of environmental mitigation measures are proposed to be undertaken in the frame of the restructuring/privatisation process to keep the RTB Bor Complex in compliance with applicable environmental standards and reduce environmental impacts generated so far.

It is anticipated that socio-economic conditions might be influenced by the proposed EMP. Obviuosly, an improved quality of air and surface watercourses would result in a better fruition of the area from a social-recreative point of view. For example, recreative uses of a number of surface watercourses at Bor, Veliki Krivelj and Ostrelj are currently forbidden due to scarce quality of water which is highly polluted by blue waters. This contamination also results in the lack of possibility to go fishing in the abovbe mentioned watercourses.

In addition, due to reduced pollution load caused by deposition on the ground, surface soil quality will improve and the risk for human helath (e.g. due to ingestion of contaminated food) would be significantly reduced.

3 RTB BOR COMPLEX

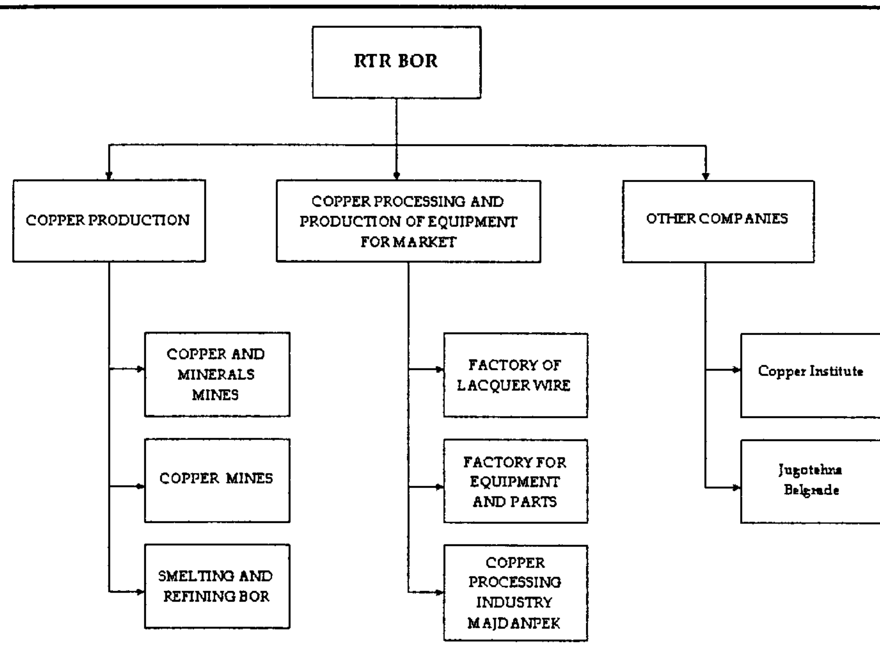
3.1 INTRODUCTION

The RTB Bor Group - Rudarsko-Topionički Basen Bor Grupa – Copper Mining and Smelting Complex Bor Group - (RTB) is a large copper mining complex which operations are located in the Bor District around the municipalities of Bor and Majdanpek (see *Figure 2.1* and *Figure 2.2* for location).

The RTB Bor Group is a state-owned company. The core holdings consist of the following facilities (see *Figure 3.1*):

- RBB - Rudnici Bakra Bor - Copper Mines in Bor, which includes:
    - Bor Mines (Jama underground mine and open pit) and Concentrator
    - Veliki Krivelj Mines and Concentrator
    - Cerovo I Mine and Mill
- RBM - Rudnik Bakra Majdanpek – Copper Mine in Majdanpek, which includes open pit and concentrator;
- TIR – Topionica and Rafinacija Bor - Copper Smelter and Refinery Bor.

Figure 3.1 ***Organizational Structure of RTB Bor Complex (Source: RTB Bor)***



The RTB Bor Group comprises also the Copper Institute at Bor, responsible for the geological analysis of Bor's reserves and chemical assays on Bor's ore and copper production, and down stream copper operations, which include a large machinery and electrical repair unit (FOD), which builds machinery equipment for both Bor and outside customers, and two downstream processors that produce copper wire.

RTB Bor's current operations include copper ore exploitation; production of copper concentrate, pyrites, magnetite and molybdenum; smelting and refining of copper, noble and rare metals; as well as production of sulphuric acid, copper billets and blocks, copper alloys and alloy-based casts.

Facilities operations are summarized in the *Table* below.

Table 3.1 ***RTB Bor Complex Operations***

Name	Operation	Product
Bor Mines	Underground Mine (Jama) - active	Copper in Ore
	Open Mine - closed	Copper in concentrate
	One Concentrator	
	Three Tailing Ponds	
Veliki Krivelj	Open mine	Copper in Ore
	One Concentrator	Copper in concentrate
	Two Tailing Ponds	
Cerovo	Open Mine	Closed
	Mill	
Majdanpek	Two open Mines	Copper in Ore
	One Concentrator	Copper in concentrate
	Two Tailing Ponds	
Bor Smelting	Smelter	Copper Cathodes
	Refinery	
	Sulphuric Acid Plants	
	Precious Metal Recovery	

Historically Bor was one of the largest copper producers in Europe, with a peak of production in 1977 of 125,000 metric tons of copper cathodes. At present, the production capacity is some 12,000 metric tons per year, which represents 10% of the peak production.

Metal ores produced by the mines, containing both valuable minerals and ordinary rock or gangue, are treated in concentrators (flotation units) for the production of copper concentrate. The concentrate is then sent to the smelter facility for further processing. The copper anodes, which are the primary product from the smelter, are then refined (electrolysis unit) to produce copper cathodes to be sold in the markets.

Different others by-products are generated from the copper processing operations, as follows: gold and silver, which are recovered from the electrolyte slurry in the so called gold factory, and sulphuric acid, which is produced in the sulphuric acid plant through the absorption of the sulphur dioxide generated during the smelting process.

The materials remaining on the bottom of the flotation tanks (tailings) is partially dewatered and then discharged to tailing ponds for disposal. The volume of tailings may be 100 times higher than the valuable product. They are transported as free-floating slurry and disposed of in ponds, and therefore large deposits are needed.
In the case of the RTB Bor, tailing fields are built up between the natural terrain and dams made of a coarser tailings fraction. After sedimentation in the pond, water is recycled back to the flotation plant.

A detailed description of facilities and operations undertaken within each asset of the RTB Bor Group is provided in the next paragraphs.

3.1.1 *Historical Background*

The ore production in Bor started at the beginning of the last century (1903) and was operated by a French company that opened the first pit mine in Bor. Production was stopped during the First and Second World War and than resumed. After the Second World War, the mines were nationalized and the ownership was taken by Federal National Republic of Yugoslavia.

Mining and Smelting Complex of Bor was founded in 1951 as a state company through the incorporation of Bor, Majdanpek and Neresnik mines. The RTB BOR GROUP Company was founded ten years after and included also the mines Rtanj, and Bogovina and Super phosphate factory located in Prahovo.

Since then, various organisational changes and restructuring programmes have occurred with the RTB Bor Group, including the presence of numerous different companies within the Complex itself.

The first restructuring programme started in 1954, and involved the construction of the new smelting and sulphuric acid plants in Bor, opening of a new mine in Majdanpek (1960), the construction of a new super-phosphate factory in Prahovo, as well as numerous infrastructure facilities, like the industrial water accumulation and supply network in Bor, railroads, river dock in Prahovo, etc.

The second developing programme was implemented between 1966 and 1971, and included the construction of the new flotation plant in Majdanpek, the renovation of the underground transport for the Jama mine in Bor, as well as the construction of additional facilities in the Smelting, such as the building of one more sulphuric acid plant, new foundry, copper wire factory, gold factory, new electrolysis plant and fertilizer factory in Prahovo and Novi Sad.

In 1982 a new copper mine in Veliki Krivelj was opened. This project included the development of a new flotation plant. In 1993 the exploitation of a new mine in Cerovo started, which was exploited for ten years. The non-metal mines (quartz and limestone) were incorporated in the RTB Bor Group in the 80's.

In this period, the third sulphuric acid plant was built, as well as the production plants for copper-sulphates, metal salts, films, friction cover plates, and others.

Production activities in metal processing factories started since 1974: Lacquer wire factory in Bor, precious metals industry in Majdanpek, Cable factory in Zajecar, non-ferrous metals factory in Prokuplje, Electro industry Elid in Donji Dusnik, and since 1980 Copper pipes factory in Majdanpek and others.

In 1991 the RTB Bor Complex was changed into a Shareholder Company and it was organised as a holding company. There were 22,000 employees in RTB Bor in that period.

The ores were enriched to concentrates in floatation plants and concentrates were further processed to pure copper at the Bor smelter. This copper was sold or further processed to final products.

The mining activities of RTB Bor have held a significant economic importance from the beginning of the 70's to the beginning of the 90's. Since the 90's production in all mines has steadily declined, also due to war condition and economics sanction imposed to Serbia during the mid-90's.

Following the restructuring process, the companies for metal processing and other activities not relevant to copper production and processing have been progressively excluded from the company. Hence, the existing RTB Bor Complex consists of mines in the Bor region and Majdanpek, metallurgy industry and the parent holding company.

Currently there is a general degradation and/or dysfunction of equipment (drilling equipment; excavators; trucks etc). The flotation plants and the smelter's current productions are lower than their capacity, because of the lack of raw material from the mines. Mining and processing activities have produced large volumes of mining wastes and there is an ongoing pollution of air, surface waters, groundwater and soil. To some degree the reduced production has lead to minor impacts to the environment as the smelter now only operates part-time. However, reduced production also results in insufficient means for investments in production and consequently in environment protection.

3.2 *RBB Bor Mines*

3.2.1 *Bor Mining Complex Description*

The Bor Mining Complex is situated within the industrial complex of RTB Bor. Its activities comprise copper ore exploitation and processing and copper mineral concentration by flotation, to produce copper concentrate.

The complex consists of the following facilities (see layout in *Annex A.1*):

- the old open pit mine of Bor;
- the Jama underground mine;
- the crushing plant with transportation system;
- the flotation facilities;
- the old crushing and flotation facilities;
- three tailing ponds;
- the pumping stations and thickeners system for tailings treatment and transportation to the ponds and for recycled water;
- waste rock storage areas.

Mining activities are now restricted to the Jama underground mine.

Old Open Pit Mine

Bor open mine is located on the northern boundary of the Bor town. The mine is approximately 300 m deep and is large 1 km at the widest point. The mine intercepts the Borska River, which is diverted eastwards via a 7 km tunnel to the Krivelj River, south of the Veliki Krivelj mine.

The exploitation of the surface copper deposits started in 1924 and ended in 1993. Total ore production from the mine is as follows:

- Total excavated ore: 96,108,468 t;
- Copper content in the ore: 1.40%;
- Copper exploited: 1,346,258 t ;
- Overburden: 170,278,511 m^3.

The open pit mine is presently used for storage of waste rock delivered by overland conveyor from Veliki Krivelj mine. In the same pit, used tires, slag from power plant and dust from the cyclones of the power plant are also stored (see Section 3 for details). Reportedly, at the current rate of disposal, the open pit mine will be filled in 22 years.

As mentioned above, the pit is located on the boundary of the town; residential buildings lie close to the western edge of the pit and land slips were recorded in 1993-1994. RBB has relocated the inhabitants living in the area, which was declared to be a safety zone, restricted for residential premises. However, since then other people have occupied the buildings. Reportedly signs of tension cracks are evident at the border of the pit. The inhabited area around the open pit mine has to be considered a high-risk zone. Issues related to open mines stability are addressed in the Section 7.

Underground Mine

The exploitation of the Jama copper ore deposits started at the beginning of the last century. The exploitation process consists of the following phases:

- Rock mass drilling, by means of electric powered drill;
- Blasting (cartridge explosive);
- Loading by means of loaders diesel-powered;
- Ore primary crushing by crushing mill, transportation by belt conveyors, and lifting out to the surface from where it is transported by belt conveyors to a further crushing section.

The underground copper mine is 650 m deep. The mine is composed of a vertical shaft fed by a series of cross cuts that follow the ore itself.
The service shaft entrance ("servisno okno") to the mine is located northwest of the old open pit and the exit lift shaft is located at the metallurgic complex. A limited quantity of overburden is generated by this type of mining activities; however, relevant amount of wastewaters are generated. Details on wastewaters generated from mining activities and related treatment /discharge operations are reported in *Section 6.3*.

The following *Table* summarizes the production rate referred to the year 2004.

Table 3.2 ***Jama Production Rate***

Product	**Production (2004)**
Copper in Ore (t)	3,777,214
Wet ore (t)	445,983,000

Mine production decreased significantly in the last ten years, due to a reduction of the Cu content in the ore, from the initial 9- 10%, at the beginning of the exploitation activities, to the current 0.7%.

Crushing Unit

The crushing process is operated as per the following phases:

- **Pit Ore Transportation:** after lifting out from the Jama underground mine, the pit ore is stored in the acceptance bunker wherefrom is transported by belt conveyors to the ore bunker above the grinding sections.
- **Grinding and Sizing**: grinding is carried out in two wet phases. The first stage comprises the ore treatment by a mill, where water and lime milk are added. The partially ground ore is then pumped to a hydro cyclone for selection: fine particles are sent to the flotation plant after conditioning; the coarse particles are returned back in a second grinding machine with balls for further grinding. The product obtained is pumped to a second battery of hydro cyclones. Sand from cyclones is returned to the ball mill, while the overflow represents the slurry, which is ready for the flotation process.

Flotation Unit

The flotation, also called the froth-flotation process, is a process for concentrating the metal-bearing mineral in an ore. Crude ore is ground to a fine powder and mixed with water, frothing reagents, and collecting reagents. When air is blown through the mixture, mineral particles cling to the bubbles, which rise to form a froth on the surface. The waste material (gangue) settles to the bottom. The froth is skimmed off, and the water and chemicals are distilled or otherwise removed, leaving a clean concentrate.

The first section of the flotation plant installed in Bor commenced operations in 1932 and is currently closed. The present operating flotation unit commenced operation in 1974.

The flotation process of Bor consists of the following phases:

- **Flotation:** the slurry from the grinding process is conveyed to the flotation tank where is subject to physical and chemical actions (chemical reagents). As a result, the copper concentration rises to the surface as a froth, and is pumped to a three stages treatment for cleaning. The final overflow of the cleaning process represents the copper concentrate, which is pumped through pipelines to the copper filtering for dewatering. The material remaining on the bottom of the flotation tank, together with the underflow resulting from the filtration process, is partially dewatered in a thickener and then transported to the active tailings dump "RTH".
- **Copper Filtering:** the final concentrate is dewatered in a thickener and then filtered before being transported to the smelter plant.
- **Preparation and Distribution of Reagents:** before entry into the flotation plant, the slurry is conditioned by adding the lime for regulation of the pH value and chemical reagents acting as frothing and collector agents. Reagents are prepared in a separate building, wherefrom they are transported by pipelines to the process. The most frequent collecting reagent applied is KEX – potassium-ethyl-xanthate - while the most frequent applied frothing reagent is D-250 (Dowfrot 250).
- **Disposal of the Tailings:** the flotation tailings are sent by pipeline to the tailings dump "RTH" (see next paragraphs). The water from sedimentation is recycled back to the production process.
- **Preparation of Lime Milk:** the lime in pieces is transported by belt conveyors from an external bin to an inner bin in the flotation facilities, where the lime milk is prepared by addition of water. The prepared lime milk is then pumped into the grinding and the flotation processes.

The following *Table 3.3* summarizes the production rate referred to 2004.

Table 3.3 *Flotation Production Rate*

Raw Materials/ Products	Quantity (t, 2004)
Raw Materials	
Wet ore	439,683,000
Dry ore	431,949,284
Copper in the ore	3,536,000
Wet slag	271,624,000
Dry slag	269,550,962
Copper in the slag	1,425,614
Products	
Wet concentrate	20,012,120
Dry concentrate	16,915,372
Copper in the concentrate	2,707,679

Tailing Ponds

Three tailing ponds are present within the mining complex for disposal of tailing materials resulted from the flotation process (see *Annex A.1*).

Two ponds, called Field 1 and Field 2, developed in the valley of the Bor River, were used between 1933 and 1987 and contain approximately 27 million tonnes of tailings, covering an area of approximately 57 ha, of which about 30 ha were re-cultivated. The remaining 27 ha are to be held flooded with water during summer period to minimise wind blown dusting. The dam of the uncultivated pond failed in the 1960's, following heavy rain, resulting in tailings pollution of agricultural land along the Borska and Timok valley. Tailing are still present along the Borska river banks between Bor and Slatina. Details on this accident are reported in Section 7.

The third pond, called "RTH", started in 1985 and is based on an old open pit mine, designated "H" pit, and is retained on one side by the slopes of a waste rock storage area. The dump is situated to the east of the flotation facilities, is elliptical in shape and stretches from the old open-pit Bor to the main railroad and the road leading to the industrial complex RTB Bor. Tailings slurry, 28% solids, is upon thickening in thickeners pumped to the pond and clarified water returned to the floatation plant. At present production level and dam height, the pond has an estimated lifetime of 4 - 5 years. The present depth of tailings is approximately 150 meters. Monitoring of the dams stability consists of daily visual inspection and weekly measurements of water levels in the 24 piezometers installed in the dam walls.

3.2.2 *Veliki Krivelj Mining Complex Description*

The Veliki Krivelj Mining Complex is located 1 km southeast of the village of Veliki Krivelj, 8 km north of Bor. Operations performed in this plant are copper ore exploitation and processing and flotation concentration of copper mineral.

The facilities at Veliki Krivelj include (see *Annex A, Figure A3*):

- One open pit mine;
- Dump areas for waste rock from the mine;
- Crushing plant;
- One flotation plant;
- Two tailing ponds (Field 1 and Field 2) used as tailings storage, retained by three dams (Dams 1A, 2A and 3A).

The flotation tailings storage facility occupies the valley south of the mining complex, 1-2 km north of Ostrelj village. Water from the Borska River is diverted north of the Bor open pit mine through pipeline to join the Kriveljska River north of the tailing ponds. The combined waters are diverted by a 1,414 km-tunnel around the first tailings pond and then conveyed under the second tailings pond by a 2,065 km-collector pipe. The pipe emerges approximately 150 m downstream of the active tailing dam. Details on the collector status are anticipated in the next section Tailing Ponds and will be addressed deeply in Section 7.

Mines Activities

The ore exploitation started in 1983. Since 1998, when the transportation system was built, overburden from the mine Veliki Krivelj is transported to the old open pit of Bor.

The mining complex covers a total area of about 254 ha, of which:

Open pit mining	=	129 ha
Dump for waste from the mine	=	124 ha
Facilities	=	0.62 ha.

The exploitation of copper ore deposits is carried out on the surface and consists of the following phases:

- **Rock Mass Drilling:** by electrically powered borers;
- **Blasting:** by explosive compound and powder explosive cartridges;
- **Loading:** by excavators with bucket volume up to 11 m^3;
- **Transportation:** by diesel-electric dumper trucks having bearing capacity of 160 t of rock mass;
- **Primary Ore Crushing:** ore breaking in the grinding plant and transportation by belt conveyors to the storage;
- **Mining waste transportation system:** overburden, after crushing, is transported by 4 km long belt conveyors towards the old open pit mine of Bor.

The planned capacity is as 10,6 million tons/year and 10 million tons/year for ore extraction and overburden, respectively. The level of the current production is about 50% of the planned capacities.

The *Table* below summarizes the raw materials and the production level for year 2004.

Table 3.4 *Mining Production Rate*

Raw Materials/ Products	Quantity (t, 2004)
Raw Materials	
Current overburden	1,059,157,000
Capital overburden	0
Total overburden	1,059,157,000
Products	
Wet ore	4,345,200.00
Copper in the ore	10,424,945

Crushing Operations

The process of crushing is developed through the following phases:

- **Primary Screening:** the primarily crushed ore is transported by belt conveyors from the open-pit to the primary screening where three different fractions are separated: the coarsest fraction is transported by belt conveyors to the secondary crushing plant, the medium one to the tertiary crushing plant, while the fine particles are sent to the flotation plant after conditioning;
- **Grinding and Sizing:** the grinding is carried out in two wet phases in the rod mill, and then in the ball mill. The ore resulting from the primary screening is collected by belt conveyors into the rod mill where water and lime milk are added. The product obtained from the rod mill and the ball mill is transported by pump to the classifying section in hydro cyclones. Sand of the cyclone is returned to the ball mill, while the overflow represents the slurry, which is ready for the flotation concentration.

Flotation Process

The flotation facility occupies a total area of 358 ha, of which:

- Flotation tailings ponds (total area) = 334 ha
- Flotation facilities = 24 ha.

The process of flotation is carried out as per the following phases:

- **Flotation:** the slurry from grinding process is conveyed to the flotation tank for prime flotation of copper mineral. The resulting overflow (copper concentrate) is treated in a three-stages section for cleaning and then sent to the filtering process. The flotation underflow represents the tailings.
- **Preparation and Distribution of Reagents:** chemical reagents such as xantogenates of alkali metals, ditiophosphats, polyglicols, and lime milk, are added in the flotation process acting as collecting and frothing agents.
- **Dewatering of the Copper Concentrate:** the final concentrate with a content of copper up to 18% is transported by gravitation to the filtration plant, which consists of a thickener and vacuum filters with drums, for dewatering and then is transported by trucks to the smelting plant in Bor.
- **Tailings Transportation and Storage:** tailings from the flotation by gravitation are transported through a concrete channel to the tailings dumps.

The *Table* below summarizes the raw materials and the production level for year 2004.

Table 3.5 ***Veliki Krivelj Flotation Production Rate***

Raw Materials/ Products	Quantity (t, 2004)
Raw Materials	
Wet ore	3,798,531.00
Dry ore	3,626,783,799
Copper in the ore	8,756,524
Products	
Wet concentrate	45,702,750
Dry concentrate	40,716,183
Copper in the concentrate	6,245,524

Tailing Ponds

The tailings from the Veliki Krivelj flotation plant, as a 25% - 30% slurry, is transported by gravity by means of a concrete canal to the tailings ponds of Veliki Krivelj. The tailings dump is formed in the Kriveljska River valley and it consists of two fields (Field 1 and Field 2) situated between three dams (1A, 2A and 3A): Field 1 is located between dams 1A and 2A; Field 2 between dams 2A and 3A. Dam 2A is 1,300 m downstream of Dam 1A and Dam 3A is 1,500 meters downstream of Dam 2A (see Annex A, Figure A3).

The flow of Kriveljska River is deviated near the first field, across the sound rock mass, while beneath the second field it passes through the collector.

Field 1 (containing at present about 94 million m^3 tailings) was used from 1983 until 1989 and is currently closed. The dump covers an area of 81 ha.
Field 2 (at present about 130 million m^3 tailings) started operations in 1989 and is currently in operation. The pond covers an area of 127 ha.

The solids are deposited by sedimentation while water is returned to the flotation plant using vertical pumps mounted on a pontoon.

The initial dam construction was of rock and compacted clay. The dikes were then raised progressively using coarse sand from the underflow of tailings classification (hydrocyclones) and pumping the fine particle slurry into the disposal area. The dam's heights are:

- Dam 1A average height 70 m over the valley bottom, maximum height 85 m;
- Dam 2A average height 80 m, maximum height 105 m;
- Dam 3A average height 100 m.

Field 2, which is currently active, has a residual capacity for another six months operation. Beyond this time RTB Bor reportedly plans to utilise space in Field 1 up to the crest level of 375 m above sea level (asl).

Since the spoil heap spreads over a rather large area of about 300 hectares and the filling level is higher than the surrounding village, its influence on the air pollution and soil contamination is considerable, due to the emission of dust from the spoil heap dams and dry areas.

The water in the lake of flotation spoil heap may contribute to the potential contamination of groundwater and surface waters.

Contamination of surface waters (the Krivelj River) may be also caused by abundant precipitation and melting of snow, when strong torrents rinse away the materials from the dam slopes.

As mentioned above, before taking the sites into operation in 1983 the Kriveljska River was deviated by a tunnel-bypassing Field 1. When the tailings area was extended to Field 2 in 1989, a 2 km long concrete collector of 3 m inner diameter underneath that field was built. The collector is now located beneath approximately 70 m of tailings and is subject to heavy stresses from the overlaying masses.

Less than 10 years after installation, leakages through cracks were detected and during 1992-97 it was therefore reinforced internally in a length of 624 m. This reinforcement has reduced the inner diameter to about 2.2 m giving lower capacity to take flood. Later, however, new cracks and leakages were detected along an additional 80 m stretch. The leaking water is acidic (pH 2-4) and corrodes the steel reinforcement. Since December 1999, the damaged part of the collector is equipped with reference points, which are regularly monitored. The readings show that the collector is under plastic deformation and that the deformation is accelerating.

The collector is at one point connected with an overflow pipe located along the original slope of the river valley. When considerable amounts of water come into the tailings field under rainy periods or snow-melting the overflow water is drained down this pipe into the collector and the waters of Kriveljska River. As anticipated, more detailed assessment of tailing ponds and dams stability and related environmental issues are presented in *Annex D*.

3.2.3 *Cerovo Mining Complex*

Mining facilities at Cerovo include an open pit mine and crushing unit. The exploitation started in 1991 and ended in 2001; the mine is temporarily closed following completion of the first phase of exploitation and pending potential exploitation of four other nearby ore bodies.

Cerovo open mine is approximately 14 km North West of Bor in a hilly, wooden countryside forming the head waters of the Kriveljska River.
The open pit is located between two streams: the Cerovo to the East and the Valja Mare to the South-West, which join to form the Kriveliska River, approximately 2 km south east of the mine, at the village of Mali Krivelj.

Some houses are present close to the mine and farming in the valley floors adjacent to the pit.

The complex occupies a total area of approximately 54 ha, of which:

- open pit = 31 ha
- mining wastes dump = 23 ha.

Exploitation of copper ore was operated in the open-surface manner and in the following phases:

- Boring of rock mass;
- Blasting, by explosive compound for mechanical charging of bore holes;
- Loading, by bucket;
- Transportation of ore and overburden by diesel-electric dumper trucks having bearing capacity up to160 t;
- Ore crushing: in primary crushing plant. The crushed rocks were transported by belt conveyors to the storage;
- Dewatering: drainage of the mine water pit.

Crushing and milling facilities and hydro transport of ore slurry to the Bor flotation plant are present close to the open pit, consisting of the following phases:

- Secondary and tertiary crushing and grinding;
- Two-phase grinding and classing;
- Thickening;
- Hydro-transportation of the slurry, by means of a set of sludgers through the pipeline to the flotation plant in Bor for further processing.

Drainage water from the mine is collected and stored in a water basin (ecological basin). Reportedly, the mine water is currently not pumped out from the mine. Details on waste waters treatment / discharge are reported in *Section 5.3*.

3.3 *RBM MAJDANPEK*

Majdanpek is a mining town about 70 km north of Bor with two open pit mines, the South Mine just south of the town and North Mine a little West of the town. The total number of employees at Majdanpek is 1,400.

The exploitation of the copper mine of Majdanpek started in the early 1955. The plans for development of the complex included opening of an open-pit mine, construction of a flotation plant and related facilities and development of an urban settlement.

During the 1980s, the production capacity reached about 13 million tons of ore per year. In the recent years, the annual capacity decreased significantly (in 2005 it amounted to about 1.2 million tons of ore) due mainly to the lower content of copper in the ore. Due to the decreased mine production, the flotation plant is reportedly run at 25% of its capacity.

RBM Majdanpek consists of the following (see Annex A, Figure A5):

- two open pit mines: South Mine and North Mine;
- crushing unit (primary, secondary and tertiary stages);
- a flotation plant;
- two tailing ponds: Šaški Potok and Valja Fundata;
- dam for retreated tailings storage in upper valley of Šaška stream;
- three main areas for waste rock storage located around the open pits.

Open Mines

The South Mine is currently not in operation. Ore exploitation is limited to the northern slope of the North Mine.

Drainage waters were observed in both the two mines during the site visit. Reportedly, waters are normally pumped out and discharged in the Mali Pek River, however they are currently naturally infiltrating in the ground. Details on mine water discharge/treatment are given in *Section 5.3*.

Mass balance of the open pits is reported in the *Table* below.

Table 3.6 ***Mass Balance of the Open-Pit***

Year	Overburden (t)	Ore (t)	Cu content in ore t	%	Au content in ore T	g/t	Ag content in ore t	g/t
2003	1,031,000	848,000	2,728	0.322	209	0.256	1,031	1,.261
2004	1,074,000	975,000	3,207	0.329	453	0.465	2,213	2,270
Jan.- Nov. 2005	807,500	997,500	3,639	0.365	486	0.510	2,403	2,522

Crushing Unit

The excavated ore is transported by trucks to the crushing process, where it is treated in a three-stages process: primary, secondary and tertiary. The grinding process takes place in the rod mill and in the ball mill. After sizing, the hydrocyclone oversize, with about 33% of solid substance, and the grinding fineness of 60% (class 0.074 mm) are gravitationally directed to the flotation process.

Flotation Unit

The flotation process consists of the following phases:

- **Flotation:** the slurry from grinding process is conveyed to the flotation tank for prime flotation of copper mineral. The flotation overflow (copper concentrate) is treated in a three stages section for cleaning, while the underflow represents the tailings.
- **Preparation and Distribution of Reagents:** chemical compounds are added as flotation reagents in the process (xantogenates of alkali metals, ditiophosphats, polyglicols, and lime milk). The preparation of the reagents is carried out in a separate builing.

- **Dewatering of the Copper Concentrate:** the final concentrate is transported by gravitation through a pipeline to the filtration plant in order to reduce the humidity content. Such a concentrate is transported by trucks to the smelting plant in Bor.
- **Tailings Transportation and Storage:** the final tailings of the flotation concentration are pumped to the tailings dump Valja Fundata, where are stored.

The quantification process charts are reported in the following *Table.*

Table 3.7 ***Flotation Mass Balance***

Year	Dry concentr. (t)	Cu content in ore		Au content in ore		Ag content in ore		Recovery		
		t	%	t	g/t	T	g/t	Cu	Au (%)	Ag
2003	19,936	2058	10.32	81	4.05	589	29.55	75.42	38.62	57.17
2004	24,090	2534	10.52	153	6.37	1244	51.64	79.01	33.87	56.21
Jan.- Nov. 2005	26,386	3639	0.365	178	6.74	1106	41.93	81.89	36.59	46.04

Tailing Ponds

There are two tailing dumps originating from the South Mine and the North Mine. The tailings deposit at Šaški Potok was in operation only between 1989-95; the present tailings deposit, Valja Fundata, which is located southwest of the South Mine, commenced operation in 1995.

The tailings dump at Šaški Potok was designed for a capacity of 40 million m^3, however it now contains only 8.4 million m^3. Actually, it was only in operation for about 4 years, since it partially broke in 1996 due to heavy rainfall and the formation of an icy cover in the pond, which stopped the water flowing out from the drainage system. After this accident, approximately 1,247 ha of the Šaška and Porecka Rivers' valleys were covered with about 350,000 m^3 of tailings. The spillage was cleaned up by the company. Although this dump is no longer active, it can be used for receiving tailings by gravity from the main floatation plant if the tailings pumps fail or in the event of a power failure.

Reportedly, the dump has a residual capacity of about 30,000 m^3. Since this incident, the dam height was raised of approximately 1 meter. No design documentation was available on the repair and reconstruction of the damaged dam.

The active tailings storage pond, Valja Fundata, was built as a replacement of the damaged one, however neither this is stable as it is not fixed to the ground below and slides downwards at a rate of about 10 cm/year. The movement is caused by pressure from the masses in the deposit. A concrete canal for collecting the drainage water is located below the dam and a pump station with three pumps, each with capacity 150 l/s, is operated to pump the drainage water back to the flotation plant.

The pond covers a total area of 300 ha with a maximum tailing depths of 140 m and contains approximately 350 million tonnes of tailings and 10 million m^3 of water. The residual capacity is estimated at about 1 million t. There is a plan to raise the dam height from 520-530 to 550 m above sea level.

The pond is retained by 3 dam walls with a fourth under construction. Dams are constructed initially by concrete walls, and then raised by the use of coarse tailing fraction derived from classification of the tailings using a two-stage hydro cyclone. Tailings are transported 2 km from the floatation plant initially in concrete channels and then by pipeline to the disposal area. Water is returned to the floatation plant by pipeline. Stability of the dams is monitored by means of piezometers.

A more detailed assessment of tailing ponds and dam's stability and related environmental issues is undertaken in the *Annex D*.

3.4 *TIR SMELTING AND REFINERY COMPLEX BOR*

The Copper smelting in Bor commenced operations in 1936 with a major expansion in the 1960s' and 1970s'. During the 1970s the smelter was partially modernised with the construction of new roasting technology, oxygen enrichment of smelting and new emission control system. However, since then there has been minimal investment and the environmental performance is now far below the one expected in the modern smelters.

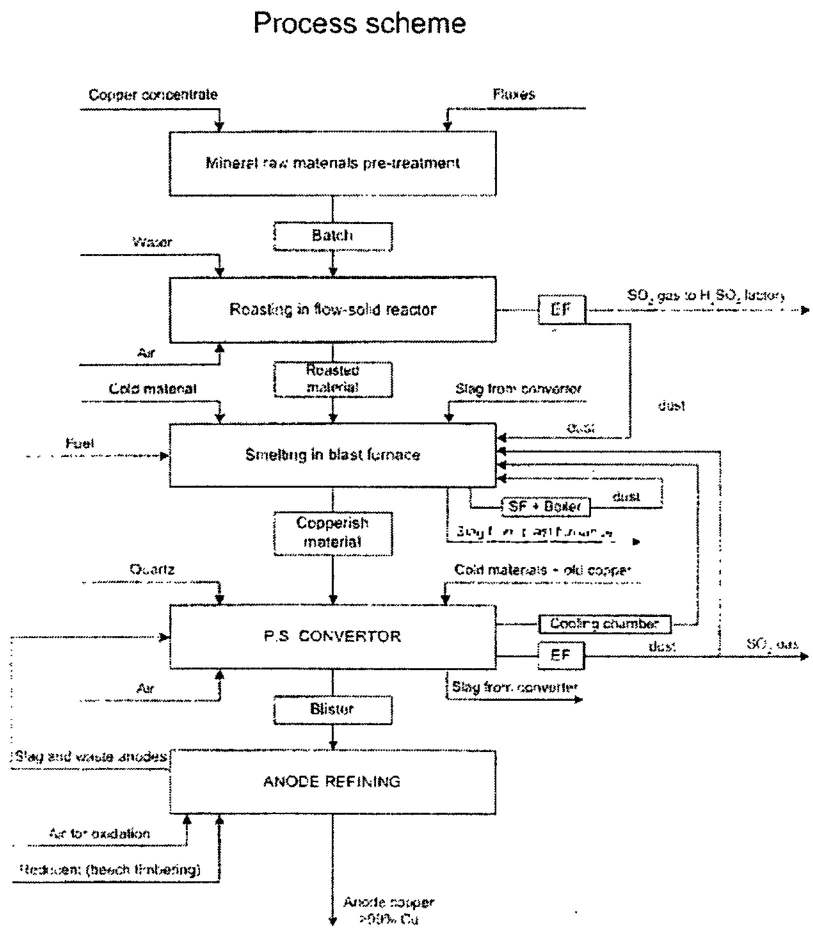
The smelter is located within a few hundred meters of residential areas of the old part of Bor.

The process consists of the following steps (see *Annex A, Figure A6*):
- Raw material pre-treatment;
- Copper Smelting Process, comprising two lines of pyrometallurgical units for remelting copper concentrate and other copper matters;
- Refinery process (fire and electrolysis), for production of cathode copper of high purity;
- Sulphuric acid factory in which sulphur acid is produced by processing smelting SO_2 gases;
- Precious metal recovery units (Au, Ag, Se, Pl, Pd) and units for production of blue stone ($CuSO_4$ $5H_2O$);.
- Copper and copper alloy foundries;
- Transportation by railroad and by trucks;
- Thermal power stations for production and delivery of heat energy and industrial water.

A simplified process scheme is reported in *Figure* 3.2.

In addition to the above-described facilities, a number of further facilities (copper wire production and dynamo wire; movies confectioning - medical, graphical; photo chemicals and sinter-metallurgic products) are present within TIR. They are currently out of the assignment's scope of work.

Figure 3.2 *Process Scheme*



3.4.1 *Smelting Unit*

Basic activity of smelting plant is remelting of copper concentrate and other copper materials, so called "cold materials". The main products are anode copper and sulphur dioxide.

The copper is obtained mostly from the sulphide raw materials and partly from secondary raw materials that are supplied to the Smelting Plant in the form of copper concentrate of the following basic content:

- Cu - 20%
- Fe - 27%
- S - 34%
- SiO - 9%
- CaO - 1%

- Al_2O_3 - 6%
- H_2O - 11%
- Other 3%.

Primary raw materials include the copper concentrates (from Majdanpek, Veliki Krivelj and Bor flotation plants) in a broad range of quality (10-30% Cu); the concentrates obtained from reverberatory-furnace slag, and the rich ores that could be processed by the existing furnaces. Secondary raw materials include the waste copper-based sludge of various origin; various copper-bearing materials from other enterprises; old copper; the waste copper from other processes, and scraps.

Smelting plant consists of the following units:

- **Preparation of batch:** the section consists of a unit for receipt and storage of raw and other materials, such as concentrates from the flotation plants of Bor, Krivelj, and Majdanpek, melting agents, quartz, limestone, coal, crude oil and naphtha. Two lines for batch preparation are present, with a storage capacity of 10,000 and 12,000 t respectively. Copper concentrate is transported by belt conveyor from the storage area to the batch unit.
- **Roasting Section:** the section consists of two fluidized-solid reactors in which the charge is roasted to remove sulphur and volatile contaminants and produce a calcine suitable for smelting. Desulphurisation achieved is about 40%-50% of the batch contents. The product of this section is calcinated ore and SO_2: the gas is extracted and treated through a cyclone, spray tower and electrostatic filters before being conveyed to the sulphuric acid plant. Calcinated ore is delivered discontinuously by gravitation to the blast furnace. The roaster is provided with a system of waste heat boiler and two hot electrostatic precipitators (efficiency 99% and exit gases containing 0.05 g/Nm^3 dust); the remaining dust plus volatile metals are captured in the gas washing section of the acid plant.
- **Smelting - Blast Furnace:** smelting involves the application of heat to fuse the calcinated ore and added cold material (consisting of fine-grain cold material and the converter slag) and simultaneously allow the separation of copper (matte) from iron and other impurities (slag). Products of blast furnace are:
  - copper matte, which is sent to the converters for further processing;
  - slag, which is put aside at the dump (the old open pit mine where slugs are discharged while still fused); and
  - flue gases, with maximum 1% of SO_2, which are discharged into the atmosphere via a 100 m high stack, after passing through a boiler-heat exchange and a hot electrostatic precipitator for dust capture (gases contain 0.5 mg/Nm^3 dust equivalent to a mass emission of 30 kg/h).

  The copper matte contains 38-42% of Cu, whereas the Cu contained in the slag does not exceed 0.6%.

  There are two blast furnaces in the smelting plant; the first one is fed with coal and the second one with crude oil. Crude oil is stored in two tanks of 1,500 t each.

Coal is stored only partially in a covered storage area and mainly on the ground. The consumption of coal is about 0.16 t per ton of dry concentrate.

- **Converters:** (Peer-Smith converters): in the converter quartz and compressed air are introduced into the molten copper matte to obtain blister-copper, with a Cu content of about 98%. Most of the remaining iron combines with the quarts to form converter slag, which is recycled back to the smelter. The sulphur is oxidized in the form of SO_2 gas (about 5% in the gas), which is sent to further processing to the sulphuric acid factory. System for gas transportation consists of heat exchange-chambers and electro filter with blowpipes for air drawing. These units are interconnected with collectors and towers and joint with a 150 m high chimney. To intensify converting process, oxygen, from the oxygen factory, is added to enrich the air.

A factory producing liquid oxygen, gaseous oxygen, liquid nitrogen and gaseous nitrogen is also present within the smelting plant. These products are partially used for the needs of smelting plant and other units of TIR and partially sold on the market.

3.4.2 *Refinery Unit*

The blister copper produced in the smelter are first refined in the anode furnaces and then sent to the electrolytic refinement.

Anode Refinement Section

The blister copper that has about 98% of Cu is fire refined in reverberatory furnaces, where, after oxidation and reduction, it is cast in the form of 235 kg weight anodes. The anodes are then sent to the electrolysis unit for further refinement. The section consists of three anode furnaces, fed with crude oil or naphtha, and two moulding machines.

Electrolytic Refinement

Electrolytic refining purifies the copper anodes by virtually eliminating the oxygen, sulphur, and base metals that limit copper's useful properties.
The copper anodes are transported by cranes to a "tank house", where they are dissolved electrolytically in acidic copper sulphate solution (the electrolyte). The copper is electrolytically deposited on "starter" sheets of purified copper to ultimately produce copper cathodes, while the anode is gradually eroded.

The residual anodes after washing are pulled by cranes out of cells, packed in buckets on railway platforms and transported to the smelting plant for remelting into anodes. During the anode washing, electrolyte is removed from the cells and transported through pipeline to the storage electrolyte tanks.

The electrolyte is a solution of copper sulphate and sulphur acid in water, at temperature of 60°C.

The contents of sulphur acid is within the range of 180-200 g/l and Cu is in the range of 45-50 g/l. Soluble impurities of iron and nickel dissolve in the electrolyte, which has to be continually purified to prevent excessive deposition onto the cathodes, which would reduce their purity.

Impurities in the anode, which are insoluble in the electrolyte (such as gold, silver, platinum and tin), fall to the bottom in a pile and form a valuable "sludge" (anode slimes), which is then sent to the gold factory for further processing.

After washing of anode residual in cells, anode slimes and outstanding electrolyte and washing water are delivered through pipeline to settling and slurry tanks. The slime is transported to the tanks for slurry preparation, from where is delivered to the gold factory. The liquid phase, upon filtering is returned back in the process.

3.4.3 *Sulphuric Acid Plant*

Sulphur dioxide produced as a by-product of the smelting processes is used for sulphuric acid production.

Three units for the production of sulphuric acid are present, of which only the Line 2 is currently in operation. The Line 2 treats only the off-gas generated by the fluidised bed roaster (approximately 9% of SO_2), since it does not have spare capacity to treat the converter furnace off-gas (4-8% SO_2), which are discharged into the atmosphere via a high stack not equipped with acid mist filter. The sulphur dioxide conversion efficiency is 97%-98%, which gives a final content of 0.09% SO_2 in the effluent gas.

The sulphuric acid is produced in a contact type technology. The process consists of four stages:

- **Gas treatment:** the smelting gas containing more than 3% SO_2 is treated in a cooling tower (D1) with 1-2% H_2SO_4 and is cooled from 220-250°C to 60-65°C. Dust is then removed, suspended in liquid phase and separated at the settling basins for further neutralization. The gas is then driven to the second tower (washing tower D2) where is treated with 1-2% H_2SO_4 and cooled to 32-35°C. The next phase is the gas purification in the wet electrostatic precipitator (MEF), with the removal of dust and sulphur acid fog.
- Gas drying: after the MEF the gas temperature is between 30 and 40°C. The gas needs to be dried as, at low temperatures, the water steam bring the sulphuric acid to condensation, which might cause the corrosion of equipment and inhibition of catalyst, as sulphuric acid breaks the vanadium catalyst. The drying process is done in two stages. Drying begins in pre-drying tower (D3), where the gas is treated with 77% of H2SO4 and then in drying tower (D4) where is treated with 96% of H2SO4. The dried gas should contain no more than 100 mg H2O/Nm3. There is one more tower (air drying tower D5), for the reduction of the sulphur dioxide lost with drying acid.

- **Oxidation of sulphur dioxide to sulphur trioxide:** Sulphur dioxide conversion is done in contact column using vanadium pentoxide as catalyst. The SO2 is converted into SO3, with a total conversion rate of about 97.6%.
- **Absorption of sulphur trioxide:** absorption of SO3 into sulphuric acid is carried out in absorption column by introducing gas to 98,3% of sulphuric acid. The main product is technical sulphuric acid (93 - 98,3%), which is then stored or sent to accumulator's factory. Absorption degree is 99,9%. Flue gas, which contains about 2,000 ppm of SO_2 and SO_3 in traces only, is then discharged into the atmosphere through a 60m high chimney.

The sulphuric acid storage consists of 26 tanks with a total capacity of about 28,000t. A containment basin is present for the collection of leakage/spills from the tanks.

3.4.4 *Gold Factory*

During the electrolytic refinement of anode copper, anode slurry is also obtained in addition to cathode copper, which contains precious and rare metals. This slurry is processed in the so-called Gold Factory for production of precious metals.

The Gold Factory is understood not to be included in then present assignment.

3.4.5 *Power Plant*

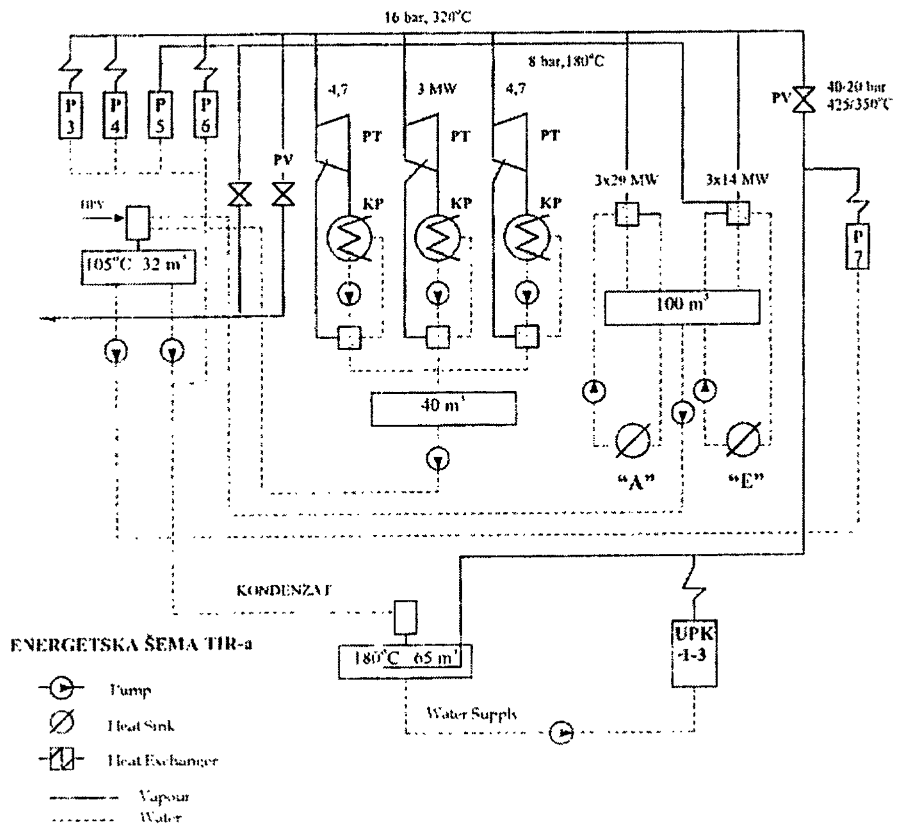
The construction of the thermal power plant dates back to 1932, for the energy supply of mining and metallurgic industries. Four steam boilers and three steam turbines were constructed. After the Second World War, two steam boilers were incorporated and the existing turbine facilities were replaced with steam turbines. In 1965 a steam boiler was constructed and turbine plant was extended with an other turbine type.

The power plant is used for supply of sanitary hot waters in RTB Bor, supply and distribution of electric power from the power plant station of the State Company (Electro Power Industry of Serbia), production of small quantities of energy for internal supply, production of demineralised and decarbonised water for boilers and heating systems as well as distribution of industrial waters.

The plant is located in the area between the flotation plant Bor and the Copper wire plant. The power plant consists of steam boilers, steam turbines, cooling towers, water heat-exchanging stations (TS-1 ant TS-2), hot water distribution system, water treatment plant and industrial water distribution.

Heat is produced from steam boilers no. 5, 6, and 7 and part of the energy is distributed by means of boilers, which uses the heat obtained in the copper smelting process.

Figure 3.3 ***Process Scheme***



LEGEND:
A, B, C and E – hot water pipeline
UPK – Recovery boilers (smelting)
P – Steam boiler
KP – Condenser
PT – Steam turbine
HPV – Water Chemical Treatment
PV – Pressure reduction valve

The main technical characteristics of the boilers are summarized in the *Table* below.

Table 3.8 ***Boilers Characteristics***

Characteristics	Steam boiler No. 5 and 6.	Steam boiler No. 7.
Operating pressure (bar)	8 / 19	36
Steam / water temperature (°C)	175/320	425
Steam production (t/h)	16 / 16	50
Fuel	coal	coal
Heat of combustion (MJ/kg)	13.5 / 13.5	13 - 17
Fuel consumption (t/h)	2.5 / 3.5	10
Capacity factor	0.6 / 0.6	0.74
Thermal power (MWt)	10.6 / 11	36

The produced heat is distributed by a system of heat exchanging stations. The produced heat energy is utilized for process purposes, as well as for heating of the facilities and sanitary waters.

A secondary source of energy is the steam produced by means of a heat recovery system at in the smelter.

Water for production of decarbonised, demineralised, hot water and superheated steam is supplied from the artificial water storage lake of Bor, which is supplied with additional water from natural basin and artificially through pumping stations from Zlotske and Beljevinske River.

Emission of flue gases and particles, as well as slag and ashes, are generated as a secondary product from the process of combustion. Emission of flue gases and particles is controlled through multi-cyclones. Slugs and ashes (approximately 1,000-1,500 t per annum) are disposed of in a separate area within the RTB complex.

Considering the age of the plant and units, state of equipment, machines and installations the power plant is within limits of functionality. However, further significant actions are considered necessary to better control and improve the efficiency of the process and the control of emission as better described in the following paragraphs.

4 ANALYSIS OF PROPOSED RESTRUCTURING AND PRIVATISATION OF RTB BOR COMPLEX

4.1 INTRODUCTION

The Environmental Assessment to be undertaken in the frame of this Project is strictly related to the Privatization Process of the RTB Bor, currently on going. As far as it was understood, the Privatisation of RTB Bor was decided to be initiated in September 2005 and two studies are under preparation for the tender procedure.

A number of studies have been prepared with regard to privatisation and restructuring activities of RTB Bor in recent years. Key studies made available to ERM in the frame of this project include:

- a study prepared by Ira Lieberman at the end of 2004, dealing with different options to privatise all or part of the complex RTB Bor;
- a technical-economical-financial due diligence, completed by IMC Deloitte aimed at defining the Restructuring and Privatisation Strategy for RTB Bor and the related Privatisation Strategy prepared by CAIB, Deloitte, HS and IMC;
- a specific study related to the modernisation of the smelter, undertaken by SNC Lavalin.

A synthetic description of these studies is reported in the following paragraphs.

4.2 EXISTING STUDIES RELATED TO THE PRIVATISATION OF RTB BOR

4.2.1 *Privatisation of RTB Bor - Ira Lieberman*

The study prepared by Ira Lieberman at the end of 2004 dealt with different options to privatise all or part of the complex RT Bor and remains, at the moment, one of the key references to identify possible future scenarios of the environmental situation in the Bor area.

This study foresaw four main privatisation alternatives:

Option 1: (proposed by the present RTB BOR management) foresees a Bor's investment plan of $45 million over the next five years; Bor's Management proposes to the Government an investment program to increase production to about 4,000 tons per month. This level of productivity is considered possible to be achieved through a full operational status of the facility and a reduction of about 26% of present mining staff.

Option 2: presents a transitional strategy for RTB Bor: it is accepted a preliminary period in which the RTB Bor operation continue producing economic losses while restructuring the facilities waiting for initiating the exploitation of the Borska Reka reserves, which is an underground deposit of porphyry copper located beneath the currently exploited Jama underground pit.
Option 3: in case the Borska Reka reserves are proved not to have a viable quantity or quality of ore that can be mined efficiently and profitably, RTB Bor operations are closed in the short term (1-2 years).
Option 4: in case the Borska Reka reserves are proved not to have a viable quantity or quality of ore that can be mined efficiently and profitably, RTB Bor operations are closed in the medium term (3-4 years).

According to the author of the above cited study, *Option 1* has to be considered not credible since it would continue to produce economic losses without solving the critical environmental problems of the area.

The other three options are in any case linked to the results of ongoing studies and investments related to discover quantity and quality of ore in the Borska Reka reserves.

Regardless the option that will be selected, many environmental issues have to be dealt with and mitigation measures need to be taken.

In fact, although *Option 1* is not dealing with environmental issues at all, some mitigation measures/clean up interventions are necessary to allow safe operations.

They should in any case be the same proposed by Ira Lieberman for the other options i.e:

- *Option 2*, maintaining the site operative would require to address a number of environmental priorities as follows: tailing ponds stability and monitoring; Veliki Krivelj collector rehabilitation; riqualification and remediation of the smelter facility; resolution of the problem related to wastewater discharge from RTB Bor.
- *Option 3/4*, closing out the activities undertaken on site would anyway require to address a number of environmental priorities as follows: tailing ponds stability and monitoring; Veliki Krivelj collector rehabilitation; remediation of the smelter area; resolution of the problem related to municipal effluents discharge and residual wastewater discharge from RTB Bor.

In conclusion, whichever will be the selected option the above cited environmental problems have to be examined and mitigation measure given.

4.2.2 *Technical-Economical-Financial Due Diligence of RTB Bor and Privatisation Strategy*

Two main documents have been made available to ERM with regard to the Privatisation of RTB Bor Complex: the Technical Due Diligence as prepared by IMC Group Consulting Limited and the Privatisation Strategy prepared by CAIB, Deloitte, HS and IMC.

Technical Due Diligence

The technical Due Diligence is a technical-economical-financial due diligence which considers RTB Bor assets from a technical point of view and analyses: current and potential exploitation of mine resources, performance and future planning of ore processing plants, smelter and refinery status, presence and conditions of infrastructures and auxiliary services.

A dedicated section is devoted to environmental issues, including a summary overview of applicable environmental regulations and standards and of environmental management practices and issues at the site. A synthetic presentation of main environmental impacts is also included focusing on air emissions, wastewater discharges and tailing storage facilities.

Financial analysis and valuation of the Complex is presented in the end.

Privatisation Strategy

With regard to the Privatisation strategy, this document outlines different options for Privatisation and recommends the most appropriate method of privatisation. The study summarises the key findings of the technical-economical-financial due diligence and analyses in depth financial forecasts for Borska reka Resources exploitation, since this is considered a key factor in the frame of the future development of RTB Bor. A study market with results of testing of interest of potential investors with regard to the Complex is also outlined as a basis for the formulation of different alternatives for privatisation, advantages/disadvantages analysis and recommendation of restructuring/privatisation option considered more appropriate.

At this stage, no closure of plants/activities is foreseen and the environmental analysis has been developed considering possible future exploitation of all the assets. When any potential closure/interruption of activities was foreseen by the Consultant based on available information, this has been highlighted as an option in the environmental issues section.

A summary of final privatisation strategy was provided by CAIB to ERM in the frame of the preparation of the final consultation meeting and presentation in order to clarify the status of the Privatisation Process. The document is reported in the following paragraph.

Recommended Privatisation/Restructuring Strategy

After thorough consideration of various options, Sale of Assets has been recommended as the most appropriate privatization/ restructuring method. The subject recommendation was made upon the cross-assessment of the social, financial and legal implications, as well as the expressed market interest. Special consideration was given to the required time for the implementation of each possible option, and the Sale of Assets is obviously the fastest method.

The Consortium anticipates that the assets will be sold as part of the following groups:

- RBB core assets;
    - Veliki Krivelj, flotation and Cerovo assets; Jama assets (including Borska Reka deposit) and flotation;
- TIR core assets;
- RBM core assets.

It is important to keep in mind that deposit Jama/Borska Reka is connected with the flotation in Veliki Krivelj. Further, it means that if eventually these assets are sold separately the future Buyer of Jama/Borska Reka will not be in position to use the flotation of Veliki Krivelj unless the certain commercial agreements have been arranged.

Social aspects

One of the goals of this privatization is to preserve, to the extent possible, the level of employment in the region. Nevertheless, the extent to which this goal can be achieved is limited. The limits are originating from: (i) technological nature of the productions process and (ii) the interest of the creditors. In addition, any attempt to force the potential buyer to take over more employees than required by the specific production process will lead to a decrease of the sale-purchase price for the assets which may provide legal grounds to the creditors to challenge the sale process. Therefore, the recommendation was to connect the social program in case of RBB and RBM to the license transfer agreement which will be signed between the Government and the future buyer, as a separate document, parallel with the sale of assets. In case of TIR the above procedure is not required since the operations do not require the mining licenses.

Investment Requirements

In case of RBB and RBM the investment requirement shall be regulated (like the social program) in the license transfer agreement for similar reasons. With regard to TIR the investment obligation shall be limited to environmental matters. The reason for this lies in the fact that any investment obligation, imposed on the future buyer, will lead to deduction of the sale-purchase price, which will further provide ground to creditors to challenge the subject sale.

Sale Process

The sale process will be initiated after the adoption of both the Privatisation/Restructuring Strategy and the Restructuring Program, and will assume:

- Sale of core assets;
- Sale of non-core assets.

Sale of core assets envisaged three tenders for three groups of assets (RBB, RBM and TIR), that should be run in parallel to allow investors to bid for more than one group. Tenders for RBM and TIR will be regular one stage tenders, while the sale of RBB assets will be organized as a two-stage tender. More specifically, RBB assets will be offered as a whole as well as divided into two subgroups as following:

1. Subgroup 1: Jama mine, Borska Reka and flotation Bor;
2. Subgroup 2: Veliki Krivelj mine and flotation and Cerovo assets.

The investors will be allowed to bid for one subgroup of assets or for both subgroups (entire RBB).

Sale of non-core assets is envisaged as the auction sale (except the assets outside SCG). These assets will be sold in specific groups:

- Operational assets (existing business units);
- Non-operational assets;
- Infrastructural assets;

The scrap metal will also be the subject of the sale.
It is important to note that the sale of non-core operations which require license (Belorecki Pescar, Fabrika kreca Zagradje, Quarry) must be in parallel with the sale of other core assets that also require license (RBB and RBM). This process will be initiated by the PA with publishing of the Public Invitation which should follow the changes in the Mining Law. The successful implementation of the sale process assumes that relevant Government agencies and official bodies are taking all necessary steps towards the fulfillment of preconditions.

Upon the completion of the core and non-core asset sale process, remaining legal entities, RBB, RBM and TIR, as well as RTB Bor, will be put in bankruptcy, upon adoption of certain decision by Steering Committee for overseeing the restructuring and privatization of RTB Bor.

The structure and time frame of the sale process will be presented in the Action plan, which will encompass specific activities, responsible parties and define certain deadlines.

4.2.3 *Technical Study for Modernisation of the Smelter*

SNC-Lavalin UK Limited (SNCL) were awarded by the Privatisation Agency a contract to undertake a technical study aimed at the modernisation of the smelter in the frame of the overall restructiring and privatisation of the RTB Bor's large mining, smelting and refinery complex.

The objective of the study was to provide expert opinion on smelter upgrading aimed at moving the Bor Smelter to environmental compliance and at developing preliminary cost estimates and timescheduling.

The main environmental issue identified by the study consists of discharge of emissions to air non in compliance with Serbian regulatory standards due to high concentrations of sulphur dioxide. Based on data collected with regard to historical operation of the plant, the report identifies a significant improvement occurred in air emissions since 1996/1997, when sulphur abatemnt was about 25-35% in comparison with current level of abatment identified to be about 50-60%. This improvement is considered to be mainly due to operating rates reduced from about 125,000 tpa copper production to the current 45,000-50,000 tpa and to refurbishment of the acid plant n.2 and some repairs to the converter gas collection system. In addition, refurbishment of the operational hot electrostatic precipitators (to which the effluents from the single operating roaster and from the converter are conveyed) have significantly improved dedusting of emitted flue gases. Nevertheless, emissions from the smelter are not in compliance with currently applicable emission limits according to Serbian legislation.

In order to reduce environmental impact deriving from the smelter and gradually achieve environmental compliance of emitted flue gases together with increasing operating rates to the design 125,000 tpa of copper to gain a commercially viable level of operation, a modernisation plan for the smelter was prepared by SNC Lavalin.

This modernisation plan would be developed through two main components: a first step would consist of improvement of the converter gas handling system and of the acid plant n.2 in order to enable all the flue gases frothe converter to be treated together with the roaster plant. The second component would require replacement of the reverberatory furnace with an electric smelting which would offer a relatively low cost alternative involving minimal change to current operations and satisfying Best Available Tecniques criteria. The modernisation plan would also include refurbishment of acid plant n.3, currently out of operation, which would be available to treat wastewater effluents from the smelter characterised by high content of metals (including As) and acidic pH (namely the acid plant weak bleed and the refinery bleed liquor.

Expected outcomes of the overall modernisation plan would therefore include operating rates up to 125,000 tpa copper fixation of sulphur dioxide up to 90-95% and compliance of flue gases from the smelter with Serbian regulatory limits both with regard to sulphur dioxide and dusts. Total investment for the proposed modernisation plant is estimated to be about 81 Million USD and timeline for implementation is about two years.

4.3 *CONCLUSIONS AND RECOMMENDATIONS*

As far as the environmental issues are concerned, it should be pointed out that the Environmental Assessment (EA) process is aimed at defining an environmental baseline study and at identifying major environmental impacts at the Complex. In the frame of the EA, a proposed environmental management plan (EMP) including mitigation measures and monitoring requirements has been prepared as detailed in section 6 of the present study.

It is anticipated that the EMP was developed regardless from the Privatisation Strategy and/or from whether any of the facilities of the Complex will be included or excluded from the Privatisation Scheme. In fact, from an environmental point of view, the need for mitigation measures is not dependent on what will be the expected development of the site except for the issue of closure against continuation of operations. The key aspect is who will be responsible for the implementation of the remediation/clean-up/monitoring.

For this reason, the proposed EMP gives a tentative indication of who should be responsible for the proposed mitigation measures/monitoring (the new investor or the Government) and whether the recommended actions are foreseen in case of operation of the facility or in case of closure. These indications are included in the EMP.

5 ENVIRONMENTAL ISSUES

Environmental issues related to RTB Bor are detailed in the following paragraphs, grouped by impacted media (air, surface water, soil, etc) and by generating plant/activity (mining, smelter, auxiliaries, etc.).

5.1 EMISSIONS TO AIR

5.1.1 Legislative Background

Air Emissions

A comprehensive review of Serbian Legislation concerning air pollution is reported in *Annex C*, together with relevant EU regulation and WB standards.

Key local legislative requirements are summarized below. In particular, *Table 5.1* presents selected national and international atmospheric emission limits (EU and WB Guidelines) for copper smelter facilities.

Table 5.1 Emission Standards and Guidelines (mg/Nm³)

Parameter	Serbian legislation	EU legislation	WB Copper Smelting (1)	WB Thermal Power Plant (1)	
				(2)	(3)
Sulphur Dioxide	1,200	2,000 (4)	1,000	2,000	2,000
Nitrogen Oxydes	-	600 (5)		750 (7)	750
Particulates-Smelter	20	-	20	-	
Particulates (Other Sources)	-	50/100 (6)	50	50	50 for units > 50 MWe input 100 for units < 50 MWe input
Arsenic	-	-	0.5	-	
Cadmium	-	-	0.05	-	
Copper	-	-	1.0	-	
Lead	-	-	0.2	-	
Mercury	-	-	0.05	-	

Parameter	Serbian legislation	EU legislation	WB Copper Smelting (1)	WB Thermal Power Plant (1)	
				(2)	(3)

(1) All of the maximum levels should be achieved for at least 95% of the plant or unit operating time, to be calculated as a proportion of annual operating hours. The remaining 5% of annual operating hours is assumed to be for start-up, shutdown, emergency fuel use, and unexpected incidents.
(2) WB Thermal Power: Guidelines for New Plants.
(3) WB General Environmental Guidelines.
(4) Directive 2001/80/EC. Limit applicable to plants burning solid fuels, with a net rated thermal input >50 and < 100 MW; a limit of 500 mg/m³ is applied to plants with a rated thermal input > 500 MW and a limit proportionally decreasing between 2000 and 500 mg/Nm³ is applied to plants with a rated thermal input between 100 and 500 MW.
When the emission limit values cannot be met due to the characteristics of the fuel, a rate of desulphurization of at least 60% shall be achieved for plants with a rated thermal input ≤ 100 MW (75% for plants with a rated thermal input between 100 and 300 MW and 90% for plants with a rated thermal input between 300 and 500 MW). For plants with a rated thermal input greater than 500 MW a desulphurization rate of at least 94% shall apply or of at least 92% where a contract for flue gas desulphurization or lime injection equipment has been signed and the installation started before January 1, 2001.
(5) Directive 2001/80/EC. Limit on NOx expressed as NO_2, applicable to plants burning solid fuels with a rated thermal input between 50 and 500 MW; a limit of 500 mg/Nm³ applies to plants with a rated thermal input >500 MW. In some cases a limit of 600 mg/Nm³ can be applied to plants > 500 MW if they do not operate over 2000 hours a year. Until 2018 a limit of 1,200 mg/Nm³ is applied to plants burning solid fuel whose volatile content is less than 10%.
(6) Directive 2001/80/EC. Limit applicable to plants burning solid fuels with a rated thermal input <500 MW. A limit of 50 mg/Nm³ applies to plants with a rated thermal input ≥ 500 MW. In some cases a limit of 100 mg/Nm³ can be applied to plants ≥ 500 MW, when the solid fuel has a heat content of less than 5.800 kJ/kg (net calorific value), a moisture content greater than 45% by weight, a combined moisture and ash content greater than 60% by weight and a calcium oxide content greater than 10%.
(7) Or 365 parts per million parts (ppm) for a coal-fired power plant. Limit value up to 1,500 mg/Nm³ for plants using coal with volatile matter less than 10%.

For the national limits please refer also to *Table 5.2* and *Table 5.3*.

Table 5.2 ***Emission Limit Values for Combustion Plants: Max. Concentration (mg/m³)***

Substance	Solid fuels fired furnaces (coal, briquette and cooks)		
	Furnace thermal rate (MW_t)		
	1-50	50-300	>300
Particulate matter	150	100	50
Carbon monoxide - CO	250	250	250
Sulphur oxides as SO_2	2,000	1,450	650
Nitrogen oxides as NO_2	1,000	800	450
Gaseous inorganic compounds of fluorine as HF	30	30	15
Gaseous inorganic compounds of chloride as HCl	200	200	100

Table 5.3 ***Emission Limit Values (ELV) for Harmful Substances***

Substance	Class	ELV (mg/m^3)	For Mass flow over
Carcinogenic substances:			
Asbestos, Cd, Be, ...	I	0,1	500 mg/h
As, Cr, Co, Pb, Ni	II	1	5 g/h
Benzene, vinyl chloride, ethylene oxide, hydrazine, ...	III	5	25 g/h
Total particulates:		50	0.5 kg/h
		150	0 and less than 0.5 kg/h
Inorganic particulates:			
Hg, Tl	I	0,2	1 g/h
As, Co, Ni, Se, Te	II	1	5 g/h
Sb, Cu, V, Sn, Mn, Pd, Pt, Rh, Cr, F, Cn	III	5	25 g/h
Inorganic compounds as aerosols, gases or evaporations:			
As, H_3, Ph_3, $COCl_2$, CnCl	I	1	10 g/h
HBR, H_2S, HF, Cl_2	II	5	50 g/h
HCl	III	30	0.3 kg/h
NO_2, SO_2, NH_3	IV	500	5 kg/h
Organic compounds:			
Very toxic substances (like phenols, formaldehyde and dioxins)	I	20	0.1 kg/h
Toxic substances (like aromatic solvents and unsaturated chlorinated hydrocarbons)	II	100	2 kg/h
Irritating and harmful substances (like aliphatic solvents, olefins - except butadiene, and paraffins - except methane)	III	150	3 kg/h

Air Quality

A comprehensive review of Serbian Legislation concerning air pollution is reported in *Annex C*. Key local legislative requirements are also summarized in *Paragraph 2.7*, in which is also presented a comparison of various ambient air quality guidelines/standards for selected parameters, at national and international (EU and WB) level.

5.1.2 *Emission Sources, Monitoring Data and Compliance Status*

RBB Bor

Main air emissions from the Mining complex are related to:

- underground mine activities;
- crushing and flotation activities both in Bor and Velikj Kivelj;
- particulate from tailing ponds and waste open dumps both in Bor and Velikj Krivelj;
- other Velikj Krivelj mining activities.

No significant emissions to air are generated at Cerovo since it is not operated.

Underground Mine Activities

Emissions consist mainly of particulate and exhaust gases generated during mining activities (action of an auger, hand-excavation hammer, conveying system of the crushing plant), diesel engine machinery operations, as well as blasting.

Air emission monitoring is performed only at the two air extraction points (V01 - Brezonik and V04 - Tilva Ros) of the venting system, only once a year. Table 5.4 shows, for example, the results of the measurements carried out on May 28, 2004.

Table 5.4 ***Emissions (20 Minutes Measurements) from V01 and V04, May 28, 2004***

Pollutants	Concentration V01 (mg/m^3)	Concentration V04 (mg/m^3)	Emission V01 (kg/h)*	Emission V04 (kg/h)*	Limit (mg/m^3)
SO_2	0.522	1.045	0.035	0.18	500
Particulate	13.6	75.7	0.907	13.21	50
* Flow rates: V01=66,673 m^3/h; V04 =174,540 m^3/h					

Please note that such frequency of monitoring (once a year) is in compliance with article 63 of the Regulation on Emission Limit Value ("Off. Jour. of RS", n. 30/97, 35/97 - see *Annex C* for more details), but is not adequate to draw reliable conclusions on air pollution. In any case, it can be noted that the measurement on V04 presents a limit exceeding for particulate.

Crushing and Flotation Activities

Air emissions generated from crushing and flotation plants come from:

- the lime dressing section and reagents plant;
- the discharge points and ore crushing (conveying belts for crushed ore transportation to the flotation vessel, waste dump, primary crushing);
- the secondary and tertiary crushing for ore screening;
- the flotation spoil heap.

In Bor and Velikj Kivelj there is no particulate abatement/extraction system neither in the buildings (for lime dressing or for ore crushing and screening), nor at the conveying belts discharge points.
Emission monitoring is not performed.

Tailing Ponds and Waste Open Dumps

In the BOR area are located operating tailing ponds, an old tailing pond (which covers an area of 86 ha and is practically filled with tailings) and waste heaps of past and present overburden. These, especially in windy and dry seasons, create particulate emissions and cause considerable effects on air and ground pollution.

According to the Regulations which establish limits for deposition rate for boundary receptors, emission measurement methods and criteria for receptors selection and data records ("Off. Jour. of RS" n. 61/92 and 30/97), air quality monitoring is carried out in the vicinity of tailing ponds (see *Paragraph 2.7* for details and results). Details on depositions monitoring are presented in *Paragraph 2.7*: the area affected by the windblown particulate emissions is wide.

Particulate from Veliki Krivelj tailing pond is considered a main source of air pollution, mainly due to the vicinity of the village of Ostrelj, which is located in the predominant wind direction. From such tailing pond (1), 1,132 to 45,292 g of particulate per second is raised and it reaches up to 4.5 km of distance. The emission index (the quantity of emitted particulate per capita) is 1.789 kg per capita annually in the village of Ostrelj and 22.5 in the village of Veliki Krivelj.

Other Velikj Krivelj Mining Activities

Other air emissions generated from the Veliki Krivelj mining complex are:

- particulate for mineral raw materials recovered from the mineral raw materials-bearing rocks;
- gases derived from the gaseous products of blasting;
- exhaust gases from the internal-combustion engines of the applied mining equipment;
- open pit particulate as a product of industrial machinery operations (loading, transportation).

RBM Majdanpek

Air emissions generated at Majdanpek are:

- particulate emissions from mining activities and mobile equipments;
- particulate emission from ore crushing and milling operations;
- wind blown particulate from tailing ponds and spoil heaps.

Emission of particulate occurs during the production processes at the mining sites (boring, blasting, loading and transportation). During the summer, wetting of the main roads, which are all unpaved, is undertaken in order to reduce the emission of particulate. Reportedly, recycled water is used, which is stored in tanks at the site complex.

Emission of particulate is generated also during the crushing process, for ore crushing and milling stages. Wet particulate suppressors are present, the efficiency is not known. Emission of particulate is generated from the floatation process. Ventilation systems are present. Emission of particulate also occurs at the filtration facility, during the loading of the Cu concentrate. No air treatment is present.

(1) LEAP, Municipality Bor

TIR Bor (Smelter)

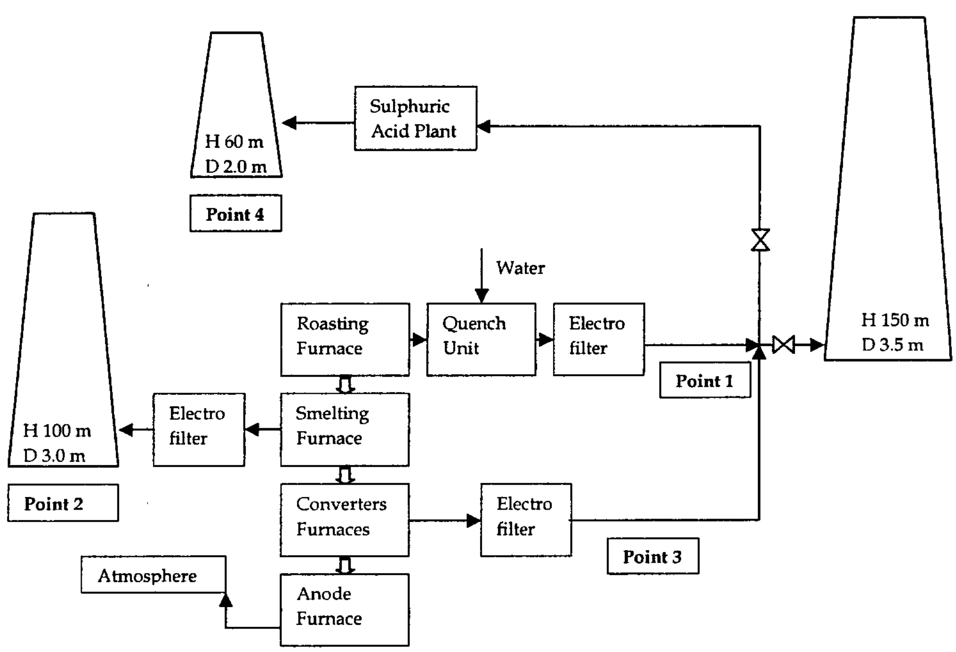
Air emissions generated from the smelting process are:

- roasting furnace fluidised off-gas containing particulate, heavy metals oxides/sulphates and sulphur dioxide;
- smelting furnaces off-gas containing particulate, heavy metals oxides/sulphates and sulphur dioxide;
- converter furnaces off-gas containing particulate, heavy metals oxides/sulphates and sulphur dioxide;
- sulphuric acid plants tail gas containing 0,12%SO_2 plus 40-60 mg SO_3/Nm^3;
- anode furnace off-gas containing products of oil combustion and particulate matter;
- fugitive emissions from furnace operations, slags, metal and matte handling containing heavy metals, particulate and sulphur dioxide;
- wind blown particulate from external storage areas and dirty roads;
- emissions from the thermal power plant.

Smelter and Sulphuric Acid Plant

Figure 5.1 shows a block scheme of the smelting process, with the identification of main air emission points.

Figure 5.1 ***Block Scheme of the Smelting Process***



The emissions from the roasting furnace (only one of the two existing is operating) pass first through a quenching unit using water, then through the electro filter; after such treatments (point n. 1 of emission, as indicated in the Figure) they are sent to the sulphuric acid plant. If the flow rate is higher than the maximum treatable in the plant, the exceeding part is sent to a stack 150 m high, with a diameter of 3.5m.

The emissions from the smelting furnace are sent, after treatment in the electro filter, to a second stack, which is 100 m high and has a diameter of 3.0m (point n. 2 of emission, as indicated in the Figure).

The converters furnaces (only two of the four existing are operative) produce gas which is sent first to an electro filter and then to the sulphuric acid plant, or to stack 150 m high if the sulphuric acid plant is out of service or if the flow rate is higher than the maximum treatable in the plant. The gas is monitored after the electro filter but before the stack (point n. 3 of emission, as indicated in the Figure).

The emissions from the anode furnace discharge directly in the atmosphere since the quantities are moderate, mainly of combustion products (for the combustion they use masut, producing SO_2).

The emissions from the sulphuric acid plant, characterized by high content of SO_2 (0.12% SO_2 gas/Nm^3) and lower content of SO_3 (40-60 mg SO_3/Nm^3), are discharged trough a stack 60 m high, with a diameter of 2.0 m (point n. 4 of emission, as indicated in the Figure).

Reportedly RTB Bor personnel performs daily controls on emissions at the above mentioned 1, 2 and 3 emission points. The following *Table 5.5*, *Table 5.6* and *Table 5.7* show the available results for 2005.

Table 5.5 ***Emission Values of the Flue Gas from the Roasting Furnace (Point n. 1) as Monthly Average (2005)***

Month	Gas composition (%)			T	Flow rate		Particulate content
	SO_2	CO_2	O_2	°C	m/s	Nm^3/h	g/Nm^3
October	9.95	0.2	5.80	307	9.53	31314	0.0388
November	8.65	0.2	6.85	297	8.52	31970	0.0371
December	7.70	0.2	7.98	292	10.53	39349	0.0380
Average	8.77*	0.2	6.88	299	9.53	34211	0.0380

*A percentage of SO_2 in the gas of 8.77% is equivalent to 250.57 g/m^3

Table 5.6 ***Emission Values of the Flue Gas from the Smelting Furnace (Point n. 2) as Monthly Average (2005)***

Month	Gas composition (%)			T	Flow rate		Particulate content
	SO_2	CO_2	O_2	°C	m/s	Nm^3/h	g/Nm^3
January	0.57	5.3	10.9	244	10.01	45,808	1.412
February	-	-	-	-	-	-	-
March	0.71	5.8	11.11	213	-	53,610	3.098
April	0.28	5.8	12.6	215	11.22	54,101	1.005
May	0.77	7.4	13.4	209	11.37	55,552	1.3815
June	0.29	6.77	13.45	221	12.05	57,489	1.1803
July	-	-	-	-	-	-	-
August	0.96	9	9.9	204	12.9	64,461	0.951
September	-	-	-	-	-	-	-
October	0.43	5.6	13.3	155	11.11	61,441	0.3136
Novembre	0.75	5.3	11.9	168	9.59	52,039	0.8539
December	0.45	4.8	13.4	204	10.54	51,816	0.9280
Average	0.58*	6.20	12.22	204	9.86	55,146	1.2359

*A percentage of SO_2 in the gas of 0.58% is equivalent to 16.57 g/m^3

Table 5.7 ***Emission Values of the Flue Gas from the Converters Furnaces (Point n. 3) as Monthly Average (2005)***

Month	SO_2 in gas %	T °C	Flow rate Nm^3/h	Particulate content g/Nm^3
January	7.53	186	97,989	0.5175
February	4.32	171	103,833	-
March	3.77	164	108,303	0.436
April	6.03	172	98,978	-
May	4.97	176	111,537	0.5055
June	3.92	178	104,926	-
July	5.59	185	108,811	-
August	5.93	286	63,018	1.2035
September	-	-	-	-
October	7.71	307	58,725	-
November	6.51	257	80,395	0.2109
December	5.48	251	85,440	0.2545
Average	5.61*	212	92,905	0.5213

*A percentage of SO_2 in the gas of 5.61% is equivalent to 160.28 g/m^3

No details on how the values presented in the above Tables have been estimated are available; the results have not been validated, therefore they have no legal effectiveness. Nevertheless, the previous tables show values of SO_2 and particulate concentration, directly discharged to atmosphere, that widely exceed both Serbian standards and World Bank emission limits.

If we consider that presently the sulphuric acid plant is practically out of service because all the acid tanks are full and there is no market for the produced acid, it is easy to deduce that also the large quantity of SO_2 and particulate which should be processed in the acid recovery plant are directly discharged to the atmosphere.

As pointed out in the "Local Environmental Action Plan, Municipality Bor" the smelting plant is in fact the major sulphur dioxide source. Sulphur dioxide emissions depend on the quantity of processed copper concentrate and on the production in the sulphuric acid plants, which take part of the waste gases from the smelting plant and process it into sulphuric acid. From 1991 to 2001, each year were emitted over 200,000 tons of SO_2. Particulate with high content of arsenic and heavy metals (zinc, lead, etc.) was emitted from the smelting plant at a rate of 2.25 kg of particulate per ton of processed raw materials.

Annual mass emissions of sulphur, as sulphur dioxide, from TIR are now significantly less than in the second half of the 1990s; this is partly due to a significant reduction in concentrate throughput in the period 2000-2005 and partly due to improved recovery to sulphuric acid. Nevertheless, the recovery of sulphur (53.5% in 2004) is very low if compared to modern copper smelting standards, which aim for over 95% recovery of sulphur. TIR's existing smelting technology has several major disadvantages, preventing any significant improvement in the recovery of sulphur and/or reduction of sulphur dioxide emissions.

As previously pointed out, the sulphuric acid plant, at present, finds difficulties in operating due to the fact that acid production finds low market demand; therefore, the flue gas from the converters furnaces and from the roasting furnace goes directly to the emission point n.1.

Moreover, the average values of particulate content in the flue gas both from the smelting furnace and from the converters furnaces (see Table 5.6 and Table 5.7) are very high if compared to a standard of 50 mg/Nm^3, meaning that the electro filters don't work as they should.

On the contrary the two electrostatic precipitators serving the roasting furnace have been renovated and operate with a typical particulate capture efficiency of 99% and exit gas containing less than 0.05 g/Nm^3 particulate. The remaining particulate plus volatile metals are captured in the gas washing section of the sulphuric acid plant.

Instead, exhaust gases from the electrostatic precipitators of the converters and smelting furnaces contain higher values of particulate, as well as volatile metals such as arsenic, lead, cadmium, mercury, selenium and fluorides. In a modern smelter these would be removed in the gas washing and cooling section of the sulphuric acid plant; at TIR they are very often discharged to atmosphere.

Other Emissions

Other emissions are the following:

- from the steam production plant (of the power plant), which has a stack 40 m high, with a diameter of 2.5 m;
- from the heating plant (which does not belong to RTB Bor), which has a stack 100 m high;

- from the gold factory (infrequent emissions), which has a stack 12 m high, with a diameter of 0.3 m.

The basic activity of the power plant is to produce thermal energy, which is used for heating and preparation of sanitary waters in RTB Bor. The secondary role is to purchase and distribute electricity from the system of Electro Power Industry of Serbia, produce its own electricity in smaller quantities, produce non-mineralized and softened water for boilers and heating systems as well as distribute industrial waters. Heat is produced by steam boilers n. 5, 6 and 7 and partly by the recovery boiler of the smelter.

The fuel that is used in the power plant is coal. Usually, there are two coal fractions (0 - 30 mm; 15 - 30 mm) that are used on regular basis and the third one (30 - 60 mm) that is used occasionally.

Table 5.8 shows the emission values of the flue gas on the stack of boiler n. 7 in the power plant, measured on November 18, 2004 and on January 30, 2006.

Table 5.8 ***Emission Values of the Flue Gas on the Stack of Boiler 7 in Power Plant***

Date	Gas composition (%)			T	Flow rate		Particulate content	
	SO_2	CO_2	O_2	°C	m/s	Nm^3/h	g/Nm^3	kg/h
18/11/04	0.024*	6.93	7.93	99	4.92	61472	0.1260	7.751
30/01/06	0.033**	6.87	8.07	139	4.96	56149	0.0703	3.952

*A percentage of SO_2 in the gas of 0.024% is equivalent to 0.69 g/m³

**A percentage of SO_2 in the gas of 0.033% is equivalent to 0.94 g/m³

The Table shows values of SO_2 and particulate in the flue gas below Serbian air emissions limits for power plants below 50 MW_t (respectively 2,000 mg/Nm³ and 150 mg/Nm³).

However, emitted values detected in 2004 would have been above EU limits and WB guidelines (100 mg/Nm³), meaning that the cyclones are not adequate and that electro filters would be needed.

Table 5.9 summarises main typical ranges of emissions from TIR as above detailed: Serbian air emissions limits for sulphur dioxide and particulate matter are exceeded by a high margin.

Table 5.9 ***TIR Typical Air Emissions***

Emission source	Typical concentration SO_2 (g/Nm^3)	Typical concentration Particulates (mg/Nm^3)
Roasting furnace off-gas after electrostatic precipitator	220-285*	37-39
Smelting furnaces off-gas after electrostatic precipitator	8-27	300-3000
Converter furnaces off-gas after electrostatic precipitator	108-220*	200-1200
Sulphuric acid plant tail gas	3.4	Negligible
Power plant	0.69-0.94	70-126
Serbian limits	0.5	50

Emission source	Typical concentration	
	SO_2 (g/Nm³)	Particulates (mg/Nm³)

* The emissions from the roasting furnace and from the converters furnaces are sent to the sulphuric acid plant. If the sulphuric acid plant is out of service or if the flow rate is higher than the maximum treatable in the plant, the exceeding part is sent to a stack 150 m high.

5.1.3 *Summary of Environmental Findings with regard to Emissions to Air*

Although incomplete, the available data show that emissions of sulphur dioxide, particulate matter and heavy metals from RTB Bor's smelter complex exceed the existing Serbian limits by a high margin; they also exceed World Bank Guideline standards for emissions from copper smelting.

Emissions from the mines ore crushing plants are not monitored but considering the lack of particulate control equipment at Veliki Krivelj and Bor, these are also likely to exceed Serbian limits for particulate matter.

Based on these data, key environmental issues with regard to emission to air in Bor area are related to:

- the operation of the metallurgy complex RTB-Bor, characterized by obsolete technologies and worn-out equipment and emitting large quantities (above any allowable limit) of sulphur dioxide, heavy metals, particulate and arsenic. Smelters operations influence an area of about 10 km radius around the plant promoting, beside air pollution, soil contamination due to heavy metals, arsenic and other pollutant deposition;
- the emission of polluted particles from tailing ponds, dams and roads endangers villages and agricultural soil both in Bor and Majdenpek areas, leading to limited agricultural production and health treat of people who live there;
- the operation of the power plant and Bor heating plants, both located in the smelter facility, which are obsolete and equipped with flue gas treatment plant not adequate to meet international standards for particulate emissions (even if compliant with Serbian regulatory limits).

These air pollution problems are well known and urgent measures to reduce current significant impact have been included in the Local Environmental Action Plan (LEAP) of Bor Municipality, which suggests the following activities to reduce pollution:

- reduction of the emissions of sulphur dioxide and arsenic from metallurgy complex by the reconstruction of the flue gas treatment systems (flue gas pipeline, electro filters repairing, reconstruction of the sulphuric acid plant). According to the LEAP, these activities should be accompanied by establishing better coordination between smelting plants and sulphuric acid factories, in order to better coordinate technological parameters with the working process. Part of these measures have been already initiated with the reconstruction of the damaged flue gas pipeline and with a better coordination of technological parameters of the smelter and the sulphuric acid plant, which led to increase the degree of utilization of sulphur dioxide, thus reducing the emissions of sulphur dioxide;

- installation of waste gases purification systems for the gold factory;
- reduction of particulate emissions, achievable by the recultivation of abandoned open pit mines, ore dump disposal sites, tailing ponds and pyrite disposal site;
- reduction of air pollution from power plants. This can be done through installation of electrofilters rather than currently installed cyclones.

All the above measure are nevertheless related to the economics of the privatization process. It is ERM opinion that the obsolete technology of the plant and the deteriorated present condition of the metallurgical complex and the power plant do not allow a restoration process capable of producing air emission in compliance with the international standards.

In addition, the technical study undertaken by SNC Lavalin confirms discharge of emissions to air non in compliance with Serbian regulatory standards due to high concentrations of sulphur dioxide. In order to reduce environmental impact deriving from the smelter and gradually achieve environmental compliance of emitted flue gases, a modernisation plan for the smelter was prepared by SNC Lavalin. This modernisation plan would be developed through two main components: a first step would consist of improvement of the converter gas handling system and of the acid plant n.2 in order to enable all the flue gases frothe converter to be treated together with the roaster plant. The second component would require replacement of the reverberatory furnace with an electric smelting which would offer a relatively low cost alternative involving minimal change to current operations and satisfying Best Available Tecniques criteria. The modernisation plan would also include refurbishment of acid plant n.3, currently out of operation, which would be available to treat wastewater effluents from the smelter characterised by high content of metals (including As) and acidic pH (namely the acid plant weak bleed and the refinery bleed liquor (see also *section 5.3*).

The suggested measures to achieve compliance with Serbian regukatory standards with regard to air emissions are presented in the following.
General

There is no integral air quality monitoring system in Bor District: it is very important to set up such a system, in compliance with the law and with national regulations; **an emission monitoring system should be introduced by Mining and Smelting Company Bor and the capacities for air quality monitoring should be set up. See for details and cost estimates *Section 6.2.***

RBB BOR

Regarding the RBB Copper Mines Bor:

1. **particulate emissions have to be eliminated.** This goal has to be obtained in case of mines decommissioning and in case of continuing production; in both cases **tailing ponds at Bor and Veliki Krivelj have to be vegetated to reduce wind blown particulate.** (see for details and cost estimate Annex D - Tailing Ponds);
2. **in case of production continuing, all the ore crushing plants at Bor and Veliki Krivelj should be fitted with ventilation systems and particulate control equipment to minimise wind blown particulate** for a cost ranging around € 5 millions (estimate provided by IMC Due Diligence).

RBM Majdanpek

Regarding the RBM Majdanpek Mine:

1. **particulate emissions have to be eliminated.** This goal has to be obtained in case of mine decommissioning and in case of continuing production; in both cases **restoration and vegetation of the tailings and waste rock storage facilities is necessary**. (see for details and cost estimate Annex D - Tailing Ponds);
2. **all the ore crushing plants at Majdanpek should be fitted with ventilation systems and particulate control equipment to minimise wind blown particulate** for a cost ranging around € 1-2.5 millions.

TIR Bor (Smelter and Refinery)

Smelter emissions have to be reduced or annulled to bring air quality in the area to acceptable international standards. This can be obtained via the following recommended actions:

1. **option 1 - replacing the old units with new ones constructed with modern technology.** An indicative cost for this replacement is estimated by IMC Due Diligence study to be **around 250-300 millions euros; option 2 - modernisation plan for the Smelter described by SNC Lavallin** should be implemented including Converter Gas Handling Component and Main Modernisation Plan (Base Case) - estimated cost is around 63 millions euros (estimate provided by SNC Lavalin).
2. **Need for installation of electro filters to comply with international standards.**

5.2 *WATER SUPPLY*

A comprehensive review of Serbian Legislation concerning water supply is reported in *Annex C*, together with relevant EU regulation and WB standards.

In particular, *Table 5.10* presents quality standards for the most common substances that can be found in drinking water as defined by the Serbian legislation (Off. Jour. Of FRY, no. 42/98, 44/99).

Table 5.10 ***Quality of Water intended for Human Consumption (mg/l)***

Parameter	Serbian Legislation (1)
Arsenic	0.01
Cadmium	0.003
Chromium	0.05
Copper	2
Cyanide	0.05
Lead	0.01
Mercury	0.001
Nickel	0.02
Selenium	0.01
Zinc	3
PCB	0.0005

(1) Off. Jour. Of FRY, no. 42/98, 44/99

5.2.1 Water Uses, Consumption, Monitoring Data and Compliance Status

RBB Bor

Water is used at the site for industrial uses and for drinking purposes.

Industrial water needs are limited to crushing unit and flotation plant make up reintegration and for machinery and equipment washing purposes. This water is supplied from Borska Lake, an artificial lake built on Brestovac River for mining and metallurgy supply, northwest of the town. Additional waters are taken from underground springs when needed [1].

Currently, process waters for crushing and flotation plants are taken from recycled water from tailings ponds. Water for flotation purposes is also supplied by the Cerovo's open mine water, which is pumped through a steel-made pipeline from the ecological basin to the floatation plant in Bor (see the following section related to Cerovo for details).

Reportedly, total consumption of industrial water for Bor Mining Complex and TIR is about 12,000 m^3/day. No water pre-treatment is undertaken at the site.

Drinking water is supplied to the site from the municipal network Bogovina which abstracts water from the following sources:

- Water wells located about 20 km to the south-west of the site;
- Karst surface springs located at Zlot (10 km to the west of Bor), Kriveljska (about 5 km to the north of Bor) and Surdup (3-5 km to the east of Bor).

No water wells are reportedly located at the site none were noticed during the site visits.

(1) Local Environmental Action Plan, Municipality Bor, 2003

Veliki Krivelj

Water supply for Veliki Krivelj is needed for industrial and potable purposes.

Industrial water, for wet crushing unit and flotation plants, is supplied from recycling water from the tailings ponds. Fresh water is supplied from the Kriveliska River, when needed.

Reportedly, total consumption of water for Veliki Krivelj is about 8,000 m^3/day. No water pre-treatment is undertaken at the site.

Cerovo

No water supply is related to Cerovo since it is not operated.

RBM Majdanpek

Water supply for the production process is currently obtained from the tailings pond Valja Fundata, through recycling of waters from the top of the pond after settling. Due to the reduced volume of production, the water intake structure "Debeli Lug" at the Veliki Pek River is currently out of operation. Reportedly, flow-rate for flotation process was approximately 150 l/s, while for the wet crushing was about 20-30 l/s.

The site has a water intake permit from the Veliki Pek River at the water catchments "Debeli Lug" issued by Ministry of Agriculture, Forestry and Water Management, with validity period until 30th October 2010.

Drinking water is obtained from the municipal water supply system.

TIR Bor (smelter)

Water is used at the site for the following purposes:

- Cooling for the blasting furnace;
- Make-up of Cooling Towers and boilers of the Power Plant;
- Services purposes
- Drinking purposes.

Details on water consumption for each plant of the TIR are reported in the following *Table*.

Table 5.11 Water Consumption from TIR Plants (January - June 2005)

Facility	Cooling Water m^3	Non-mineralised Water m^3	Non-carbonised Water m^3	Potable Water m^3
Smelter	43,440	58,486		101,647
Electrolysis	74,879	1,483		7,857
Power plant and waterworks	181,000	2,271	90,474	4,513
Sulphuric acid plant	106,706			15,816

Facility	Cooling Water m³	Non-mineralised Water m³	Non-carbonised Water m³	Potable Water m³
Transport	293			3,410
TOTAL	406,318	62,240	90,474	133,243

Source: TIR

Industrial waters are supplied from Borska Lake, and from underground springs, when needed.

This water undergoes chemical treatment in a treatment section at the Power Plant station, for the production of de-mineralised and softened waters for boilers and heating systems.

Drinking water is supplied to the site from the municipal network Bogovina.

No water wells are reportedly located at the site none were noticed during the site visits.

5.2.2 *Summary of Environmental Findings with regard to Water Supply*

Main significant environmental finding with regard to water supply is related to the scarce use of recycled industrial / domestic water. Fresh water consumption is therefore high if compared with other similar installation.
No significant environmental findings have been identified with regard to water supply.

However, a detailed water balance should be prepared including quantities of water consumed per each activity, source, use and final discharge. Based on this balance, possible water consumption reduction measures should be identified and implemented (reuse, recycle, etc.). A periodical monitoring campaign of water (e.g. on a yearly basis) should be evaluated.

5.3 *WASTEWATER DISCHARGES*

5.3.1 *Legislative Background*

A comprehensive review of Serbian Legislation concerning water supply is reported in *Annex C*, together with relevant EU regulation and WB standards.

In particular, the following *Table 5.12* compares the legislated Serbian effluent standards with EU standards and World Bank guidelines.

Table 5.12 ***Effluents Standards***

Parameter		Serbian Legislation (1)		EU	WB Guidelines			
	Unit	Class I and II	Class III and IV	Legislation	Mining and Milling	Base Metal & Iron Ore Mining	General Guidelines	Copper Smelting

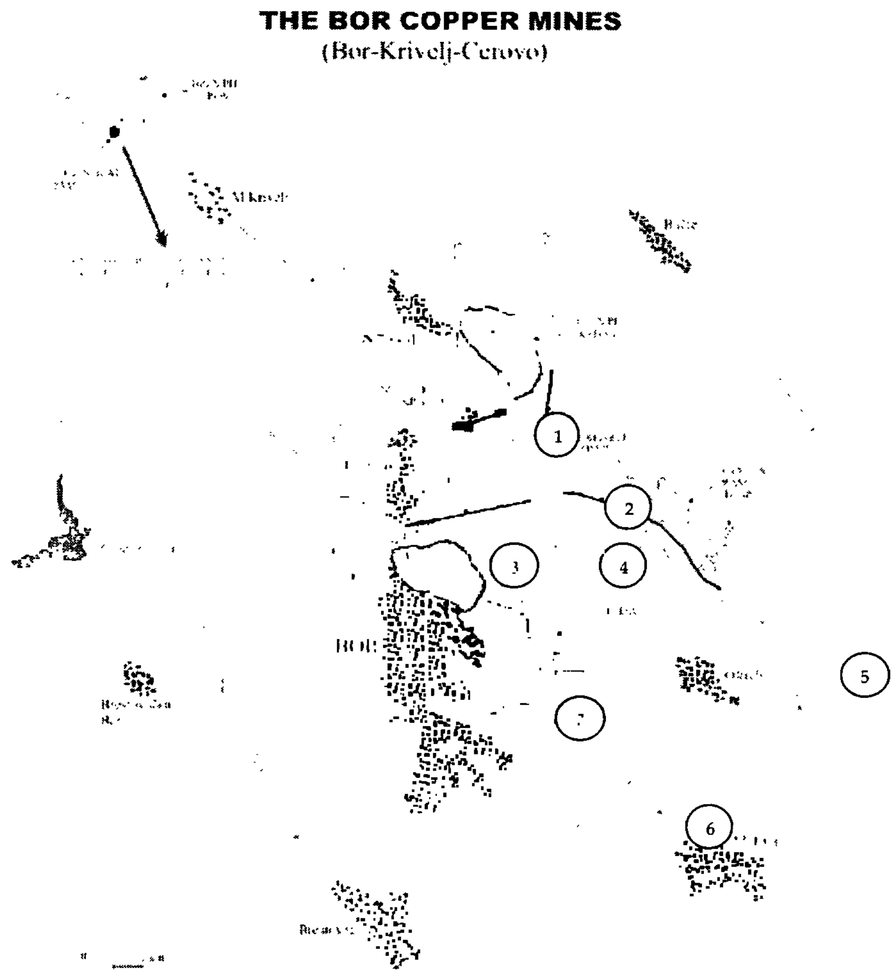
Parameter	Unit	Serbian Legislation (1)		EU	WB Guidelines			
		Class I and II	Class III and IV	Legislation	Mining and Milling	Base Metal & Iron Ore Mining	General Guidelines	Copper Smelting
pH		6,8 ÷ 8,5	6 ÷ 9 (2)			6 ÷ 9		
BOD_5	mgO/l				50			-
COD	mgO/l					150	250	-
Oil and greases	mg/l				20	10	10	-
Total Suspended Solids (TSS)	mg/l	10 Class I 30 Class II	80 (2)			50		
Total Dissolved Solids (TDS)	mg/l							
Heavy metals - Total	mg/l					10		10
Arsenic	mg/l	0.05	0.05		1.0	0.1		0.1
Cadmium	mg/l	0.005	0.01	0.2 (3) (5)		0.1		
Chromium (hexavalent)	mg/l	0.1	0.1		0.05	0.1		-
Chromium Total	mg/l				1.0			
Copper	mg/l	0.1 (0.01)*	0.1		0.3	0.5		0.5
Iron	mg/l	0.3	1.0		2	3.5		3.5
Lead	mg/l	0.05	0.1	(5)	0.6	0.2		0.1
Mercury	mg/l	0.0001	0.0001	0.05 (4) (5)	0.002	0.01		0.01
Nickel	mg/l	0.05	0.1	(5)	0.5	0.5		-
Zinc	mg/l	0.2	1.0		1.0	2		1.0
Cyanide	mg/l	0.1	0.1		1.0			
Free	mg/l				0.1			
WAD	mg/l	6.0	10.0		0.5			
Temperature Increase	°C				<5°C** <3°C***			≤ 3°C****

(1) Maximum Allowable Concentrations
* for salmonides
** Max 5° C above ambient temperature of receiving waters
*** Max 3° C if receiving waters >28°
**** The effluent should result in a temperature increase of no more than 3° C at the edge of the zone where initial mixing and dilution take place. Where the zone is not defined, use 100 meters from the point of discharge.
(2) the limit value is not defined for Class IV waters
(3) Directive 83/513/EEC. Limit value applicable since 01/01/1989 to the industrial sector "extraction of zinc, refining of lead and zinc, industry of non-ferrous metals and of metallic cadmium". Average monthly concentration of total cadmium,
(4) Directive 84/156/EEC. Limit value applicable since 01/01/1989 to the industrial sector "extraction and refining of non-ferrous metals".
(5) Included in the Priority Substances list of the Decision 2455/2001/EC. According to art. 16 specific measures shall be adopted by the EC for the progressive reduction and the cessation or phasing out of discharges, emissions and losses.

5.3.2 *Effluents Generated, Monitoring Data and Compliance Status*

A schematic diagram of different streams originated at the Bor complex (including mining and the smelter), as detailed in the following paragraphs, is reported in the following *Figure 5.2*.

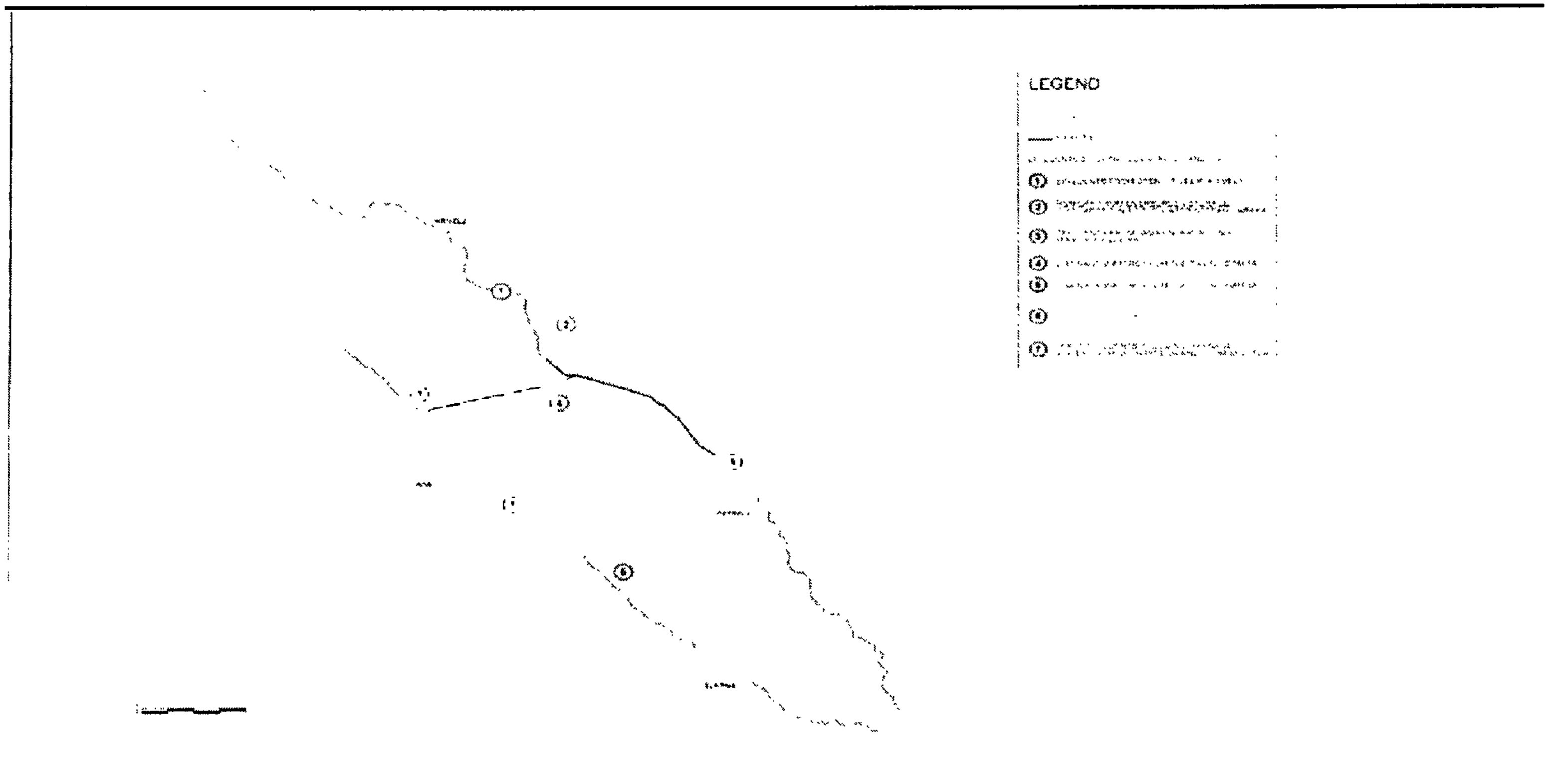
Figure 5.2 ***Wastewater Effluents Generated in the RBB and TIR Complex***



1: Wastewater from the bottom of open pit Veliki Krivelj discharged into the Kriveliska River
2: Run-off from historical overburden storage discharged in to the water stream Saraka
3: Effluents from Jama underground mine (blue water) occasionally discharged into the Kriveliska River
4: Drainage waters from the tailing dam 1A discharged into the Kriveliska River
5. Drainage waters from the tailing dam 3A discharged into the Kriveliska River
6. Wastewater from lake Robule, collecting stormwater runoff from overburden disposal sites
7. Mixed effluents including stormwater from open pit Bor (closed in 1992) and from copper smelting and refinery plants.

An indicative representation of location of effluents generated and final receptors for RBB and TIR is reported in the following Figure:

Figure 5.3 Location of Effluents Generated and Final Receptors at Bor



RBB Bor

In the present paragraph are described the effluents generated by mining activities and preliminary processing of ore (crushing, milling and flotation) at Bor, Veliki Krivelj and Cerovo, discharged in surface watercourses (refer to number 1-6 and partially 7 of the above mentioned figure).

Main effluents generated from the Bor mining complex are listed in the following *Table*.

Table 5.13 ***Wastewaters from Bor Mining Complex***

Type	Quantity	Pre-treatment	Sampling	Final Discharge
Effluents from the Jama underground mine (blue water)	250 m^3/h	partially	yes	V.K. tailing pond 2
Water from the open pit Bor	100 m^3/h	no	yes	Borska Reka
Runoff from overburden disposal sites	n.a.	no	no	Bor open pit (then Borska Reka)
Water drained from the tailing ponds dams	n.a.	no	No	Accumulation basin (then Borska Reka)

Details on wastewaters streams are reported in the following paragraphs.

Jama Waste Waters

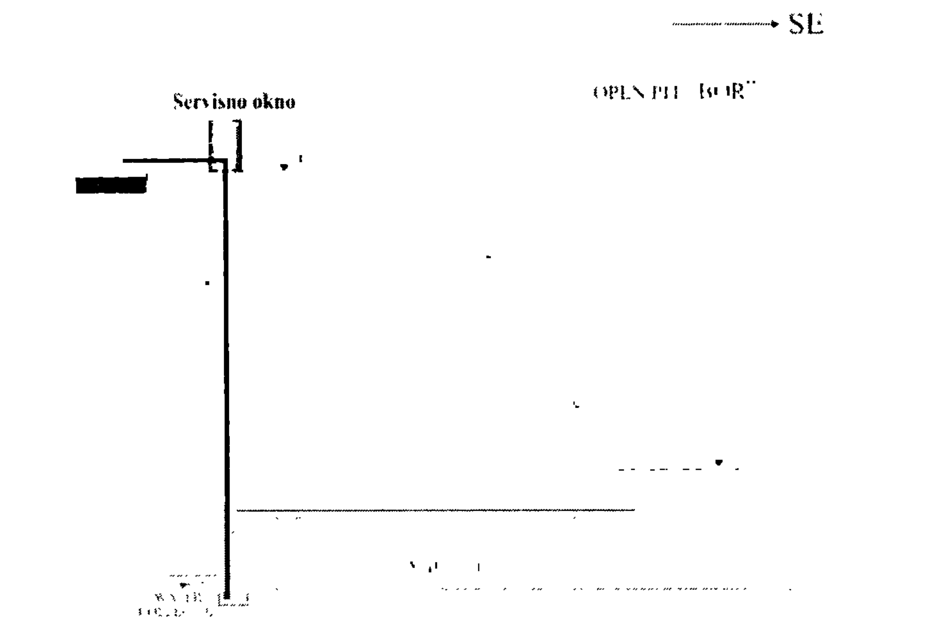
Wastewaters from the Jama underground mine are composed of: 1) waste waters from the crushing process; and 2) water from infiltration to the underground mine which are pumped out to avoid mine flooding (blue water).

Wastewaters from the crushing process are recycled back to the process and are therefore not discharged.

Blue water from Jama (**point 3** of the *Figure 5.2*) - characterized by a pH of about 3 - too low for directly being used for flotation - was in the past treated into a cementation plant for pre-treating the water before being dispersed to the tailings dams for further recycling to the flotation plant. Reportedly, the wastewaters were pumped out through a collector "Servisno okno" (see *Figure* 5.4 below), and after pre-treating discharged to the tailing pond 2 of Veliki Krivelj, at an average flow-rate of 250 m^3/h. The pre-treating system, through addition of iron, allowed water pH rise to 4-5. All the water was therefore recycled to the flotation plant. The system was put out of service in 2004.

Currently, waters from infiltration into the underground mine are pumped out through the collector "Servisno okno" and collected into a temporary storage pond (20,000 m³ capacity). A flow rate of 50 m³/h is abstracted from this basin, pumped and treated in a newly installed (reportedly in 2004) plant for copper recovery, designed and installed by AEROAKVA. The treating system, a variation of the traditional cementation plant, consists of adsorption over three ion-exchange columns and precipitation of copper by means of addition of solid iron. After pre-treating, the water is recycled to the accumulation basin. Water from the accumulation basin presumably[1] reaches by means of this treatment a pH of 4-5 and is suitable for being discharged to the tailing pond 2 of Veliki Krivelj and therefore recycled to the flotation plant Veliki Krivelj.

Figure 5.4 *Jama Scheme*



Reportedly, when the pumping system is out of function (as it was during one of the site visits undertaken), the effluents are directly discharged into the Borska Reka Deviation and finally conveyed to the Veliki Krivelj river.

Wastewater monitoring is performed by 1 Maj – Institute for Protection of Working Environment and Environment, of Nis. Analytical results of monitoring of the different effluents generated at the site complex are reported in the next paragraphs under each section. Additional characterisation of quality of effluents is provided by means of the report "Industrial Wastewaters treatment technologies" prepared on behalf of the EU in the frame of the INTREAT Project (report provided by RTB Bor representatives).

(1) [1] no monitoring of water discharged to the tailing pond is available.

Analytical results of wastewaters from the Jama underground are summarized in the following *Table*. The analytical results are prudentially compared to the threshold limit values for Class III/IV surface waters as defined by the Serbian Legislation for the Veliki Krivelj River since wastewaters are occasionally conveyed to the Bor River diversion subsequently discharging into the Veliki Krivelj River (see *section 2.5* for the surface water bodies classification).

Table 5.14 ***Analytical Results of Wastewaters from Jama Mine - August 2005 (Source 1 Maj - Institute for Protection of Working Environment and Environment, of Nis - provided by RTB Bor)***

Parameters	Unit	Sample from Jama Mine	Threshold Limit Value (class III/IV)
Water temperature	°C	25/19	n.a.
Water colour	n.a.	Light yellow	n.a.
Water smell	n.a.	No	n.a.
Floating matter	/	No	No
pH	/	2.7	6-9
Sedimentation for 2h	ml/l	2.1	n.a.
Total Suspended Solids (TSS)	mg/l	217	80
Total Dissolved Solids (TDS)	mg/l	955	n.a.
$KMnO_4$ Consumption	mg/l	14.2	n.a.
BOD_5	mg O_2/l	21.8	n.a.
COD (COD from $K_2Cr_2O_7$)	mg O_2/l	106	n.a.
Nitrates (as N)	mg/l	3.19	n.a.
Nitrites (as N)	mg/l	0.03	n.a.
Ammonia ion salts (NH_4)	mg/l	1.52	n.a.
Chlorides (Cl)	mg/l	884	n.a.
Sulphates (SO_4)	mg/l	490	n.a.
Sulphites (SO_3)	mg/l	n.d.	n.a.
Sulphides (S)	mg/l	n.d.	n.a.
Cyanides (CN)	mg/l	n.d.	0.1
Phosphates (PO_4)	mg/l	n.d.	n.a.
Phenol	mg/l	n.d.	n.a.
Detergents (ABS)	mg/l	n.d.	n.a.
Oils and lubricants	mg/l	n.d.	n.a.
Iron (Fe)	mg/l	1,596.4	1
Chromium (Cr^{6+}/Cr^{3+})	mg/l	n.d.	0.1/0.5
Copper (Cu)	mg/l	522.6	0.1
Nickel (Ni)	mg/l	0.063	0.1
Arsenic (As)	mg/l	0.214	0.05
Zinc (Zn)	mg/l	54.23	1
Lead (Pb)	mg/l	n.d.	0.1
Dissolved oxygen	mg/l	/	min. 0.5

Although incomplete, the analyses shown in the table indicate that the effluent from the Jama mine is characterized by low value of pH and high concentrations of dissolved heavy metals (copper, iron, arsenic and zinc).
In particular, the pH value of 2.7 is lower than the maximum allowable concentration set by Serbian Legislation and by WB Guidelines, which both define a pH value in the range of 6-9. With regard to heavy metals, the analysis reported a concentration of copper of 522.6 mg/l, which is well above the limit values of 0.1 mg/l and 0.3 mg/l set by Serbian standards and WB Guidelines respectively; a concentration of iron of 1,596.4 mg/l, higher than

the limit values of 1.0 mg/l and 2 mg/l set by Serbian standards and WB Guidelines respectively; concentrations of zinc was of 54.23 mg/l and of arsenic was of 0.214, both higher than the respective limit values (the Serbian standards for zinc is 1.0 mg/l and for arsenic is 0.05 mg/l, while WB gives guidelines values of 1.0 for zinc and 0.1 for arsenic).

No information was available on operation status of the WWTP at the time of sampling neither of rainwater presence in the discharge.
In addition to the above presented monitoring results, chemical characterisation of the effluent included in the above mentioned report Industrial Wastewaters treatment technologies, highlights copper content up to 300 mg/l, iron up to 1,800 mg/l, zinc up to 287 mg/l and arsenic up to 1.2 mg/l.

As long as Jama underground mine will be active and in any case should the Borska Reka resources initiate to be exploited, this effluent should be fully treated in an adequate wastewater treatment plant.

Open Pit Bor Waste Waters

Drainage and rainfall waters from the open pit Bor accumulates at the bottom of the pit and infiltrates into the Jama underground mine and is pumped out and conveyed to the accumulation basin of smelter plant effluents for further discharge to the Bor river (**point** 7 of *Figure 5.2)*. Reported flow rate is about 100 m^3/h.

Analytical results of wastewaters from the open pit mine are summarized in the following Table. The analytical results are compared to the threshold limit values for Class III/IV surface waters as defined by the Serbian Legislation for the Bor River (see *section 2.5* for the surface water bodies classification). However, it must be pointed out that wastewaters from open pit Bor are mixed with effluents from the smelter before final discharge to the Bor River.

Table 5.15 ***Wastewaters from Bor Open Pit - August 2005 (Source 1 Maj - Institute for Protection of Working Environment and Environment, of Nis - provided by RTB Bor)***

Parameters	Unit	Open Pit Bor	Threshold Limit Value (class III/IV)
Water temperature	°C	22/19	n.a.
Water colour	/	No	n.a.
Water smell	/	No	n.a.
Floating matter	/	No	No
pH	/	7.7	6-9
Sedimentation for 2h	ml/l	0.5	n.a.
Total Suspended Solids (TSS)	**mg/l**	**219**	**80**
Total Dissolved Solids (TDS)	mg/l	774	n.a.
$KMnO_4$ Consumption	mg/l	19.0	n.a.
BOD_5	mg O_2/l	17.5	n.a.
COD (COD from $K_2Cr_2O_7$)	mg O_2/l	91	n.a.
Nitrates (as N)	mg/l	0.09	n.a.
Nitrites (as N)	mg/l	0.22	n.a.

Parameters	Unit	Open Pit Bor	Threshold Limit Value (class III/IV)
Ammonia ion salts (NH_4)	mg/l	1.16	n.a.
Chlorides (Cl)	mg/l	24.8	n.a.
Sulphates (SO_4)	mg/l	30.2	n.a.
Sulphites (SO_3)	mg/l	n.d.	n.a.
Sulphides (S)	mg/l	n.d.	n.a.
Cyanides (CN)	mg/l	n.d.	0.1
Phosphates (PO_4)	mg/l	0.94	n.a.
Phenol	mg/l	n.d.	n.a.
Detergents (ABS)	mg/l	n.d.	n.a.
Oils and lubricants	mg/l	2.53	n.a.
Iron (Fe)	mg/l	0.056	1
Chromium (Cr^{6+}/Cr^{3+})	mg/l	n.d.	0.1/0.5
Copper (Cu)	mg/l	n.d.	0.1
Nickel (Ni)	mg/l	n.d.	0.1
Cadmium (Cd)	mg/l	n.d.	0.05
Zinc (Zn)	mg/l	0.080	1
Lead (Pb)	mg/l	n.d.	0.1
Dissolved oxygen	mg/l	n.d.	min. 0.5

The analyses show that the water from the open mine is not acidic and that the concentrations of the most relevant parameters (except for Total suspended solids, with a concentration of 219 mg/l against a limit of 80 mg/l) are in compliance with the standards. However, it should be noted that no arsenic monitoring is undertaken. Additional parameters to be monitored would include nickel, lead, manganese, cadmium.

Run Off Water

Run off waters are collected at the site at the following locations:
Robule lake (from overburden heaps located in the south-eastern area of the open pit Bor) **point 6** of the *Figure 5.2* - average estimated flow rate based on the last five years data is about 500 m^3/d. As reported by RTB Bor management, water level in the lake is quite constant which indicates that there must be some water recharge (e.g. groundwater or springs).

No monitoring is undertaken on this effluent by the 1 Maj – Institute for Protection of Working Environment and Environment, of Nis. As reported in the report Industrial Wastewaters treatment technologies, the effluent is characterised by the composition reported in then following table. The analytical results are compared to the threshold limit values for Class III/IV surface waters as defined by the Serbian Legislation for the Bor River (see *section 2.5* for the surface water bodies classification).

Table 5.16 ***Stormwater collected into the Robule lake – February 2005 (Source: Report Industrial Wastewaters treatment technologies, provided by RTB Bor)***

Parameters	Unit	Robule lake - point 6	Threshold Limit Value (class III/IV)
Water temperature	°C	6/8	n.a.
Water colour	/	Yes	n.a.
Water smell	/	No	n.a.
Floating matter	/	No	No

Parameters	Unit	Robule lake - point 6	Threshold Limit Value (class III/IV)
pH	**/**	**2.97**	**6-9**
Sedimentation for 2h	ml/l	n.d.	2
Total Suspended Solids (TSS)	**ml/l**	**199.6**	**80**
Total Dissolved Solids (TDS)	ml/l	20,040	n.a.
$KMnO_4$ Consumption	ml/l	16.1	n.a.
BOD 5	mg O_2/l	4.63	n.a.
COD (COD from $K_2Cr_2O_7$)	mg O_2/l	4.02	n.a.
Nitrates (as N)	mg/l	6.33	n.a.
Nitrites (as N)	mg/l	0.004	n.a.
Ammonia ion salts (NH_4)	mg/l	n.d.	n.a.
Chlorides (Cl)	mg/l	42	n.a.
Sulphates (SO_4)	mg/l	4,145.45	n.a.
Phosphates (PO_4)	mg/l	0.05	n.a.
Detergents (ABS)	mg/l	0.06	n.a.
Iron (Fe)	**mg/l**	**895**	**1.0**
Chromium (Cr^{6+}/Cr^{3+})	mg/l	0.002	n.a.
Copper (Cu)	**mg/l**	**55.16**	**0.1**
Nickel (Ni)	**mg/l**	**0.322**	**0.1**
Arsenic (As)	mg/l	0.001	0.05
Cadmium (Cd)	**mg/l**	**0.034**	**0.01**
Zinc (Zn)	**mg/l**	**26.5**	**1.0**
Lead (Pb)	mg/l	0.01	0.1
Manganese (Mn)	mg/l	125	n.a.
Dissolved oxygen	mg/l	11.92	n.a.

The analyses shown in the above reported table indicate that the effluent from the Robule lake is characterized by very low value of pH and high concentrations of dissolved heavy metals (copper, iron, nickel, cadmium and zinc).

In particular, the pH value of 2.7 is lower than the maximum allowable concentration set by Serbian Legislation and by WB Guidelines, which both define a pH value in the range of 6.5-8.5. With regard to heavy metals, the analysis reported a concentration of copper of 55.16 mg/l, which is well above the limit values of 0.1 mg/l and 0.3 mg/l set by Serbian standards and WB Guidelines respectively; a concentration of iron of 895 mg/l, higher than the limit values of 0.3 mg/l and 2 mg/l set by Serbian standards and WB Guidelines respectively; a concentration of zinc of 26.5 mg/l, higher than the limit values of 0.2 mg/l and 1 mg/l set by Serbian standards and WB Guidelines respectively; concentrations of cadmium was 0.034 mg/l and of nickel was of 0.322, both higher than the respective limit values (the Serbian standards for cadmium is 0.005 mg/l and for nickel is 0.05 mg/l, while WB gives guidelines values of 0.5 for nickel).

No pre-treatment is undertaken at the moment on this effluent, which is directly discharged into the Bor river. In the past, a cementation plant for copper recovery from leaching of waste heaps was installed. The process consisted of sulpuhric acid solution spray over the heaps, collection of leachate, addition of de-tinned iron and separation of copper. Water was then discharged in the Bor river. The cementation plant was dismantled at the beginning of 1990s.

On the other side of the hill, to the north east of the Robule lake, is present another small lake called Ostrelj lake. No information was available with regard to this lake (water quality, water inlets and outlets and final destination of eventual outlets, etc.).

Other run-off waters from the overburden disposal areas present in the Mining Complex and around the old open pit of Bor are not collected.
As it is recommended by WB Guidelines, leachates from waste heaps have to be collected in order to avoid contact with and contamination of surface water and groundwater. No information is available at this stage on chemical composition of this water. Based on the general characteristics of the ores, it can be assumed that these waters might be contaminated by heavy metals, arsenic, pyrites and sulphides contained in the ore itself.

As long as leachates from waste heaps will be generated, this effluent should be fully treated in an adequate cementation plant. In the long-term, waste heaps capping and remediation of the Robule lake should be addressed.

Drains from Tailing Pond Dams

Waters drained from the dams of the tailing pond RTH are currently conveyed to the sewage collector conveying surface and municipal wastewaters from the Bor Municipality.

The collector, in which are discharged effluents from the Bor Municipality (branch A and branch C), from the smelter (branch B) and from the drainage of dams/tailings (branch Y), passes under the Bor tailings field and is finally discharged to Borska stream. Based on available documentation, the collector dates back to 1930 and was subject to further refurbishment/enlargement. Due to stresses and corrosion from acidic tailings above, the collector has been damaged and leaking the last 20 years. The leakages led to tailings being spread over large land areas around the Bor and Timok Rivers.

The collector status is analysed in detail in *Annex D* (Tailing Ponds).

The waters are discharged without any treatment. No information is available on the water quantity and chemical characteristics.

Wastewaters from Veliki Krivelj

Main effluents generated from the Veliki Krivelj mining complex are listed in *Table* below.

Table 5.17 ***Wastewaters from Veliki Krivelj Mining Complex***

Type	Quantity (m^3/h) *	Pre-treatment	Sampling	Final Discharge
Discharge of mine drainage water	100	No	Yes	Kriveliska River

Type	Quantity (m^3/h) *	Pre-treatment	Sampling	Final Discharge
Run-off water from historical overburden	n.a.	No	Yes	Saraka Creek
Wastewaters from flotation process	360	No	Yes	recycled to the flotation plant
Under drain water from the tailings dam 1A	80	No		Kriveliska River (before the collector)
Under drain water from the tailings dam 3A	120	No	Yes	Kriveliska River (after the collector)

** flow rates estimate provided by RTB Bor*

Details on wastewaters streams are reported in the followings.

Mine Drainage Water

Rainfall and drainage waters accumulated on the bottom of the pit are pumped out and discharged without any treatment to the Kriveliska River (see **point 1** of the *Figure* 5.2).

Based on information available, flow rate of this effluent is approximately 100 m^3/h. As observed during the site visit, water was present at the bottom of the pit. Based on the characteristics of the mineral ores, these waters should be highly acidic and might contain high concentrations of dissolved heavy metals and this is confirmed by analytical results presented below.

Wastewaters monitoring is reportedly performed by 1 Maj – Institute for Protection of Working Environment and Environment, of Nis, but this monitoring result was not available.

As reported in the above mentioned report Industrial Wastewaters treatment technologies, the effluent is characterised by the composition reported in the following table. The analytical results are compared to the threshold limit for Class III/IV surface waters as defined by the Serbian Legislation for the Veliki Krivelj River (see *section* 2.5 for the surface water bodies classification).

Table 5.18 ***Wastewaters from Veliki Krivelj Open Pit – June 2004 (Source: Report Industrial Wastewaters treatment technologies, provided by RTB Bor)***

Parameters	Unit	Veliki Krivelj Open Pit	Threshold Limit Value (Class III/IV)
Water temperature	°C	26,5/22	n.a.
Water colour	/	Yes	n.a.
Water smell	/	No	n.a.
Floating matter	/	No	No
pH	**/**	**4.4**	**6-9**
Sedimentation for 2h	ml/l	1	n.a.
Total suspended solids (TSS)	**ml/l**	**218**	**80**
Total dissolved solids (TDS)	ml/l	560	n.a.
$KMnO_4$ Consumption	ml/l	52.3	n.a.
BOD_5	mg O_2/l	27.7	n.a.

Parameters	Unit	Veliki Krivelj Open Pit	Threshold Limit Value (Class III/IV)
COD (COD from $K_2Cr_2O_7$)	mg O_2/l	-	n.a.
Nitrates (as N)	mg/l	0.42	n.a.
Nitrites (as N)	mg/l	-	n.a.
Ammonia ion salts (NH_4)	mg/l	-	n.a.
Chlorides (Cl)	mg/l	150.8	n.a.
Sulphates (SO_4)	mg/l	360	n.a.
Sulphites (SO_3)	mg/l	n.d.	n.a.
Sulphides (S)	mg/l	n.d.	n.a.
Cyanides (CN)	mg/l	n.d.	0.1
Phosphates (PO_4)	mg/l	1.34	n.a.
Phenol	mg/l	n.d.	n.a.
Detergents (ABS)	mg/l	n.d.	n.a.
Oils and lubricants	mg/l	n.d.	n.a.
Iron (Fe)	mg/l	0.38	1
Chromium (Cr^{6+}/Cr^{3+})	mg/l	n.d.	0.1/0.5
Copper (Cu)	**mg/l**	**127.5**	**0.1**
Nickel (Ni)	mg/l	0.076	0.1
Cadmium (Cd)	mg/l	n.d.	0.01
Arsenic	mg/l	n.d.	0.05
Zinc (Zn)	**mg/l**	**3.1**	**1**
Lead (Pb)	mg/l	n.d.	0.1
Dissolved oxygen	mg/l	n.d.	n.a.

The analyses shown in the above reported table indicate that the effluent from the open pit Veliki Krivelj is characterized by very low value of pH and high concentrations of dissolved heavy metals (copper and zinc).
In particular, the pH value of 4.4 is lower than the maximum allowable concentration set by Serbian Legislation and by WB Guidelines, which both define a pH value in the range of 6-9. With regard to heavy metals, the analysis reported a concentration of copper of 127.5 mg/l, which is well above the limit values of 0.1 mg/l and 0.3 mg/l set by Serbian standards and WB Guidelines respectively; a concentration of zinc of 3.1 mg/l higher than the threshold values of 1 mg/l set both by Serbian standards and WB Guidelines.

As long as Veliki Krivelj open pit mine will be active, this effluent should be fully treated in an adequate cementation plant. In the long term, post-closure remediation/revegetation of Veliki Krivelj open mines should be considered.

Run Off Water

Run off waters are collected at the site at the following locations:
Saraka creek (from overburden heaps located in the south-eastern area of the Veliki Krivelj open pit mine) **point 2** as reported in *Figure 5.2* - average estimated flow rate based on the last five years data is about 3,800 m^3/d.

As observed during the site visit, rainfall water from the overburden is drained by natural and artificial canals to the Saraka Creek.

Other run-off waters from the overburden disposal areas present at Veliki Krivelj are not collected. As it is recommended by WB Guidelines, leachates from waste heaps have to be collected in order to avoid contact with and contamination of surface water and groundwater.

Analytical results of runoff waters from the overburden stored to the south-eastern side of Veliki Krivelj open pit mine are summarized in the following *Table*. The analytical results are compared to the threshold limit values for Class III/IV waters as defined by the Serbian Legislation for the Veliki Krivelj River, in which the Saraka River flows (see *paragraph 2.5* for the surface water bodies classification).

Table 5.19 ***Runoff Waters from Veliki Krivelj - September 2005 (Source 1 Maj - Institute for Protection of Working Environment and Environment, of Nis - provided by RTB Bor)***

Parameters	**Unit**	**12**	**Threshold Limit Value (ClassIII/IV)**
Water temperature	°C	17/19	n.a.
Water colour	/	Light green	No
Water smell	/	No	No
Floating matter	/	No	No
pH	**/**	**4.9**	**6 – 9**
Sedimentation for 2h	ml/l	16	n.a.
Total suspended solids (TSS)	**mg/l**	**119**	**80**
Total dissolved solids (TDS)	mg/l	904	n.a.
$KMnO_4$ Consumption	mg/l	34.8	n.a.
BOD 5	mg O_2/l	9.4*	n.a.
COD (COD from $K_2Cr_2O_7$)	mg O_2/l	/	n.a.
Nitrates (as N)	mg/l	1.8	n.a.
Nitrites (as N)	mg/l	0.00	n.a.
Ammonia ion salts (NH_4)	mg/l	0.00	n.a.
Chlorides (Cl)	mg/l	40	n.a.
Sulphates (SO_4)	mg/l	353	n.a.
Sulphites (SO_3)	mg/l	/	n.a.
Sulphides (S)	mg/l	/	n.a.
Cyanides (CN)	mg/l	/	0.1
Phosphates (PO_4)	mg/l	2.9	n.a.
Phenol	mg/l	0.0	n.a.
Detergents (ABS)	mg/l	0.0	n.a.
Oils and lubricants	mg/l	0.0	n.a.
Iron (Fe)	**mg/l**	**3.7**	**1**
Chromium (Cr^{6+}/Cr^{3+})	mg/l	n.d.	0.1/0.5
Copper (Cu)	**mg/l**	**27.55**	**0.1**
Nickel (Ni)	mg/l	0.088	0.1
Cadmium (Cd)	mg/l	n.d.	0.05
Zinc (Zn)	mg/l	0.823	1
Lead (Pb)	mg/l	n.d.	0.1
Dissolved oxygen	mg/l	6.4	min. 4

Analytical results show that the waters are highly contaminated, with a pH value of 4.9 that is lower than the Serbian threshold limit value and the WB guideline value (6-9). High concentrations of copper (27.55 mg/l) and iron (3.7 mg/l) were recorded, which exceed the related limit values (for copper are 0.1 mg/l for Serbia standards and 0.3 mg/l for WB Guidelines, and for iron are 1.0 mg/l for Serbia standards and 2 mg/l for WB Guidelines).

It should be pointed out that no arsenic monitoring was undertaken.

In addition to the above presented monitoring results, chemical characterisation of the effluent included in the above mentioned report Industrial Wastewaters treatment technologies, points out that these effluents are highly acidic and present a high concentration of heavy metals. Monitoring results of sampling conducted between 2000 and 2004, show pH values ranging from 3.6 to 7.74; copper content is detected up to 217 mg/l, iron up to 67 mg/l, zinc up to 2.3 mg/l, cadmium up to 0.017 mg/l, manganese up to 28 mg/l and arsenic up to 0.013 mg/l.
As long as leachates from waste heaps will be generated, this effluent should be fully treated in an adequate cementation plant. In the long-term, waste heaps capping and should be addressed.

Wastewaters from Flotation

Effluents from the flotation unit are reportedly recycled back to the flotation plant, with a flow rate of 360 m^3/h.

Analytical results of effluents from the flotation process are summarized in the following *Table 5.20*. No comparison with threshold limit is provided since these effluent ts are not discharged.

Table 5.20 ***Waste Waters from Flotation - September 2005 (Source 1 Maj - Institute for Protection of Working Environment and Environment, of Nis - provided by RTB Bor)***

Parameters	**Unit**	**Flotation effluents**
Water temperature	°C	18/19
Water colour	/	No
Water smell	/	No
Floating matter	/	No
pH	/	7.3
Sedimentation for 2h	ml/l	0.9
Total suspended solids (TSS)	mg/l	380
Total dissolved solids (TDS)	mg/l	822
$KMnO_4$ Consumption	mg/l	29.4
BOD 5	mg O_2/l	27.1
COD (COD from $K_2Cr_2O_7$)	mg O_2/l	94.5
Nitrates (as N)	mg/l	1.52
Nitrites (as N)	mg/l	n.d.
Ammonia ion salts (NH_4)	mg/l	0.86
Chlorides (Cl)	mg/l	12.0
Sulphates (SO_4)	mg/l	184
Sulphites (SO_3)	mg/l	n.d.
Sulphides (S)	mg/l	n.d.
Cyanides (CN)	mg/l	n.d.
Phosphates (PO_4)	mg/l	0.40
Phenol	mg/l	n.d.
Detergents (ABS)	mg/l	n.d.
Oils and lubricants	mg/l	n.d.
Iron (Fe)	mg/l	0.037

Parameters	Unit	Flotation effluents
Chromium (Cr^{6+}/Cr^{3+})	mg/l	n.d.
Copper (Cu)	mg/l	0.025
Nickel (Ni)	mg/l	n.d.
Cadmium (Cd)	mg/l	n.d.
Zinc (Zn)	mg/l	n.d.
Lead (Pb)	mg/l	n.d.
Dissolved oxygen	mg/l	n.d.

Drainage Water from the Tailings Dams

Drainage waters from the dams 1A and 3A is currently discharged into the Krivelj River before and after the collector respectively (see *Figure 5.2* points 4 and 5). Flow rates are estimated to be respectively 80 m^3/h and 120 m^3/h as reported by RTB Bor management.

Analytical results of drainage water from the dams are summarized in the following *Table*. The analytical results are compared to the threshold limit values for Class III/IV waters as defined by the Serbian Legislation for the Veliki Krivelj River (see *paragraph 2.5* for the surface water bodies classification).

Table 5.21 ***Waste Waters from Under Drain Water from the Tailing Dams of Veliki Krivelj - September 2005 (Source 1 Maj – Institute for Protection of Working Environment and Environment, of Nis – provided by RTB Bor)***

Parameters	Unit	Dam 1A	Dam 3A	Threshold Limit Value (class III/IV)
Water temperature	°C	21/19	15/19	n.a.
Water colour	/	No	No	No
Water smell	/	No	No	No
Floating matter	/	No	No	No
pH	/	6.9	6.3	6-9
Sedimentation for 2h	ml/l	0.8	0.5	n.a.
Total suspended solids (TSS)	**mg/l**	**114**	**93**	**80**
Total dissolved solids (TDS)	mg/l	747	702	n.a.
$KMnO_4$ Consumption	mg/l	19	14.2	n.a.
BOD_5	mg O_2/l	17.6	15.8	n.a.
COD (COD from $K_2Cr_2O_7$)	mg O_2/l	67.8	66.1	n.a.
Nitrates (as N)	mg/l	0.00	0.00	n.a.
Nitrites (as N)	mg/l	0.00	0.03	n.a.
Ammonia ion salts (NH_4)	mg/l	0.20	0.22	n.a.
Chlorides (Cl)	mg/l	22	16.4	n.a.
Sulphates (SO_4)	mg/l	296	307	n.a.
Iron (Fe)	mg/l	0.000	0.000	1
Chromium (Cr^{6+}/Cr^{3+})	mg/l	0.000	0.000	0.5
Copper (Cu)	mg/l	0.014	0.057	0.1
Nickel (Ni)	mg/l	0.000	0.000	0.1
Cadmium (Cd)	mg/l	0.000	0.000	0.01
Zinc (Zn)	mg/l	0.000	0.000	1
Lead (Pb)	mg/l	0.000	0.000	0.1
Dissolved oxygen	mg/l	/	/	min. 4

The analytical results are compared to the threshold limit values for Class III/IV waters as defined by the Serbian Legislation for the Kriveliska River (see *paragraph 2.5* for the surface water bodies classification).

Drainage waters from the dams show that the waters are in compliance with Serbian standards, with the exception of the concentrations of Suspended Solids (114 mg/l for the Dam 1A and 93 mg/l for Dam 3A).
In addition to the above presented monitoring results, chemical characterisation of the effluent included in the above mentioned report Industrial Wastewaters treatment technologies, points out that Arsenic concentration was detected above Serbian regulatory limits in 2000 (0.2 versus 0.05 mg/l and 0.1 WB guidelines).

A solid settlement treatment should be installed in order to ascertain compliance of effluents with the limit set for suspended solids. Periodical monitoring of Arsenic should also be undertaken.

Wastewaters from the Cerovo Mine Complex

Since the mining site is not operating at the moment, wastewaters generated from the complex are currently limited to open pit waters and storm waters from runoff of overburden and other areas around the pit, as listed in the following *Table 5.22*.

Table 5.22 ***Wastewaters form Cerovo Mining Complex***

Type	Quantity (m3/year)	Pre-treatment	Sampling	Final Discharge
Drainage water from open pit	200,000*	Sedimentation	Yes	RTH tailing pond
Runoff water from overburden storage areas		No	Yes	RTH tailing pond

** including both streams*

Drainage waters that accumulate at the bottom of the pit were in the past pumped out from the mine towards a water storage basin called Ecological basin, which has a capacity of 50,000 m^3, in order to avoid water level rising to a level which may lead to an hydraulic connection with the streams Cerovo and Valja Mare with consequent contamination of these two streams. The pump is currently out of function and no pumping is undertaken since 6-7 months.

Reportedly, before the closure of the mine, these drainage waters were recycled in the wet crushing process. As reported by RTB Bor representatives, water from the ecological basin were pumped to the Bor flotation plant through a 14 km pipelines system. The system, which consists of four pipelines, includes:

- one pipe with a diameter of 350 cm for transport of ore slurry from Cerovo to Flotation Bor;
- one pipe for industrial raw water supply from Bor to Cerovo (with a diameter of 300 cm diameter)

Parameters	Unit	Open pit	Ecological basin	Threshold Limit Value (Class III/IV)
Oils and lubricants	mg/l	n.d.	n.d.	10
Iron (Fe)	**mg/l**	**4..53**	**n.d.**	**1**
Chromium (Cr^{6+}/Cr^{3+})	mg/l	n.d.	n.d.	0.5
Copper (Cu)	**mg/l**	**855.2**	**4.08**	**0.1**
Nickel (Ni)	**mg/l**	**0.260**	**n.d.**	**0.1**
Cadmium (Cd)	**mg/l**	**0.066**	**n.d.**	**0.05**
Zinc (Zn)	**mg/l**	**51.91**	**11.29**	**1**
Dissolved oxygen	mg/l	/	/	min. 4

As shown in the *Table*, the waters from the open pit are highly acidic with a pH value of 3.6, while the wastewaters from the ecological basin have a higher pH value (6.0). With regard to heavy metals content, high concentrations of iron (4.53 mg/l), copper (855.2 mg/l), zinc (51.913 mg/l), cadmium (0.066 mg/l) and Nickel (0.260 mg/l) were detected in the open pit effluents, which all exceed the standards (Serbian standard limit values are 0.1 mg/l for copper, 1.0 mg/l for iron, 1.0 mg/l for zinc, 0.05 mg/l for cadmium and 0.1 mg/l for nickel, while WB gives guidelines value of 0.3 mg/l for copper, 2 mg/l for iron, of 1.0 for zinc, 0.1 for cadmium and 0.5 for nickel). Analytical results for the wastewaters from the ecological dam show concentrations above permitted limits only for copper (4.08 mg/l) and zinc (11.29 mg/l).

As long as contaminated rainwater is generated at Cerovo open pit, this effluent should be fully treated in an adequate cementation plant. Moreover, in the short term, the pipework should be urgently repaired in order to prevent soil and groundwater impact caused by acid water spillage. In addition, the pump for water supply from the open mine to the Ecological basin should be replaced since it is not working

In case Cerovo will not be further exploited, open pit closure and revegetation and Ecological basin reclamation should be addressed.

RBM Majdanpek

Main wastewaters generated from the mining complex are listed in the following *Table*.

Table 5.24 ***Wastewaters form Majdanpek Mining Complex***

Type	Quantity (m^3/h)	Pre-treatment	Sampling	Final Discharge
Effluents from washing activities of crushing plant	Occasionally discharged		Yes	Mali Pek River
Effluents from the light workshop	n.a.	No	Yes	Veliki Pek River
Effluents from filtration of flotation slurry process	n.a.	No	Yes	Veliki Pek stream
Effluents from the heavy Services	0.1 l/s	Oil separator	Yes	Mali Pek River

- one pipe for drinking water supply from Bor to Cerovo (with a diameter of 300 cm diameter);
- one pipe for recycled water from RTH tailing pond to be used at Cerovo for crushing.

The pipework passes through agricultural land on the route for Bor flotation plant. For most of the route the pipes run underground.

The pipe formerly used for slurry transport is currently used for transport of the acid mine drainage water from the Ecological basin to the Bor flotation plant. Due to water acidity, the steel-made pipeline has been damaged and water spills contaminated the soil with consequent risk of pollution of the underground water. Spillage from the pipe is reportedly an issue of complaint from the landowners for impact of land and crops. A plan to replace the existing pipeline has been prepared by the RTB Bor with an estimated cost of about 840,000 Euro. Further details are provided in *section 5.7.*

Analytical results of wastewaters from the open pit mine and from the catchment's area are summarized in the following *Table*. The analytical results are compared to the threshold limit values for Class III/IV waters as defined by the Serbian Legislation for the Cerovo River and the Valja Mare River since these are potential receptors in case of hydraulic connection between the basin and the rivers (see *paragraph* 2.5 for the surface water bodies classification).

Table 5.23 ***Open Pit and Ecological Basin Cerovo – September 2005 (Source 1 Maj – Institute for Protection of Working Environment and Environment, of Nis – provided by RTB Bor)***

Parameters	**Unit**	**Open pit**	**Ecological basin**	**Threshold Limit Value (Class III/IV)**
Water temperature	°C	14/19	14/19	< 28
Water colour	/	Blue-green	No	No
Water smell	/	No	No	No
Floating matter	/	No	No	No
pH	**/**	**3.6**	**6.0**	**6-9**
Sedimentation for 2h	ml/l	0.5	0.8	/
Total suspended solids (TSS)	**mg/l**	**90**	**117**	**80**
Total dissolved solids (TDS)	mg/l	1,016	717	1,500
$KMnO_4$ Consumption	mg/l	81.5	21.8	20
BOD 5	mg O_2/l	3.8	/	7.0
COD (COD from $K_2Cr_2O_7$)	mg O_2/l	106	71.3	/
Nitrates (as N)	mg/l	0.71	0.88	15
Nitrites (as N)	Mg/l	0.00	0.00	0.5
Ammonia ion salts (NH_4)	mg/l	0.00	0.00	10
Chlorides (Cl)	mg/l	554	278	/
Sulphates (SO_4)	mg/l	466	362	/
Sulphites (SO_3)	mg/l	/	/	/
Sulphides (S)	mg/l	/	/	/
Cyanides (CN)	mg/l	/	/	/
Phosphates (PO_4)	mg/l	n.d.	n.d.	/
Phenol	mg/l	n.d.	n.d.	0.3
Detergents (ABS)	mg/l	n.d.	n.d.	1

Type	Quantity (m^3/h)	Pre-treatment	Sampling	Final Discharge
Drainage water from the tailing ponds dams	n.a.	no	No	Mali Pek River

An indicative representation of localisation of effluents sources and final receptors is reported in the following Figure

Figure 5.5 Effluents Sources and Final Receptors at Majdanpek

Effluents from the flotation plant are recycled into the process. No wastewater effluents come from the southern nor from the northern open pits since no pumping of these wastewaters is undertaken at the moment. Effluents from the crushing plant are occasionally discharged to the Mali Pek River when washing of crushing plant is undertaken.

Together with this water, wastewater from the heavy services and drainage water from the tailing ponds dams are discharged.
Wastewaters coming from the heavy vehicles repair shop are collected by a canal to a separator of oils and lubricants. The purified water is then discharged through a pipe into the stream Dugi Potok that flows into the Mali Pek River. The designed capacity of the separator is 12 l/s but due to the reduced volume of production, the flow of wastewater is limited to 0.1 l/s.

Effluents from filtration of flotation slurry process are discharged into the Veliki Pek stream, instead of being recycled in the process.
Effluents from the light vehicles workshop are discharged to the Veliki Pek stream without any treatment.

In case of an electricity shortage, tailings from the flotation plant are redirect to the "Saski Potok" tailing pond. Drainage water from "Saski Potok" is then pumped to the Valja Fundata tailing ponds, in order to be recycled to the flotation and crushing process.

Wastewaters monitoring is performed by the Public Health Institute Timok from Zajecar, 4 times per year. Relevant results of wastewaters from the site are summarized in the following *Table*, while the monitoring results for surface waters are reported in *Section 2.5*. The analytical results are compared to the threshold limit values for Class III/IV waters as defined by the Serbian Legislation for the Mali Pek and Veliki Pek Rivers respectively (see section 2.5 for the surface water bodies classification).

Table 5.25 ***Wastewaters Monitoring Results 2005 (Source Public Health Institute Timok from Zajecar - provided by RBM)***

Parameters	Unit	Crushing effluents	Filtration wastewaters	Heavy Vehicles workshop	Light vehicles workshop	Threshold Limit Value (Class III/IV)
Water temperature	°C	6	7	6	8	
Air temperature	°C	7	6	7	8	
Floating matter		Yes	No	No	No	No
Water colour		Yes	Yes	Yes	No	
Water smell		No	Yes	Yes	Yes	
pH		8.13	7.84	8.32	8.35	6.0-9.0
Ammonia ion salts	mg/l	0.44	0.12	4.80	1.44	10.0
Nitrites (as N)	mg/l	0.011	0.010	0.027	0.046	0.50
Nitrates (as N)	mg/l	1.81	0.90	1.81	1.36	10.0
$KMnO_4$ Consumption	mg/l	5.6	31.3	21.4	11.2	

Parameters	Unit	Crushing effluents	Filtration wastewaters	Heavy Vehicles workshop	Light vehicles workshop	Threshold Limit Value (Class III/IV)
Chlorides	mg/l	13.0	15.7	8.86	29.3	
Fluorides	mg/l					
Iron	**mg/l**	**2.51**	**5.43**	**0.44**	**0.14**	**0.50**
Manganese	mg/l	0.615	0.013	<0.025	<0.025	
Phosphates	mg/l	0.03	0.06	1.76	0.52	
Sulphates	mg/l	96.50	98.17	71.68	74.30	
Total dissolved solids (TDS)	**mg/l**	**984**	**2,312.0**	**476.0**	**468.0**	**< 1,500**
Total suspended solids (TSS)	mg/l	0.0	8.4	0.2	14.0	< 80
BOD_5	mg O_2/l	11.20	3.37	1.60	6.92	< 7
COD (from $KMnO_4$)	mg O_2/l	1.00	7.82	5.35	2.80	< 20
Detergents	mg/l	1.40				1.0
Lead	mg/l	<0.010	0.045			0.1
Cadmium	mg/l	0.001	0.001			0.01
Zinc	mg/l	0.205	0.353			1.0
Nickel	mg/l	0.006	<0.005			0.1
Copper	**mg/l**	**0.141**	**4.992**			**0.1**
Chromium	mg/l	0.006	0.004			0.1
Arsenic	mg/l	0.001	0.001			0.05
Mineral oils	mg/l					

As shown in the above reported table, wastewaters from flotation and crushing units are characterized by high content of heavy metals. With regard to the crushing effluent, concentrations of iron (2.51 mg/l) and copper (0.141 mg/l), above standards (Serbian limit values are 0.5 mg/l for iron and 0.1 mg/l for copper while WB gives guidelines value of 2 mg/l for iron and 0.3 mg/l for copper). With regard to the filtration effluent, concentrations of iron (5.43 mg/l) and copper (4.99 mg/l) are above standards (Serbian limit values are 0.5 mg/l for iron and 0.1 mg/l for copper while WB gives guidelines value of 2 mg/l for iron and 0.3 mg/l for copper).

No monitoring results are available with regard to water collected in the open pits neither any information with regard to quality of eventual leachates from overburden sites (blue waters).

The opportunity of recycling the effluents from the filtration process and crushing into the flotation should be ascertained since provision of a dedicated treatment plant is considered not economically sustainable. A specific monitoring should be undertaken to ascertain quality and quantity of blue waters generated at Majdanpek. Should these effluents be not in compliance with regulatory limits, an adequate treatment should be provided or generation of these effluents should be avoided by means of land reclamation and revegetation.

TIR Bor (smelter)

Main wastewaters generated from the smelting process (as represented in the *Figure 5.2*– **point 7**) are listed in the following Table. These effluents are conveyed to the 20,000 m³ capacity accumulation basin located to the south of the open pit Bor and are then discharged in the Bor river together with the open pit Bor effluents.

Table 5.26 ***Wastewaters form Smelter Complex***

Type	Quantity (m^3/h)	Pre-treatment	Final Discharge
Sulphuric Acid Plant Wastewaters	4*	Neutralization plant - out of function	Bor river
Spent electrolyte solution/bleed	1*	Neutralization plant - out of function	Bor river
Site storm water	n.a.	Non e	Bor river
Blow down cooling waters from oxygen plant and foundry	n.a.	None	Bor river
Washing and flushing waters (vehicle services, maintenance, etc.)	n.a.	None	Bor river

** based on the report Industrial Wastewaters treatment technologies data*

Sulphuric Acid Plant Wastewaters

Wastewaters generated from the Sulphuric Acid Plant consist mainly of acid plant blow-down, which originates in the gas cleaning section (scrubber) due to the water spraying of the smelter converter gases. These effluents were in the past treated in a neutralisation plant (flow rate 15 m^3/h) currently out of order. Currently, the effluents are discharged into a pre-treatment basin where lime is dosed and then conveyed to the accumulation basin located to the south of the open pit Bor, in which all the effluents are discharged.
No detailed monitoring is provided with regard to the stream from the sulphuric acid plant. Based on literature data, this kind of wastewater generally contain sulphates (up to 15%), and dissolved heavy metals, mainly copper and iron (up to 1-2%); furthermore, significant concentrations of arsenic, cadmium, lead, molybdenum and selenium may be present. Based on the report Industrial Wastewaters treatment technologies, the average content of copper in this effluent is about 41 mg/l and sulphuric acid is up to 0.25%.

The above mentioned neutralisation plant needs refurbishments and/or replacements since it has not the capacity to treat arsenic, which is likely to be present in the wastewaters. The cost for refurbishing that system is calculated to be about 1,000,000 €.

Spent Electrolyte Solution/Bleed

Spent electrolyte results from the electrolytic refining process. Spent electrolyte solution is subject to lime dosing and then conveyed to the accumulation basin. The bleed from the electrolyte has a commercial value with its high content of copper and nickel and is therefore sent to such recovery.

No detailed monitoring is provided with regard to the stream from the electrolysis section of the plant. Based on literature data, these waters are generally characterised by a high concentration of heavy metals (arsenic, cadmium, chromium, lead, selenium and silver) and is corrosive.

These waters were in the past treated in the neutralization plant, while are currently conveyed to the above mentioned accumulation basin.

Site Storm Water

No separated site sewage system exists for rainfall water. Storm water are collected and discharged.

Washing and Flushing Waters

Washing and flushing waters include waters from washing of trucks and other machinery and from flushing floors inside buildings.

Cooling Waters

Blow down cooling waters originate from heat exchanging operations in the oxygen plant and smelter. Waters used for indirect cooling are often recycled and if there is any open handling of the waters, e.g. cooling towers, the water will become contaminated and a certain part has to be bled off in order to keep the necessary quality of the water.

Monitoring of wastewaters from the basin collecting effluents from the open pit Bor and from the TIR (including sulphuric acid plant, electrolysis, refinery, etc.) is reported in the following *Table 5.27*. Analytical results are compared to the threshold limit for Class III/IV surface waters as defined by the Serbian Legislation for the Bor River (see *section 2.5* for the surface water bodies classification).

Table 5.27 ***Smelter+Open Pit Bor Effluents Analytical Results - February 2005 (Source: Report Industrial Wastewaters treatment technologies, provided by RTB Bor)***

Parameters	Unit	Effluents from smelter+open pit Bor	Threshold Limit Value (Class III/IV)
Water temperature	°C	17/11	< 28
Water colour	/	Yes	No
Water smell	/	No	No
Floating matter	/	No	No
pH	/	2.35	6-9
Sedimentation for 2h	ml/l	n.d.	/
Total suspended solids (TSS)	mg/l	63	80
Total dissolved solids (TDS)	mg/l	4,156	1,500
$KMnO_4$ Consumption	mg/l	159.2	20
BOD_5	mg O_2/l	n.d.	7.0

Parameters	Unit	Effluents from smelter+open pit Bor	Threshold Limit Value (Class III/IV)
COD (COD from $K_2Cr_2O_7$)	mg O_2/l	39.8	/
Nitrates (as N)	mg/l	0.45	15
Nitrites (as N)	Mg/l	0.003	0.5
Ammonia ion salts (NH_4)	mg/l	2.43	10
Chlorides (Cl)	mg/l	22	/
Sulphates (SO_4)	mg/l	1,670	/
Phosphates (PO_4)	mg/l	3.93	/
Detergents (ABS)	mg/l	0.31	1
Iron (Fe)	**mg/l**	**322.5**	**1**
Chromium (Cr^{6+}/Cr^{3+})	mg/l	0.009	0.5
Copper (Cu)	**mg/l**	**54.04**	**0.1**
Nickel (Ni)	**mg/l**	**1.046**	**0.1**
Zinc (Zn)	**mg/l**	**1.92**	**1**
Arsenic	mg/l	0.017	0.05

As shown in the above reported table, mixed effluents from the TIR and open pit are highly acidic with a pH value of 2.35 and are characterised by a high concentration of heavy metals. Concentrations of iron (322.5 mg/l), copper (54.04 mg/l), zinc (1.92 mg/l) and nickel (1.04 mg/l) were detected in the effluents, which all exceed the standards (Serbian standard limit values are 0.1 mg/l for copper, 1.0 mg/l for iron, 1.0 mg/l for zinc, and 0.1 mg/l for nickel, while WB gives guidelines value of 0.3 mg/l for copper, 2 mg/l for iron, of 1.0 for zinc and 0.5 for nickel).

As long as contaminated rainwater is generated at the TIR complex, this effluent should be fully treated in an adequate cementation plant.

5.3.3 *Summary of Environmental Findings with regard to Wastewaters*

Based on data available so far, key environmental issues with regard to wastewater discharges at the site are related to the discharge of contaminated effluents into the rivers without any treatment.

In particular, the following effluents are discharged not in compliance with applicable Serbian, WB and EU standards:

- Effluents from Jama mining activities (blue waters). In case further mining activities will be undertaken at Jama in the future and in any case should the Borska Reka resources initiate to be exploited, these effluents, with a total flow rate of 250 m^3/h, need to be treated before final discharge since they are characterised by a very acidic pH (2.7) and high concentrations of copper, iron and zinc. Three options can be foreseen for treatment of these effluents: **option 1)** lined basin with three stages of treatment (total surface of the basin is estimated to be about 25,000 m^2) carbonatic rocks for pH raising to about 7, a secondary pH correction basin with dosing of calcium hydroxide to raise pH to 9 and a sedimentation basin for heavy metals precipitation – preliminary estimated cost is around 450,000 Euro. In this case, sludges will have to be periodically collected and dried and consequently disposed of and metal recovered if economic; **option 2)** a three stage wastewater treatment plant including carbonatic rocks for pH raising to about 7, a pH correction stage with dosing of calcium hydroxide to raise pH to 9 and a sedimentation tank for heavy metals precipitation - preliminary estimated cost is around 1,000,000 Euro. In both cases, metals recycling opportunity from the sludge should be evaluated; **option 3)** since the AEROAKVA technology is currently treating a flow rate of 50 m^3/h, but it is reportedly sized for higher flow rate, a pre-feasibility study should be conducted to ascertain needs for plant enlarging and additional supply infrastructure needs (water pipelines, pumping stations, chemicals storage, etc.) to ensure fully treatment of this effluent with consequent copper recovery. Cost estimate provided by AEROAKVA for plant enlarging is around 3,000,000 Euro.

- Leachates from waste heaps collected at the Robule Lake. These effluents, with an estimated flow rate of 500 m^3/d, need to be treated before final discharge since they are characterised by a very acidic pH (2.97) and high concentrations of copper, iron, nickel, cadmium and zinc. As long as these effluents will be generated, proper treatment (e.g. by means of a wastewater treatment plant) must be ensured. In the long-term, waste heaps capping/recycling and remediation of the Robule lake should be addressed (see *sections 5.4* and *5.7*).
- Mine drainage water from open pit Veliki Krivelj. These effluents, with an estimated flow rate of 100 m^3/h, need to be treated before final discharge since they are characterised by an acidic pH (4.4) and high concentrations of copper and zinc. As long as these effluents will be generated, proper treatment (e.g. by means of a wastewater treatment plant) must be ensured. In the long-term, open pit post-closure and revegetation should be addressed (see *section 5.7*).
- Leachates from waste heaps collected to the south eastern side of Veliki Krivelj, discharged into the Saraka stream. These effluents, with an estimated flow rate of 3,800 m^3/d, need to be treated before final discharge since they are characterised by a low pH (4.9) and high concentrations of copper and iron. As long as these effluents will be generated, proper treatment (e.g. by means of a wastewater treatment plant) must be ensured. In the long-term, waste heaps capping/recycling to avoid overburden leaching should be addressed (see *section 5.4*).
- Drainage waters from the dams of Veliki Krivelj, discharged into the Kriveljska river. These effluents, with an estimated flow rate of 200 m^3/h, need to be treated before final discharge since they are characterised by a slightly acidic pH (6.3-6.9) and suspended solids concentrations slightly above the limits. A settlement treatment should be provided in order to comply with applicable limits.
- Effluents from the open pit and from the Ecological basin of Cerovo. In case further activities will be undertaken at the site, through exploitation of further Cerovo ore deposits (Cerovo 2 to Cerovo 4), a physical-chemical wastewater treatment plant will have to be installed with a capacity of about 200,000 m^3/y since effluents from the ecological dam are characterised by low pH and high concentrations of

iron, copper, nickel and zinc; two options are foreseen for treatment of these effluents: **option 1)** Preliminary estimate of treatment, based on the hypothesis to have a pH correction basin with dosing of calcium hydroxide to raise pH to 9 and a sedimentation basin for sludge precipitation, and a drying unit (filterpress) is around 300,000 Euro. Metals recycling opportunity from the sludge should be evaluated; **option 2)** installation of an adequate wastewater treatment plant to ensure fully treatment of this effluent with consequent copper recovery; a pre-feasibility study should be conducted to ascertain wastewater quality, flow rates, needs for infrastructure needs (water pipelines, pumping stations, chemicals storage, etc.). Moreover, in the short term, the pipework should be urgently repaired in order to prevent soil and groundwater impact caused by contaminated water spillage. In addition, the pump for water supply from the open pit to the ecological basin should be replaced. Estimated cost for repair of the pipework is about 840,000 Euro. In case Cerovo will not be further exploited, open pit closure and revegetation and Ecological basin reclamation should be addressed (see *section 5.7*).

- Filtration effluents from RBM Majdanpek, discharged into the Veliki Pek river. No estimate of wastewater flow rate is provided. These effluents are not in compliance with applicable limits for iron and copper. Based on flow rate, the feasibility of recycling these effluents should be considered, since provision of a dedicated treatment is considered not economically sustainable.
- A specific monitoring should be undertaken to ascertain quality and quantity of blue waters generated at Majdanpek. Should these effluents be not in compliance with regulatory limits, an adequate treatment should be provided or generation of these effluents should be avoided by means of land reclamation and revegetation.
- Effluents from the smelter complex. In case further activities will be undertaken at the site, a physical-chemical wastewater treatment plant will have to be installed with a capacity of 10 m^3/h since effluents from the smelter are characterised by pH 2.35 and high concentrations of iron copper, zinc; two options are foreseen for treatment of these effluents: **option 1)** Preliminary estimate of treatment, based on the hypothesis to have a pH correction basin with dosing of calcium hydroxide to raise pH to 9 and a sedimentation basin for sludge precipitation, and a drying unit (filterpress) is around 150,000 Euro. Metals recycling opportunity from the sludge should be evaluated; **option 2)** installation of an adequate wastewater treatment plant to ensure fully treatment of this effluent with consequent copper recovery; a pre-feasibility study should be conducted to ascertain wastewater quality, flow rates, needs for infrastructure needs (water pipelines, pumping stations, chemicals storage, etc.).

With regard to rivers degradation, due to historical discharge of polluted effluents, a specific monitoring campaign and risk assessment will be developed which is addressed in detail in *section 6.2*. Since flow rates of effluents discharged are not considered to be reliable and are in some cases completely missing, it is not possible to astimate a figure for the pollution load discharged into the Bor and Veliki Krivelj rivers and subsequently conveyed to the Timok river and to the Danube. A similar situation is verified at Majdanpek, where no data are available with regard to the main wastewater streams which are potentially open mine drainage effluents and leachates from waste heaps.

Finally, it should be pointed out that no detailed sewer system layout is available at the sites and no information was provided with regard to sewer clean-up, integrity testing and periodical maintenance. It is recommended to perform an investigation of the status of the sewer system at all the sites including verification of layout and preparation of maps, cleanup and integrity testing. Sewer repairs may be necessary based on results of the sewer status investigation.

5.4 *WASTE MANAGEMENT*

5.4.1 *Legislative Background*

A comprehensive review of Serbian Legislation concerning waste management is reported in *Annex C*, together with relevant EU requirements and WB operative guidelines on management of solid waste.

5.4.2 *Waste Generated, Management and Compliance Status*

RBB Bor

Main wastes generated in the frame of mining activities include:
- Waste generated at the Jama underground mine;
- Overburden from the old open pit Bor;
- Waste from flotation unit.

The following waste materials are derived from the exploitation process of copper ore in the subsurface-pit Jama:
- scrap iron resulting from the replacement of worn-out machines and installations. Scrap iron is stored in the plant yard and being sold as a secondary raw material;
- waste grease and lubricating oils, derived from mining machinery maintenance. Reportedly, waste oil is temporarily stored in drums and reused on site for rotating machinery lubricating purposes;
- spent accumulators derived from maintenance of the diesel-powered engines of the mining machinery. They are stored in the plant yard and sold as a secondary raw material;
- sludge from sedimentation of Jama drilling water is deposited nearby the plant on the Bor excavation site.

Total waste material generated in year 2004 is shown in *Table* below.

Table 5.28 ***Waste Generated by Jama Operations (2004)***

Waste	Index No.*	Unit	Quantity
Scrap iron	16 01 99	t	178.01
Waste grease and lubricating oils	13 02 08	-	-
Waste accumulators	16 06 01	t	10.86
Sludge	19 09 02	m^3	10

Index number* is decided on the basis of REGULATIONS ON TERMS AND CONDITIONS OF SECONDARY RAW MATERIALS CLASSIFICATION, PACKING AND STORAGE ("Official Gazette of the Republic of Serbia" No. 55/2001).

During the site visit, huge amounts of scrap iron and other metals, redundant equipment, out of use machinery, accumulators were noticed to be stored on the ground at various locations (e.g. near the sulphuric acid plant, in the area of the power plant and in the waste open dump located to the south-east of the old open mine Bor).

Overburden from the old open pit is stored at the following location within the complex:

- Heaps of waste rock together with slag from the smelter run approximately 4 km along the eastern ridge of the Borska valley above the metallurgical complex;
- A long waste heap running north west of the pit along the ridge of the Borska valley and embankment carrying the Krivelj road and Jama mine access;
- Smaller mounds immediately east of Bor pit;
- A series of smaller mounds to the south of the metallurgical complex which are also used as a municipal waste dump.

Waste materials generated from the Bor flotation plant are:

- Waste steel materials consisting of waste steel rods, balls and linings resulting from ore grinding operations and maintenance. Waste steel rods and balls are removed daily and stored in a bunker nearby the rod mill, while waste steel linings are stored in the production plant yard. Waste steel rods, balls and linings are sold as a secondary raw material;
- Scrap iron resulting from the replacement of worn-out machines and installations. Scrap iron is stored in the plant yard and being sold as a secondary raw material;
- Waste rubber belts resulting from replacement and maintenance operations. There is no special storage location for waste rubber belts but they are mixed with other waste materials and were noticed to be stored at various location at the site;
- Waste grease and lubricating oils, derived from mining machinery maintenance. Reportedly, waste oil is temporarily stored in drums and reused on site for rotating machinery lubricating purposes;
- Flotation tailings resulting from flotation concentrating process of copper mineral. Flotation tailing is pumped over to the tailing pond located in Bor, so called RTH.

Total waste material generated in year 2004 is shown in *Table* below.

Table 5.29 ***Production Waste from Flotation Operations (2004)***

Waste	Index No.*	Unit	Quantity
Scrap iron	16 01 99	t	477.21
Waste steel rods	120121/120199	-	-
Waste steel balls	120121/120199		24.20
Waste steel linings	120121/120199		141.36
Waste rubber belts + r. linings	07 02 99	t	-
Flotation tailing	01 03 04	m^3	645,148

Index number* is decided on the basis of REGULATIONS ON TERMS AND CONDITIONS OF SECONDARY RAW MATERIALS CLASSIFICATION, PACKING AND STORAGE ("Official Gazette of the Republic of Serbia" No. 55/2001).

Main solid waste materials derived from the mining complex of Veliki Krivelj are:

- Waste derived from mining activities;
- Overburden from excavations;
- Waste derived from flotation activities.

Main solid waste materials generated from mining activities are:

- Waste tyres of heavy vehicles, which are stored in the plant yard and everywhere in the complex area.
- Waste grease and lubricating oils derived from mining and support machinery operations and maintenance. They are reportedly temporarily stored in drums at various locations within the production plant and on site recycled for rotating machinery lubricating purposes.
- Waste conveying belts, which are stored in the plant yard.
- Scrap iron consisting of disused machinery parts, old parts of the trucks and other mining equipment, old steel ropes and other parts made of iron. Scrap iron is reportedly sold as a secondary raw material.

Total waste material generated in year 2004 is shown in the *Table* below.

Table 5.30 ***Production of Waste from Veliki Krivelj Open Pit (2004)***

Waste	Index No.*	Unit	Quantity
Waste tyres of heavy vehicles	07 02 99	pc.	25
Waste grease and lubricating oils	13 02 08	t	15.99
Waste conveying belts	07 02 99	m	433
Scrap iron	16 01 99	t	311.88

Index number* is decided on the basis of REGULATIONS ON TERMS AND CONDITIONS OF SECONDARY RAW MATERIALS CLASSIFICATION, PACKING AND STORAGE ("Official Gazette of the Republic of Serbia" No. 55/2001).

Since 1998, when transportation system was built, overburden from the mine is transported to the excavated area of the old open pit Bor. Previously, the waste rock was disposed of close to the excavated area.

Waste materials generated from the flotation plant of Veliki Krivelj are:

- waste steel materials consisting of waste steel rods, balls and linings resulting from ore grinding operations and maintenance. Waste steel rods and balls are removed daily and stored in a bunker nearby the rod mill, while waste steel linings are stored in the production plant yard. Waste steel rods, balls and linings are being sold as a secondary raw material;
- scrap iron resulting from the replacement of worn-out machines and installations. Scrap iron is stored in the plant yard and everywhere in the complex area; reportedly is being sold as a secondary raw material
- waste rubber belts resulting from replacement and maintenance operations, which are mixed with other waste materials;
- waste grease and lubricating oils, derived from mining machinery maintenance. Reportedly, waste oil is temporarily stored in drums and reused on site for rotating machinery lubricating purposes;
- flotation tailing results from flotation concentrating process of copper mineral. Flotation tailing is gravitationally drained by a concrete canal to the tailing pond located in Veliki Krivelj, n.2.

Total waste material generated in year 2004 is shown in *Table* below.

Table 5.31 ***Production Waste from Flotation Operations (2004)***

Waste	Index No.*	Unit	Quantity
Waste steel rods	120121/120199	t	154.53
Waste steel balls	120121/120199	t	317.68
Waste steel linings	120121/120199	t	-
Scrap iron	16 01 99	t	147.56
Waste rubber belts + r. linings	07 02 99	t	1.25
Flotation tailing	01 03 04	t	3,585.994

Index number* is decided on the basis of REGULATIONS ON TERMS AND CONDITIONS OF SECONDARY RAW MATERIALS CLASSIFICATION, PACKING AND STORAGE ("Official Gazette of the Republic of Serbia" No. 55/2001).

No wastes are generated at Cerovo since it is not operated.

A proper waste management system should be implemented. Waste open dumping at the site must be stopped and generated waste must be adequately stored on site in order to prevent soil/groundwater/stormwater runoff contamination and to allow recycling/reuse of secondary raw materials. Existing open dumps need to be reclaimed.

RBM Majdanpek

Main solid waste materials derived from RBM Majdanpek are:

- Waste derived from mining activities;
- Overburden from excavations;
- Waste derived from flotation activities.

Main solid wastes generated from mining activities are:

- Waste tyres of heavy vehicles, which are stored in the plant yard and on site dumped.
- Waste grease and lubricating oils derived from mining and support machinery operations and maintenance. They are reportedly temporarily stored in drums at various locations within the production plant and on site recycled for rotating machinery lubricating purposes.
- Waste conveying belts, which are stored in the plant yard and reportedly sold as a secondary raw material.
- Scrap iron consisting of disused machinery parts, old parts of the trucks and other mining equipment, old steel ropes and other parts made of iron. Scrap iron is reportedly sold as a secondary raw material.
- Spent accumulators derived from maintenance of the diesel-powered engines of the mining machinery. They are stored in the plant yard and sold as a secondary raw material.

Overburden from RBM Majdanpek is located at the following four disposal sites:
- Saska open dump, located to the east of the southern open pit;
- Bugarski potok open dump, located to the south-west of the southern open pit, bordered to the east by the river Mali Pek;
- Ujevac open dump, located to the south-west of the northern open pit;
- Sevirni revir open dump, located to the north-west of the northern open pit.

Overburden storage dumps are represented in Figure A5, in Annex A.

Waste materials generated from the flotation plant of Majdanpek are:
- waste steel materials consisting of waste steel rods, balls and linings resulting from ore grinding operations and maintenance. Waste steel rods and balls are removed daily and stored in a bunker nearby the rod mill, while waste steel linings are stored in the production plant yard. Waste steel rods, balls and linings are being sold as a secondary raw material;
- scrap iron resulting from the replacement of worn-out machines and installations. Scrap iron is stored in the plant yard and everywhere in the complex area; reportedly is being sold as a secondary raw material;
- waste rubber belts resulting from replacement and maintenance operations, which are mixed with other waste materials and on site dumped;
- waste grease and lubricating oils, derived from mining machinery maintenance. Reportedly, waste oil is temporarily stored in drums and reused on site for rotating machinery lubricating purposes;
- flotation tailing results from flotation concentrating process of copper mineral. Flotation tailing is dumped in Valja Fundata tailing pond.

Other waste materials generated at RBM Majdanpek include:
- slag from boilers, reportedly used as backfilling material for internal roads construction;

- turnings from metal working which are reportedly stored near the heavy vehicles workshop and on site dumped.

Waste materials generated at RBM Majdanpek are summarized in the following *Table*.

Table 5.32 ***Waste Generated at RBM Majdanpek (2004)***

Item No.	Source of Waste	Place of Origin	Physical Properties	Quantity (2005)
1.	Overburden	Open-pit	Solid	857,000 t
2.	Flotation tailing	Flotation	Solid	1,022,645 t
3.	Steel balls, rods and linings	Flotation	Solid	117 t
4.	Rubber linings	Flotation	Solid	7.5 t
5.	Rubber belts	Open-pit, Flotation	Solid	1,500 t
6.	Waste lubricating oil	Open-pit, Flotation, Production services	Liquid	14,800 t
7.	Conveyor belts	Crushing	Solid	10 t
8.	Old vehicles	Open-pit, Production services	Solid	130 t
9.	Worn-out machines parts	Open-pit, Flotation, Production services	Solid	32.5 t
10.	Accumulators	Open-pit, Production services	Solid	46 units
11.	Worn-out tyres	Open-pit, Production services	Solid	127 units
12.	Turnings from metal working	Production services	Solid	200 kg
13.	Slag from boiler	Production services	Solid	150 t

During the site visit, huge amounts of scrap iron and other metals, redundant equipment, out of use machinery, accumulators were noticed to be stored on the ground at various locations (e.g. to the north of the open pit North, towards the crushing units, near the flotation plant and the warehouse).

A proper waste management system should be implemented. Waste open dumping at the site must be stopped and generated waste must be adequately stored on site in order to prevent soil/groundwater/stormwater runoff contamination and to allow recycling/reuse of secondary raw materials. Existing open dumps need to be reclaimed.

TIR Bor (smelter)

Wastes generated from the smelting process are:

- Slag from blast furnace is currently collected in dedicated rail vans and discharged in the open pit Bor without any prior treatment; in the past, the slag was dumped in the so called "open dump" located between the sulphuric acid plant and the tailing pond RTH;

- Slag from converter is recycled to the blast furnace for further processing;
- General non-process waste such as used refractories and packaging are dumped on site in the old open pit Bor;
- Mixture of glass wool, aluminum tin, scrap iron and plastic (estimated annual production is 1,2 t/year) is dumped on site in the open pit Bor;

Dusts from air emission treatment containing Cu, Hg, As, Pb, Fe (estimated annual production is 3 t/year) are reportedly recycled to the furnace for metals recovery.

Table 5.33 *Chemical Analysis of Slug from Reverberatory Furnace*

Element / Compound	Content (%) [g/t]	Distribution (%)
Cu_{max}	0,79	100.00
Cu_{sulf}	0,606	76.71
Cu_{ox}	0,184	23.29
Fe	38,45	100.00
S	2,03	100.00
SiO_2	34,76	100.00
Al_2O_3	5,38	100.00
Au	0,40	100.00
Ag	7,57	100.00

The slug from reverberatery furnace has been tested on integral sample, and on two fractions + 12 mm and - 12+0 mm.

A proper waste management system should be implemented. Waste open dumping at the site must be stopped and generated waste must be adequately stored on site in order to prevent soil/groundwater/stormwater runoff contamination and to allow recycling/reuse of secondary raw materials. Existing open dumps need to be reclaimed.

5.4.3 *Summary of Environmental Findings with regard to Waste Management*

The sites generate a variety of waste which are stored at different locations throughout the site itself. No formal waste management procedures are in place at the site and waste generated are generally on site temporarily stored waiting to be re-used or sold out or on site dumped. No reliable figures with regard to type and detailed estimates of waste are available and it is therefore not possible to provide an estimated cost for disposal.

Based on available information and interviews conducted at the site, waste have historically been on site abandoned/dumped and the same procedure is currently in place with the exception of secondary raw materials that can be sold or reused at the site (metal scraps, redundant equipment, spent batteries, exhausted oils).

There is a lack of awareness of waste management issues such as waste minimisation, safe storage and handling of waste, waste labelling and segregate collection implementation.

Waste are generally placed directly on the ground, without any soil protection devices and any mitigation measures to avoid stormwater runoff contamination and fugitive emissions to air of dusts and vapours.

The main open dumps identified within the complex are described as follows:

- Open pit RBB Bor (see Figure A8) - into the old open pit, several waste streams are currently disposed of including: slag from blast furnace, slag from the power plant and from the District Heating plant, overburden from currently ongoing mining activities in Veliki Krivelj. Other types of waste are reported to be disposed in the open pit (e.g. vehicles tyres);
- Open dump RBB Bor (see Figure A8) - in the area placed to the east of the old flotation and the RTH Tailing pond, an open dump was noticed; during the site overwalk, in the open dump were present several types of waste including sulphur containing sludges, oil tars, coal residuals, power plant ashes and slags, metal scraps, redundant equipment; in the same area, the PCB contaminated waste as described in the UNEP report Dump Site at RTB Bor are also present mainly consisting of damaged capacitors, heavily contaminated soil and inert materials contaminated by PCB oils;
- Municipal waste dump Bor[1] (see Figure A8) - municipal waste from Bor town and other villages are since 1983 open dumped in an area located to the east of tailing pond RTH (reported total surface is 11 ha). During the site visit, it was noticed that the light fraction of municipal waste is dispersed to the adjoining street and in the bed of River Bor. In addition, it was noticed that people undertake a selection of reusable waste in the area where waste is primarily stored. Finally, fumes deriving from self-firing of waste was noticed and consequent risk of fire/explosion is therefore pointed out.
- Overburden heaps RBB Bor (see Figure A8) - to the north of the old open pit and to the eastern side of the metallurgical complex, waste heaps deriving from historical overburden storage have been originated; along the northern border of the old open pit Bor, a huge amount of overburden and other waste (e.g. tyres) are placed;
- Overburden heaps RBB Veliki Krivelj (see Figure A3) - overburden heaps located in the south-eastern area of the Veliki Krivelj open pit mine;
- Overburden heaps RBM Majdanpek (see Figure A5) - four overburden disposal sites (Saska, Bugarski potok, Ujevac and Sevirni revir open dumps) located to the south-west of the southern open pit, bordered to the east by the river Mali Pek.

These open dumps are not provided with adequate lining/soil protection devices and no mitigation measures are in place to avoid stormwater runoff contamination and fugitive emissions to air of dusts and vapours.

(2) [1] even if the municipal open dump is not generated by activities undertaken at the RTB Complex, it is included in the list of findings since it is located within the site area.

This situation is likely to have led to soil contamination due to the presence in the waste of hazardous substances such as heavy metals, oils, PCBs. Soil and groundwater impact deriving from waste dumping at the site is assessed in the frame of the *section 5.7.*

Two components will have two be addressed in the environmental action plan: existing solid waste and future waste generation.

Existing Solid Waste

Solid waste generated so far and present on site should be properly managed. A number of dedicated areas should be instituted in order to consent safe temporary storage of generated secondary raw materials (e.g. metal scraps, redundant equipment, tyres, etc.) waiting for recycle/reuse.

A proper solution for existing open dumps management (open pit Bor and open dump Bor) would require:

- Immediate securing of the two open dumps to avoid public access;
- An inventory of waste currently present in the open dumps in terms of types, amount and current location, including chemical characterisation by means of waste excavation, sampling and chemical characterisation (leachate monitoring) - preliminary cost estimate (1) for this task is about 50,000 Euro;
- A risk assessment of potential impacts deriving from the presence of waste with regard to release to air, surface water, groundwater and soil) - preliminary cost estimate for this task is about 60,000 Euro;
- Based on risk assessment results, mitigation measures should be designed and implemented including: 1) waste capping: wastes should be adequately profiled in order to consent stormwater runoff discharge and then capped with geomembranes and backfill soils) - preliminary cost estimate for this task is about 300,000 Euro; 2) waste removal and transfer to a lined landfill and soil/groundwater remedial - additional data are necessary to give a preliminary cost estimate for this option.

To address the situation of the municipal solid waste landfill, the following actions should be taken:

- Immediate securing of the open dump to avoid public access and waste flowing in the vicinity of the open dump (e.g. to the street and to the river Bor);
- Preliminary design of landfill reclamation measures including waste compacting, covering with soil and provision of biogas abstraction and leachate collection systems – an alternative disposal site for municipal

(1) Cost estimates have been based on the assumption that inventory, characterisation and capping are required for the open pit and open dump site in Bor for which an extension of about 15,000 m^2 and 10,000 m^2 is respectively assumed.

waste generated at Bor district should also be undertaken; preliminary cost estimate (1) for this task is about 50,000 Euro;

- A risk assessment of potential impacts deriving from the presence of waste with regard to release to air, surface water, groundwater and soil) - preliminary cost estimate for this task is about 60,000 Euro;

- Based on risk assessment results, mitigation measures should be designed and implemented including: 1) waste capping: wastes should be adequately profiled in order to consent stormwater runoff discharge and then capped with geomembranes and backfill soils) - preliminary cost estimate for this task is about 300,000 Euro; 2) waste removal and transfer to a lined landfill and soil/groundwater remedial - additional data are necessary to give a preliminary cost estimate for this option.

With regard to overburden disposal sites (Bor, Veliki Krivelj and Majdanpek), pre-feasibility studies are on going to ascertain whether any exploitation of overburden for copper recovery is economically sustainable given current high prices of copper.

The existing overburden could be reclaimed and re treated for the further extraction of copper. Reclamation of material for processing could be undertaken two different ways:

- mechanical reclamation utilizing conventional earth moving equipment. Typically this will entail a load and haul method utilizing excavators, loaders and dump trucks.
- residue recovery by means of hydraulic methods. This method requires industrial water to be pressurized with the resultant jet of water directed onto the existing residue deposit. When the pressurized water impinges onto the existing residue it is re-slurrified thereby enabling it to gravitate in an open trench to a collection point from where it may be pumped to a plant for processing.

Once processed, the resultant residue will need to be disposed of on a new TDF. The cleaned areas will then be contoured and re vegetated.

Should the closed overburden disposal sites in Majdanpek be considered not suitable for reclamation and recovery of copper, (Saska, Bugarski potok and Andenzitski prst for a total area of about 50 hectares), adequate remediation should be undertaken. Activities would include overburden capping (wastes should be adequately profiled in order to consent stormwater runoff discharge and then capped with geomembranes and backfill soils) and revegetation preliminary cost estimate for this task is about 5-10 millions Euro based on need for geomembranes to be used for capping.

With regard to waste tyres, a total estimated quantity of about 20,000 t of tyres is reportedly present at the sites. These tyres should be adequately stored at

(2) Cost estimates have been based on the assumption that inventory, characterisation and capping are required for the open pit and open dump site in Bor for which an extension of about 15,000 m^2 and 10,000 m^2 is respectively assumed.

selected locations instead of being stored throughout the site. Cost-benefits analysis should be undertaken to assess potential opportunities for recycle (e.g. for rubber-based antivibration materials, acoustic insulation, etc.) and/or for energy recovery.

Future Waste Generation

Future waste generation management will obviously depend on the future of the RTB Bor. In case further activities will be undertaken and the site will continue to be operational, current open dumping on site should be stopped.

Segregate collection of reusable/recyclable waste should be improved and waste should be sent for recycling to proper plants. A dedicated, adequately lined landfill should be designed and constructed in order to safely dispose of not-recyclable waste generated on site.

In case the site will be closed, the only future waste generation will be connected to eventual decommissioning/dismantling activities.

5.5 *ENVIRONMENTAL NOISE*

5.5.1 *Legislative Background*

An overview of Serbian legislation on environmental noise is presented in *Annex C*, as well as an overview of relavent EU legislation and WB guidelines.

The following *Table 5.34* and *Table 5.35* show respectively the Serbia standards and the WB guidelines values set for ambient noise.

Table 5.34 Serbian Noise Limits set by the Regulation on ambient noise limit values, Official Gazette of Republic of Serbia, No. 54/92

Environment	**Limit value [dB(A)]**	
	by day	by night
Dwelling houses (with closed windows)		
a) Noise source within building	35	30
b) Noise source outside the building	40	35
Public and other facilities (with closed windows)		
Hospitals, Health centres, etc.		
a) Patients room	35	30
b) Medical practises	40	40
c) Surgery rooms	35	35
Recreation and resting rooms for children and students, bed-rooms of homes for elderly people and pensioners		
a) Noise source within building	35	30
b) Noise source outside the building	40	35
Educational institutions Cinemas Reading room & libraries	40	40

Theatres and auditoriums	30	30
Hotel rooms		
a) Noise source within building	35	30
b) Noise source outside the building	40	35

Table 5.35 *WB Ambient Noise Standard (1)*

Receptor	Day (07:00-22:00)	Night (22:00-07:00)
Residential, Institutional, Educational	55	45
Industrial, Commercial	70	70

(1) Maximum allowable log equivalent (hourly measurements), in dB(A)

5.5.2 *Noise Sources, Monitoring Data and Compliance Status*

RBB Bor

Key noise sources at RBB Bor are limited to drilling activities in the open mines and crushing.

No monitoring data are available to date with regard to noise impact from the site. However, since active open mines are not positioned in the immediate vicinity of sensitive receptors, significant noise impact is considered unlikely.

RBM Majdanpek

Key noise sources at RBM Majdanpek are limited to drilling activities in the open mines and crushing.

No monitoring data are available to date with regard to noise impact from the site. However, since active open mines are not positioned in the immediate vicinity of sensitive receptors, significant noise impact is considered unlikely.

TIR Bor (smelter)

Key noise sources at TIR are limited to the presence of air abatement system devices, belt-conveyors, etc.

No monitoring data are available to date with regard to noise impact from the site. However, since no significant noise sources are present at the site, significant noise impact is considered unlikely.

5.5.3 *Summary of Environmental Findings with regard to Environmental Noise*

A noise survey should be undertaken and proper comparison with applicable standards should be performed in order to ascertain potential non compliance and necessary mitigation measures. Estimated cost for the survey is about 25,000 Euro assuming 10 monitoring points per each site (RBB Bor, RBB Veliki Krivelj, RBB Cerovo, RBM Majdanpek and TIR).

However, based on limited information available and ERM experience, noise is not regarded as a key aspect to be addressed in the frame of the due diligence.

5.6 *HAZARDOUS SUBSTANCES (CHEMICALS/OILS/COAL, ASBESTOS AND PCBS)*

This section considers the management of the following hazardous materials within the RTB Bor Complex:

- Chemicals/Oils/Coal;
- Polychlorinated Biphenyils (PCBs); and
- Asbestos.

5.6.1 *Legislative Background*

A comprehensive overview of Serbian legislation and EU and international requirements on management of hazardous substances, with particular regard to Polychlorinated Biphenyls (PCBs) and Asbestos containing materials, is reported in *Annex C.*

It has to be noted that no specific national regulation has been issued with respect to PCBs and asbestos

5.6.2 *Hazardous Substances Present at the Site, Management Practices, Monitoring Data and Compliance Status*

Chemicals/Oils/Coal

RBB Bor

A complete inventory of chemicals and oil bulk storage facilities present at the Bor, Veliki Krivelj and Cerovo sites was not undertaken so far.

Based on available information and finding of the site visits, the following chemicals/oils are present:

- Reagents (including lime and chemical agents) for the flotation process in Bor; they are stored in a building located close to the flotation plant;
- Reagents (including lime and chemical agents) for the flotation process in Veliki Krivelj; they are stored in a building located close to the flotation plant;
- Explosive materials for the exploitation activities at the Veliki Krivelj open mine;
- 1 diesel oil underground tank with a capacity of 230 m^3; the tank is used for the operations of the open pit of V. K. and Bor Complex;
- Lubricating oils for maintenance operations.

RBM Majdanpek

An inventory of chemicals and oil bulk storage facilities present at the sites is summarized in the following *Table.*

Table 5.36 *Bulk Storage of Chemicals/Oils*

No of Tanks	Content	Total Capacity (m^3)	Storage Location	Use	AST/UST*	Containment System/other	Note
n.a.	Reagents	n.a.	Flotation plant	Flotation plant	AST	Paved area	
4	Lubricating Oil	9	Open pit	Heavy vehicles repair shop	UST	No information	3 tanks for fresh oil 1 tank for waste oil
1	Lubricating Oil	1	Light vehicles repair shop	Light vehicles repair shop	AST	No information	
2	Diesel oil	100	Crushing Department		UST	No information	Owned by Jugopetrol
2	Diesel oil	130 (100+30)	Warehouse	Operations	UST	No information	Owned by Jugopetrol
2	Gasoline	60 (30+30)	Warehouse	Operations	UST	No information	Owned by Jugopetrol
1	Antifreeze	20	Warehouse	Operations	AST	No information	Owned by Jugopetrol

* AST - Aboveground storage tank; UST - Underground storage tank

No detailed information is available with regard to containment and leak detection systems.

Storing of explosives (blasting agents and dynamites) is performed in two warehouses with a covered area of 50 m^2 and 200 m^2 respectively.

The reagents currently used are:

- Collecting reagents: SKIK-B2-2020 (water solution of mercaptobenzothiazole sodium chloride) or Potasium-amyl-xanthate and sodium-isopropyl-xanthate
- pH regulators (lime cream);
- Frothers: Aerofroth 76A (mixture of the alcohols of large molecular weight) and Dowfroth 250.

The reagents are stored in a building located near the flotation plant covering an area of 429 m^2. The preparation of the reagents is carried out within the building, in kilns.

TIR Bor (smelter)

A complete inventory of chemicals and oil bulk storage facilities present at the sites was not undertaken so far.

Following chemicals/ oils are present:

- Diesel fuel for feeding the vehicles;
- Lubricating oil for maintenance operations;
- Fuel oil;
- Sulphuric acid, produced by the sulphuric acid plant;
- Coal for feeding the smelting and the power plant.

The sulphur acid storage consists of 26 tanks of a total capacity of about 28,000 t. A containment basin is present for the collection of eventual leakage/spills from the tanks.

Two different coal storage areas were observed during the site visit, the first one close to the edge of the old open pit, for the smelter feeding, and a second one close to the power plant for feeding the boilers. No proper storage procedures were implemented, the coal lies on the ground without any kind of containment nor covering.

It has to be noted that no procedure exists to properly store raw materials, chemicals and oils. They are posed often on the ground without any protection and regardless the type of the danger to environment they can cause.

PCBs

RBB Bor

No information is available so far with regard to PCBs presence at the sites. Given the age and status of the site equipment, it is highly likely that PCBs are contained in the transformers and capacitors oils.

A comprehensive inventory of all PCB-oil containing equipment installed at each site is recommended based on sampling and monitoring of potentially containing PCBs oils.
Based on the results of the inventory, a decontamination/disposal plan should be implemented according to applicable legislation.

RBM Majdanpek

No information is available so far with regard to PCBs presence at the sites. Giving the age and status of the site equipment, it is highly likely that PCBs are contained in the transformers and capacitors oils.

A comprehensive inventory of all PCB-oil containing equipment installed at each site is recommended based on sampling and monitoring of potentially containing PCBs oils. Based on the results of the inventory, a decontamination/disposal plan should be implemented according to applicable legislation.

TIR - Smelter

An inventory of potential PCBs containers present at the site has been carried out by the Company and is summarized in the following *Table*.

Table 5.37 *Inventory of Potentially Containing PCBs Equipment*

Unit	Equipment	Type	Age	Oil Weight (kg)
Smelter Unit	Oil Transformer	n.a.	n.a.	685
	Oil Transformer	AA 187000	1975	1,100
	Oil Transformer	DONX	1975	925
	Oil Transformer	PDOR 63	1987	325

Unit	Equipment	Type	Age	Oil Weight (kg)
	Oil Switches	HG 4018E	n.a.	15
	Oil Switches	HG 4018F	n.a.	21
	Oil Capacitors	48A3	n.a.	n.a.
	Oil Capacitors	48A3	n.a.	n.a.
	Oil Capacitors	48A3	n.a.	n.a.
Smelter.Unit	Oil Transformer	T3DU6	1971	720
	Oil Transformer	3TNP 20-10	n.a.	n.a.
	Oil Transformer	T3DU6	1971	720
	Oil Transformer	3TNP 20-10	n.a.	n.a.
	Oil Transformer	TP8363 1000	1988	465.5
	Oil Transformer	FE-DIU 230/3750	n.a.	n.a.
	Oil Transformer	T3N63	1979	1,000
	Oil Transformer	O-1004	1970	770
	Oil Transformer	T3DU6	1971	640
	Oil Switches	H515-1ON 630-350/6 EU	1970	n.a.
	Oil Switches	H515-1ON 1600-350/6 EU	1970	n.a.
	Oil Capacitors	CBW 10138	1971	100
	Oil Capacitors	CBW 7138	1971	75
	Oil Capacitors	PMKS	1988	7.5
	Oil Capacitors	PMKS	1991	9
EL - 2A	Oil Transformer	KLR 1135Q/10	1968	9,350
	Oil Transformer	KLR 1135Q/10	1968	9,350
	Oil Transformer	KLR 1095Q/10	1968	9,100
	Oil Transformer	KLR 1163Q/10	1961	9,600
	Oil Transformer	MSPJ 6341	1986	6,500
	Oil Transformer	909	1968	920
	Oil Transformer	809	1968	735
	Oil Switches	H515-1ON	1968	10
	Oil Switches	H515-1ON	1968	10
	Oil Switches	PU	1986	5
	Oil Capacitors	Cd 380/40	1968	n.a.
	Oil Capacitors	Cd 380/50	1968	n.a.
Power Plant	Oil Transformer	TUN 804	1960	550
	Oil Transformer	TP8368 1000	1984	650
	Oil Transformer	3TSNV 400-12E	1986	299
	Oil Transformer	WOP 163 N/45	-	150
	Oil Switches	HG3 GC	n.a.	23
	Oil Switches	HG3 6F	n.a.	35
	Oil Switches	HG3 6H	n.a.	50
	Oil Switches	PU 116M	n.a.	200
	Oil Capacitors	KHK 5003	1985	n.a.
	Oil Capacitors	PMKS 25	n.a.	n.a.
	Oil Capacitors	PMKS 50	n.a.	n.a.
Smelter Unit	Oil Switches	PU-106-350	1980	-
	Oil Switches	PU-108-350	1980	-
	Oil Switches	PU-106-350	-	2
	Oil Capacitors	KUK 5003	1985	10
	Oil Capacitors	CHVA	1979	-
	Oil Capacitors	THV	1980	6.6
	Oil Capacitors	PTK	1980	6

Unit	Equipment	Type	Age	Oil Weight (kg)
	Oil Capacitors	CHVA	1979	-
Smelter Unit	Oil Transformer	TOF 233	1971	1,110
	Oil Transformer	TP 9224	1972	750
	Oil Transformer	TOF 184	1971	450
	Oil Transformer	TP 7223	1972	350
	Oil Transformer	TOO 263	1971	640
	Oil Transformer	TOO 233	1971	515
	Oil Switches	PR 108 500	1971	-
	Oil Capacitors	CLD5	1971	10.8
	Oil Capacitors	KNK 8101	1988	10.8
	Oil Capacitors	CVG	1971	60
H_2SO_4 Plant	Oil Transformers	OF1 604	1968	1,080
	Oil Transformers	n.a.	n.a.	n.a.
	Oil Transformers	n.a.	1970	n.a.
	Oil Transformers	TP7564	1978	n.a.
	Oil Transformers	n.a.	n.a.	n.a.
	Oil Transformers	n.a.	n.a.	n.a.
	Oil Transformers	n.a.	n.a.	n.a.
	Oil Switches	H615 10/630	1968	10
	Oil Switches	H615 10630	1970	10
	Oil Switches	H615 10/1250	1968	20
	Oil Capacitors	PMKS/25	1980	n.a.
	Oil Capacitors	PMKS/100	1982	n.a.
	Oil Capacitors	PMKS/50	1982	n.a.
	Oil Capacitors	n.a.	1968	n.a.
	Oil Capacitors	n.a.	1968	n.a.
	Oil Current Transformator	ESQ0455/750	1967	450
	Oil Current Transformator	n.a.	1967	450
	Oil Current Transformator	n.a.	1967	450
	Oil Current Transformator	ESQ0355/7500	1968	850
	Oil Current Transformator	n.a.	1968	850
	Oil Current Transformator	n.a.	1968	850
	Oil Former Transformator	n.a.	1978	610
	Oil Former Transformator	n.a.	1978	610
	Oil Former Transformator	n.a.	1978	610
	Oil Former Transformator	n.a.	1978	610
	Oil Former Transformator	n.a.	1978	610
	Oil Former Transformator	n.a.	1978	610
	Oil Former Transformator	n.a.	1978	610
	Oil Former Transformator	n.a.	1978	610

Unit	Equipment	Type	Age	Oil Weight (kg)
	Oil Current Limiting Reactors	n.a.	1979	1,890
	Oil Current Limiting Reactors	n.a.	1979	1,890
	Oil Resistor Motors Starters	AO640W	1968	700
	Oil Resistor Motors Starters	AO640W	1968	700
	Oil Resistor Motors Starters	AO560W	1970	700

n.a. - not available

Reportedly, no PCB sampling of oils contained in the transformers and capacitors has ever been undertaken at the sites. Giving the age and status of the site equipment, it is likely that PCBs are contained in the transformers and capacitors oils.

A comprehensive inventory of all PCB-oil containing equipment installed at each site is recommended based on sampling and monitoring of potentially containing PCBs oils. Based on the results of the inventory, a decontamination/disposal plan should be implemented according to applicable legislation.

Two dumpsites are present within the premises of the TIR Company for storage of PCB-contaminated materials and equipment (see for details *Sections 6.4* and *6.7*). The dumpsites were created as the result of removing debris remaining after the bombing of the former site's transformer station 3 (TS3) during the Kosovo Conflict (1999). The dumpsites are located approximately 800 m northeast of the former TS3, between the flotation tailing pond RTH and the sulphuric acid plant and cover an area of approximately 4,860 m^2 and 1,574 m^2. [1]

Originally, the TS3 housed three large transformers and 160 capacitors, but one of the transformers was emptied and removed prior to the air strikes. The remaining two transformers each contained 25 tonnes of oil. Between 80 and 100 of the capacitors, each holding approximately one litre of oil, were destroyed. Analysis conducted by UNEP (1999 field mission) confirmed the presence of PCB in the capacitors oil [2].

During 1999-2000, construction material debris contaminated with PCB, PCB polluted soil and some 120 damaged PCB oil-containing capacitors were removed from the bombed TS3 and deposited at the dumpsite at different locations.

The existence of the damaged capacitor frames and the presence of building debris were confirmed by a UNEP site inspection carried out in August 2002[1]. During *ERM* site visit of February 2006, capacitor frames and construction materials were still present at the dumpsite, together with other waste.

(1) Risk Assessment of Dump Site - Bor Mining Complex, UNEP, October 2002

(2) The Kosovo Conflict - Consequences for the Environment & Human Settlements, UNEP, UNCHS,1999

Relevant oil leakages were visible over the ground, probably due to oil spillages from the damaged capacitors. As reported in UNEP report, undamaged capacitors were disassembled and stored in an indoor secured room. No information is available with regard to the location and present condition of the indoor storage room.

In August/September 2001, *UNEP* conducted an assessment at the former TS3 site in order to study the extent and levels of remaining PCB pollution in soil and associated underground water and to review the feasibility of a further remediation project. Based on the analysis performed and applying the risk-based protective level of PCB of 25 mg/kg in the surface soil it was recommended to implement the remedial alternative "No action".

In 2002, a baseline Risk Assessment of the dumpsite was performed by UNEP in order to evaluate whether the dumpsite contains contaminants that pose a threat to human health or the environment. Analytical results of soil sampling confirmed the presence of PCB in the soil in the restricted areas, mostly related to the presence of the capacitors. PCB values detected in these areas exceeded risk-based concentration corresponding to 100 times the acceptable risk levels for human exposure to PCB or its congeners and therefore these areas maybe characterized as 'hot-spots''. However, based on the analysis (1), PCB contaminant seemed to be confined to the upper soil layers and that the penetration after two years has not impacted the subsoil in depth.

The following five remedial alternatives were evaluated for suitability for the Dump Site Remediation:

- Alternative 1: No action inclusive On-Site management through engineering and institutional controls;
- Alternative 2: Excavation to protective level and off-site disposal;
- Alternative 3: Excavation to protective levels and Solidification with Stabilization and Off-site Disposal;
- Alternative 4: Excavation to protective levels and off-Site Treatment by Incineration;
- Alternative 5: Excavation to protective levels, on-Site Treatment by Indirect Thermal Desorption and Off-Site Disposal of treatment residues.

The preferred one was the alternative 2, which implies the removal of the soil to a depth of approximately 10 cm in hot spot areas, until concentration of PCB is equal to or less than the proposed Final Remediation Levels for PCB (25 mg/kg), and subsequent off-site treatment. No estimation of cost was undertaken.

No remedial action has been undertaken so far.

As long as the dumpsite will exist it will continue to pose a threat to the soil and groundwater as well as to the workers. Urgent remedial actions should

(1) Total average concentration of PCB at surface soil was of 16 211 ppm and at subsurface soil (1.1 m) was of 5 ppm. - Risk Assessment of Dump Site - Bor Mining Complex, UNEP, October 2002

be undertaken in order to reduce the risk for human exposure and environment. A preliminary cost/benefits evaluation of the alternatives proposed by UNEP is recommended.

Asbestos

No detailed ACMs Inventory and Mapping has been conducted at the sites, nor ACMs has been reported to be present at the sites.

The following potentially containing asbestos materials (PCAMs) were identified during the site visits and based on available information provided:

- Cement slabs of roofs (boilers house, facilities, belt conveyors, etc.)
- Insulating materials of boilers and pipelines;
- Pipeline gaskets.

The identified PCAMs were noticed to be in poor conditions.

A comprehensive ACMs survey should be conducted at each site in order to ascertain the presence, location and conservation status of the asbestos containing materials. Based on the results of the inventory, appropriate repair/removal/encapsulating measures should be taken in case asbestos pose a risk for human health.

5.6.3 *Summary of Environmental Findings with regard to Hazardous Substances*

An inventory of chemicals stored and handled at the site should be prepared including details regarding age and status of maintenance of the tanks/drums, environmental protection devices presence (secondary containment, leakage detection system, etc) and an environmental management plan including periodical visual inspection and integrity testing should be put in place.

A comprehensive survey of all PCB-oil containing equipment installed at each site is recommended based on sampling and monitoring of potentially containing PCBs oils. Based on the results of the inventory, a decontamination/disposal plan should be implemented according to applicable legislation. Cost estimate for the survey is 45,000 Euro assuming that a total of 45 transformers will be sampled. Following this survey, an environmental management plan including labelling and periodical visual inspection of equipment integrity should be put in place.

As long as the dumpsite will exist it will continue to pose a threat to the soil and groundwater as well as to the workers. Urgent remedial actions should be undertaken in order to reduce the risk for human exposure and environment. A preliminary cost/benefits evaluation of the alternatives proposed by UNEP is recommended.

A comprehensive ACMs inventory and mapping should be conducted at each site in order to ascertain the presence, location and conservation status

of the asbestos containing materials. Based on the results of the inventory, appropriate repair/removal/encapsulating measures should be taken in case asbestos pose a risk for human health. Cost estimate for the inventory and mapping is 50,000 Euro assuming that a total of 70 samples will be taken and analysed. Following the inventory, an environmental management plan including appropriate labelling and periodical visual inspection of conservation status of identified ACMs should be put in place.

5.7 *SOIL AND GROUNDWATER CONTAMINATION*

5.7.1 *Legislative Bckground*

An overview of Serbian legislation on soil and groundwater contamination is presented in *Annex C.*

As anticipated under *section 2.4*, soil quality standards are set by **Regulations on permitted amounts of hazardous and harmful substances in soil and water for irrigation and methods of their testing** ("Off. Jour. of RS", No. 23/94), which prescribes maximum permitted quantities of hazardous and harmful substances in soil and water for irrigation that can deteriorate or change production capacities (fertility) of agricultural land and quality of water for irrigation. As hazardous substances are considered cadmium, lead, mercury, arsenic, chromium, nickel and fluor, and harmful substances are copper, zinc and boracium.

Maximum permitted quantities of hazardous and harmful substances are listed in the following *Table*:

Table 5.38 ***Soil Standards set by Serbian Regulation (Off. Jour. of RS n. 23/94)***

Parameter	Unit	Concentration
Cadmium	mg/kg	3
Lead	mg/kg	100
Mercury	mg/kg	2
Arsenic	mg/kg	25
Chromium	mg/kg	100
Nickel	mg/kg	50
Fluorine	mg/kg	300
Copper	mg/kg	100
Zinc	mg/kg	300
Boron	mg/kg	50

As already presented in *section 2.5*, both surface and groundwater quality standards are defined, according to Serbian regulation, based on water pollution level and use. Limits are summarized in *Table 5.39* as presented in Order on Water Classification, official Gazette of Social Republic of Serbia, No. 5/68 (ecological parameters) and official Gazette of Social Republic of Serbia, No. 31/82 (chemical quality parameters). A selection of most representative parameters is presented in the following *Table*.

Table 5.39 ***Groundwater Quality Standards per Class****

Indicator	Class I	Class II	Sub-class IIa	Sub-class IIb	Class III	Class IV
Suspended solids in dry weather conditions [mg/l]	10	30	30	40	80	-
Total dissolved substances in dry weather conditions [mg/l]	800	1000	1000	1000	1500	
pH	6.8 - 8.5	6.8 - 8.5	6.8 - 8.5	6.5 - 8.5	6.0 - 9.0	-
BOD_5 [mg/l]	2	4	4	6	7	-
Most probable number of coliform germs in 100 ml of water, up to	200	6000	6000	10000	-	-
Noticeable waste materials	none	none	none	none	none	none
Colour	none	none	none	none	-	-
Smell	none	none	none	none	-	-
Cyanides	0.1	0.1	0.1	0.1	0.1	0.1
Iron (mg/l)	0.3	0.3	0.3	0.3	1.0	1.0
Copper (mg/l)	0.1 (0.01)	0.1 (0.01)	0.1 (0.01)	0.1 (0.01)	0.1	0.1
Nikel (mg/l)	0.05	0.05	0.05	0.05	0.1	0.1
Cadmium (mg/l)	0.005	0.005	0.005	0.005	0.01	0.01
Zinc (mg/l)	0.2	0.2	0.2	0.2	1	1
Arsenic	0.05	0.05	0.05	0.05	0.05	0.05

*Indicated classes are:

- Class I: water that, in natural state or after disinfection, can be used for drinking water supply, food industry and fine fish (salmonidae) breeding.
- Class II: water appropriate for bathing, recreation, water sports, less fine fish (cyprinidae) breeding, including water that, after basic treatment methods (coagulation, filtration and disinfection), can be used for drinking water supply and food industry. Class II is then divided in two further subclasses: sub-class IIa and sub-class IIb.
- Class III: water that can be used for irrigation and industries except food industry.
- Class IV: water that can be used only after special treatment.

As far as the soil quality is concerned, no regulatory requirement has been yet set up at the European level. A number of EU members have issued standard limits for soil and groundwater contamination (Germany, Italy, France, etc.).

Italian standards set by *Ministerial Decree 471/99* for key parameters for soil (both for residential and industrial landuse) and for groundwater are reported as a reference in the following *Table.*

Table 5.40 ***Soil and Groundwater Standards set by Italian Ministerial Decree 471/99***

Parameter	Soil - Residential Land Use (mg/kg)	Soil - Industrial Land Use (mg/kg)	Groundwater (µg/l)
Cadmium	2	15	5
Lead	100	1,000	10
Mercury	1	5	1
Arsenic	20	50	10
$Chromium^{VI}$	2	15	5
$Chromium^{tot}$	150	800	50
Nickel	120	500	20
Copper	120	600	1,000
Zinc	150	1,500	3,000
Boron	n.a.	n.a.	1,000

5.7.2 *Sources of Contamination, Monitoring Data and Compliance Status*

RBB Bor and TIR

Main sources of soil and groundwater contamination identified at the site include:

- Wet/dry deposition on the surface soil of air pollutants deriving from the smelter and of dusts from the tailing ponds;
- Historical and current waste dumping at the site in a number of areas including Bor open dump, as detailed in *Section 6.4;*
- Historical and past discharge of untreated wastewater effluents in rivers that led to pollution of sediments along Borska and Kriveljska rivers.

With regard to the deposition of air pollutants originated by the smelter and from the tailing ponds, land degradation is related to acidity of soil and presence of heavy metals, as detailed in *Section 2.4.*

Soil acidity and heavy metals above quality standards (copper) is detected by means of the study Impacts of the industry complex RTB Bor on the environment and public health on the territory of Bor municipality, subproject Industrial complex impacts on soil "carried out by the Centre for agriculture and technological research ", Zajecar, 1997. No detailed information was available with regard to exact location of sampling points and depth of sampling.

Existing data are however not enough for a complete characterization of soil quality in the studied area. Only very restricted areas have been subiect to appropriate soil investigation.

One of these is the waste dumping site at Bor (see *section 5.4* to which the overview is cross-referenced). Concerning soil and groundwater impact deriving from on site waste dumping, the only available document is the study Risk Assessment of Dump Site - Bor Mining Complex edited by UNEP.

In the frame of this project, a risk assessment has been conducted based on analytical results of superficial soil samples taken at depths of 0.1 m, 0.5 m and 1.5 m. The study evidenced the presence of hot-spots with high-level soil contamination with PCB and heavy metals (Pb, Zn, Cr, Cu, Hg, Cd, Ni, Cr and As). Based on the analytical results for contaminants of concern such as PCB and heavy metals, in particular Arsenic, and their spatial distribution, remedial measures have been proposed by in situ thermal desorption technique. The aim of this intervention is to restrict the extent of the polluted hot-spots to the regulatory criteria for PCB (25 ppm for US EPA). Heavy metal concentration will subsequently decrease.

For the other waste disposal sites, no monitoring data is available. A risk analysis has been recommended in *section 5.4* to evaluate the suitability of a capping solution or the removal of waste and off-site disposal. In case the off-site disposal will result the most appropriate solution, a monitoring plan on the underneath soil should be performed. In both cases, a soil and groundwater monitoring plan should be developed and implemented.

With regard to uncontrolled discharge of polluted liquid effluents into the rivers and streams, as described in *sections 2.5* and *6.3* wastewater affects river banks that are covered by solid material deposited by wastewater and deposited mine tailings (tailings overstep in the Kriveljska river basin after the collapse of a part of the dam).

As anticipated in *section 2.4*, monitoring undertaken by UNEP in 2002 has shown that analized sediments are highly contaminated with copper and arsenic.

In addition, with the aim of evaluating the possible interference of acid water existing in Bor open pit and aquifers, groundwater quality data has been collected and analysed. Details are provided in *section 2.5*. Here is pointed out that no significant impact has been detected since analyses undertaken for the three groundwater samples analized for ecological parameters, metals, methanes, by-products of disinfection, chlor alkanes, chlor ethenes, chlor benzene and volatile aromatic hydrocarbons evidenced no relevant quality problem in groundwater analized by the IPH Belgrade.

RBM Majdanpek

Key sources of soil and groundwater contamination identified at the site include:

- Existence of tailings along the river and stream basins due to the break of the tailing ponds dam;
- Interference of acid water existing in open pits and groundwater.

No data are available on soil nor on groundwater quality.

TIR Bor (smelter)

Key sources of soil and groundwater contamination have been identified in the RBB section to which the present is addressed.

5.7.3 *Summary of Environmental Findings with regard to Soil and Groundwater Contamination*

With regard to Bor, main sources of soil and groundwater contamination identified at the RTB Bor complex include: 1) Wet/dry deposition on the surface soil of air pollutants deriving from the smelter and of dusts from the tailing ponds; 2) Historical and current waste dumping at the site in a number of areas including Bor open dump, as detailed in *Section 5.4*) Historical and past discharge of untreated wastewater effluents in rivers that led to pollution of sediments along Borska and Kriveljska rivers.

With regard to the deposition of air pollutants from the smelter, available analyses of annual average values of deposition rates are referring only to the surroundings of the tailing ponds (sampling points 14, 15, 16, 17 located between the ponds and Ostrelj and sampling point 13 between tailing ponds and Veliki Krivelj). Soil samples analysed reported by UNEP (year 2002 report) indicates only copper contamination in Bor area. Soil results acid in many areas. The area potentially impacted by depositions could be estimated in 5 km radius. SO_2 emissions from metallurgical section lead to soil acidity that interacts with heavy metals dynamics. The lower the pH of soil is, the larger quantities of heavy metals are released in the soil solution. Copper, present in soil as sulphide compounds, has a very small mobility and high toxicity for plants. Arsenic presents a high adsorption in the soil and it accumulates in surface layers (0,2-0,3 m). For this reason, a superficial soil sampling is proposed in this section to ascertain potential risks for human health deriving from direct exposure and/or foodchain pathaways.

To complete existing data, a monitoring programme is proposed: a polar soil sampling network consisting of 80 sampling points individuated by the intersection of 10 concentric rings centred on the smelter with 8 radial vectors. Considering the prevalent wind directions from WNW and ENE, radial vectors will be set on the following angular distance from N and clockwise: 0°, 90°, 105°, 120°, 180°, 240°, 255°, 270°. The radius of the internal circle is 500 m and the other rings are spaced each other of a 500 m radial distance. Estimated cost for this monitoring program is about 45,000 Euro.

As previously discussed, with regard to open dumps in Bor, a risk analysis has been proposed in section 5.4 to evaluate the suitability of a capping solution or the removal of waste and off-site disposal. In case the off-site disposal will result the most appropriate solution, a monitoring plan on the underneath soil should be performed.

In both cases, a soil monitoring plan should be developed and implemented. The maximum areal extension of the area to be monitored is approximately of 40.000 m^2.

Grid sampling, based on a specified pattern with sample collection at regular intervals along that defined pattern is proposed. In this way, samples taken at regular intervals, such as at every node of the area defined by a grid will fulfil the goal of estimating spatial extension of potentially polluted soil and of hot-spots and/or to identify a pattern. Proposed grid is 20*20 m resulting in 100 sampling points. Samples should be collected at pre-determined depths of 0,2 m and 1 m (total 100 sampling locations, 200 samples to be analized). Estimated cost for this monitoring program is 85,000 Euro.

On the basis of the sampling programme, and in case contamination will be found in some areas, the following activities could be necessary:

- removal, proper storage and management of topsoil;
- on-site soil remediation.

With regard to contaminated sediments along river banks, a rough estimation could address to a linear extension of the polluted area of 25.000 m^2. A visual on site assessment and a monitoring campaign should be carried out to estimate with more detail the axial extension of contaminated sediment from the water courses (Bor river and Kriveljska river). Sediment sampling could be scheduled every 250 m on the two banks (approximately 200 samples) along the rivers' banks. Variations of the scheduled distances between sampling location could be modify in consequence of the findings of the on site assessment. Sediment samples should be analyzed for: pH, organic matter, mineral oil, hydrocarbons and heavy metals (Pb, Cd, Zn, Cu, Cr, Ni, As, Hg). Estimated cost for this monitoring program is 75,000 Euro.

On the basis of the analytical results a risk analysis should be performed to estimate the risk associated to the presence of contaminants. Consequentially, the action to be taken on areas characterized by high risk could be an of-site disposal of sediments. On areas characterized by low risk no action could be taken and natural self-treatment process of soils could led to environmental improvement as no further wastewater discharge will be performed in future.

With regard to open pit final reclamation, the following observations can be preliminarly outlined:

- Bor and Veliki Krivelj: concerning potential groundwater contamination due to the existence of Jama underground pit and Bor and Veliki Krivelj open pits, a clear connection cannot be detected. A detailed hydrogeological study should be undertaken with reference to the area including Bor and Veliki Krivelj in order to assess groundwater circulation. Based on results of this study, further actions to be undertaken could involve water pumping and treatment and stability assessment.
- Cerovo: Cerovo open pit exploitation reduced in the past years both because of the reduced copper content in the ore, till it ended. At present Cerovo open pit is partially filled with water that is acid and contains high concentrations of heavy metals (iron, copper and zinc). Water is pumped out of the pit and addressed to the ecological basin first and to a steel pipeline connecting the basin to Bor flotation plant. In case no future activity is planned at Cerovo, both the open pit and the Ecological basin should be reclaimed and revegetated. The stability of the slope of the pit and disposal site was evaluated in the main mining project of the permanent closure of Cerovo. No movements of the rock mass and no cracks in rocks have ever occurred. The pit banks are less sloped than scheduled and safety factor $F \geq 1{,}30$ determined by regulation on mining has been reached by final slopes of the open pit and disposal sites. No further steady activity is necessary. Water management at Cerovo will be performed by the following activities: 1) construction of a new rim canal around open pit catchments area

and disposal location areas. These canals should be used for drainage of the waters that gravitate towards open pit; 2) collection of all storm waters and pumping towards wastewaters treatment (see section 6.3); 3) hydrogeological detailed study to assess the depth of the aquifers. As far as water contained in the open pit is acid and contaminated, it could be necessary to keep its surface below a certain level in order to avoid potential contact with groundwater and surface water courses Cerovo and Valja Mare. Exceed water will then be pumped to a treatment plant; 4) in case further use of the pipeline is expected, replacement of the steel pipeline for water transport from ecological lake to flotation plant in Bor (14 km length) since the pipeline is in poor condition due to corrosion carried out by acid water discharged. Estimated cost for pipeline maintenance and replacement is reported in section 6.3; should activities at Cerovo be stopped, visual inpections and spot sampling of potentially impacted soil along the pipeline should be undertaken and proper measures implemented to avoid direct exposure to acid soil.

No hipotesis can be made at this stage with regard to soil and groundwater remedial needs and applicable technologies due to:

- Lack of site-specific and reliable geological/hydrogeological data;
- Limited data on soil and groundwater quality.

6 *ENVIRONMENTAL MANAGEMENT PLAN*

The present section describes the proposed EMP and includes:

- recommended mitigation measures summarising recognised environmental impacts,
- proposed environmental monitoring plan;
- recommendations with regard to the legislative and institutional framework.

6.1 *MITIGATION MEASURES*

This section presents the environmental mitigation measures proposed by the Consultants based on data collected in the frame of the Environmental Assessment process including the outline of Environemental Baseline and the Identification of Environmental Impacts which is fully detailed respectively under section 2 - *Environmental Setting* and *section 5 - Environmental Issues.*

6.1.1 *Approach and Methodology*

Environmental situation at RTB Bor is very complex for a number of different reasons. First of all, the environmental setting has been deeply influenced by historical mining activities with particular regard to geology, hydrogeology and hydrology modifications occurred. This aspect makes very complicated any identification of environmental impacts with specific regard to soil and groundwater aspects. In addition, many environmental data are available, but there is a lack of some key data e.g. adequate topographical maps, geological and hydrogeological sections. A huge amount of environmental studies have been produced in the past 10 years by a number of national and international funds.

Due to the long history of this area, environmental issues are strictly connected one to the other and any environmental aspect has to be evaluated both by itself and in relation to the consequences to other environmental issues that can occur. Finally, the Privatisation and Restructuring Program poses a number of technical issues by one side and a high level of uncertainty of which the environmental assessment had to take into account in the process of issues description and mitigation measures/clean up interventions identification. All these consideration lead to the conclusion that this area can be considered as one of the most polluted in this part of Europe.

From a qualitative point of view, it can be pointed out that the key issues at the complex are the very bad quality of air, which need urgently an intervention (closure of air polluting sources - mainly identified in the smelting complex - or modernisation of this plant) and the discharge of untreated effluents from mining activities, characterised by acidic pH and high content of heavy metals, into surface watercourses, which requires installation of adequate wastewater treatment plants and/or prevention of generation of these effluents by means of modelling and revegetation of open pits and overburden heaps. In addition to these two aspects, it is anticipated that soil and groundwater contamination may pose an additional, severe risk, that can not be quantified at this stage due to a general lack of data.

Since the situation is so complex, the Consultant is hereby proposing a phased approach, focusing on realistic, gradual interventions to be prioritised by means of an urgency criterion.

Identified environmental issues have been classified as follows:

- Immediate, high risk issues both with regard to the people and the environment.
- Chronical high risk issues both with regard to the people and the environment.

In order to give an indication of which mitigation measures are considered to be more urgent to be addressed, a prioritisation scheme (high priority - priority 1; medium priority - priority 2; long-term priority - priority 3) has been proposed according to the following criteria:

- Immediate, high risk issues both with regard to the people and the environment have been classified as priority 1.
- Chronical high risk issues both with regard to the people and the environment have been classified as priority 1, 2 or 3 based on gravity of consequences.

All mitigation measures have been prioritised as follows:
***Priority** 1* - Immediate, high risk issues both with regard to the people and the environment and chronical high risk issues that pose a real, actual threat with regard to the people;
***Priority** 2* - Chronical high risk issues with regard to the environment;
***Priority** 3* - Chronical high risk issues mainly related to environmental liabilities.

Finally, it should be highlighted that, in view of the very limited time period, preliminary nature and actual timing of this study it has not been feasible to secure even budgetary costings from major technology vendors. The Consortium has thus undertaken the cost estimation almost wholly based on in-house data and experience from similar plants and projects.

Therefore, the presented costings have to be considered as indicative estimates for budget allocation. To provide a morte detailed estimate, a more in-depth analysis of full applicability of proposed design solutions and a validation of collected data (e.g. through direct monitoring) should be undertaken.

6.1.2 *Description of Mitigation Measures*

Identified Environmental criticalities and non compliances with Serbian Legilation with proposed mitigation measures are fully described in the following tables (grouped by each facility, e.g. RBB, RBM and TIR) including:

- ID - a progressive code;
- Description of the issue - a concise description is given in the table, together with reference to the section of the study where full details are available;
- Mitigation Measure - description of proposed mitigation measures to be addressed; in case environmental monitoring is suggested, the proposed plan is included in the table and is fully discussed under *Section 6.2 - Environmental monitoring plan;*
- Priority - based on the above described approach, a prioritisation of intervention has been attributed to each proposed action, varying between 1 - high priority - and 3 long-term measure;
- Timing - a rough timeline to undertake the mitigation measure is reported based on ERM experience and available technical data;
- Estimated Cost - when estimated cost is below 25,000 Euro an indication of Minor costs is reported;
- Responsibility - a tentative indication of proposed responsibility to be set per each issue, based on ERM experience and information available to date; it should be highlighted that this indication is only a technical opinion since the attribution of responsibility is to be defined in the frame of the Privatisation Contract;
- Future Operative Option - in this column, a specification whether the issue is applicable based on future operative option as follows: C.O. = in case of continuation of facility operation; S.O. = in case of stop of facility operation; R.F.O.O. = regardlelss future operative option.

No detailed implementation schedule can be provided at this stage with regard to mitigation measures due to many uncertain issues to be defined in the course of the Privatisation Process. However, it can be anticipated that all activities classified as priority 1 should be initiated as soon as the privatisation contract will be signed. The investigation activities will have to be undertaken prior to proceeding with design details. With regard to activities classified as priority 2, these should be initiated at a maximum one year after the signature of privatisation contract. Finally, activities classified as priority 3 will be addressed in the course of the privatisation program implementation since these attain with aspects which are mainly related to economic value of the assets.

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
A	**RBB**						
	Immediate, High Risk Issues						
	Risk of environmental catastrophe						
A1.1	Tailing ponds Veliki Krivelj	A stability study is recommended including geotechnical investigation, new piezometers installation and stability analysis (see for details *Annex D* - item 1.03).	1	67,000	9 months	GoS for closed Tailing ponds; new owner for active Tailing Ponds	R.F.O.O.
A1.2		Recommended urgent measures would include seepage containment and silt wash containment (see for details *Annex D* - item 1.05-1.06).	1	252,000	9 months	GoS for closed Tailing ponds; new owner for active Tailing Ponds	R.F.O.O.
A1.3		Final rehabilitation of tailing ponds including side slopes and flat surface (see for details *Annex D* – item 1.07).	1	3,200,000	6 months earthworks + 6 months vegetation establishment + min 3yr aftercare period	GoS for closed Tailing ponds; new owner for active Tailing Ponds	R.F.O.O.
A2.1	Tailing ponds RTH	A stability study is recommended including geotechnical investigation, new piezometers installation and stability analysis (see for details *Annex D* - item 2.05).	1	67,000	9 months	GoS for closed Tailing ponds; new owner for active Tailing Ponds	R.F.O.O.
A2.2		Recommended urgent measures would include seepage containment and silt wash containment (see for details *Annex D* - item 2.01-2.02.	1	252,000	9 months	GoS for closed Tailing ponds; new owner for active Tailing Ponds	R.F.O.O.

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
A2.3		Final rehabilitation of tailing ponds including side slopes and flat surface (see for details *Annex D* - item 2.03).	1	1,800,000	6 months earthworks + 6 months vegetation establishment + min 3yr aftercare period	GoS for closed Tailing ponds; new owner for active Tailing Ponds	R.F.O.O.
A3.1	Tailing ponds Bor town	A stability study is recommended including geotechnical investigation, new piezometers installation and stability analysis (see for details *Annex D* - item 3.01).	1	67,000	9 months	GoS for closed Tailing ponds; new owner for active Tailing Ponds	R.F.O.O.
A3.2		Final rehabilitation of tailing ponds including side slopes and flat surface (see for details *Annex D* - item 3.02).	1	1,300,000	6 months earthworks + 6 months vegetation establishment + min 3yr aftercare period	GoS for closed Tailing ponds; new owner for active Tailing Ponds	R.F.O.O.
	Collector Veliki Krivelj		1				
A4.1	Option 1	In situ remediation measures to existing tunnel and collector around Field 1 and beneath Field 2 respectively.		7,000,000	N.A.	New Owner	R.F.O.O.
A4.2	Option 2	In situ remediation measures to portion of existing tunnel around Field 1 and construction of new tunnel around/beneath Field 2 on its northern (left) side.		14,550,000	N.A.	New Owner	R.F.O.O.

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
A4.3	Option 3	In situ remediation measures to portion of existing tunnel around Field 1 and construction of new tunnel near Dam 2 wall and around/beneath Field 2 on its southern (right) side		5,500,000	N.A.	New Owner	R.F.O.O.
A4.4	Option 4	Construction of new tunnel bypassing Field 1 and 2 on their southern (right) side and closing and abandonment of existing tunnel / collector system.		7,050,000	N.A.	New Owner	R.F.O.O.
A5.1	Collector Bor	Remedial work analysis and sewage pipe remedial work	1	550,000	N.A.	New Owner	R.F.O.O.
A6.1	Explosion/Burning of open dumps	Immediate securing of the open dumps to avoid access of people	1	Minor costs	1 month	New Owner	R.F.O.O.
	Immediate risk for human health						
A7.1	Risk of failure into the open pits/open dumps	Implement access restriction devices and maintain them into operation through a periodical verification service	1	Minor costs	1 month	GoS	R.F.O.O.
A7.2	Direct contact with contaminated soils	Based on available data and future monitoring to be undertaken, impacted soils mapping should be prepared and appropriate fencing/labelling should be consequently introduced	1	Minor costs	1 year	GoS	R.F.O.O.
A7.3	Ingestion of contaminated food	Based on available data with regard to soil quality, adequate land use should be ascertained; quality of water for irrigating purposes should be also monitored.	1	Minor costs	1 year	GoS	R.F.O.O.

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
	Chronical, High Risk Issues						
	Air Emissions and Quality						
A8.1	Emissions to air and ambient air monitoring should be improved	Spot sampling of air emissions, specific monitoring of particulate from tailing ponds and an air emission monitoring system with regard to ambient air (2 additional stations+equipment of existing ones with fine particulate detection system) should be introduced and the capacities for air monitoring should be set up. Monitoring details are further described under *Section 6.2*.	1	500,000 Euro for equipment and periodical analysis	6 months	New owner except for air monitoring stations (up to 210,000 Euro)	C.O.
A8.2	Dusts emission from crushing plants at Bor and Veliki Krivelj	All the ore crushing plants at Bor and Veliki Krivelj should be fitted with ventilation systems and particulate control equipment to minimise particulate emissions.	2	5 Millions euro (IMC Due Diligence estimate)	1 year	New owner	C.O.
A8.3	Particulate emissions from tailing ponds and open dumps	Flattening side slopes and re-vegetation on newly formed surfaces where deposition has been stopped.	1	Included under issues A1.3-A2.3 and A3.2 for tailing ponds; for open dumps, 16,000 Euro/ha + aftercare costs	1 year (6 months to flatten slope and initial vegetation planting plus 6 months for initial maintenance of vegetation) following closure of tailing ponds	GoS for closed Tailing ponds; new owner for active Tailing Ponds; GoS for open dumps	R.F.O.O.

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
	Wastewater Effluents						
A9.1	No reliable data are available with regard to flow rates of generated effluents	Flow rates of process water discharged should be measured and wastewater effluents monitored in order to gather reliable data for preliminary design of WWTP. See for details section 6.2	1	45,000 Euro for flow rates, minor costs for quality assessment	6 months	New owner	C.O.
A9.2	Effluents from Jama mining activities are currently discharged into surface watercourses not in compliance with Serbian standards	As long as Jama underground mine will be active and in case Borska Reka resources initiate to be exploited, this effluent should be fully treated in an adequate wastewater treatment plant. Since the AEROAKVA technology is currently treating a flow rate of 50 m^3/h, but it is reportedly sized for higher flow rate, a pre-feasibility study should be conducted to ascertain needs for plant enlarging and additional auxiliaries to be installed (water pipelines, pumping stations, chemicals storage, etc.) to ensure fully treatment of this effluent with consequent copper recovery. Cost estimate provided by AEROAKVA for plant enlarging is around 3,000,000 Euro.	2[1]	3,000,000 (Aeroakva estimate)	2 years	New owner	C.O. (in case of stop of operation, a different mitigation measure might be necessary based on hydrogeological study results)

(1) [1] assuming there is no connection with the drinking water network.

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
A9.3	Waste waters from open pit Bor and smelter complex are discharged into Bor river not in compliance with Serbian standards.	An adequate WWTP (e.g. a Wastewater treatment plant for copper recovery) should be installed and operated at the site to treat the effluents from Smelter complex and waste waters from open pit Bor for which a flow rate of 10 m^3/h is assumed based on available data. In case the Modernisation Plan for the Smelter is implemented, sulphuric acid wastewater and spent electrolyte solutions would be treated into Acid Plant n.3 (to be refurbished under the MP option). Consequently, the flow rate deriving from these two effluents (assumed to be about 5 m^3/h) would not be conveyed to this additional WWTP.	2[1]	75,000 for WWTP assuming a flow rate of 10 m^3/h (cost to be shared between RBB and TIR see also issue C4.2)	1 year	New owner	C.O.
A9.4	Wastewaters from Cerovo open pit and ecological basin	As long as contaminated rainwater is generated at Cerovo and in case further activities will be undertaken at the site, through exploitation of further Cerovo ore deposits (Cerovo 2 to Cerovo 4), a physical-chemical wastewater treatment plant will have to be installed. Preliminary estimate of treatment, based on the hypothesis to have a pH correction basin with dosing of calcium hydroxide to raise pH to 9 and a sedimentation basin for sludge precipitation, and a drying unit (filterpress).	2[1]	300,000	1 year	New owner	C.O.

(2) [1] assuming there is no connection with the drinking water network.

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
A9.5	Cerovo pipeline repair - the 14 km steel pipeline is leaking due to corrosion	The pipework should be urgently repaired in order to prevent soil and groundwater impact caused by contaminated water spillage. In addition, the pump for water supply from the open pit to the ecological basin should be replaced.	1	840,000	2 years	New owner in case the Cerovo open mine will continue to be exploited	C.O.
A9.6	Cerovo open pit	In case Cerovo will not be further exploited, rehabilitation of the open pit should be performed in order to prevent generation of contaminated effluents from the pit.	3[1]	See section soil and groundwater issue A13.3	See section soil and groundwater issue A13.3		
A9.7	Stormwater from Robule lake and other areas contaminated by stormwater runoff	Leachates from waste heaps collected at the Robule lake and potentially in other surface water basins (e.g. Ostrelj basin) should be treated in dedicated WWTP. Estimated flow rate to be treated is about 500 m^3/d. Water effluents are characterised b y low pH (around 3) and presence of Cu, Fe, Cd e Zn above permitted limits.		See below	See below		
A9.8	Mine drainage water from open pit Veliki Krivelj is discharged into Kriveliska river not in compliance with Serbian regulatory standards	Mine drainage effluents from open pit Veliki Krivelj, with an estimated flow rate of 100 m^3/h, need to be treated before final discharge since they are characterised by an acidic pH (4.4) and concentrations of copper and zinc above regulatory limits.		See below	See below		

(3) [1] assuming that geological and hydrogeological study results will not evidence any threat for human health or the environment

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
A9.9	Stormwater from waste heaps collected to the south eastern side of Veliki Krivelj, discharged into the Saraka stream not in compliance with Serbian regulatory limits	Leachates from waste heaps, with an estimated flow rate of 3,800 m^3/d, need to be treated before final discharge since they are characterised by a low pH (4.9) and high concentrations of copper and iron. As long as these effluents will be generated, proper treatment (e.g. by means of a wastewater treatment plant) must be ensured.		See below	See below		
		A pre-feasibility study should be undertaken to ascertain flow rates and input data for a detailed design of wastewater treatment plant to ensure compliance of effluents above described. However the reported costs are derived from preliminary design hypotesis to have a pH correction basin (dosing of calcium hydroxide to raise pH to 9), a sedimentation basin for sludge precipitation, and a drying unit (filterpress).	2[1]	500,000-1,000,000	2 years	New owner	C.O.
A9.10		In the long term, rehabilitation of the water basins (e.g. Robule lake) and closed open pits (e.g. Cerovo and Bor) should be performed in order to prevent generation of contaminated effluents.	3[2]	See section soil and groundwater issues A13.3-4-5.	See section soil and groundwater issues A13.3-4-5.		

(4) [1] assuming there is no connection with the drinking water network.

(5) [2] assuming that geological and hydrogeological study results will not evidence any threat for human health or the environment

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
A9.11		In the long-term, waste heaps capping/recycling to avoid overburden leaching should be addressed.	3[2]	See section waste management issue A10.4	See section waste management issue A10.4		
A9.12	Drainage waters from the dams of Veliki Krivelj, discharged into the Kriveljska river not in compliance with regulatory limits.	These effluents, with an estimated flow rate of 200 m^3/h, need to be treated before final discharge since they are characterised by suspended solids concentrations slightly above the limits. A settlement treatment should be provided in order to comply with applicable limits.	2[1]	Minor costs	6 months	New owner	C.O.
	Waste Management						
A10.1	Open dumps management (open pit Bor and open dump Bor)	Waste inventory in terms of types, amount and current location, including chemical characterisation by means of waste excavation, sampling and chemical characterisation (leachate monitoring).	1	50,000[1]	3 months	GoS	R.F.O.O.
A10.2		Risk assessment of potential impacts deriving from the presence of waste with regard to release to air, surface water, groundwater and soil).	1	60,000	6 months	GoS	R.F.O.O.
		Based on risk assessment results, the following two options are foreseen as far as mitigation measures are concerned:				GoS	

(1) [1] Cost estimate based on the assumption that inventory, characterisation and capping are required for the open pit and open dump site in Bor for which an extension of about 15,000 m^2 band 10,000 m^2 respectively has been assumed.

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
A10.3		Option 1) waste capping: wastes should be adequately profiled in order to consent stormwater runoff discharge and then capped with geomembranes and backfill soils.	3[1]	300,000	2 years	GoS	R.F.O.O.
A10.4		Option 2) waste removal and transfer to a lined landfill and soil/groundwater remedial – additional data are necessary to give a preliminary cost estimate for this option.	3[2]	To be defined based on results of issues A10.1-2 and A13.1	To be defined based on results of issues A10.1-2 and A13.1	GoS	R.F.O.O.
A10.5	Overburden disposal/reuse alternatives	Pre-feasibility studies are on going to ascertain whether any exploitation of overburden for copper recovery is economically sustainable given current high prices of copper. Once processed, the resultant residue will need to be disposed of on a new TDF. The cleaned areas will then be contoured and re vegetated.	3[3]	Studies are ongoing. For new TDF see Annex D	Studies are ongoing. For new TDF see Annex D	GoS	R.F.O.O.
A10.6	Tyres recycle and/or energy recovery	Cost-benefits analysis should be undertaken to assess potential opportunities for recycle (e.g. for rubber-based antivibration materials, acoustic insulation, etc.) and/or for energy recovery.	3[1]	50,000 euro	1 year	GoS	R.F.O.O.

(6) [1] assuming that risk assessment results will not evidence any threat for human health or the environment

(7) [2] assuming that risk assessment results will not evidence any threat for human health or the environment

(8) [3] assuming that risk assessment results will not evidence any threat for human health or the environment

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
	Noise Impact						
A11.1	Noise impact from the sites	A noise survey should be undertaken and proper comparison with applicable standards should be performed in order to ascertain potential non compliance and necessary mitigation measures.	3	Minor costs	1 month	New owner	C.O.
	Hazardous Substances						
A12.1	Chemicals/oils/coal	An inventory of chemicals stored and handled at the site should be prepared including details regarding age and status of maintenance of the tanks/drums, environmental protection devices presence (secondary containment, leakage detection system, etc) and an environmental management plan including periodical visual inspection and integrity testing should be put in place.	3	Minor costs	1 month	New owner	C.O.

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
A12.2	Asbestos containing materials	A comprehensive ACMs inventory and mapping should be conducted at each site in order to ascertain the presence, location and conservation status of the asbestos containing materials. Based on the results of the inventory, appropriate repair/removal/encapsulating measures should be taken in case asbestos pose a risk for human health. Cost estimate for the inventory and mapping is 50,000 Euro assuming that a total of 70 samples will be taken and analysed. Following the inventory, an environmental management plan including appropriate labelling and periodical visual inspection of conservation status of identified ACMs should be put in place.	3[1]	Minor costs	1 month	New owner	C.O.
A12.3	PCB-oils containing equipment	A comprehensive inventory of all PCB-oil containing equipment installed at each site is recommended based on sampling and monitoring of potentially containing PCBs oils. Based on the results of the inventory, a decontamination/disposal plan should be implemented according to applicable legislation.	3	Minor costs	1 month	New owner	C.O.

(9) [1] assuming that inventory results will not evidence any threat for human health

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
	Soil and Groundwater Impact						
A13.1	No detailed information is available with regard to local geology and hydrogeology.	A site specific survey should be undertaken at all open pits including data review, monitoring wells and boreholes drilling, corelogs preparation, freatimetry elaboration and reporting. See for details section 6.2.	1	375,000	6 months	GoS	R.F.O.O.
A13,.2	River sediments characterisation	Sediment sampling should be undertaken every 250 m on the two banks (estimated linear extension is 25,000 m resulting in approximately 200 samples). Sediment samples should be analyzed for: pH and heavy metals (Pb, Cd, Zn, Cu, Cr, Ni, As, Hg).	1	75,000	6 months	GoS	R.F.O.O.
A13.3	Abandoned open pits reclamation and revegetation - Cerovo	Cerovo - Rehabilitation of the open pit should be performed in order to prevent generation of contaminated effluents from the pit.	3[1]	To be defined based on results of the hydrogeological study	To be defined based on results of the hydrogeological study	GoS	S.O.
A13.4	Abandoned open pits reclamation and revegetation - Bor	Bor - Rehabilitation of the open pit should be performed in order to prevent generation of contaminated effluents from the pit.	3	To be defined based on results of the hydrogeological study	To be defined based on results of the hydrogeological study	GoS	S.O.

(10) [1] assuming that geological and hydrogeological study results will not evidence any threat for human health and the env ironment

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
A13.5	Robule Lake and other surface water basins reclamation	Reclamation of the water basins through waste heaps recycle/appropriate capping and revegetation should be addressed.	3	To be defined based on results of the hydrogeological study	To be defined based on results of the hydrogeological study	GoS	S.O.

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
B	**RBM**						
	Immediate, High Risk Issues						
	Risk of environmental catastrophe						
B1.1	Tailing dams Majdanpek - Valja Fudata	A stability study is recommended including geotechnical investigation, new piezometers installation and stability analysis (see for details *Annex D* - item 5.01).	1	67,000	9 months	GoS for closed Tailing ponds; new owner for active Tailing Ponds	R.F.O.O.
B.1.2		Recommended urgent measures would include seepage containment and silt wash containment (see for details *Annex D* - item 5.02-5.03).	1	127,000	9 months	GoS for closed Tailing ponds; new owner for active Tailing Ponds	R.F.O.O.
B1.3		Final rehabilitation of tailing ponds including side slopes and flat surface (see for details *Annex D* - item 5.04).	1	4,800,000	12 months earthworks + 6 months vegetation establishment + min 3yr aftercare period	GoS for closed Tailing ponds; new owner for active Tailing Ponds	R.F.O.O.
B2.1	Tailing dams Majdanpek - Saski Potok	A stability study is recommended including geotechnical investigation, new piezometers installation and stability analysis (see for details *Annex D* - item 6.01).	1	67,000	9 months	GoS for closed Tailing ponds; new owner for active Tailing Ponds	R.F.O.O.

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
B2.2		Recommended urgent measures would include lifting impoundment wall, storm water cut off trench and installation of penstock decant (see for details *Annex D* - items 6.02-6.03 and 6.04).	1	670,000	23 months	GoS for closed Tailing ponds; new owner for active Tailing Ponds	R.F.O.O.
B2.3		Final rehabilitation of tailing ponds including side slopes and flat surface (see for details *Annex D* - item 6.05).	1	3,800,000	12 months earthworks + 6 months vegetation establishment + min 3yr aftercare period	GoS for closed Tailing ponds; new owner for active Tailing Ponds	R.F.O.O.
	Chronical, High Risk Issues						
	Air Emissions and Quality						
B3.1	Emissions to air and ambient air monitoring should be improved	Spot sampling of air emissions, specific monitoring of particulate from tailing ponds and 1 monitoring station for particulate detection should be introduced and the capacities for air monitoring should be set up. Monitoring details are further described under *Section 6.2*.	1	150,000 Euro for equipment and periodical analysis	6 months	New owner except for ambient air monitoring station (up to 50,000 Euro)	C.O.

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
B3.2	No monitoring data are available to ascertain compliance of air emissions from crushing plants at Majdanpek with relevant legislation.	Based on monitoring results, crushing plants at Majdanpek should be fitted with ventilation systems and particulate control equipment to minimise particulate emissions.	2	1-2,5 Millions euro	1 year	New owner	C.O.
B3.1	Particulate emissions from tailing ponds and open dumps	Flattening side slopes and re-vegetation on newly formed surfaces where deposition has been stopped.	1	Included under issues B1.3 and B2.3 for tailing ponds; for open dumps, 16,000 Euro/ha + aftercare costs	1 year (6 months to flatten slope and initial vegetation planting plus 6 months for initial maintenance of vegetation) following closure of tailing ponds	GoS for closed Tailing ponds; new owner for active Tailing Ponds; GoS for open dumps	R.F.O.O.

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
	Wastewater Effluents						
B4.1	Filtration effluents from RBM Majdanpek, discharged into the Veliki Pek river.	These effluents are not in compliance with applicable limits for iron and copper. No estimate of wastewater flow rate is available. A preliminary study should be undertaken to assess flow rate of these effluents. Based on flow rate, the feasibility of recycling these effluents should be considered, since provision of a dedicated treatment is considered not economically sustainable.	2[1]	Minor costs for study and monitoring	6 months	New owner	C.O.
B4.2	Stormwater from overburden leaching and open pits drainage water	In the short term, monitoring should be carried out on these effluents to ascertain their quality and a preliminary estimate of the flow rates to be eventually treated should be undertaken. Based on results of the monitoring and of the hydrogeological survey, adequate WWTP provision/open pits rehabilitation should be planned and undertaken.	1	Minor cost for monitoring	6 months	New owner	R.F.O.O.
B4.3		In the long-term, waste heaps capping/recycling to avoid overburden leaching should be addressed.	3[2]	See section waste management issue B5.1	See section waste management issue B5.1		R.F.O.O.

(11) [1] assuming there is no connection with the drinking water network.

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
	Waste Management						
B5.1	Should the closed overburden disposal sites in Majdanpek be considered not suitable for reclamation and recovery of copper, (Saska, Bugarski potok and Andenzitski prst for a total area of about 50 hectares), adequate remediation should be undertaken.	Activities would include overburden capping. (wastes should be adequately profiled in order to consent stormwater runoff discharge and then capped with geomembranes and backfill soils) and revegetation.	3[1]	5-10 millions euro	2-3 years	GoS	R.F.O.O.
B5.2	Tyres recycle and/or energy recovery	Cost-benefits analysis should be undertaken to assess potential opportunities for recycle (e.g. for rubber-based antivibration materials, acoustic insulation, etc.) and/or for energy recovery.	3[1]	50,000 euro	1 year	GoS	R.F.O.O.
	Noise Impact						
B6.1	Noise impact from the sites	A noise survey should be undertaken and proper comparison with applicable standards should be performed in order to ascertain potential non compliance and necessary mitigation measures.	3	Minor costs	1 month	New owner	C.O.

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
	Hazardous Substances						
B7.1	Chemicals/oils/coal	An inventory of chemicals stored and handled at the site should be prepared including details regarding age and status of maintenance of the tanks/drums, environmental protection devices presence (secondary containment, leakage detection system, etc) and an environmental management plan including periodical visual inspection and integrity testing should be put in place.	3	Minor costs	1 month	New owner	C.O.
B7.2	Asbestos containing materials	A comprehensive ACMs inventory and mapping should be conducted at each site in order to ascertain the presence, location and conservation status of the asbestos containing materials. Based on the results of the inventory, appropriate repair/removal/encapsulating measures should be taken in case asbestos pose a risk for human health. Cost estimate for the inventory and mapping is 50,000 Euro assuming that a total of 70 samples will be taken and analysed. Following the inventory, an environmental management plan including appropriate labelling and periodical visual inspection of conservation status of identified ACMs should be put in place.	3[1]	Minor costs	1 month	New owner	C.O.

(12) [1] assuming that inventory results will not evidence any threat for human health

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
B7.3	PCB-oils containing equipment	A comprehensive inventory of all PCB-oil containing equipment installed at each site is recommended based on sampling and monitoring of potentially containing PCBs oils. Based on the results of the inventory, a decontamination/ disposal plan should be implemented according to applicable legislation.	3	Minor costs	1 month	New owner	C.O.
	Soil and Groundwater Impact						
B8.1	No detailed information is available with regard to local geology and hydrogeology.	A site specific survey should be undertaken at all open pits including data review, monitoring wells and boreholes drilling, corelogs preparation, freatimetry elaboration and reporting. See for details section 6.2.	1	250,000	6 months	GoS	R.F.O.O.
B8.2	Potential for air pollutants deposition on the soil from tailing ponds	A superficial soil sampling is proposed in an area of 2 km downwind the tailing ponds in the prevailing wind direction to ascertain potential risks for human health deriving from direct exposure and/or food chain pathways. See for details section 6.2.	1	30,000	6 months	GoS	R.F.O.O.

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
B8.3	No information with regards to river sediments characterisation	A first screening is proposed to ascertain whether any impact is detected prior to proceeding with a comprehensive monitoring campaign. River sediments sampling from Mali Pek and Veliki Pek rivers) should be undertaken one point upstream of the outlet and two points downstream on the two banks (approximately 20 samples are foreseen at this stage). See for details section 6.2.	1	25,000	6 months	GoS	R.F.O.O.

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
C	**TIR**						
	Immediate, High Risk Issues						
	Risk of environmental catastrophe						
C1.1	Explosion/Burning of open dumps	Immediate securing of the open dumps to avoid access of people	1	Minor costs	1 month	GoS	R.F.O.O.
	Immediate risk for human health						
C2.1	Risk of failure into the open pits/open dumps	Implement access restriction devices and maintain them into operation through a periodical verification service	1	Minor costs	1 month	GoS	R.F.O.O.
C2.2	Direct contact with contaminated soils	Based on available data and future monitoring to be undertaken, impacted soils mapping should be prepared and appropriate fencing/labelling should be consequently introduced	1	Minor costs	1 year	GoS	R.F.O.O.
C2.3	Ingestion of contaminated food	Based on available data with regard to soil quality, adequate land use should be ascertained; quality of water for irrigating purposes should be also monitored.	1	Minor costs	1 year	GoS	R.F.O.O.

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
	Chronical, High Risk Issues						
	Air Emissions and Quality						
C3.1	Emissions to air and ambient air monitoring should be improved	An air emission monitoring system both at the stacks (continuous for the m ain stacks and spot sampling) and with regard to ambient air (1-2 additional stations+equipment of existing ones with fine particulate detection system) should be introduced and the capacities for air monitoring should be set up. Monitoring details are further described under *Section 6.2*.	1	770,000 Euro for equipment and periodical analysis	6 months	New owner except for air monitoring stations (up to 210,000 Euro)	C.O.
C3.2	Emissions from the smelter are not in compliance with Serbian standards	Option 1) Replacing the old units with new ones constructed with modern technology[1].	1	250 Millions Euro (IMC Due Diligence estimate)	3 years	New owner	C.O.
C3.3		Option 2) Modernisation plan for the Smelter described by SNC Lavallin should be implemented including Converter Gas Handling Component and Main Modernisation Plan (Base Case).	1	63 Millions Euro (SNC Lavallin estimate)	2 years	New owner	C.O.
C3.4	Power plant emissions of particulate are not in compliance with international standards	Need for installation of electro filters to comply with international standards (WB and EU).	2	1-3 Millions euro	2 years	New owner	C.O.

(13) [1] assuming to maintain pyrometallurgic technology rather than adopting hydrometallurgic technology (SNC Lavalin)

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
	Wastewater Effluents						
C4.1	No reliable data are available with regard to flow rates of generated effluents	Flow rates of process water discharged should be measured and wastewater effluents monitored in order to gather reliable data for preliminary design of WWTP. See for details section 6.2	1	Minor costs for flow rates, minor costs for quality assessment	6 months	New owner	C.O.
C4.2	Waste waters from open pit Bor and smelter complex are discharged into Bor river not in compliance with Serbian standards.	An adequate WWTP (e.g. a Wastewater treatment plant for copper recovery) should be installed and operated at the site to treat the effluents from Smelter complex and waste waters from open pit Bor for which a flow rate of 10 m^3/h is assumed based on available data. In case the Modernisation Plan for the Smelter is implemented, sulphuric acid wastewater and spent electrolyte solutions would be treated into Acid Plant n.3 (to be refurbished under the MP option). Consequently, the flow rate deriving from these two effluents (assumed to be about 5 m^3/h) would not be conveyed to this additional WWTP.	2[1]	75,000 for WWTP assuming a flow rate of 10 m^3/h (cost to be shared between RBB and TIR see also issue A9.3)	1 year	New owner	C.O.
	Waste Management						
C5.1	Municipal waste landfill at Bor[2]	Preliminary design of landfill reclamation measures including waste compacting, covering with soil and provision of biogas abstraction and leachate collection systems	1	50,000	3 months	GoS	R.F.O.O.

(14) [1] assuming there is no connection with the drinking water network.

(2) [2] even if the municipal open dump is not generated by activities undertaken at the RTB Complex, it is included in the list of findings since it is located within the site area.

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsi bility	Comments
C5.2		Risk assessment of potential impacts deriving from the presence of waste with regard to release to air, surface water, groundwater and soil. Based on risk assessment results, the following two options are foreseen as far as mitigation measures are concerned:	1	60,000	6 months	GoS	R.F.O.O.
C5.3		Option 1) waste capping: wastes should be adequately profiled in order to consent stormwater runoff discharge and then capped with geomembranes and backfill soil.	3[1]	300,000	2 years	GoS	R.F.O.O.
		Option 2) waste removal and transfer to a lined landfill and soil/groundwater remedial - additional data are necessary to give a preliminary cost estimate for this option.	3[1]	To be defined based on results of issues C5.1-2 andA13.1	To be defined based on results of issues C5.1-2 andA13.1	GoS	R.F.O.O.
	Noise Impact						
C6.1	Noise impact from the sites	A noise survey should be undertaken and proper comparison with applicable standards should be performed in order to ascertain potential non compliance and necessary mitigation measures.	3	Minor costs	1 month	New owner	C.O.

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsibility	Comments
	Hazardous Substances						
C7.1	Chemicals/oils/coal	An inventory of chemicals stored and handled at the site should be prepared including details regarding age and status of maintenance of the tanks/drums, environmental protection devices presence (secondary containment, leakage detection system, etc) and an environmental management plan including periodical visual inspection and integrity testing should be put in place.	3	Minor costs	1 month	New owner	C.O.
C7.2	Asbestos containing materials	A comprehensive ACMs inventory and mapping should be conducted at each site in order to ascertain the presence, location and conservation status of the asbestos containing materials. Based on the results of the inventory, appropriate repair/removal/encapsulating measures should be taken in case asbestos pose a risk for human health. Cost estimate for the inventory and mapping is 50,000 Euro assuming that a total of 70 samples will be taken and analysed. Following the inventory, an environmental management plan including appropriate labelling and periodical visual inspection of conservation status of identified ACMs should be put in place.	3[1]	50,000	1 month	New owner	C.O.

(15) [1] assuming that inventory results will not evidence any threat for human healthC.O.

ID	Issue	Proposed Mitigation Measures	Priority	Cost Estimate (Euro)	Timing	Responsi bility	Comments
C7.3	PCB-oils containing equipment	A comprehensive inventory of all PCB-oil containing equipment installed at each site is recommended based on sampling and monitoring of potentially containing PCBs oils. Based on the results of the inventory, a decontamination/disposal plan should be implemented according to applicable legislation.	3	45,000	1 month	New owner	C.O.
C7.4	PCBs Dump Site	As long as the dumpsite will exist it will continue to pose a threat to the soil and groundwater as well as to the workers. Urgent remedial actions should be undertaken in order to reduce the risk for human exposure and environment. A preliminary cost/benefits evaluation of the alternatives proposed by UNEP is recommended.	3	Minor costs	6 months	GoS	R.F.O.O.
	Soil and Groundwater Impact						
C8.1	Air pollutants deposition on the soil	A superficial soil sampling is proposed in an area of 5 km radius from the smelter to ascertain potential risks for human health deriving from direct exposure and/or food chain pathways. See for details section 6.2.	1	45,000	6 months	GoS	R.F.O.O.
C8.2	Waste open dumps	Grid sampling (grid 20*20 m resulting in 100 sampling points) is proposed to monitor soil impact deriving from waste open dumps (total area estimated around 40,000 m^2). Samples should be collected at pre-determined depths of 0,2 m and 1 m (total 100 sampling locations, 200 samples to be analysed). See for details section 6.2.	1	85,000	6 months	GoS	R.F.O.O.

6.1.3 *Negative Side Effects Deriving from the Proposed Mitigation Measures*

The proposed environmental mitigation measures will obviously have a number of positive environmental impacts in terms of reduction of the pollution load and contamination status of the area.

However, in principle, it can not be excluded that implementation of the mitigation measures may be accomplished by negative environmental side effects deriving from the implementation of the mitigation measures.

The identification of negative side effects is at this stage not feasible since very little detail is available with regard to technical details (e.g. number and location of treatment facilities, necessary auxiliaries, generated wastes, etc.). However, based on ERM experience, it can be anticipated that, since no high impact treatment facilities are proposed (e.g. incinerators, abatement plants, etc.) these negative side effects are not expected to be significant.

6.2 *ENVIRONMENTAL MONITORING PLAN*

The present section describes the proposed Environmental Monitoring Plan (EMP) for the RTB Bor Complex during and after the privatisation process, when environmental mitigation measures will be defined and a program for their implementation will be agreed.

The present paragraph provides some ideas on possible monitoring program objectives, identifying the variables of concern and establishing baselines against which the nature, magnitude and significance of future changes can be evaluated.

As already mentioned, the environmental situation at RTB Bor is very complex for a number of different reasons; the most important among them are historical mining activities which have deeply influenced the environmental setting.

A huge amount of environmental studies have been produced in the past 10 years by a number of national and international funds. Nevertheless, as highlighted during the Environmental Assessment (EA) process, in the aim to describe the environmental baseline and identify the environmental impacts (which are fully detailed respectively under section 2 - *Environmental Setting* and section 5 - *Environmental Issues*), some additional information, concerning also key data (e.g. adequate topographical maps, geological and hydrogeological sections, etc.), are to be considered advisable.

The proposed EMP, as detailed in the following paragraphs, is aimed to:

- acquire new elements to complete the environmental data collection;
- provide an outline of a tool which will help to monitor the environmental data and assess the implementation and the efficiency of the agreed environmental mitigation measures.

Specifically, the scope of the EMP is to define methods, parameters, frequency and reporting of monitoring activities that will be carried out. The key objectives are to:

- demonstrate compliance with applicable treaties, laws and standards;
- assess the efficiency of the implemented mitigation measures;
- monitor the achievement of environmental objectives and targets and provide potential corrective measures;
- identify potential sources of negative environmental impact on air, water and soil;
- provide information to environmental authorities and stakeholders.

All environmental responsibilities and obligations are officially and legally addressed.

Monitoring already performed at present (which are fully detailed respectively under section 2 - *Environmental Setting* and section 5 - *Environmental Issues*) will continue.

6.2.1 Approach and Methodology

The EMP has to be the instrument that provides, on one hand, a constant updating of the state of the environment useful for keeping the mitigation process under control, and that, on the other hand, makes sure that the predefined goals are punctually achieved.

For such purpose it is proposed to appoint an Environmental Advisory Committee (EAC), gathering a group of highly qualified experts, which will have the duty to monitor the implementation of the agreed mitigation measures and monitoring activities as above specified.

The members of the EAC will be the following:

- one representative of the Municipality of Bor;
- one representative of the Privatisation Agency;
- the new owner(s);
- one representative of the Ministry for the Environment;
- one representative of NGOs;
- representatives of local communities.

The need for a similar committee for Majdanpek should be evaluated. During the final consultation meeting at Majdanpek, only few people attended and one of the participants highlighted that this low affluence was an indicator of limited environmental awareness at Majdanpek. Even if the environmental situation at Majdanpek is not critical as it is in Bor, the institution of an Environmental Advisory Committee is considered by the Consultant to be very useful to raise environmental awareness.

The members of the EAC at Majdanpek would be the following:

- one representative of the Municipality of Majdanpek;

- one representative of the Privatisation Agency;
- the new owner(s);
- one representative of the Ministry for the Environment;
- one representative of NGOs;
- representatives of local communities.

Local and national regulators together with results-oriented members of environmental groups will be invited to participate in the development and implementation of the monitoring plan.

The environmental program goals and objectives will be clearly outlined: at the beginning of the process the proposed program will be described in details.

The EAC members will:
- analyse monitoring data, evaluating the trend and comparing new data with previous ones;
- discuss and interpret monitoring results;
- suggest eventually corrective actions;
- check the implementation of foreseen mitigation measures and suggest further measures eventually required;
- report on monitoring results and mitigation work in progress; the periodic reports will be available for the population on the Municipality's Web site.

In particular, routinely meetings (every month) are foreseen to discuss progress and results and suggest measures to address findings, so that action plans can be developed in time to prevent problems. The EAC will invite the necessary cross-section of experienced stakeholders to participate in these types of discussions. A cooperative process for resolution of any potential regulatory disputes will be developed.

After each meeting, a member of the EAC will issue a report on the results and interpretation of the results, in which specifics on water, air, soil, wastes and miscellaneous environmental concerns will be noted.

The reports will help decision-makers and public institutions at the various stages of the process, with the introduction of any necessary mitigation and compensation measures and the definition of new environmental activities or corrective actions that can be taken to address the observations or findings.

The reports will be distributed to the managers responsible to ensure the implementation and effectiveness of the mitigation measures and to public authorities involved; they will also be available on the Municipality's Web site.

The reports will contain:
- the intermediate monitoring results foreseen by the EMP;
- the state of progress of the environmental programmes;

- the identification of any corrective actions.

Every six months the EAC will meet with the managers responsible to ensure the implementation and effectiveness of the mitigation measures to discuss any problems and ensure that problems are addressed.

One of the tasks of the EAC will be also to review the authority and capability of institutions at local, provincial/regional and national levels and recommend steps to strengthen or expand them so that the monitoring plan can be implemented. The recommendations may extend to new laws and regulations, new agencies or agency functions, intersectional arrangements, management procedures and training, staffing, operation and maintenance training, budgeting, and financial support.

Upon being formed, the EAC will begin an environmental monitoring training program for institutions, population and stakeholders on how to convey the importance of the monitoring plan, its goals and how their contribution and commitment could improve the success of the plan itself.

Once a year, the EAC will arrange a public conference and present results and progress.

6.2.2 *Technical Description of EMP: Environmental Data Collection*

In order to gain statistically significant environmental monitoring data, at least a 5 year monitoring program is developed and implemented, starting from the privatization process. This will allow for the establishment of background data and comparison of impacts before and after mitigation measures implementation. This is particularly important for air, water and soil quality monitoring programs.

Environmental monitoring information will be gathered for air quality, water supply, wastewater, waste management, environmental noise, hazardous substances and soil and groundwater contamination. The EMP, as detailed in the following paragraphs, provides also information on environmental monitoring protocols in terms of who is responsible for data collection and how and where the monitoring has to be performed.

The parameters taken into account in the comprehensive environmental monitoring program have been identified during the EA process and derive also from regulatory requirements. The sampling locations (when feasible) and frequencies have been chosen in order to have the appropriate spatial and temporal coverage, in relation to specific parameters or effects.

As mentioned in the previous paragraph, the monitoring results will be summarized in periodic monitoring reports, which will be published on Bor Municipality's Web site.

Monitoring measures identified for air quality, wastewater and soil and groundwater are described in the following paragraphs, including, per each issue identified, the following details:

- description of the proposed monitoring measures to be implemented;
- method/equipment to be used to carry out sampling activities;
- location of where the sample has to be taken (when feasible);
- monitoring frequency (based on ERM experience and technical data);
- estimated cost (please note that when the estimated cost is below 25,000 Euro, an indication of "minor cost" is reported).

A graphic representation of proposed monitoring points is reported in Annex A, Figure A9 (Bor Area) and Figure A10 (Majdanpek Area).

Bio-Monitoring

It is ERM's understanding that the actual interferences that the mining activities have on the surrounding flora and fauna is to date unknown. The implementation of a biological monitoring system using biological and ecological indicators would enable the assessment of the environmental impacts of the pollutants associated with such activities, helping to define their ecological footprint. The bio-monitoring system would first of all require a detailed baseline ecological study of the area allowing for a better knowledge of the adjacent ecosystem and offering first hand data on the area's biodiversity, species composition and distribution. Biological measurements are often subject to much greater variability than physical and chemical measurements, and the establishment of the true baseline conditions is crucial for the successful outcome of the measurement. The initial characterisation period should be used to measure seasonal variation, and to establish any significant correlation between biological and physical/chemical measurements.

The ecology of the surrounding area will undoubtedly be affected by the large scale changes that the area is undergoing. Once the baseline ecological characterisation has been completed, the biological indicators will provide a good indication of how the new management strategies and upgrading works are affecting the ecosystem, keeping track of the beneficial effects of the new leachate management techniques.

A lichenic monitoring is furthermore recommended in an area about 5 km radius from the main TIR stacks.

About 60 station will be selected and inside each station at least 3 plants will be used to verify the different type of lichens to evaluate a biodiversity index .

A grid of 30 x 50 cm, divided in 10 units of 15 x 10 cm will be used.

Any station will be accurately identified to facilitate the repetition of the test in different time For each tree present inside the selected station will be recorded:

- exact location (by means of GPS);
- location (exposure) of the grid;
- elevation of the grid center 8from round level);
- trunk circumference where is the grid.

The biodiversity index as proposed by Wirth 1995 will be evaluated for every station and the measurements will be repeated every year.

Air Quality

Monitoring activities foreseen for air quality and emissions to air characterisation are described in the following paragraphs.

Installation of continuous monitoring devices at main stacks present at TIR

Current monitoring of emissions from the TIR complex is made on a spot basis which do not allow to have consolidated, reliable data to ascertain compliance with regulatory limits.

The installation of continuous monitoring devices is foreseen at four key stacks which are recognised to represent major sources of emissions to air consisting of stacks from:

- roasting furnace;
- smelting furnace;
- sulphuric acid plant; and
- power plant.

Complete continuos flue gas analysis of CO, O_2, SO_2, CO_2, NO, NO_2 and Total NOx and opacity, an indirect way to measure particulate matter is essential for both efficient and environmentally acceptable performance.

Data acquisition and analysis software systems will also be installed

The devices will be connected to a computer net which will receive all the data and elaborate them to ascertain respect of applicable standards.

In case of detected values above permitted limits, an early warning system will inform site management to adopt required measures (reduction of work-load, check of efficiency of abatement system and in case stop of the activities). The data will also be monthly elaborated to keep statistics and provide information to the Muinicipality.

Estimated cost for the proposed continuous monitoring devices is about 550,000 Euro.

Spot sampling of air emissions

In order to complete the description of the air emission scenario, the following spot sampling is proposed to be underatekn:

- quarterly monitoring is proposed at the four main stacks to investigate the chemical composition of particulate for heavy metals contents (Cadmium, Lead, Copper, Zinc and Arsenic);
- quarterly monitoring of all stacks not equipped with continuous monitoring devices. These emissions should be monitored for SO_2, particulate (also for heavy metals - Cadmium, Lead, Copper, Zinc and Arsenic - contents) and NO_x.

Sampling will be undertaken by means of a sampling pump according to national and international guidelines. All the stacks will have to be provided with adequate sampling point to be positioned and realised according to national and international guidelines. Chemical analysis for parameters screening will have to be undertaken by a certified laboratory.

A minor cost is annually foreseen for equipment (provision of adequate sampling points at the stacks and sampling unit) and analysis.

Air quality monitoring in the Bor District

An integral ambient air quality monitoring system has to be established since current monitoring undertaken at Bor is not fitted with PM10 measuring devices as described in *Section* 2.7 while no monitoring at all is undertaken at Majdanpek.

With regard to the Bor area, according to the key sources of contamination installed and based on monitoring of air emissions, it is suggested that parameters to be monitored on a continuous basis will include NO_x, NO_2, CO, PM_{10}, $PM_{2,5}$, O_3: at least two of the monitoring station will be fitted with device to measure temperature, wind intensity and direction, solar radiation, rain fall and arsenic .

In particular, since four monitoring stations are already present, it is proposed to install 2 new ones. and verify the equipment of the old stations be updated to the above specifications. In particular old stations have to be fitted with fine particulate (PM_{10}) monitoring devices .

The following table specifies pollutants to be monitored and a reference method :

Elemnts	Reference measuring method
CO	NDIR (Non Dispersive InfraRed)
SO2	Fluorescence
NO_x ($NO + NO_2$)	Chemiluminescenza
O_3	UV absorption
Particolato (PM_{10} e $PM_{2,5}$)	Beta Rays Absorption

The following measurements ranges will be available

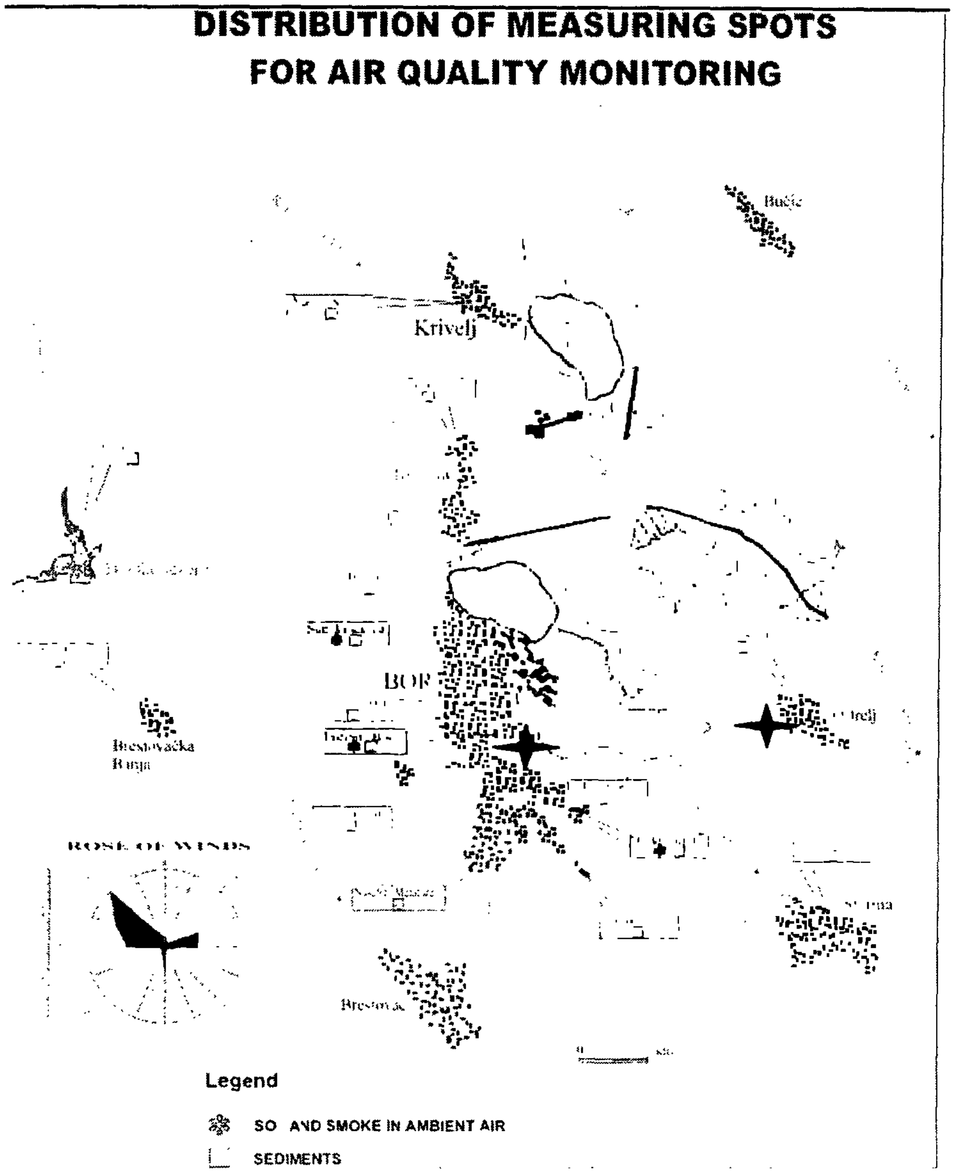
Element	Min.measurement range	Max mesuremente range
CO	0 - 10 ppm	0 - 200 ppm
SO2	0 - 50 ppb	0 - 20 ppm
NO_x ($NO + NO_2$)	0 - 50 ppb	0 - 20 ppm
O_3	0 - 100 ppb	0 - 10 ppm
Particolato (PM_{10} e $PM_{2,5}$)	0 - 100 $\mu g/m^3$	0 - 10.000 $\mu g/m^3$

Al the monitoring stations will be fitted with a data acquisition and data transmission system capable of transferring data to municipality for continuous control. In case of limit exceeding an intervention protocols has to be set up.: key personnel within site management will be trained in order to adopt required measures to reduce pollution under limits (reduction of work-load, check of efficiency of abatement system and in case stop of the activities). The data will also be monthly elaborated to keep statistics and provide information to the public.

Concentrations will also be monitored every three months for the chemical composition of particulate which will be investigated for heavy metals (Cadmium, Lead, Copper, Zinc) contents. Periodic reports will be issued (comparing the results with legislative limits) and sent to the Municipality; such reports will be available on the Municipality's WEB site.

A preliminary proposed location of the two additional monitoring stations is represented in the following figure:

Figure 6.1 *Proposed Location of Additional Monitoring Stations to be Installed in Bor Area*



Additional Monitoring Station

Based on rose winds and a preliminary evaluation of expected distance from the emission source of concentration peaks (about 1 km), it is proposed to install one monitoring station to the south of tailing ponds Old Bor and one additional station at Ostrelj.

An estimated cost of 420,000 Euro is foreseen for the equipment and minor costs for the analysis.

With regard to the Majdanpek Municipality, since no monitoring stations are present, it is proposed to install at least one for particulate monitoring. Based on wind roses and location of emission sources, it is proposed to install the monitoring station close to the main receptors, in the northern part of the village of Majdanpek, since the major expected impacts are foreseen in that area.

An estimated cost of 50,000 Euro is foreseen for the equipment and minor costs for the analysis.

Air immissions in Bor and Majdanpek, up wind and down wind from tailing ponds and reclamation areas.
In order to ascertain impact deriving from dispersion from of particulate from tailing ponds, the installation of a specific monitoring network is proposed upwind and downwind to the tailing ponds.

In particular, concentration of total particulate will be monitored on a continuous basis by means of dedicated monitoring stations to be installed upwind and downwind to each tailing pond, along the prevailing wind direction. A total of 8 monitoring stations is expected, located as detailed below:

- Tailing Ponds Old Bor and RTH Bor - one upwind and two downwind;
- Tailing Ponds Veliki Krivelj - one upwind and two downwind;
- Tailing ponds Valja Fundata and Saski Potok one upwind and one downwind.

Proposed location for Monitoring Stations is reported in Annex A, *Figure A9* and *Figure A10* respectively for Bor and Majdanpek.

Once a month (1 day of monitoring with a sampling pump) the chemical composition of particulate will be also investigated for heavy metals (Cadmium, Lead, Copper, Zinc and Arsenic) contents.

Periodic reports will be issued (comparing the results with legislative limits) and sent to the Municipalities of Bor and Majdanpek.

An estimated cost of 375,000 Euro is foreseen assuming 8 monitoring stations.

Wastewater

Monitoring activities foreseen for wastewater flow rates and quality are described in the following paragraphs.

Flow rates monitoring
Flow rates of process water discharged will be monitored on a periodical/continuous basis in order to have reliable data for preliminary design of WWTP; these effluents include: 1) wastewaters from Jama, 2) mixed effluents from Bor open pit and the smelter, 3) wastewaters from Cerovo, leachates from waste heaps collected at 4) Robule Lake and 5) Saraka stream

and 6) mine drainage effluents from open pit Veliki Krivelj, 7) drainage waters from tailing dams in Veliki Krivelj, 8) Filtration effluents from RBM.

Flow rates from rain will be evaluated based of precipitation rates, drainage surfaces and soil characteristics. The survey will require close cooperation of water specialists with site personnel who should give specific input with regard to reliability of data to be collected.

Estimated cost for this survey is about 45,000 Euro.

Wastewater quality
Generated wastewater will be analysed before and after treatment to ascertain quality of effluents discharged and to monitor efficiency of WWTPs installed.

With regard to Bor, monitoring will be undertaken every three months, to ensure that all recorded parameters are in compliance with the legislative limits in force. The analysed parameters should be the following: pH, COD, TSS, metals including - as a minimum – Cu, Fe, Zn, As, Cd, Pb, Cr, Ni; standard water sampling equipment and laboratories are required.

Assuming five WWTPs will be installed, a Minor cost is expected for monitoring every year.

As far as Majdanpek is concerned, existing monitoring procedures (quarterly) should be continued; in addition, it is suggested to monitor quality of water drainage from open pits and rainwater runoff from overburden disposal sites. Based on results of additional monitoring, (effluents to be analysed for acidity, heavy metals including arsenic), need of treatment should be assessed; should be necessary, costs for treatment of these effluents may be significant.

Minor cost is expected for monitoring every year.

Soil and Groundwater

For soil and groundwater, the following monitoring activities are foreseen:

Geology and hydrogeology
No site specific data are available with regard to geology and hydrogeology at the sites including detailed topographic maps, geological characterisation of the soil, stratigraphies, geological sections, depth of water tables (shallow and deep), groundwater flow direction.

To complete the environmental baseline regarding geology and hydrogeology, a detailed investigation is foreseen for each open pit (Bor, Veliki Krivelj, Cerovo, Northern Open Pit Majdanpek and Southern Open Pit Majdanpek) including:

- desk review of any additional data not available in the course of the present Project;

- drilling of additional piezometers (at least 10 per each open pit) to have more site-specific information. In particular, the aim is to further investigate on geological sections, stratigraphy, depth of shallow aquifer and flow direction. As a preliminary estimate, soil bores will be drilled in concentric rings out of the water level at the bottom of the pit and at a distance of minimum 100-150 m from the internal ring (4 boreholes on the internal ring (r) - indicated at P_r1, P_r2, P_r3, P_r4 to a depth of 20 m plus 4 boreholes on the external ring (R) - indicated at P_R1, P_R2, P_R3, P_R4 to a depth of 75-100 m);
- installation of additional 2 monitoring wells at each site (i9ndicated as MW1 and MW2) upgradient and downgradient the open pit.

Assuming specific studies will have to be developed for Cerovo, Veliki Krivelj, Majdanpek northern and southern pit and a more extensive study for Bor, estimated cost for this survey is about 625,000 Euro (of which about 275,000 for Majdanpek and 350,000 for Bor).

Groundwater quality

To verify the influence of the open pit mines on groundwater quality, two piezometers are foreseen, one upstream and one down stream in flow direction; cost for the installation of monitoring wells is included under the above described geological and hydrogeological survey.

Monitoring of groundwater quality should be undertaken on a periodical basis (quarterly for the first two years then the frequency might be annual in case no impact is detected). Parameters to be monitored woulkd include, as a minimum: pH, organic matter, mineral oil, hydrocarbons and heavy metals (Pb, Cd, Zn, Cu, Cr, Ni, As, Hg).

Related costs are estimated to be Minor.

River sediments characterisation

With regard to the Bor area, contaminated sediments along river banks (Bor river and Kriveljska river) will be analysed for pH, organic matter, mineral oil, hydrocarbons and heavy metals (Cadmium, Lead, Copper, Zinc, Arsenic, Chrome, Nickel and Mercury). The foreseen samples are approximately 200 (one every 250 m on the two banks, for an estimated linear extension of 25,000 m); the scheduled distances between sampling locations could be modified in consequence of the findings of the on site assessment. Monitoring should be repeated once a year to ascertain the self-treatment of the river and to monitor eventual further impacts deriving from the RTB Bor Complex. An estimated cost of 75,000 Euro is foreseen; the buyer will be responsible for such investment.

With regard to Majdanpek, due to the lack of available data with regard to river sediments quality, a first screening is proposed to ascertain whether any impact is detected prior to proceeding with a comprehensive monitoring campaign. River sediments sampling from Mali Pek and Veliki Pek rivers) should be undertaken one point upstream of the outlet and two points downstream on the two banks (approximately 20 samples are foreseen at this stage). Sediment samples should be analyzed for: pH, organic matter, mineral oil, hydrocarbons and heavy metals (Pb, Cd, Zn, Cu, Cr, Ni, As, Hg). An estimated cost of 25,000 Euro is foreseen.

Superficial soils quality

With regard to the Bor area, some samples of contaminated soils will be taken in an area (considered the most critical) of 5 km radius from the smelter, once a year. A polar soil sampling network, consisting of 80 sampling points individuated by the intersection of 10 concentric rings centred on the smelter with 8 radial vectors, is proposed. Considering the prevalent wind directions from WNW and ENE, radial vectors will be set on the following angular distance from N and clockwise: 0°, 90°, 105°, 120°, 180°, 240°, 255°, 270° (see graphic representation of sampling point locations reported in Annex A, Figure A9). The radius of the internal circle is 500 m and the other rings are spaced each other of a 500 m radial distance. Eighty superficial soil samples will be collected and analyzed for pH, organic matter, mineral oil, hydrocarbons and heavy metals (Cadmium, Lead, Copper, Zinc, Arsenic, Chrome, Nickel and Mercury). An estimated cost of 45,000 Euro is foreseen.

With regard to Majdanpek, a surface soil sampling program is proposed in an area of 2 km from the tailing ponds. A total of 40 samples are foreseen to be analysed for pH, organic matter, mineral oil, hydrocarbons and heavy metals (Cadmium, Lead, Copper, Zinc, Arsenic, Chrome, Nickel and Mercury). Estimated cost is around 30,000 Euro.

Soils quality for waste open dumps

A more accurate and detailed soil monitoring plan is proposed to be undertaken in the waste open dump area located near the RTH tailing pond in order to define what kind of remedial actions are needed also with regard to waste stored in this area (old open pit Bor and open dump Bor).

Based on available information, the hot spot area is estimated to have an extention of about 25,000 m^2(of which open pit Bor occupies about 15,000 m^2 and open dump Bor occupies about 10,000 m^2).

Grid sampling, based on a specified pattern with sample collection at regular intervals along that defined pattern is proposed. As a preliminary estimate, sampling grid 20 x 20 m is foreseen for a total of about 100 sampling points. Soil samples should be collected at pre-determined depths of 0,2 m and 1 m (total 200 samples to be analysed). In case of organoleptic evidences, preferred soil samples location/depth of sampling will be evaluated by the field geologist.

Soil samples will be analysed for pH, organic matter, mineral oil, hydrocarbons and heavy metals (Cadmium, Lead, Copper, Zinc, Arsenic, Chrome, Nickel and Mercury).

An estimated cost of 85,000 Euro is foreseen.

Soil and Groundwater Monitoring Methodology

Field Activities

Prior to field activities commencement, a Safety Plan will have to be prepared for the identification of risks related to the activities carried out at the site, due both to site characteristics and to planned investigations. The Safety Plan also includes prevention and protection measures to be adopted in order to reduce the risk for personnel involved in the planned activities.

As far as geological and hydrogeological surveys are concerned, prior to drilling commencement, a site walkover will be performed with site personnel and with the drilling company representative in order to agree the location of each soil boring, in order to reduce risks deriving from unstability of open pits slopes.

Borehole drilling and soil and groundwater sampling will be performed using USEPA procedures. Surface soil borings will be performed using a continuous coring method, using a small-size rotary drilling machine and avoiding as much as possible fluid circulation to preserve the representativity of the soil samples. Core logs will be recorded to allow stratigraphies preparation. In order to prevent potential cross-contamination, all equipment and tools will be appropriately cleaned. The sampling tools and drilling bit will be decontaminated prior to use, between each boring location and prior to departure from the site according to the following protocol: non-phosphate detergent scrub and rinse potable water. Dedicated disposable sampling equipment will be used as a first preference whenever possible to mitigate cross-contamination.

In case groundwater is detected, drilling will be stopped prior to reaching the designed depth. In order to preserve natural aquifer protective layers, no cohesive layers - if any - will be traversed with the coring tools.

Once the planned depth is reached, prior to moving the drilling machine to the next location, each boring will be filled with clean soil provided by the site (e.g. quarry sand and gravel).

Monitoring wells in the upper aquifer will be installed at a designed depth of 25 m bgl (or lower in case of shallower clay layer) using the same drilling machine used for the soil boring. A 3" PVC casing will be installed in each monitoring well, while screens will be placed from 1 m above groundwater level till well depth; a sorted gravely pack will be placed around the screens and covered by a 0.5 m thick bentonite seal.

Each monitoring well will be purged with a submersible pump and protected in a manhole cover; well head levelling will be performed to define local groundwater flow direction.

Soil and groundwater samples will be collected directly into laboratory pre-labelled bottles. During the course of sampling, care will be taken to fill the sample bottles completely and to minimize headspace. In order to ensure sample representativity, collected soil and groundwater samples will be refrigerated (at approximately 5°C) both during field works (in a dedicated refrigerator provided by the site) and for shipping to the laboratory (with refrigerated cooler-boxes with ice packs by an express courier).

Sampling and decontamination procedures adopted during the course of the site investigation will be designed to minimise the potential for cross-contamination between sampling locations. These methods will include detailed decontamination procedures, sample labelling, sample preparation, preservation and chain of custody documentation. In addition, a rigorous programme of field Quality Assurance/Quality Control (QA/QC) will be implemented (including dedicated sample containers for each analyse, pre-labelling of sample containers labelling and triplicate chain of custody documentation). In addition, recording of USEPA analytical holding times will be observed to ensure that analysis is undertaken within an acceptable time-frame.

Analytical methods for soil and groundwater chemical analysis, will have to be in compliance with national and international standards. A certified national or international laboratory will be selected in order to ensure QA/QC procedures respect and reliability of monitoring results.

6.3 LEGISLATIVE AND INSTITUTIONAL FRAMEWORK CONCLUSIONS AND RECOMMENDATIONS

6.3.1 Background

Based on results of the review of legal and institutianl framework unedartekn in the frame of the project and detailed in *Annex C*, it is highlighted that the legal framework for environmental management has gone through an important phase of development over the past few years. Four key new environmental laws have been adopted including a new Environmental Protection Law which sets out the overarching structure for a modern environmental management system. The new SEA and EIA laws are starting to work as a powerful tool for working towards more sustainable development and the IPPC law sets out a framework for a modern environmental permitting system.

A number of the necessary implementing regulations have been developed as well and more key regulations are expected to be adopted during 2006 including laws on air, waste, water and nature protection. They are all being developed according to EU standards and methodologies and aim to harmonise with EC Directives as much as possible.

The legal framework that is thus being built is of great significance as it provides for the establishment of an integral management system for natural resources, the introduction of the concept of sustainable development, prevention and control of pollution, informing the public and providing for participation in decision-making. These developments are addressing the previous problems related to the legal framework such as too many and conflicting laws, lack of regulation (eg for environmental permitting, environmental Fund, environmental management system), lack of public participation in decision-making, lack of clarity in terms of institutional responsibility etc.

In addition, autonomous province and local government are gaining more authority and a new and more important role in environmental management. There are still some problems connected to conflicts between the new environmental legislation and other laws such as the urban planning law which currently doesn't mention the need for EIA as part of the permitting process.

However, implementation and enforcement of this emerging modern legal framework is a great challenge and much remains to be done to make an impact on the ground.

Institutions at the local level cope with a lack of financial and human resources. The move towards creating greater financial independence such as through the set up of local environmental funds are a key step forward. Even though the funds expected to be collected are not nearly enough in comparison to the environmental infrastructure investment needed, they do provide a first step in the right direction and can serve as co-financing for attracting international funds. Much remains to be done in terms of training staff at the local level, set up stable coordination and cooperation mechanisms between different authorities and different levels of government, awareness raising on environment (outside as well as inside government), development of tools and guidance for the implementation of environmental laws, strengthening of the environmental inspectorate through training etc.

6.3.2 *Recommendations*

Legislation

- Further development of the legal framework in line with EC directives as planned;
- Identification and removal of conflicts between new environmental legislation and other laws;
- Adoption of the new regulation on the environmental fund within the Bor municipality, as soon as possible.

Institutional strengthening

EIA and Permitting

- Development of further tools and guidance documents to help better implementation of the EIA law.
- Training on implementation of the EIA law and IPPC permitting system at all levels;

- Strengthening of the local municipality environmental office (additional experts, additional trainings and necessary equipment, better coordination between the environmental secretariat and other offices in relevant sectoral policies and between environmental secretariat and local and republican inspections);
- Established Local Environmental Fund and training of the experts.

Inspection

- Creation of coordination mechanism between the republican inspectorate and the municipal environmental secretariats.
- Development of a strategic approach to inspection through the development of inspection plans at all levels;
- Further training for environmental inspectors;

Monitoring

- Further development of the monitoring system (clarify the role of certain elements in system and obligations of relevant subjects);
- Strengthening institutions relevant for monitoring system (especially the Agency for environmental protection);
- Solving the problem of further financing of the existing air monitoring system in Bor (guarantee will soon expire);
- Improvement of the self monitoring system in companies and coordination with local monitoring system.

Annex A

Figures

Figure [illegible] Geological and Hydrogeological Cross-Section Locations of Veliki Krivelj and Bor Mines (Scale 1:25,000)

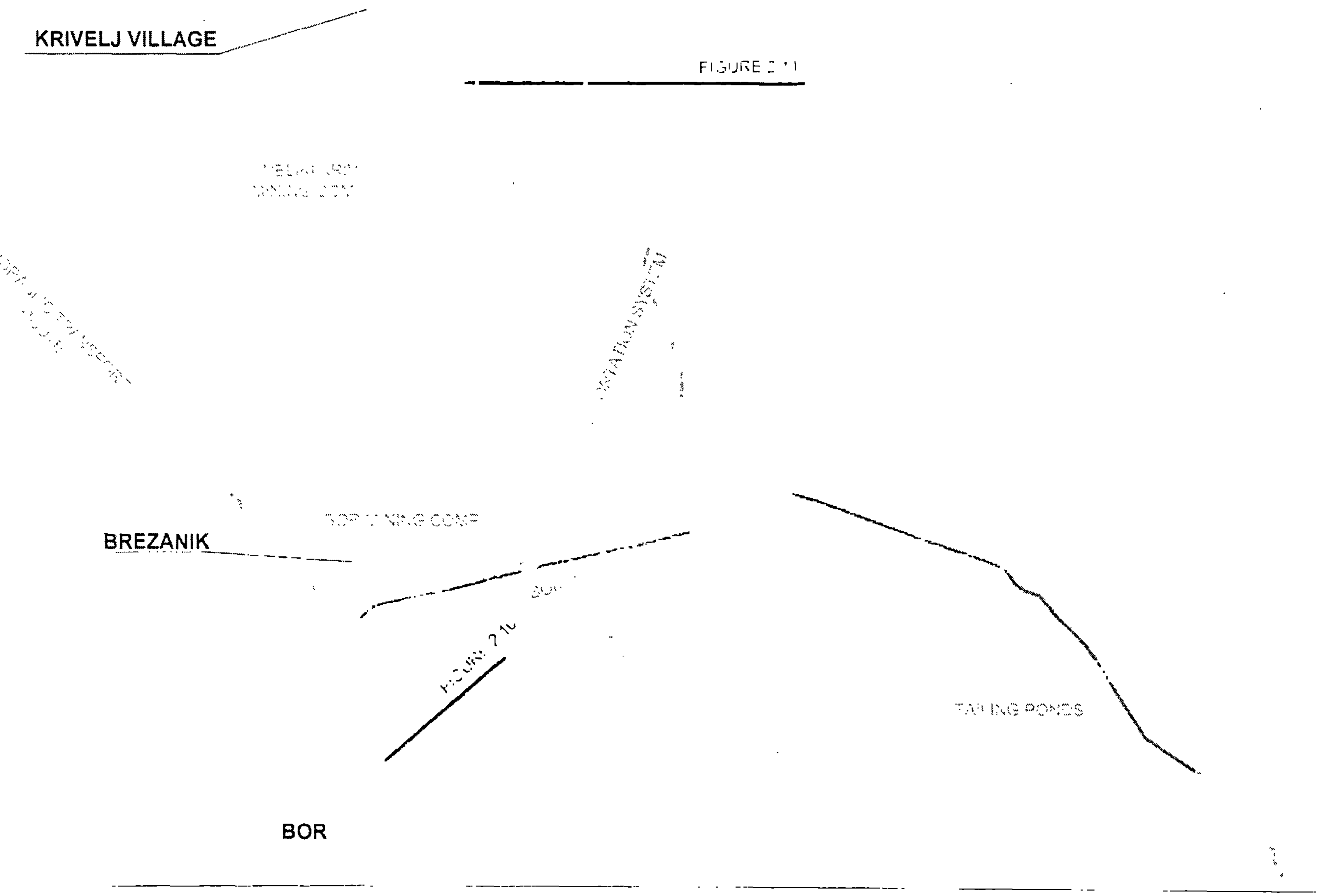


Figure A2 Bor Mining Complex Location (Scale 1:50000)

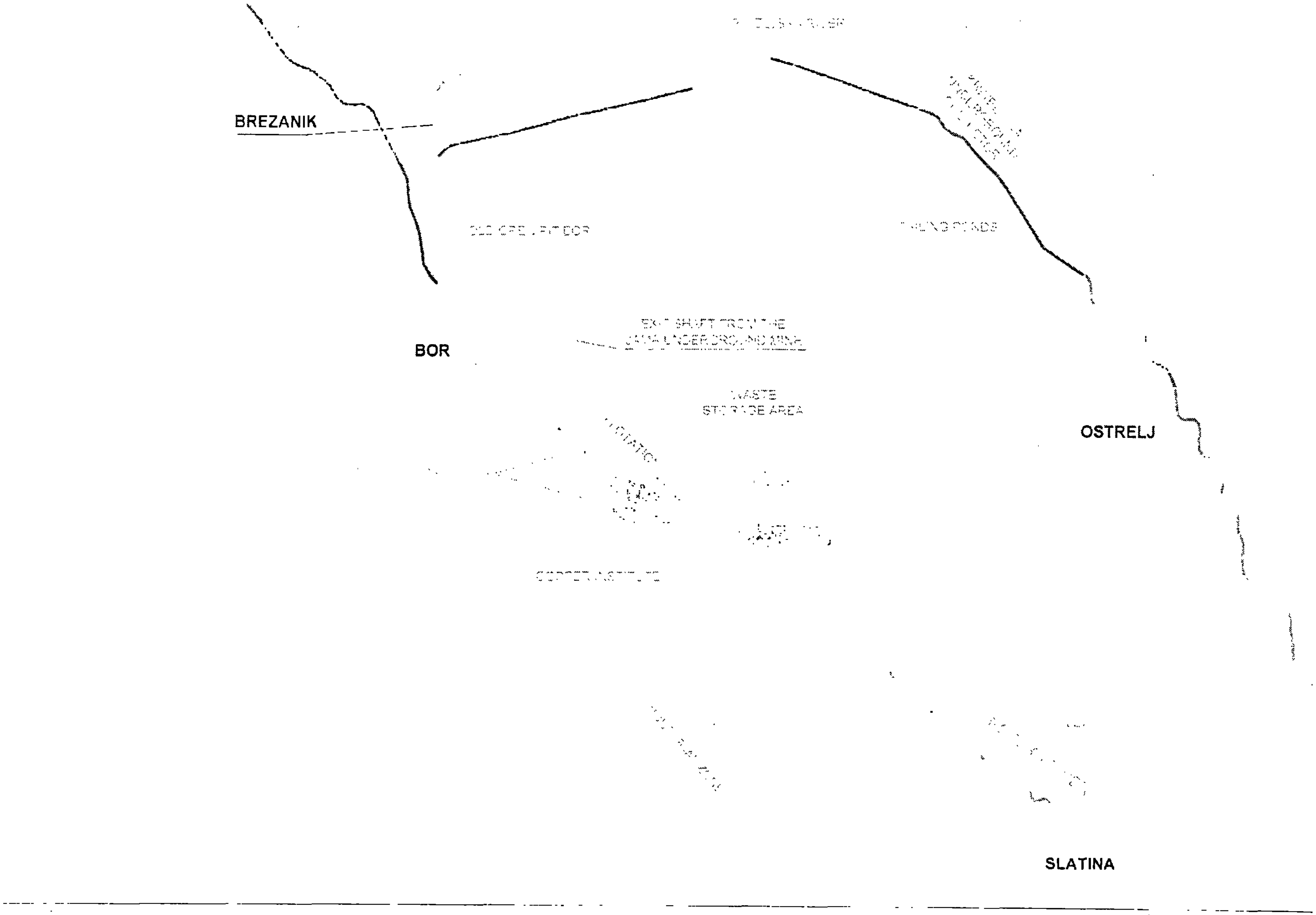


Figure 43 Veliki Krivelj Mining Complex Location (Scale 1:25 000)

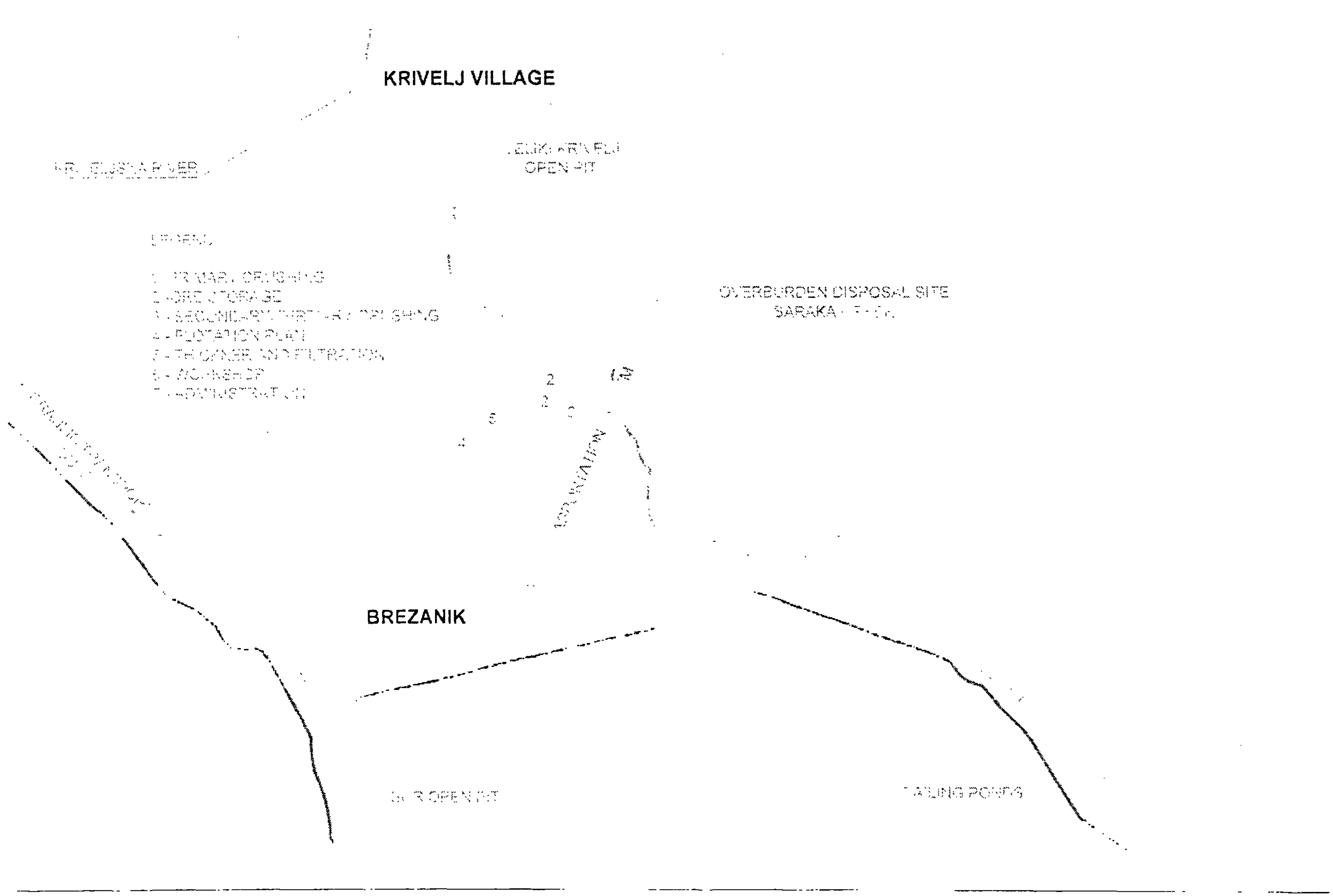


Figure A4 *Cerovo Mining Complex Location (Scale 1:25.000)*

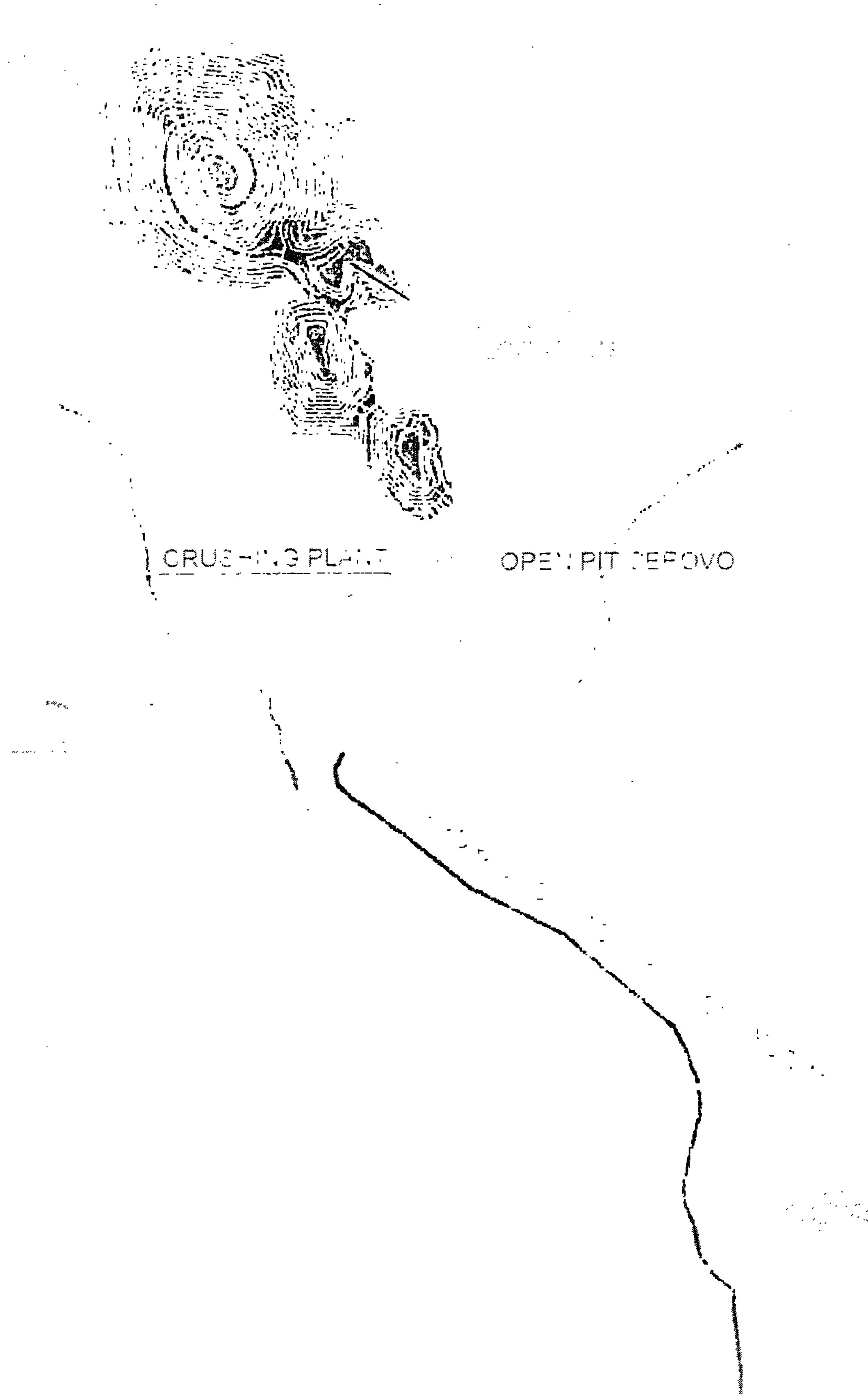


Figure A5 *Majdanpek Mining Complex (Scala 1:25.000)*

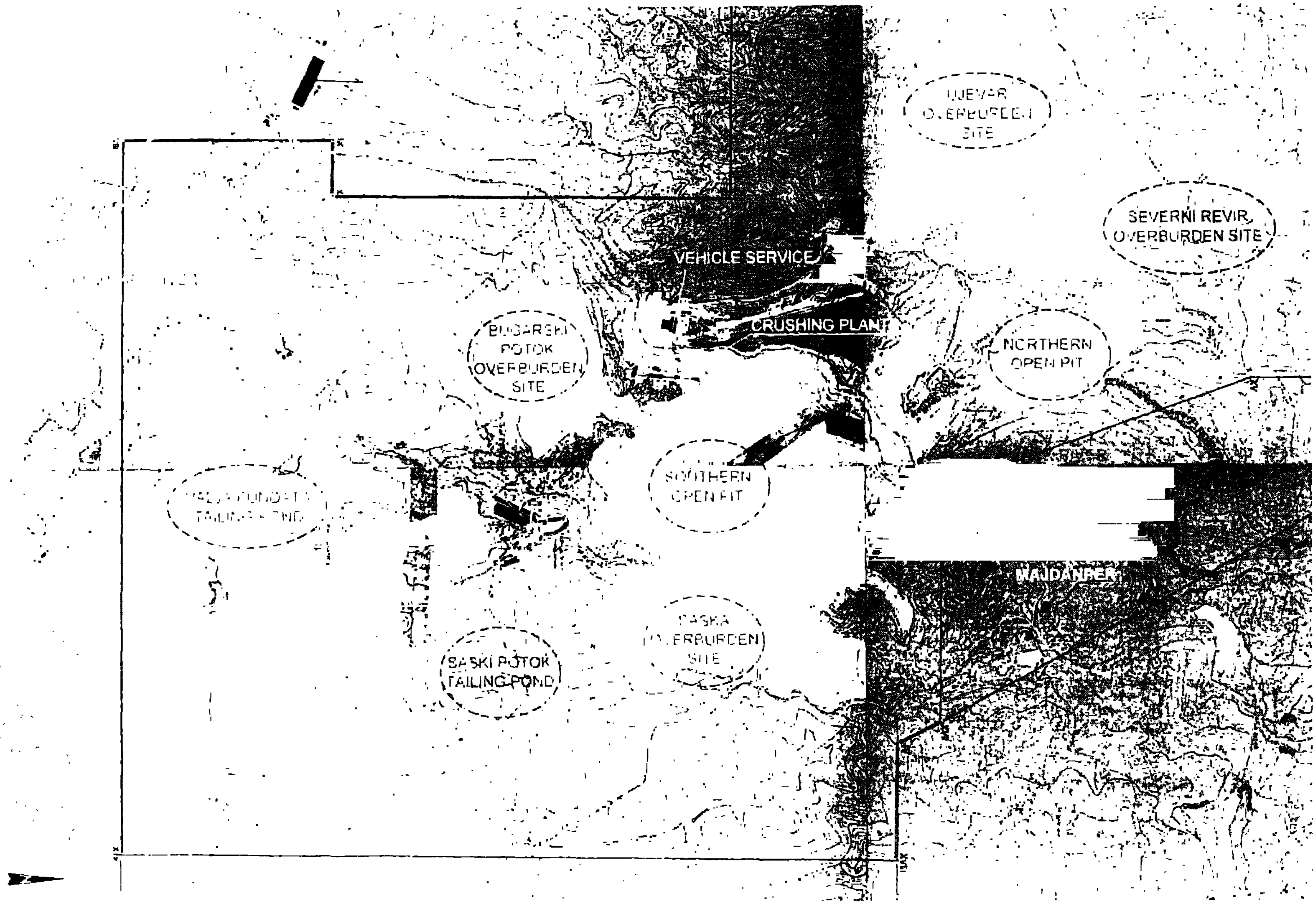


Figure A6 *Smelter and Refining Complex Layout*

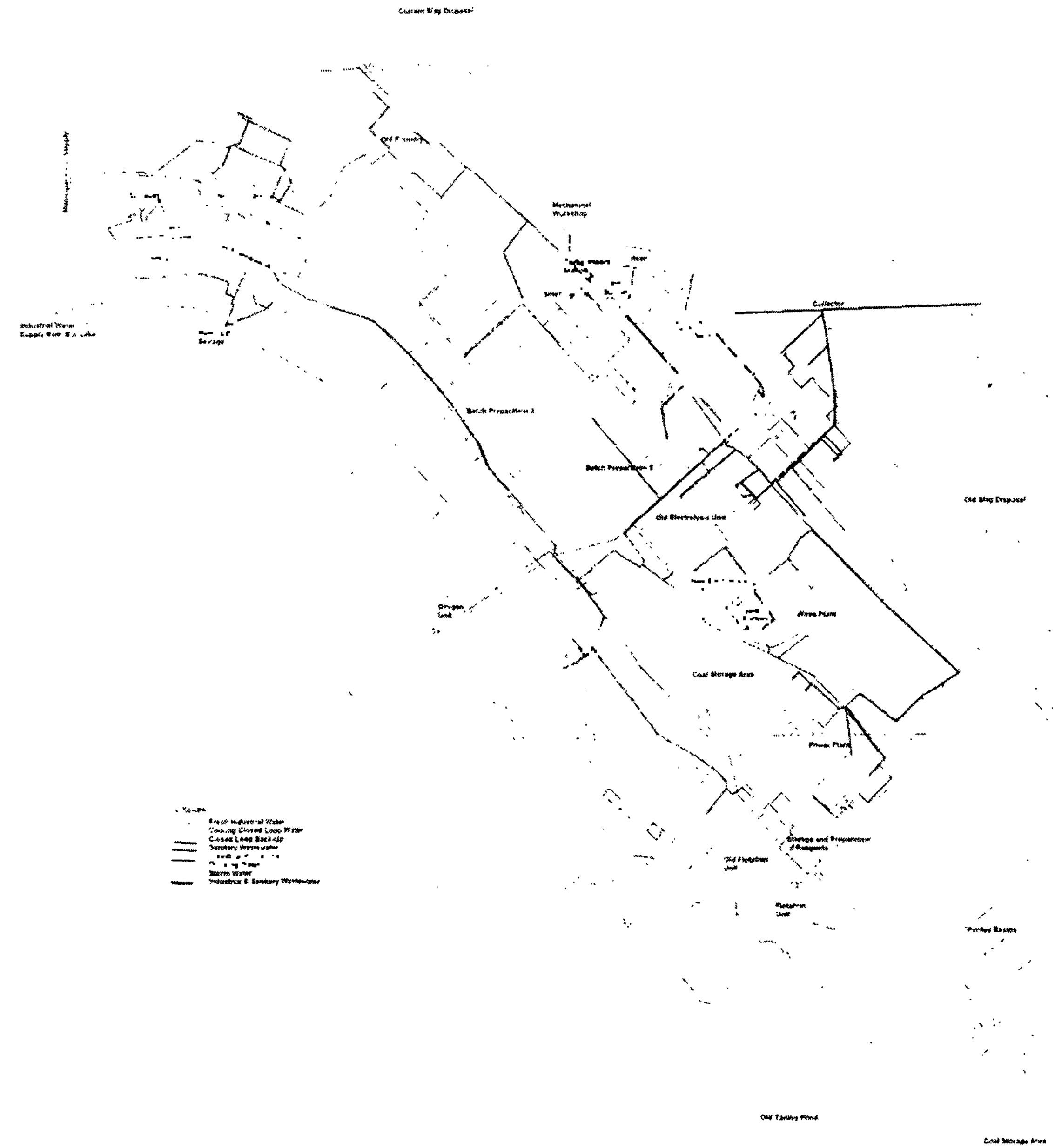


Figure 17 Groundwater, Rivers and River Sediment Sampling Point Locations (Scale 1:[illegible])

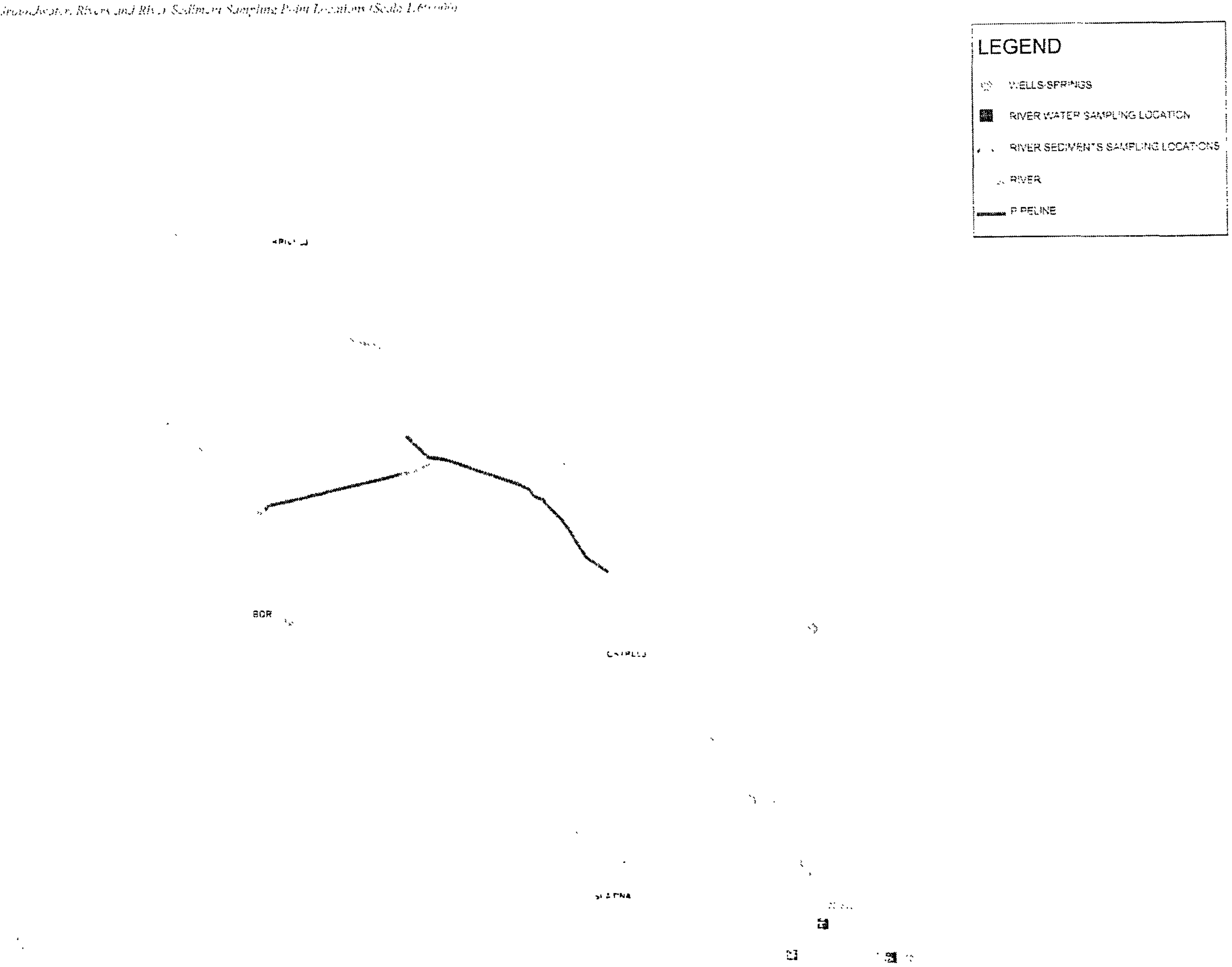


Figure 18 Waste Dumps at RBB Bor (Scale 1:25000)

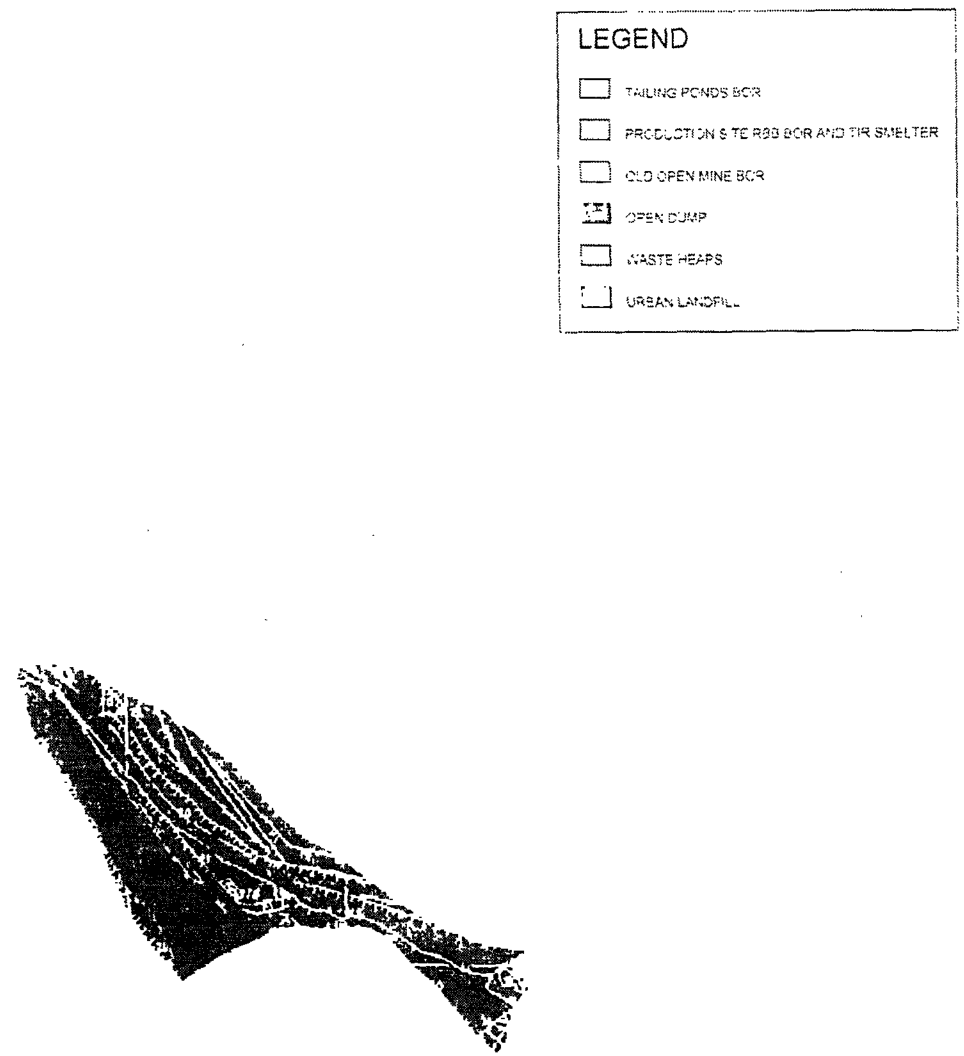
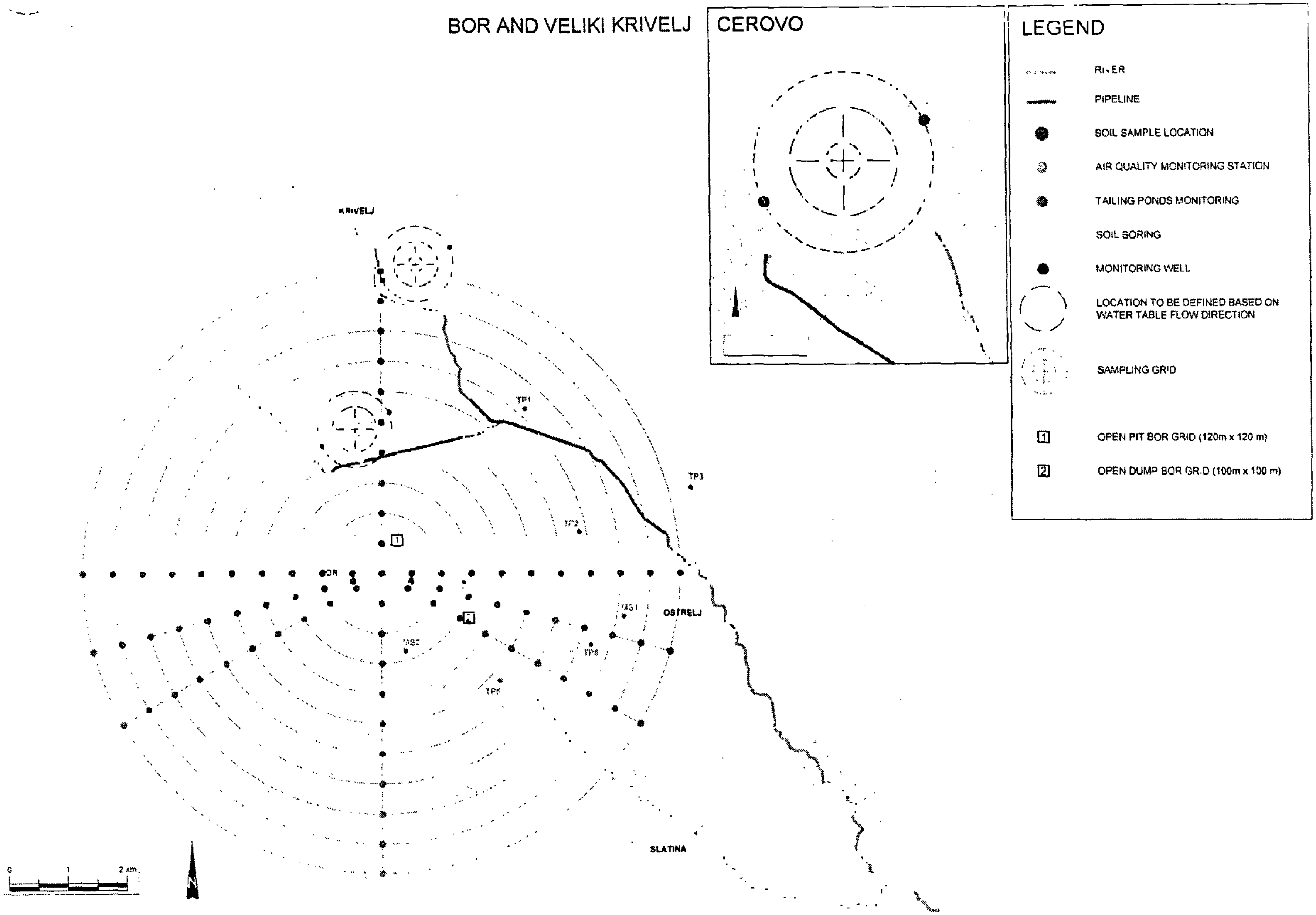
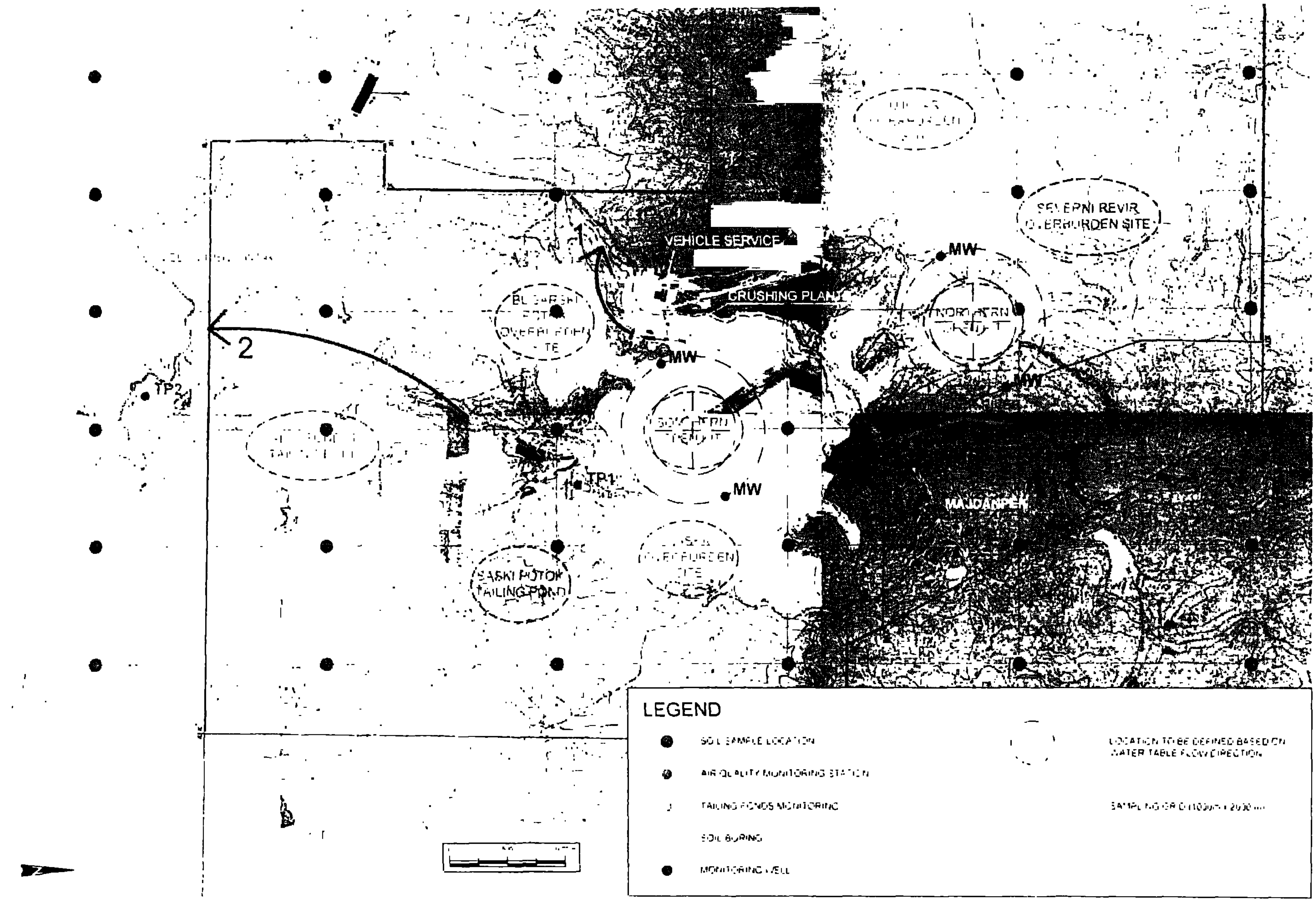


Figure A9 *Proposed Monitoring at Bor*




VEHICLE SERVICE
CRUSHING PLANT
SEVERNI REVIR OVERBURDEN SITE
MW
MW
MW
MW
TP1
TP2
2
MAJDANPEK
SASKI POTOK TAILING POND
LEGEND
SOIL SAMPLE LOCATION
AIR QUALITY MONITORING STATION
TAILING PONDS MONITORING
SOIL BORING
MONITORING WELL
LOCATION TO BE DEFINED BASED ON WATER TABLE FLOW DIRECTION

Annex B

List of Documents Collected/Reviewed

Annex B1

List of Data Reviewed by ERM

Table B1 ***List of Data Reviewed by ERM***

No.	Document Title	Author	Type of Study	Key-words	Language	Date
1	Impacts of the industry complex RTB Bor on the environment and public health on the territory of Bor municipality - Industrial complex impacts on soil	Centre for Agriculture and Technological Research, Zajecar	Study report	Soil	Serbian	1997
2	Protection of catchment area of the Krivelj River	RBB	Reports	Water	Serbian	2004
3	Economic, Environmental & Public Health Assessment, Bor Municipality, Yugoslavia, Part I, II, III	International Waste Management Group	Reports	General	English	Decembe r 2000 February 2001
4	Chemical risk assessment and environmental impact assessment from RTB Bor	MIN institute a.d.	Risk Assessment including plans for prevention measures, preparedness and emergency response	Risk Assessment	Serbian	2004
5	General description of RBB and RBM - copper mines and floatation unit	RBB/RBM	Process description	Production	Serbian	n/a
6	Wastewater Analytical Results in Bor Mines	SE Institute for quality of working surrounding and environment - 1.maj, Nis	Monitoring Report	Wastewater	Serbian	2005 2004 2003
7	Risk Assessment of Dump Bor Site Mining Complex	UNEP/UNOPS	Study report	Risk assessment	English	ott-02
8	Situation spatial plan of copper mines in Bor	RBB	Map	General	n/a	n/a
9	Air quality in the environment around copper mines	Copper Institute RTB	Reports	Air	Serbian	2005 2004 2003
10	Annual report on water consumption and protection in 2004	RBB	Report to statistical office	Water	Serbian	2004
11	LEAP Municipality Bor	LEAP office	Study report	General	English	2003
12	Information on environmental state in production	n/a	Brief description	General	Serbian	n/a

No.	Document Title	Author	Type of Study	Key-words	Language	Date
13	General description of RBM Majdanpek - copper mines and floatation unit	RBM	Brief description	General	Serbian	n/a
14	DEAP (District Environmental Action Plan) - Summary of action plans from DEAP	DHV&FIDECO	Project proposals	General	English	2004
15	Amendment to Risk Assessment of Dump site Bor Mining Complex	UNOPS/UNEP	Study report	Accident/ hazardous waste	English	2002
16	Assessment of Environmental Monitoring Capacities in Bor	UNEP	Mission report	Monitoring	English	2002
17	DEAP (District Environmental Action Plan)	DHV&FIDECO	Study report	General	Serbian	2004
18	Repair of Collector underneath Tailings Field Veliki Krivelj	DHV	draft report	Collector/Water	English	2004
19	Environmental project ideas for Bor and Majdanpek	DHV	draft report	Project proposal	English	2004
20	Preparation of project for remediation problems with wastewater collector underneath tailings field Bor	DHV	draft report	Project proposal	English	2004
21	The possible consumption of sulphuric acid in RTB Bor	Copper Institute RTB	Brief description		Serbian	2005
22	History of RTB Bor	RTB Bor	Brief description	Site History	Serbian	n/a
23	Copper production in Bor	RTB Bor	Tables		Serbian	1902 - 2005
24	Meteorological data	n/a	n/a	Air	Serbian	
25	Expert study on current state of flotation tailings pond in valley of the Krivelj River including conceptual disposal alternative	Copper Institute RTB	Study report	Project proposal	Serbian	2003
26	General description of sulphuric acid production in Bor	TIR	Brief description	General	Serbian	n/a
27	Smelting unit - production scheme	TIR	Brief description	General	Serbian	n/a
28	Power plant	TIR	Brief description	General	Serbian	2005
29	Report on air quality in Bor	Copper Institute RTB	Reports	Air	Serbian	1-9 2005 2004 2003
30	Wastewaters in TIR	TIR	Brief description	Water	Serbian	

No.	Document Title	Author	Type of Study	Key-words	Language	Date
31	Water permit	Ministry for agriculture, forest and water management - Directorate for water	Permit	Water	Serbian	2004
32	Report on testing waster quality	Health Institute Timok, Zajecar	Reports	Water	Serbian	2005
33	Situation plan of TIR		Map	General	Serbian	n/a
34	Situation plan of RBM		Map	General	Serbian	n/a
35	Technical due diligence	IMC Deloitte	Study report	General	English	n/a
36	State of the environment in Central and Eastern Europe	UNEP	Study report	General	English	2003
37	Environmental hot spots	UNEP	Study report	General	English	n/a
38	Bor LEAP	DHV	Study report	General	Serbian with Summary in English	2005
39	Demonstration project in Bor, Serbia and Montenegro	Association of Young Researchers Bor (NGO)	presentation of Pilot Project	General	English	Novembe r 2005
40	Enhancing Access to Information and Public Participation in Environmental Decision Making	UNDP GEF Danube Regional Project	presentation of Pilot Project	General	English	
41	Clean up of Environmental Hotspots - Federal Republic of Yugoslavia - Assessmetn of Monitoring Capabilities in Bor	UNEP	Assessment of Environmental Capacity Bor	Monitoring	English	March 2002
42	Proposed Activities for Bor	The Regional Environmental Center for Central and Eastern Europe	Capacity Building	Capacity Building	English	
43	Bor Environmental Assessment	Institute of Public Health of Belgrade			English	2002
45	Privatization through Restructuring of RTB Bor Group Technical Due Diligence – Environmental Issues and Management	IMC/Deloitte	Technical report	Due Diligence	English	2005
46	Smelter Data [Relevant Sections] discharges	IMC/Deloitte	Charts		Serbian	

No.	Document Title	Author	Type of Study	Key-words	Language	Date
47	Urban Spatial Plan - Municipality of Majdanpek	Institute for Urbanism and Communal Issues, Belgrade	Technical Plan	Urban Spatial Plan	Serbian	1996
48	Industrial Wastewaters Treatment Technolgies	RTB Bor		Wastewaters		2005
49	Accident in Saski Potok Tailings Pond	Republican inspectors	Records from the site visit	Tailings Pond		1996
50	AGENDA 21 - 7/1935	EKOAGENDA 7/1935	General	General	English	2003
51	Bor tailings pond	RTB Bor	Description	Tailings Pond	English	2006
52	List of Potential PCB's Containers	TIR	Description	PCB		
53	Main mining project for the closure of the Cerovo copper mine - Executive Summary		Remediation Activities	Cerovo	English	
54	Veleiki Krivelj - Collector Remediation Options		Map	Veliki Krivelj - Collector	Serbian	
56	LEAP Bor district	HNB/FIDECO 2005	Summary report		English	
57	Environmental Action Plan for the Energy and Mining Sectors in Serbia	E&M WG	NEAP Final Report Energy and Mining	energy sector	English	2004
58	Strategy for Serbia and Montenegro	European Bank for Reconstruction and Development	Strategy EBRD	National Strategy	English	2004
59	Serbia and Montenegro - Country Environmental Analysis	World Bank	World Bank Report	Country Analysis	English	2003
60	Smelter Process Data	TIR		Fuel consumption, Coal quality	English	2006
61	Air emission analytical results - Jama Underground Mine	RBM	Monitoring Report	Air emission - Jama Underground Mine	Serbian	2003, 2004, 2005
62	Air emission analytical results - Smelter	TIR	Monitoring Report	Air emission - Smelter	Serbian	2005
63	Water Quality	Public Utility Company "Vodovod", Bor	Monitoring Report	Water	Serbian	2005
64	Chemical Characterization of tailings - Bor and Majdanpek	RBB, RBM	Chemical Report	Tailings Chemical Composition	Serbian	2005

Annex B2

Documentation and Table of References in regard to the TDF assessment undertaken in March 2006

Table B2 ***Documentation and Table of References in regard to the TDF assessment undertaken in March 2006***

N.	Reference	Compiled by	Date
1	Various reports of inspectors from the Ministry for environmental protection following the accident at Saski Potok	Inspectors	1996
2	Various reports of inspectors from the Ministry for agriculture, forestry and water management following the accident at Saski Potok	Inspectors	
3	Assessment of danger from chemical accident and environmental pollution for RTB Bor factories, Bor	Unknown	Unknown
4	Environmental Assessment of RTB Bor Operations First Draft	ERM	Feb 2006
5	Information on Bor Mining and Smelting Works (RTB Bor) Copper Mines Bor (RBB	Slavisa Stefanovic, B.Sc	21st July 2005
6	Local Environmental Action Plan Municipality Bor	Citizen's Forum Technical Expert Team Leap Office	September 2003
7	Executive summary from Main mining project for the closure of the Cerovo copper mine	Expert Study	Unknown
8	Portion of Technical Due Diligence Environmental Issues and management	IMC Deloitte	Unknown
9	Environmental Assessment of the Environmental Damages from Past Operations of RTB Bor – Technical Proposal	ERM	Oct 2005
10	Environmental Project Ideas for Bor and Majdanpek - Draft	Directorate for Environmental Protection by Erik Solbu	20 November 2004
11	Preparation of Project for Remediation of Problems with Wastewater Collector underneath Tailings Field Bor - Draft	Directorate for Environmental Protection by Erik Solbu	20 November 2004
12	Repair of Collector underneath Tailings Field Veliki Krivelj - Draft	Directorate for Environmental Protection by Erik Solbu	20 November 2004

Annex C

Legislative and Institutional Framework

C1 REGULATORY AND INSTITUTIONAL FRAMEWORK

C1.1 BACKGROUND

The field of environmental protection in Serbia is regulated by a considerable number of legal and sub-legal acts at the national level as well as by international treaties ratified by Serbia and Montenegro (1). Over the past few years, as a general characteristic, these regulations have been harmonized as much as possible with contemporary international tendencies and standards, primarily those of the European Union. In fact, all newly proposed legislation now has to be accompanied by an analysis on the level of its harmonization with the relevant EU Directives.

Many new legal acts and regulations have been developed and adopted recently and more are still under preparation (e.g. waste management, nature protection, water protection, air protection, ionizing radiation, etc). Overall, this brings the environmental legislation to a well-developed framework moving closely towards the standards from EU directives.

In addition, a draft of the National Environmental Strategy has been prepared during 2005 and sets out the strategic issues of national environmental policy (2). A number of sectoral strategies (e.g. water, waste, energy, agriculture) have also been developed as well as Local Environmental Action Plans (LEAP, including one for the Bor region).

Some non-environmental specific legal documents recognise the importance of environment as follows:

- The Constitution of the Republic of Serbia ("Off. Journal of the Republic of Serbia", No. 1/90) (hereinafter: "Off. Jour.of RS) stipulates a right to a healthy environment in Article 31: «Man shall have the right to a healthy environment. Every person is bound, in accordance with law, to protect and enhance the human environment. »
- The Charter on Human and Minority Rights and Civil Liberties ("Off. Journal of the Serbia and Montenegro", No. 1/03) (hereinafter: "Off. Jour. of SM") which is main constitutional act of state union of Serbia and Montenegro provides in Article 46 that: "Everyone and the State Union and Member States in particular, shall be responsible for environmental protection. Everyone shall have the right to a healthy environment and to receive timely and full information about its status. Everyone shall be bound to protect and improve the environment."
- Competencies and responsibilities of the Republic of Serbia are defined by Article 72 of the Constitution: "The following shall be regulated and provided by the Republic of Serbia: .... 5. The system of protection and advancement of human environment; protection and promotion of plants and animals; ..."

To implement these obligations and legal documents, Serbia has started strengthening the institutional structure at national, regional and local levels. However, implementation of the many new laws and regulation to improve the country's environmental management is a major challenge and an area that will need much focus for the years to come.

(1) However, a number of international environmental treaties still need ratification. More detail is provided further-on.
(2) See: www.ecoserb.sr.gov.yu.

This report sets out the current legal and institutional framework for environmental management, identifies strengths and weaknesses and recommendations for improvement. The focus of the recommendations is on environmental management for mining and related activities in the Bor region.

C1.2 *NATIONAL LEGAL FRAMEWORK*

This section sets out the current legal framework for environmental management with a particular relevance to the mining sector, including the following areas:

- Environmental Framework Law;
- EIA;
- IPPC;
- Water and Waste water;
- Solid waste;
- Air pollution;
- Monitoring;
- Soil protection and land use control;
- Nature protection;
- Environmental liability;
- Health and safety.

C1.2.1 *Environmental Protection Law*

The basic legal act which regulates environmental issues in the Republic of Serbia is the Environmental Protection Law (hereinafter: "EPL") adopted by the National assembly of the Republic of Serbia on 21 December 2004. (Off. Jour. of RS, No. 135/2004, p. 29-43).

The EPL regulates "the integral system of environmental protection which shall ensure the human right to live and develop in healthy environment as well as balanced economy growth and protection of the environment in the Republic" (Article 1).

Provisions of the Law are divided in ten chapters as outlined in *Box 1.1*.

Box 1.1 *EPL Chapters*

1. General Provisions: subject of the law, system of environmental protection, definitions, subjects involved in the environmental protection system, subjects' liability, raising awareness, civic societies, cooperation, principles of environmental protection, special laws;
2. Management of Natural Values: 1. planning and utilization of natural values - management of natural values, strategic documents, plans and programs of the Autonomous provinces and local self-government units, control over utilization and protection, consent on usage, users' duties, protected natural goods, utilization and protection of public natural goods, utilization of space, public green areas, 2. protection of natural values - integrated protection, protection of land and soil, water protection, air protection, protection and preservation of forests, biosphere preservation and biodiversity protection, protection and use of flora and fauna, trade with endangered and protected species of wild flora and fauna, hazardous matters, waste management, protection from noise and vibrations, protection from radiation;
3. Measures and Conditions of Environmental Protection: 1.preventive measures, planning and construction, spatial and urban planning, strategic impact assessment, environmental impact assessment, integrated prevention, pollution and control, accident risk assessment, 2. requirements for environmental protection - environmental quality standards and emission standards - limit values, conditions for facility' work and activities, limits to enable standards, public alerts, status of endangered environment, 2.2. environmental protection management system - integration into the Environmental Protection Management System, request for registration into EMAS System, accreditation, registers of EMAS System, decline and cancellation of registration, EMAS logo, authorization for regulations promulgation, 2.3. products, processes and services standards - technology, process, products, semi-products, row materials, warning in the declaration, ecological sign, granting and withdrawal of ecological sign, appreciations and awards, 3. measures of protection from hazardous matters 3.1. production and placement on the market: substances damaging ozone layer, import, export and transit of waste, 3.2. handling with hazardous matters - obligations of legal and private entities, response to accident, obligatory notification, obligations of competent authority, proclamation of the state of endangerment, rehabilitation measures and subsidiary liability, 4. programs and plans - national program, action plan, rehabilitation plan, contents of plans, programs and plans of Autonomous province and local self - governance unit;
4. Environmental Monitoring: 1. monitoring - provision of monitoring, contents and mode of monitoring, authorized organization, polluter monitoring, data submission, 2. information system and manner of data submission - information system, integrated polluter cadastre, 3. environmental status report - contents of environmental status report;
5. Information and Public Participation: access to information, data supply at request, rejecting request for data supply, participation of public in decision - making, limited participation of public in decision making;
6. Economic Instruments - financing environmental protection: 1.types of economic instruments, 1.1. charges for use of natural resources, 1.2. environmental pollution charges, refund, relief or reduction of environmental charges, charges of the local self-governance unit, ensuring payment of charges, 1.3. budgetary and international financial assistance funds, use of funds, 1.4. Fund for environmental protection, establishment of the Fund, Fund's activities, revenues of the Fund, use of the Fund's finances, manner of use of Fund's assets, programs of the Fund, bodies of the Fund, general acts of the Fund, publicity of the Fund, professional and other activities, funds of the Province and Local self-governance, 1.5. Economic incentives, types of incentives;
7. Liability for Environmental Pollution: liability of legal and private entities, liability for pollution, polluters obligation, liability for damage, insurance, reimbursement of damage, appropriate law implementation;
8. Supervision: administrative supervision, rights and duties of the inspector, powers of inspectors;
9. Penalty Provisions: commercial offences, offences;
10. Transitional and Final Provisions.

The EPL contains some radically new features in comparison with the previous one and sets out a modern environmental management framework in line with European environmental directives. Important changes include the introduction of development of strategies, the establishment of the Environmental Protection Agency, EMAS, the Environmental Protection Fund, economic instruments, decentralization, improved environmental impact assessment and strategic environmental assessment, Integrated Pollution Prevention and Control, ecolabelling, etc.

The law is a framework law and many issues need further regulation through bylaws and amendment of already existing bylaws.

According to the Article 122 of the Law legal and private entities shall harmonize their operations with the provisions of this Law within a year from the day when this Law enters into force. This period has now expired for legal and fiscal persons.

C1.2.2 Environmental Impact Assessment

The Law on Environmental Impact Assessment (EIA) was adopted by the National assembly of the Republic of Serbia on 21 December 2004. (Off. Jour. of RS", No. 135/2004, p. 14-18). The Law contains 47 articles divided in to five chapters: basic provisions, impact assessment procedure, supervision, penalty provisions, transitional and final provisions.

According to article 1 "This Law regulates the impact assessment procedure for projects that may have significant effects on the environment, the contents of the Environmental Impact Assessment (EIA) Study, the participation of authorities and organizations concerned, the public participation, transboundary exchange of information for projects that may have significant impact on the environment of another state, supervision and other issues of relevance to impact assessment. The provisions of this Law do not apply to projects designated for national defence purposes."

The subjects of the impact assessment are planned projects and projects being implemented, changes in technology, reconstruction, the extension of capacity, the termination of operations, and the removal of projects that may have significant impact on the environment. The law also introduces the interesting obligation of EIA for existing projects that have been realized without the elaboration of the EIA Study and that did not have a construction or utilization permit on the day this Law entered into force.

Impact assessments shall be elaborated for projects in the fields of industry, mining, energy production, transport, tourism, agriculture, forestry, water management, waste management and utility services, as well as for all the projects that are planned in areas with protected natural resources of special value and within the protected zones of cultural resources.

The law introduces screening, scoping and public participation procedures in line with the EU Directive on EIA. The annexes defining which projects need EIA have also been harmonised.

Further elaboration of basic intentions contained in this Law has been done by adoption of certain number of bylaws. These are:

a) On the basis of Article 4, par 1 and 3 of the Law on environmental impact assessment the Government adopted on October 4 2005 Regulation on the List of projects for which EIA is obligatory and the List of projects for which EIA may be required. (Off. Jour. of RS", No. 84/2005, pp. 7-21;
b) On the basis of Article 20 par.5 of the Law, the minister decreed on August 9 2005 Rules on the procedures of the public access, presentation and public debate on study of the environmental impact assessment (Off. Jour. of RS", No. 69/2005, pp. 3-4);
c) On the basis of Article 23 par.5 of the Law, the minister decreed on August 9 2005 Rules on work of technical commission for assessment of the study of the environmental impact assessment. (Off. Jour. of RS", No. 69/2005, p. 4-5);
d) On the basis of Article 17 par.4 of the Law, the minister decreed on August 9 2005 Rules on contents of the study on environmental impact assessment (Off. Jour. of RS", No. 69/2005, p. 5-6);
e) On the basis of Article 34 of the Law, the minister decreed on August 9 2005 Rules on contents, forms and method of keeping of public book on executed procedures and adopted decisions regarding environmental impact assessment (Off. Jour. of RS", No. 69/2005, p. 8-10);
f) On the basis of Article 8 par.3 and Article 12 par. 3. Of the Law, the minister decreed on August 9 2005 Rules on contents of the application on needs for the impact assessment and contents of application for determination of size and contents of the study of the environmental impact assessment (Off. Jour. of RS", No. 69/2005, p. 10-19).

Serbia and Montenegro is not yet a member of the Convention on Environmental Impact Assessment in a Trans-boundary Context (Espoo, 1991) although a draft law on ratification has been prepared.

C1.2.3 Strategic Environmental Assessment

The Law on Strategic Environmental Assessment (SEA) (Off. Jour. of the Republic of Serbia", No. 135/2004, p. 18-23) contains 27 articles divided into four chapters: basic provisions (art. 1-4), strategic assessment procedure (art. 5-24), penalty provisions (art. 25), transitional and final provisions (art. 26-27).

This Law regulates "the conditions, methods and procedure according to which the assessment of impact of certain plans and programmes on the environment shall be carried out in order to provide for the environmental protection and improvement of sustainable development through integration of basic principles of environmental protection into the procedure of preparation and adoption of plans and programmes" (art.1).

The subject of strategic assessment, according to the provisions of Article 5 of the Law, are plans, programmes, grounds in the field of spatial and urban planning or land use, agriculture, forestry, fishing, hunting, energy, industry, transport, waste management, water management, telecommunication, tourism, protection of natural habitats and wild flora and fauna, by which the framework for obtaining a permit for future developmental projects is prescribed by regulations regarding environmental impact assessment. (1)

Assessment of possible impacts of plans and programmes on the environment contains the elements defined in Article 15. Among these elements are environmental elements including the data on air, water, soil, climate, ionizing and non-ionizing radiation, noise and vibrations, plant and animal life, etc. Annex I to the Law defines criteria for assessment of possible characteristics of important impacts.

In Annex II of the Law criteria for the assessment of the strategic assessment report are given.

This law follows the EU SEA Directive. The UN/ECE protocol on Strategic Environmental Assessment has been signed by Serbia and Montenegro.

C1.2.4 Integrated Pollution Prevention and Control

The Law on Integrated Pollution Prevention and Control (IPPC) (Off. Jour. of RS, No. 135/2004, p. 23-28) regulates "the conditions and procedure of granting of integrated permits for installations and activities that may have adverse effects on human health, environment or material resources, types of activities and installations, supervision and other issues that are of relevance for environmental pollution prevention and control" (art.1).

Article 4 prescribes that "types of activities and installations, for which the integrated permit shall be granted, shall be sorted according to the level of pollution and risk that such activities may have to human health and the environment, including other technically similar activities that can cause emissions and environmental pollution". The types of activities and installations relate to both new and existing installations. (2) Article 8 prescribes that the application for permit issuance which the operator submits to the competent authority should contain data on emission sources originating from installations as well as the nature and quantity of foreseen emissions to water, air or soil.

Article 11 regulates participation of organizations and the public regarding the permit issuance.

(1) Exemptions are: "plans and programs designated to the national defence purposes, plans of mitigation and elimination of consequences of natural disasters and financial and budget plans" (art.2).
(2) See: Footnote relating to the Regulation on kinds of activities and installations for which the integrated permit is issued. (Off. Jour. of RS", No. 84/2005, p. 3-4)

Competent authorities inform authorities and organizations in the fields of agriculture, water management, forests, planning, building, transport, energy, mining, etc, as well as authorities of local government on whose territory the activities are planned or the installation is situated and they are allowed to submit their opinions which have to be taken into account in the decision-making process.
The permit conditions are regulated by Article 16 of the Law. These should include thresholds values for the emissions of the polluting substances, prescribed for the given installations, as well as measures of protection of air, water and soil.

The transitional and final provisions of the Law (Article 33) prescribe that the program of adaptation of certain sectors of the economy to the provisions of this Law is adopted by the Government following a proposal of the Ministry and in coordination with other authorities and organizations. It is also prescribed that the Government, in the period of six months after this Law comes in force, should define thresholds values of emissions into air and water for the first five years of adaptation of certain branches of the economy to the provisions of this Law.

Article 34 (Obligations of operators of the existing installations) prescribes: **"The operator shall obtain a permit for existing installations and activities by the year 2015** the latest, in accordance with the Programme of bringing of certain branches of economy in compliance with provisions of this Law."

The IPPC law is harmonised with the EU Directive on IPPC.

In accordance with these provisions the Government of the Republic of Serbia has adopted on 4 October 2005 the **Regulation on kinds of activities and installations for which the integrated permit is issued.** (Off. Jour. of RS", No. 84/2005, p. 3-4) [(1)] and the **Regulation on criteria for defining of the best available techniques, for application of quality standards, as well as for defining of thresholds values of emissions in the integrated permit.** (Off. Jour. of RS", No. 84/2005, p. 5-6)

On the basis of Article 9 of the Law the Government has also adopted **the Regulations on contents of programme of measures of adaptation of work of existing installation or activities according to the prescribed conditions** (Off. Jour. of RS", No. 84/2005, p. 6-7).

On the basis of Article 25 of the Law the Minister has decreed **Regulations on content and method of keeping the register of the issued permits** (Off. Jour. of RS", No. 69/2005, p. 6-8).

[(1)] According to this Regulation the kind of activities and installations for which the integral permit will be issued includes: 1. energy production (....); 2. Production and processing of metals (.... 2.5. Installations: a) for production of nonferrous row metals from the ore, concentrate or secondary row materials, by metallurgical and chemical processes or by electrolytic processes; b) for smelting including production of alloys from nonferrous metals, as well as production obtained by recycling (refining, smelting, etc) with smelting capacity over 4 tons per day for lead and cadmium, or over 20 t per day for other metals ....) ; 3. Mineral industry (....), 4. chemical industry (Production in categories of activities contained in this chapter are related to industrial production in which chemical processing is used for substances or group of substances as listed in divisions 4.1. till 4..6.; 4.1. chemical installations for production of basic organic chemicals, as: carbohydrogens ... 4.2. chemical installations for production of basic non organic chemicals, as: a) sulphuric compounds, sulphur dioxide, ... b) acids as: sulphuric acid, chloride hydrogen acid, phosphoric acid, nitrogen acid, ...) , 5. Waste management (installations for purpose of dumping or recycling of dangerous waste with capacity over ten tons per day ....), 6. Other activities.

C1.2.5 *Water and Waste Water*

Current Law

The field of water is regulated by numerous laws and regulations. These include:

1. Law on waters (Off. Jour. of RS, No. 46/91, 53/93, 67/93, 48/94, 54/96)
2. Law on water regime (Off. Jour. of FRY, No. 59/98)
3. Law on hydro-meteorological affairs of interest for the whole country (Official Journal of the Socialistic Federal Republic of Yugoslavia", No. 18/88, 63/90) (hereinafter: "Off. Jour. of SFRY")
4. Regulations on methods and minimum number of wastewater quality testing (Official Journal of Socialist Republic of Serbia, No. 47/83, 13/84) (hereinafter: "Off. Jour. of SRS")
5. Bylaw on method for determining and maintenance of areas and belts for sanitary protection of drinking water plants (Off. Jour. SRS 33/78)
6. Regulations on harmful substances in waters (Off. Jour. of SRS, No. 31/82)
7. Regulations on water classification (Off. Jour. of SRS, No. 5/68)
8. Regulations on categorization of watercourses (Off. Jour. of SRS, No. 5/68)
9. Regulations of the sanitary quality of the drinking water (Off. Jour. of FRY, No.42/98, 44/99)
10. Regulations on permitted amounts of hazardous and harmful substances in soil and water for irrigation and methods of their testing ("Off. Jour. of RS", No. 23/94)
11. Bylaw on conditions which must be fulfilled by firms and other legal persons performing certain kind of examination of surface and groundwater, as well as examination of wastewater quality (Off. Jour. of RS 41/94, 47/94)
12. General plan for protection from floods (»Off. Jour. of RS« No. 34/03)
13. Operative plan for protection from floods (»Off. Jour. of RS« No. 38/03)

The basic source of law is the **Law on Waters** (Off. Jour. of RS, No. 46/91, 53/93, 67/93, 48/94, 54/96). It regulates key areas such as: water protection, protection from harmful impact of waters, use and management of waters as goods of public interests, conditions and method of water management activities, organization and financing of water management activities, supervision over implementation of the Law. The Law deals with land water and underground waters including drinking water, thermal and mineral water. The Law deals also with transboundary watercourses as well as water-sources shared by two republic members of state union.

The law states that water should be used: »in a manner by which natural characteristics of water is not endangered, by which human life and human health are not imperilled, by which plant and animal life are not imperilled as well as natural goods and immovable cultural goods.

The Law contains rules concerning: water areas, water regime (water management strategy, water management plans water management conditions, water management permit, etc), water management activities (protection from harmful impact of waters, use of waters, protection of water), limitation of rights, special measures as well as the role of Public water management enterprises.
Chapter X of the Law is devoted to financing of water management activities and to administrative supervision. Chapter XI of the Law contains penal provisions.

A new Law on Water is currently being drafted and aims for harmonisation with the Water Framework Directive.

The Law on the water regime (Off. Jour. of FRY, No. 59/98) regulates the regime of surface and underground "waters of interest of the whole country", international waters, as well as the regime of the coastal sea and activities concerning water accumulations (Art. 1). Waters of interest of the whole country are defined as watercourses crossing the inter-republican boundaries, as well as waters in their drainage basins. International waters are defined as watercourses and lakes crossing or forming borders of FR Yugoslavia, waters in their drainage basins and the coastal sea.

The Law on spatial plan of Republic of Serbia (Off. Jour. of RS, No.13/96) in its second part contains special provision dealing with use and protection of water and water infrastructure (point 3). The same text also contains formulation of goals and basic principles of use and protection of water and of development of water sector.

Provisions related to water resources management are contained in different sections of the Law on environmental protection. A part of them is directly related to these issues while others are indirectly important (Article 3 Paragraphs 3, 5, 9, Articles 33, 34, 35, 36, 40,65,68, 70, 93 etc). Probably most of important for water resources are provision of article 23 of this Law: »Water may be used and loaded, and wastewaters discharged in water by applying adequate treatment, in a way and up to the level which shall not represent threat towards natural resources or quality and quantity of water renewal and which shall not reduce the possibility of their multi-purpose usage. Protection and use of water shall be realized within the integral water management through implementation of measures for preservation of surface and ground waters and their reserves, quality and quantity, as well as through protection of river beds, waterfronts and courses in accordance with special law. Measures of water protection shall ensure prevention or restriction of introduction of hazardous, waste and other harmful matters into the water, monitoring and research of quality of surface and ground water, as well as quality of wastewaters and their treatment." The law this article refers to is the Law on Waters.

On the basis of the Law on Waters a number of regulations are passed every year including the Regulation on the program of building, reconstruction and maintaining of water objects, Regulation on water use charges, water protection charges and charges for the material extracted from watercourses. Also, every year the Government adopts a Regulation on systematic control of water quality (volume, kind and frequency of systematic water control).

Regulations on hazardous substances in waters ("Off. Jour. of RS", No. 31/82) have been adopted by the Secretary for health and social policy jointly with the Secretary for agricultural industry, forestry and water economy ("Official Herald of RS",No 33/75, 53/75, 18/76, 21/76,14/77 and 7/82).

These regulations prescribe hazardous substances that are not permitted to be directly or in-directly brought into waters. Hazardous substances are substances quoted below that because of their structure, quantity, level of radio activity or other qualities can endanger life and health of people, fish and animals.

In the **Regulation on classification of water,** waters are divided in four classes on the basis of the level of pollution and purpose for which the water will be used (I class - waters which can, after treatment, be used for drinking, in food industry and for breeding of highly sensitive kind of fish, II class - waters for bathing, recreation and water sports, breeding of less sensitive fish, etc, III class - waters for irrigation, industry with exception of food industry, IV class - waters which could be used only after special processing).

The **Regulation on hygienic quality of drinking water** prescribes hygienic standards for drinking water used for public supply or for food production for public consumption. Criteria of hygienic standards for drinking water are defined by microbiological characteristics, physical, physicochemical and chemical characteristics, maximally allowed concentration of chemical substances, remains of disinfections substances and radiological characteristics. In comparison with Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption there are differences concerning formulated quality parameters as well as maximally allowed concentration.

Generally speaking it could be said that the legal regulations in the field of water protection are based on immission standards. The existing method of control of discharge of waste waters is not compatible with European practice. Harmonization of the system in this field with the EU regulations should be done by adoption of a number of new regulations or amendment of some existing regulations (regulation on thresholds of emissions, regulation on quality control of surface and waste waters, regulation on classification and categorization of waters, cadastre of polluters, information of the public, etc).

The Law on EIA, SEA and IPPC all have impact on water issues as well. International treaties in the field of water that Serbia and Montenegro has ratified include:

- Convention on Co-operation for the Protection and Sustainable Use of the Danube River (Danube River Protection Convention), Sophia 1994.
- Framework Agreement on the Sava River Basin, 2002.

However, Serbia and Montenegro has not yet ratified:

- Convention on the Trans-boundary Effects of Industrial Accidents. Helsinki, 1992.
- Convention on the Protection and Use of Trans-boundary Watercourses and International Lakes. Helsinki, 1992 and protocols.

New Water Law

There are several provisions of the new draft Law on Water that are relevant for activities relating to **wastewater and permits**. Article 119 prescribes the "obligation to treat wastewater" (1), Article 124 "measuring of volume and analysis of quality of wastewaters", (2) and Article 125 "company for water quality analysis" (3).

Facilities and activities subject to water conditions are defined by the Article 136 and includes a large number of activities among which: hydroelectric power stations, steam power plants, and mines; facilities specified in Article 137 discharging **wastewaters** into surface waters or sanitary sewers; -**wastewater** treatment plants and facilities for transport and **discharge of wastewater**; (4) - mining, geological and hydro geological exploration and exploitation works and facilities; -the storage of substances that might contaminate water on the banks; -the flushing of reservoir lakes or cleaning of the sediments from reservoir lakes; -the construction and filling of drilled pits and infiltration galleries, as well as other boreholes for mining, geological and other works.

According to the Article 139 **"Water consent"** needs to be obtained prior to the start of the construction of new and the reconstruction of the existing constructions and plants, and the implementation of other works that might have impact on the water regime. Water consent shall verify the compliance of the technical documentation for the constructions and works specified in Para. 1 of Article 136 of this Law with the issued water conditions.

(1) "Legal entities and physical persons discharging or disposing substances that might contaminate water shall, before the discharge into the sanitary sewer system or other recipient, remove partially or completely such substances in compliance with the provision of this Law and other law, and the regulations adopted on the basis of such laws. Companies and legal entities **discharging wastewaters** directly into recipients shall ensure the treatment of **wastewaters** to comply with the standards specified in regulations on effluents (emission). For the purposes of ensuring the treatment of **wastewaters** to comply with the standards specified in the regulation under Para. 2 of Article 118 of this Law, companies and legal entities **discharging wastewaters** into sanitary sewers shall provide resources and specify timelines for the construction and putting in operation of equipment for such purposes."

(2) "A water supply and sanitation company and other companies, as well as legal entities **discharging wastewaters** into recipients and sanitary sewers shall install the measuring equipment, measure the volume and analyze the quality of **wastewater**, and shall submit the data on the measuring and analyses to the relevant public water management company. Companies and other legal entities possessing the **wastewater** treatment equipment and measuring equipment shall keep such equipment in order, ensure its regular functioning and shall keep the journal on the operation of the **wastewater** treatment equipment. Upon obtaining the opinion of the ministry in charge of environmental protection and the ministry in charge of public health, the Ministry shall adopt a more detailed regulation on the methodology and procedures for **wastewater** quality analysis, minimum number of tests, and the contents of the reports on the results of **wastewater** quality analysis. The Ministry shall adopt a more detailed regulation on the terms and procedures for measuring the volume of effluent discharged into the recipient."

(3) "Companies and other legal entities may conduct specific types of surface and ground water quality analyses (physical and chemical, microbiological, bacteriological and radiological), as well as the **wastewater** quality analyses, provided they fulfil the conditions for personnel, equipment, space, and other prescribed conditions, and they are registered in the relevant register. Upon obtaining the opinion of the ministry in charge of environmental protection and the ministry in charge of public health, the Ministry shall adopt a more detailed regulation on: eligibility conditions for the companies and other legal entities under Para. 1 above; procedures for licensing and withdrawal of licenses. The Ministry shall issue licenses to any company and other legal entity fulfilling the conditions under Para. 1 above. The companies and other legal entities under Para. 1 above shall submit to the Republic Hydro meteorological Authority monthly results of analyses, and shall submit notifications on water pollution accidents during that same day."

(4) Article 137: "The facilities under Items 6 and 7 of Para. 1 of Article 136 shall include: -facilities for the generation and use of nuclear energy; **-base and chemical industry, and ferrous and non-ferrous metallurgy facilities**; -facilities for the production and processing of oil and gas; -facilities for the generation of heath and energy; **-facilities for the production, processing, and enrichment of mineral ores; etc.**.

Exceptionally, water consent may be issued also without water conditions provided that the technical documentation under *Para.* 2 above proves that the construction or works covered by such technical documentation does not disrupt the water regime. The water consent under Para. 1 above shall be issued by the authority that originally issued the water conditions.

According to the Article 142 the **"Water license"** shall specify the terms and conditions, and the scope for water use and **discharge of wastewaters**, the terms and conditions for storage and discharge of hazardous and other substances that might contaminate water, as well as the terms and conditions for other actions with impact on the water regime.

C1.2.6 Solid Waste

Current Law

A National Waste Management Strategy was adopted by the Government of Serbia on 4 July 2003. It represents a key strategic document and aims to introduce integrated waste management according to EU principles. It defines the following priority activities:

- preparation and adoption of a Law on Waste (currently under development);
- preparation a Law on Packaging and Packaging Waste (currently under development);
- revision and harmonization of the existing relevant bylaws;
- revision of the existing decisions on communal activities
- adoption of technical standards for specific kinds of waste (communal, industrial, commercial, medical, hazardous);
- introduction of liability of producers for recycling and prefabrication of certain kinds of products;
- preparation of proposals for introduction different kind of taxes for different methods of waste management.

Several articles of the EPL are related to waste management. For example Article 30: «Waste management shall be enforced according to regulated conditions and measures of waste treatment through system of collecting, transport, treatment and disposal, including supervision over those activities and concern for the facilities for waste treatment after their closure. The owner of the waste is obliged to undertake measures of waste management in order to prevent or reduce waste generation, reuse and recycle; separation of secondary raw materials and use of waste as energents, i.e. waste disposal."

Another legal act which is relevant, is the Law on handling waste substances (Off. Jour. of RS, Nos. 25/96 and 26/96). Its main purpose is the organization of various activities concerning collection of useful waste and its reprocessing. A special institution has been established by the Law for that purpose: The Agency for Recycling (Articles 22-24).

Furthermore, the following legal acts are relevant:

- Regulations on criteria for determining location and disposition of waste materials deposit sites (Off. Jour. of RS, 54/92)
- Regulations on methodology for chemical accident risk and environmental pollution assessment preparatory measures and measure for remediation consequences (Off. Jour. of RS, No. 60/94);
- Regulations on handling waste products of hazardous nature (Off. Jour. of RS, No. 12/95);

Regulations on Methodology for Chemical Accident Risk and Environmental Pollution Assessment, Preparatory Measures and Measures for Remediation Consequences ("Off. Jour. of RS 60/94) define that assessment of danger, i.e. chemical accident risk and risk of environmental pollution includes identification of possible risks of accident, establishment of mechanisms of their beginning and development and also view of possible consequences. Preparations for possible accident include measures of protection in spatial planning, projecting, construction, work process, deposit and preservation of hazardous substances, control of use and maintenance of hazardous installations, as like other measures taken during performance of hazardous activities that prevent, respectively diminish the probability of accident and possible consequences.

Regulations on Handling Waste of Hazardous Nature ("Off. Jour. of RS", No. 12/95) Processing of hazardous waste products is realized by the company that produces the waste products. They need to be collected in temporary storages and classified and prepared for processing and transportation. Waste products are transferred later from the temporary storages to special storages. The company is obligated to submit a monthly report on amounts and types of produced, acquired, processed and stored hazardous waste products to the republic Ministry in charge with environmental protection affairs.

Transboundary transport of waste is regulated by the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989), ratified by FR Yugoslavia in 1998 (Off. Jour. of SFRY, No. 24/98). In 1998 special Regulations regarding documentation necessary for import, export or transit of waste were enacted (Off. Jour. of SFRY, No. 69/98).

For hazardous waste, the following legal acts are relevant:

- Law on circulation of explosive substances (Off. Jour. of SFRY, Nos. 30/85, 6/89 and 53/91, Off. Jour. of FRY, No. 24/94);
- Law on transportation of harmful substances (Off. Jour. of SFRY, Nos. 27/90 and 45/90, Off. Jour. of FRY, Nos. 24/94, 28/96 and 21/99);
- Law on production and circulation of poisonous substances (Off. Jour. of FRY, Nos. 15/95, 28/96);
- Law on explosive substances, inflammable liquids and gases (Off. Jour. of SRS, Nos. 44/77, 45/85 and 18/89, Off. Jour. of RS, Nos. 53/93, 67/93 and 48/94);
- Regulations on destroying unused poisons and packages used for packing poisons and on withdrawal of poisons from circulation (Off. Jour. of SFRY, No. 7/83);
- Regulations on criteria for classification of poisons into groups and on methods for determining levels of toxicity for certain poisons (Off. Jour. of SFRY, No. 79/91);
- Regulations on documentation submitted in the procedure for granting waste import, export and transit permits (Off. Jour. of FRY, No. 69/99);

- Regulations on conditions and methods of selection, packing and keeping of secondary row materials (Off. Jour. of RS, No. 55/01);
- Decision on establishing the coordinative team for chemical accidents of a larger scale (Off. Jour. of RS, No. 47/97).
- Decision on marking poisons in circulation (Off. Jour. of FRY, No. 38/97);
- List of poisons with prohibited production, circulation and utilization (Off. Jour. of FRY, No. 12/00);
- List of poisons classified into groups (Off. Jour. of FRY, No. 12/00).

New Draft Law on Waste Management

The new Draft Law on waste management regulates „planning and organization of waste management, means for handling of waste during its collection, transport, storage, reuse, treatment and dumping, management of specific kinds of waste, supervision and other questions important for waste management" (art.1).

The Law contains 97 articles divided into 15 chapters: general provisions, basic principles, kinds and classification of waste, planning of waste management, organs and organizations for waste management, liability and obligations in waste management, organization of waste management, management of specific kind of wastes, license for waste management, transboundary transport of waste, information concerning waste and data basis, financing of waste management, supervision, penal provisions, transitional and final provisions.

Article 5 point 5 defines the waste management permit as „ the document issued by the competent authority to a legal of physical person whose activity is collection, transport, treatment, reuse or dumping of waste." Conditions of handling the waste are also prescribed in the way which guaranties the smallest risk for human health and environment. In the chapter 9 of the Law rules are defined concerning "the waste management permits" (procedure for permit issuance, permit contents, rejection of permit issuance, term of validity, withdrawal, revision and amendments, informing the public, etc). The permit is issued «for activities concerning waste management for which, according to the IPPC regulations, is not issued an integrated permit.
The permit from the paragraph 1 of this article is issued for: waste storage, waste treatment, waste dumping. The permit defines conditions for activities of the installation operator.
A permit is not required for: waste transport within the location of waste producer, mobile installations for waste treatment (except for location permit), waste containers from households in public places, sites on which less than 10 tons of inert material is stored, sites on which less than 2 tons of non dangerous waste is stored.

C1.2.7 *Air Pollution*

Current Legislation

Currently, the basic legal act which contains provisions relevant to air pollution is the old Law on Environmental Protection ("Off. Jour. of RS", n. 66/91, 83/92, 67/93, 48/94, 53/95) which is still in force regarding air pollution issues.

A new Law on Air Pollution Protection in line with the relevant EC Directives is under development and the old EPL articles will be repealed when the new Law gets adopted.

Key issues concerning air protection have been regulated by Articles 18, 19, 20, 21 and 22. Article 18 sets the basic rule that the enterprise having sources of air pollution is obliged to, by technological and other means, process the emitting substances, in such a way that the emissions into the air do not exceed the emission limit values. If the emission limit values are exceeded, due to malfunction of the processing installations or the disturbance of the technological process, the enterprise is obliged to eliminate the malfunction or disturbance, to adapt its activities to the situation and/or, if necessary, to stop the technological process.

Besides the competent authorities of the Republic, city and county authorities have certain competences concerning air pollution protection too. They must develop programmes for air protection including the obligation to organize monitoring and other activities necessary for air protection such as the obligation to make public the information concerning air pollution (Article 20, paragraph 7).

Article 24 of the new Law on environmental protection ("Off. Jour. of RS" n. 135/04) sets out a framework for air protection in general way. It prescribes that «Air protection shall be ensured through undertaking measures of systematic air quality monitoring, reducing air pollution to regulated limit values and below and by undertaking technical-technological and other necessary measures for emission reduction and by monitoring polluted air impact towards human health and environment. Measures of air protection shall ensure overall atmosphere preservation with all the processes and climate characteristics thereof. Legal and private entity shall implement measures of environmental protection from paragraph 1 of this Article on their own or via authorized organization." The will also be regulated in the new Law on Air Pollution.

Besides the mentioned Law, the following legal acts regulate air protection:

1. Law on Hydro-meteorological affairs of interest for the whole country (Off. Jour. Of SFRY, No. 18/88, 63/90)
2. Decree on the Establishment of the Air Quality Control Programme in 2004 and 2005 (Off. Jour. of RS no. 48/2004)
3. Regulations on establishing networks and work programs of meteorological stations of interest for the whole country (Off. Jour. of SFRY, No. 50/90)
4. Regulations on limit values, immission measuring methods, selection of sample spots criteria and data collecting (Off. Jour. of RS, Nos. 54/92 and 30/99);
5. Regulations on emission limit values, methods and timeframe for measuring and data noting (Off. Jour. of RS, Nos. 30/97 and 35/97);
6. Regulation on detailed conditions which must be fulfilled by professional organizations which perform emissions and imissions measurement (Off. Jour. of RS 5/2002)
7. Regulations on Methodology for Chemical Accident Risk and Environmental Pollution Assessment, Preparatory Measures and Measures for Remediation Consequences ("Off. Jour. of RS 60/94)
8. Law on prohibiting smoking in closed rooms (Off. Jour. of RS, No. 16/95);
9. Regulations on the shape and contents of the "non-smoking" sign (Off. Jour. of RS, No. 30/95);

10. Decree on determining organizations for measuring air quality and measuring air emission of harmful substances (Off. Jour. of SRS, Nos. 27/73, 14/74, 47/74, 24/78 and 52/80)

Regulations on Limit Values, Imission measuring Methods, Selection of Sample Spots Criteria and Data Collecting ("Off. Jour. of RS", n. 54/92, 30/99 and 19/06) prescribe imission limit values, which represent the highest permitted level of concentration of polluting substances in the air, in particular for:

1. inorganic substances (Sulphur dioxide, Soot, Suspended particles, Nitrogen dioxide, Ozone, Carbon monoxide, H_2Cl_2, Chlorine, H_2F_2, Ammonia, Hydrogen sulphide);
2. sedimentary substances from air (heavy metals in sediment substances: Lead, Cadmium, Zinc);
3. metals in suspended particles (Cadmium, Manganese, Lead, Mercury);
4. organic substances (Carbon bisulphide, Styrene, Tetrachlorethylene, Toluene, Formic aldehyde, 1,2 Dichlorethane, Acrylic aldehyde);
5. carcinogenic substances (Acrynitrite, Arsenic, Benzene, Chromium hexavalent, Nickel, Polycyclic aromatic hydrocarbon, Vinyl chloride, C_2H_2Cl, Asbestos).

Regulation on Emission Limit Values, Methodologies and Terms of Measurements and Data Collection ("Off. Jour. of RS", n. 30/97, 35/97) defines the following: classification of harmful and dangerous substances in five classes (carcinogenic substances, total particulates, inorganic particulates, inorganic compounds as aerosols, gases or evaporations and organic compounds), emission limit values for combustion plants, emission limit values for particular industrial plants, emission limit values for inside combustion engines and the way of emission measurements.

According to Article 63 emission measuring can be performed as: 1) guarantee measuring - the measuring after the object construction or reconstruction, on account of getting permission for operation; 2) singly measuring - the measuring on account of periodical controls according to the established plan for measuring, at last once during a year; 3) continual measuring - for plants and establishments, i.e. objects that have possibility of crossing determined emission limit values, 4) annual control measuring - the measuring for checking of data on emission values.

A Report on the emission of harmful and hazardous substances is delivered to Ministry of environmental protection as: 1) report on singly measuring - within 30 days from the day of performing of measuring, 2) report on continual measuring - within 2 months after the expiration of the calendar year, 3) report on the mission measuring of substances of the class I within 8 days from the day when measured emission limit values were exceeded (article 75).

Generally speaking it could be said that there are still differences between the existing regulations related to air protection in the Republic of Serbia and EU regulations in this field. The existing provisions in the Regulation on emission thresholds values, method and timeframes of measurement and data evidence are very strict which causes difficulties in implementation of these regulations in practice.

Serbia and Montenegro is also a member of the Convention on Long-range Trans-boundary Air Pollution, Geneva, 1979 and the Protocol on Financing of the Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP), Geneva, 1984. However, Serbia and Montenegro has not ratified any of the other protocols to this Convention.

New Draft Law on Air Protection

The Draft Law on Air Protection regulates "air quality management and measures, method of organization, implementation and supervision of protection and improvement of air quality, as natural value of public interest which is under special protection of Republic of Serbia"

The Law contains 78 articles divided into 8 chapters: basic provisions, air quality management, measures for prevention and reduction of air pollution, monitoring and informing of the state of air pollution, financing, supervision, penal provisions, transitional and final provisions.

Article 71 prescribes that: "legal and physical persons will harmonize their activities with provisions of this law in the period of 12 months from the day of its coming into force." Specifically defined existing stationary sources of air pollution, for which it is necessary to undertake reconstruction with the aim of harmonization with provisions of this law, will be harmonized with this law after the period prescribed in the paragraph 1 of this article, if by law something different is not prescribed.
When monitoring and thresholds values of emissions into air are concerned, the draft Law prescribes that the special bylaws should be adopted. Article 8 prescribes that "for monitoring of air quality, assessment of level of pollution and for undertaking measures aimed at prevention and reduction of pollution, thresholds values of immission of polluting materials into air are prescribed. The Government of the Republic of Serbia ... prescribes the thresholds values".

Article 29 prescribes that "thresholds values of emissions of polluting materials into air, method, procedure, frequency and measuring methodology, criteria for establishment of measuring sites, method of checking of functionality and calibration, i.e. calibration of measuring gadgets, method of evaluation of results and of the level of harmonization with prescribed normative, contents of the report on carried out emission measurement and emission balance and terms for date submission is prescribed by the Government."

However, until adoption of bylaws on the basis of this Law regulation adopted on the basis of previous Law on environmental protection will be applied ("Off. Jour. of RS", n. 66/91, 83/92, 53/93, 67/93, 48/94, 53/95 135/04) (Article 75).

C1.2.8 Monitoring

There are several sources of law which regulate the field of environmental monitoring. Basic provisions are contained in the EPL in its chapter 4 (art. 69-77). Article 69 provides that "The Republic, autonomous province, and local self-governance unit, within their respective competencies under the law, shall provide for continual control and monitoring of the state of the environment in compliance with this and special laws. Monitoring shall be an integral part of the uniform information system on the environment. The Government shall develop the programme of monitoring for a two year period. Autonomous provinces, namely local self-governance unites shall develop monitoring programmes on its own territory that must be in compliance with the programme (made by Government). The Republic, autonomous province and local self-governance unit shall provide for financial means for monitoring."

Article 70 of the Law prescribes that "State monitoring shall be carried out by systematic measurement, examination and rating of indicators of the status and pollution of environment, including the monitoring of natural factors, namely changes of status and characteristic of the environment, including transboundary monitoring of: air, water, land, forest, biodiversity, flora and fauna, elements of climate, ozone layer, ionizing and non-ionizing radiation, noise, waste and early warning of accidents with monitoring and assessment of the development of environmental pollution, as well as obligations from international agreements. The Government shall determine criteria for the number and lay-out of measurement points, measurement point's network, scope and frequency of measurement, classification of phenomena monitored, methodology and indicators about the pollution of the environment and their monitoring, deadlines and manner of data submission."

Monitoring can be carried out by authorized organizations if it meets the conditions prescribed by Law (requirements in relation to human resources, equipment and space, accreditation for the measurement of the given parameter and JUS ISO standards in the domain of sampling, measurement, analysis and reliability of data).

Obligations of polluters are prescribed by the Article 72 of the Law: "legal and private entity who is the owner, namely operator of a plant that is the source of emission and pollution of the environment, is obliged to: 1) perform emission monitoring; 2) provide for meteorological measurements for big industry complexes or facilities of special interest for the Republic, autonomous province or local self-governance unit; 3) participate in expenditures of measurement of immissions in the impact zone, when necessary; 4) monitor other impacts of their activity towards the environment.

Submission of data is also regulated by Law. It is prescribed that the subjects who carry out monitoring (State authorities, organizations, authorities of autonomous province and local self-governance unit, authorized organizations and polluters) are obliged to send data (articles 70 and 72) to the Agency for Environmental Protection [(1)]. The establishment of the integral polluter cadastre is regulated by Article 75. Reporting on the state of environment and its contents are regulated by Article 76 and 77. Several other provisions of the Law on environmental protection are referring to monitoring as well: art.14 - control over utilization and protection, article 23 - water protection, article 24 - air protection, etc.

The following bylaws are also relevant:

- Regulations on establishing networks and work programs of meteorological stations of interest for the whole country (Off. Jour. of SFRY, No. 50/90)
- Regulations on limit values, imission measuring methods, selection of sample spots criteria and data collecting (Off. Jour. of RS, No. 54/92, 30/99)
- Regulations on emission limit values, methods and timeframe for measuring and data noting (Off. Jour. of RS, No. 30/97, 35/97)
- Regulation on detailed conditions which must be fulfilled by professional organisations which perform emissions and imissions measurement (Off. Jour. of RS no. 5/2002)
- Decree on the Establishment of the Air Quality Control Programme in 2004 and 2005 (Off. Jour. of RS no. 48/2004)

C1.2.9 *Soil Protection and Land Use Control*

Some general regulations concerning soil protection, zoning and land-use planning in Serbia are contained in the EPL. According to the article 22 "protection, utilization and arrangement of land, agricultural and forest soil and goods of general interest shall comprise preservation of productivity, structure, layers, rocks and mineral formation, as well as their natural and transitive shapes and processes. The activities that shall not pollute or damage the soil may be carried out on the ground surface or under it. Throughout project realization as well as before its execution (constructing, mineral raw material exploiting and so on), the protection of land and soil shall be ensured."

Article 34 of the Law prescribes that the conditions for measures (for environmental protection in spatial and urban plans) "shall be issued by the Ministry, autonomous province body or self-governance units at request of the authority in charge of plan preparation and its passing in, and on the basis of conditions and measures of competent authorities."
The Law on Agricultural Land (Off. Jour. of RS, Nos. 49/92, 53/93, 67/93, 48/94, 46/95, 54/96 and 14/00) regulates in detail the exploitation of minerals, building fish ponds, examination of the levels of pollution of agricultural land etc.

(1) Competencies of the Agency are defined by the Law on ministries.

The following legal acts are also relevant for soil protection in Serbia:

- Law on geological investigations (Off. Jour. of RS, No. 44/9) regulates conditions under which geological research and the use of its results must be done, programming of geological research, its financing and inspection. Among other matters, environmental protection is mentioned in Article 2 and in Articles 21-34;
- Law on mining (Off. Jour. of RS, No. 44/95) regulates conditions under which the mining activity can be done, on ground, underground, on river or lake bed or under it. It does not apply to exploitation of sand, stone or gravel from river beds and / or from natural or man made accumulations;
- Law on determining and classification of mineral raw materials and presenting results of geological investigations (Off. Jour. of FRY, No. 12/98, 13/98);
- Regulations on permitted amounts of hazardous and harmful substances in soil and water for irrigation and methods of their testing (Off. Jour. of RS, No. 23/94);
- Regulations on maximum amounts of harmful substances in the fodder (Off. Jour. of SFRY, No. 2/90, 27/90);
- Law on protection of plants from illness and damaging species (Off. Jour. of SRS 14/84,
- 6/89 and Off. Jour. of RS 53/93, 67/93, 48/94);
- Law on organic agriculture (Off. Jour. of FRY 28/2000);
- Bylaw on method of destroying plants for which measures of destroying are ordered (Off. Jour. of FRY 67/2001);
- Bylaw on types of packaging for pesticides and fertilizers and on destroying pesticides and fertilizers (Off. Jour. of FRY 35/99, 63/2001);
- Bylaw on trade, import and sampling of fertilizers (Off. Jour. of FRY 59/2001);
- Bylaw on trade, import and sampling of pesticides (Off. Jour. of FRY 59/2001);
- Bylaw on methods of organic plant production and on collecting forest fruits and curative plants as products of organic agriculture (Off. Jour. of FRY 51/2001);
- Bylaw on methods of organic livestock production (Off. Jour. of FRY 51/2002);
- Bylaw on conditions which must be fulfilled by legal persons performing examination of methods of organic production process (Off. Jour. of FRY 67/2002).

The main legal act on spatial planning in Serbia is the Law on Planning and Construction (Off. Jour. of RS, No. 47/2003). This Law regulates conditions and method of planning and arrangement of space and arrangement and use of building land and building; establishment of the Republic Agency for Spatial Planning; supervision over implementation of this Law and other relevant issues.

Law on the Spatial Plan of the Republic of Serbia (Off. Jour. of RS, No. 13/96), was adopted in 1996 by the Republican Assembly, as a strategic development document for the period 1996-2010. The document contains basic rules concerning long term spatial organization and spatial use in Serbia. According to this document, the territory of the Republic has been divided into ten regions.

For each of these regions special environmental measures were planned, based upon the characteristics and the state of the environment. Specially protected zones with natural values and protection of cultural heritage sites have also been established at the national level by this Law.

C1.2.10 *Nature Protection*

The field of nature protection is currently regulated by numerous legal and sub-legal acts. As most important could be regarded:

1. The Old Law on Environmental Protection (Off. Jour. of RS, No. 66/91, 83/92, 53/93, 67/93, 48/94, 53/95);
2. Law on Environmental Protection (Off. Jour. of RS, No. 135/04);
3. Law on National Parks (Off. Jour. of RS, No. 39/93, 44/93, 53/93, 67/93, 48/94);
4. Regulation on Protection of Natural Rarities (Off. Jour. of RS, No. 50/63, 93/93);
5. Regulation on the control of use and marketing of wild flora and fauna (Off. Jour. of RS, No. 31/05, 45/05);
6. Decision on protecting animal species as natural rarities (Off. Jour. of RS, No. 11/90, 49/91);
7. Regulation of categorization of natural goods (Off. Jour. of RS, No.30/92);
8. Regulation on methods of marking protected natural goods (Off. Jour. of RS, No.30/92, 24/94,17/96);
9. Regulation on the registry of protected areas (Off. Jour. of RS, No.30/92);
10. Regulations on the form for national park supervisor off. ID (Off. Jour. of RS, No. 70/94);
11. Statute of the Institute for the protection of nature of Republic of Serbia (Off. Jour. of RS, No. 59/93, 22/95) (1).

In a wider sense regulations related to water, forestry, fishing (2), hunting, mining, spatial planning, traffic, tourism, etc. are also relevant.

The Old EPL in chapter 2 point 5 contains provisions related to protection of natural goods (article 41-61). This chapter will stay in force until a new Law on Nature Protection will get adopted (expected during 2006) which will follow the EU approach and the IUCN framework for classification of protected areas.

The Old EPL regulates the following issues: categories of natural goods, procedure of putting of natural goods under protection, regime of natural goods protection, expert supervision, financing of protected natural goods, rights and duties of owners of natural goods, maintain of activities of natural goods protection. Article 41 identifies six categories: national park, natural park, area of exceptional values, natural reserves (general and special), natural monument and natural rarity.

Article 49 prescribes "In protected natural goods are not allowed activities which could endanger: plant and animal life, hydro graphic, geomorphologic, geologic, and cultural and landscape values, except activities by which natural balance is established and maintained ..." According to the Law three different levels of protection can be established.

(1) The regime of protection of specific locations is regulated by a number of sub legal acts for each individual protected area: for example: Regulations on protection of a special nature reserve "Stari Begej-Carska Bara Swamp" (Off. Jour. of RS, No. 56/94); Regulations on protection of special reserve "Ludasko jezero Lake" (Off. Jour. of RS, No. 56/94), Regulations on protection of special nature reserve "Obedska swamp" (Off. Jour. of RS, No. 56/94), Regulations on protection of general nature reserve "Vitanovaca" (Off. Jour. of RS, No. 9/95), Regulations on protection of special nature reserve "Jelasnicka klisure gorge" (Off. Jour. of RS, No. 9/95), Regulations on protection of natural monument "Homoljska Potajnica" (Off. Jour. of RS, No. 9/95), Regulations on protection of natural monument "Risovaca" (Off. Jour. of RS, No. 9/95), Regulations on protection of natural monument "Vrelo Mlave" (Off. Jour. of RS, No. 9/95), Regulations on protection of natural monument "Resavska cave" (Off. Jour. of RS, No. 9/95), Regulations on protection of natural monument "Krupajsko vrelo" (Off. Jour. of RS, No. 9/95), Regulations on protection of natural monument "Lisine" (Off. Jour. of RS, No. 9/95), Regulations on protection of natural monument "Djavolja Varos" (Off. Jour. of RS, No. 9/95), etc.
(2) A new Law on fishery is under development.

In the New EPL the whole second part of the Law is devoted to "management of natural values" (art.11-32). On the basis of the EPL, a ten-year Strategy for the Sustainable Use of Natural Resources will be developed to be followed by specific plans for autonomous regions and local self government units. The new nature protection law will provide a detailed framework for nature management.

Serbia and Montenegro is member of several international treaties relating to nature protection: European Convention for the Protection of Animals during International Transport (1968), International Plant Protection Convention (1951), International Convention for the Protection of Birds (1950), European Convention for the Protection of Animals Kept for Farming Purposes (1976), Convention on Wetlands of International Importance Especially as Waterfowl Habitat (1971), Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973), Convention on Biological Diversity (1992),

But, Serbia and Montenegro is not member of the following treaties: Convention on the Conservation of Migratory Wild Animals (1979), Convention on the Conservation of European Wildlife and Their Natural Habitats (1979), Protocol on Biosafety to the Convention on Biodiversity (2000).

C1.2.11 Environmental Liability

The question of environmental liability in national Serbian law could be addressed from a few different angles. This section aims to provide an overview.

Criminal Code

A new Criminal Code (Off. Jour. of the Republic of Serbia", No. 85/05) has come into force on 1 January 2006. It contains a separate chapter devoted to criminal acts against environment (XXIV). There are all together 18 criminal acts some of which have a general character.

These are: -environmental pollution (art.260), -omission to apply measures of environmental protection (art. 261), -illegal building and use of objects and installations which pollute environment (art. 262), -damage of objects and installations for environmental protection (art. 263), -impairment of environment (art. 264), -endangerment of right to information on the state of the environment (art. 268), etc.

Article 260 deserves special attention. It prescribes that:

1. "persons who by breaking rules on protection, conservation and improvement of environment, pollute air, water or soil in considerable measure or in wider space will be punished by the prison up to three years.
2. If the act from paragraph 1 of this Article is done by negligence the perpetrator will be fined or punished by prison up to one year.
3. If the act from paragraph 1 of this Article caused destruction or damage of the animal or plant life in grate extend or to environmental pollution which is so intensive that for its rehabilitation are needed longer time and considerable expenditure the perpetrator will be punished by prison from one to eight years.

4. If the act from paragraph 2 of this Article caused destruction or damage of the animal or plant life in grate extend or to environmental pollution which is so intensive that for its rehabilitation are needed longer time and considerable expenditure the perpetrator will be punished by prison from six months to five years.
5. If conditional verdict for acts from paragraphs from 1 to 4 of these articles is decided, the court could prescribe the obligation for the perpetrator to undertake certain measures aimed at protection, conservation and improvement the environment."

The EPL does not contain provisions on criminal responsibility. The Law on Water ("Off. Jour. of the Republic of Serbia", No. 46/91) contains three criminal acts. They are: -damaging, destruction or disabling of water objects (art.114), -damaging of riverbed, riverbanks and regulation buildings by extraction of sends, pebbles and other materials (art. 115), -causing dangerous for life and health or property of greater dimensions by filling accumulations without permit or by using water from accumulation (art. 116).

Civil Legal Procedures

Some basic sources of law also provide legal means of protection from environmental damages:

- The Law on basic property relations (Off. Jour. of the SFRJ", No. 6/80--89, 36/90-119; Off. Jour. of the SRJ", No.29/96);
- The Law on obligation relations (Off. Jour. of the SFRJ", No. 29/78, 39/85, 45/89, 57/89, Off. Jour. of the SRJ", No. 31/93, (22/99, 23/99, 35/99, 44/99).

In the case of the Law on Basic Property Relations Article 5 offer two elements of key importance:

- duty of the owner of the real estate to, while using his real estate, avoids activities; -by which usage of other real estate is made harder (transmission of smoke, unpleasant smelt, heat, soot, vibrations, noise, outlet of wastewater, etc) above the measure which is usual (common) regarding to the nature and purpose of real estate as well as local circumstance, or -by which is caused more considerable damage; and,
- duty of the owner of the real estate to remove causes which originated from his real estate and -by which usage of other real estate is made harder (transmission of smoke, unpleasant smelt, heat, soot, vibrations, noise, outlet of wastewater, etc) above the measure which is usual (common) regarding to the nature and purpose of real estate as well as local circumstance, or by which is caused more considerable damage.

In the Law on Obligation Relations a number of provisions are important although most of the discussions by experts are caused by the Article 156.

This article establishes the right to demand removal of the danger from damage or disturbance, which establishes the co-called ecological claim. Article 156 prescribes:

1. Everybody can claim from other persons to remove the source of danger which could cause more considerable damage to the claimant or indefinite number of other persons, as well as to abstinence from activities which causes disturbance or danger from damage, if the disturbance or damage can not be prevented by adequate measures.
2. The Court, reacting to the claim of interested person, will order undertaking adequate measures for preventing the damage or disturbance, or to remove the source of danger. This will be done on the expense of the owner of the source of danger, if he himself does not do it.
3. If the damage is caused in the course of activity which has general interest which is authorized by competent authority, only compensation for damage which overpasses normal thresholds could be demanded.
4. But, even in that case it is possible to demand undertaking of socially acceptable measures for prevention of the damage or its minimizing."

Environmental Protection Law

The EPL contains a special chapter (VII) devoted to questions of responsibility for environmental pollution (liabilities of legal and private entities, art. 102 (1), liability for pollution, art. 103 (2), polluters obligation, art. 104 (3), liability for damage, art. 105 (4), insurance, art. 106, reimbursement of damage, art. 107 (5), appropriate law implementation, art. 108).

(1) "Legal and private entity shall be obliged to ensure environmental protection while performing their activity, through: 1) applying and implementing regulations on environmental protection; 2) sustainable use of natural resources, goods and energy; 3) introducing energy efficient technologies and use of renewable natural resources; 4) using products, processes, technologies and practice less harmful to the environment; 5) undertaking preventive measures or eliminating the consequences of threat and damage to the environment; 6) keeping records in a prescribed way on raw materials and energy consumption, polluting matters and energy release, classification, characteristics and quantities of waste, as well as on other data and their submission to competent authorities; 7) controlling the activities and operation of plants that may represent risk or that may cause danger towards human health and environment; 8) Other measures in compliance with law. Legal and private entity shall implement measures of environmental protection from paragraph 1 of this Article on their own or via authorized organization."

(2) "Polluter causing environmental pollution shall be responsible for the occurred damage under the principle of objective responsibility. Legal and private entity that through their illegal or inadequate acting has enabled or allowed environmental pollution shall also be responsible."

(3) "Polluter causing environmental pollution by its acting or non-acting shall be obliged to, without any delay, undertake measures determined by rehabilitation and plan of protection from accident, namely to undertake necessary measures in order to reduce damage in the environment or eliminate further risks, hazard or rehabilitation of the damage in the environment.
If the damage made to the environment cannot be rehabilitated through adequate measures, the person that has caused it shall be responsible to pay charge equivalent to the value of the destroyed good."

(4) "Polluter shall be liable for the damage made to the environment and space and shall cover expenditures for the evaluation of damage and elimination thereof, and in particular: 1) costs of urgent interventions undertaken at the moment of the damage occurrence which are necessary for organizing and preventing the effects of damage towards the environment, space and human health; 2) direct and indirect costs of rehabilitation, establishment of new or recoverage of the previous environmental and spatial status, as well as monitoring of rehabilitation and environmental damage effects; 3) costs for prevention of the occurrence of the same or similar damage towards the environment and space; 4) Charge costs which are to be paid to persons directly threatened by environmental and spatial damage. The polluter is obliged to ensure financial or other warranties in order to ensure the payment of the charge from paragraph 1 of this Article, during and after performance of the activity. The Government shall prescribe type of warranty from paragraph 2 of this Article, the amount of the means and validity period of the warranty supplied by the polluters."

(5) "Every person affected by damage shall have right to reimbursement. The request for reimbursement may be submitted directly to the polluter or insurer, namely to the financial guarantee of the polluter where the accident happened, if such insurer, namely financial guarantee exists. If several polluters are responsible for the environmental damage, and if it is not possible to determine share of certain polluters, the costs shall be borne jointly and individually. The procedure for reimbursement shall be out-of-date in three years Period since the damaged party found out about the damage and damage maker. However, this claim shall be out-of-date in 20 (twenty) years after the occurrence of the damage. Court procedure for reimbursement shall be urgent. The Republic shall keep the right to reimburse the means if there are no other persons with such right."

Some other provisions of the EPL address the question of environmental liability in a more general way: Article 5 - Subjects' Liabilities, Article 9 par 5 - Principle of polluters' and legal successors' liability (1), Article 9 par. 8 - Principle of subsidiary liability (2), Article 63 - Rehabilitation Measures and Subsidiary Liability (3), Article 66 – Rehabilitation plan. (4)

The EPL also contains provisions concerning 23 commercial offences. The following subjects could be responsible for the offence: legal person (and responsible person in legal person), entrepreneur and physical person. State authorities and authorities of local governments can not be responsible for offences but responsible persons in these authorities could be responsible for certain offences when so prescribed by law.

Initiation of the offence procedure is done in accordance with provisions of the Law on offences (Off. Jour. of the SRS", No. 44/89, Off. Jour. of the Republic of Serbia", 21/90, 1/92, 6/93, 20/93, 53/93, 67/93, 28/94, 16/97, 37/97, 36/98, 44/98, 65/2001).

Liability for Past Environmental Damage – Law on Privatization

An especially relevant issue for this report is the issue of environmental damage caused in the past which is of importance for activities of existing enterprises which have been privatized or are in process of privatization. In Serbia an attempt has been done to regulate this issue.

A World Bank project at the end of 2004 developed a proposal for amendment of the Article 41 g of the Law on privatization (Off. Journal of the Republic of Serbia, No. 38/01, 18/03) as well as a proposal for a Decree on the manner and conditions under which the funds are to be provided for the remedy of the damage to environment due to former activities of the privatized companies.

At the same time a number of guidelines were proposed by which certain procedures on the assessment of environmental damage are regulated in more detail.

(1) "Any legal or private entity who shall be involved in environmental pollution by its illegal or improper activities shall be liable in compliance with the law. The polluter shall be liable for environmental pollution also in the case of liquidation or bankruptcy of the company or other legal entities, in accordance with the law. The polluter or its legal successor shall be bound to eliminate the cause of pollution and the consequences of direct or indirect environmental pollution. Changes in the ownership of companies or other legal entities or other changes in the ownership structure shall include assessment and allocation of liability for environmental pollution, and settlement of debts (charges) of the ex-owner on account of pollution or damage to the environment.

(2) "Principle of subsidiary liability - state authorities, within their financial abilities, shall eliminate the consequences of environmental pollution and reduce damages when the polluter is unknown, and when pollution originates from the sources outside the territory of the Republic."

(3) "To prevent further spread of pollution caused by an accident, legal and private entity shall immediately take rehabilitation measures planned for protection at its own cost. If the polluter who is responsible for the accident has been determined subsequently, the authority that paid the cost of elimination of the consequences of environmental pollution shall claim the reimbursement."

(4) "The rehabilitation plan shall be made whenever pollution in the given area exceeds the effects of the measures taken, namely when the capacity of the environment is at risk or there is a risk of permanent degradation of the quality or damage in the environment.
The rehabilitation plan shall be made by the Government in the following cases: 1) When the level and the scope of degradation of the environment exceeds the rehabilitation possibilities of the autonomous province, namely local self governance unit; 2) When the responsible polluter is unknown and the environmental pollution causes harmful consequences across the borders of the Republic; 3) When the responsible polluter is beyond the jurisdiction of the Republic, and the environmental pollution causes harmful effects in its territory;"

The guidelines include: methodology for assessment of the state of environment, content of the claim for decision concerning the need of production of overall state analysis, forms for a dynamic plan of harmonization with environmental protection conditions, directives for activities for rehabilitation, standard forms of project task for production of overall analysis of state of the environment, integration of the question of environmental responsibility into privatization procedure (by method of tender, method of public auction), etc.

Article 21 of Law on Amendment and Supplement of the Law on Privatization prescribes that: „Article 41 g is amended and reads:

- Financial means necessary for rehabilitation of damage done by subject of privatization before conclusion of the contract on sale of the capital and/or property are provided in the Budget of the Republic of Serbia.
- Government of the Republic of Serbia will regulate in detail method and conditions of the use of the financial means from the paragraph 1 of this Article."

This means that the State is fully liable for past damages. However, the guidelines to implement this principle have not been enacted which leaves a legal gap.

C1.2.12 *Health and Safety*

The Law on Security and Health at Work entered in force on 29 November 2005 (Off. Jour. of RS, No. 101/05). The new law is in line with contemporary tendencies and standards in this field (EU regulations and conventions of International Labour Organization [(1)]).

The Law is divided in twelve chapters: basic provisions, preventive measures, duties and responsibilities of employers, rights and duties of employee, organization of security and health protection at work, representative of employees for security and health at work, evidence keeping, cooperation and reporting, professional examination and license issuance, Directorate for security and health at work, supervision, penal provisions, transitional and final provisions.

The Law regulate «application and improvement of security and health at work of persons who participate in working processes, as well as other persons present in working environment, aimed at prevention of injuries at work, professional diseases and diseases related to work» (Art. 1).

To enable implementation this Law establishes the Directorate for Security and Health at Work as an administrative body within the Ministry of Labour, Employment and Social Affairs.

(1) Serbia and Montenegro is member of several ILO conventions: Convention Concerning the Use of the White Lead in Painting, (1921), Convention Concerning Protection Against Hazards of Poisoning Arising from Benzene, (1971), Convention Concerning Prevention and Control of Occupational Hazards Caused by Carcinogenic Substances and Agents, (1974), Convention Concerning the Protection of Workers Against Occupational Hazards in the Working Environment due to Air Pollution, Noise and Vibration, (1977), Convention Concerning Occupational Safety and Health and the Working Environment, (1981).

Rights, duties and responsibilities related to security and health at work defined by this law, are regulated in more detail by collective contract, general act of employer or working contract (Art.3.)

According to provisions of Article 5 of the Law right to security and health at work is enjoyed by:

1) Employees;
2) pupils and students while they are participating on obligatory productive work, professional practice and practical teaching (workshops, farms, cabinets, laboratories, etc.);
3) persons who are in process of professional education, prequalification and additional qualification;
4) persons on professional rehabilitation;
5) persons who are while being in prison, engaged in working unit of the penitentiary institution (workshops, building sites, etc) or in some other place of work;
6) persons engaged in public works organized in public interest, working actions, and competitions related to work;
7) Persons who are present in the working environment because of doing some business, if the employer is informed about his presence.

Inspection supervisions upon implementation of this law, bylaws adopted according to it, technical and other measures related to security and health at work, as well as concerning application of measures regarding security and health at work which are regulated by the general act of employer, collective contract or working contract, is done by the Ministry competent for labour through labour inspectors (Art. 61).

According to Article 76 and 80 of the Law, legal persons and employers are obliged to harmonize their activities with provisions of this law within one year from the date of coming into force of this law.

A certain number of previous bylaws are still in force.
According to Article 77 of Law they are:

1) Regulation on condition for checking technical documentation, checking and testing of working tools, dangerous maters, installations and working environment, means and equipment for personal protection and for training of workers for safe work (Off. Jour. of the Republic of Serbia", No. 13/00);
2) Regulation on method of checking and examination of working environment, dangerous maters, working tools, installations and means and equipment for personal protection (Off. Jour. of the Republic of Serbia", No. 7/99);
3) Regulation on contents of elaborates on organization of building site (Off. Jour. of the Republic of Serbia", No. 31/92);
4) Regulation on keeping evidence concerning protection at work (Off. Jour. of the Republic of Serbia", No. 2/92);
5) Regulation on method and conditions for carry out preliminary and periodical medical examination (Off. Jour. of the Republic of Serbia", No. 23/92);
6) Regulation on contents and method of issuance of the list on injuries at work (Off. Jour. of the Republic of Serbia", No. 2/92);
7) Regulation on method of assessment of fulfilment of prescribed conditions for protection at work (Off. Jour. of the Republic of Serbia", No. 7/99);
8) Regulation on the amount of expenditures regarding the method of assessment of fulfilment of prescribed conditions concerning protection at work (Off. Jour. of the Republic of Serbia", No. 40/01, 53/01).

On the basis of Article 78 of the Law, until adoption of relevant new regulations regarding preventive measures for security and health at work, the following existing measures for protection at work with relevance to the mining sector will be applied:

1) Rules on specific protection measures concerning prefabrication of non-metallic minerals (Off. Jour. of SRS", No. 2/83);
2) Rules on specific protection measures concerning production and processing of nonferrous metals (Off. Jour. of SRS", No 19/85);
3) Rules on specific protection measures concerning ferrous metallurgy (Off. Jour. of SRS", No 25/87);
4) Rules on specific protection measures concerning dangerous impact of electric current in objects used for work, working rooms and building sites (Off. Jour. of SRS", No 21/89).

Until adoption of relevant regulations regarding preventive measures for security and health at work, the following existing measures with relevance for the mining sector will be applied:

1) General rules on hygienic and technical protective measures at work (Off. Jour. of FNRJ", No 16/47, 18/47, 36/50), except art. 26. - 32, art. 50. - 75, art. 78. - 86, art. 88. - 99, art. 104. - 151 and art. 184. - 186;
2) Rules on hygienic and technical protective measures at work in quarries and brick producing enterprises, as well as in extracting clay, send and pebble (Off. Jour. of FNRJ", No 69/48), except art. 58. - 61;
3) Rules on technical and health-technical protective measures concerning chemical - technological processes (Off. Jour. of FNRJ", No 55/50) – Annex no. 9;
4) Rules on technical normative concerning the handling of explosive means and mines in mining (Off. Jour. of SFRJ", No 26/88, and 63/88);
5) Rules on providing food and lodging of workers and on their transport from the place of housing to the working site and back (Off. Jour. of SFRJ", No 41/68);
6) Rules on means for personal protection at work and on personal protective equipment (Off. Jour. of SFRJ", No 35/69);
7) Rules on protection at work in the process of production of explosive and gun powders and during the process of manipulation with explosive and gun powders (Off. Jour. of SFRJ", No 55/69);
8) Rules on equipment and method in giving first aid in organization of rescue service in case of accidence at work (Off. Jour. of SFRJ", No 21/71);
9) Rules on measures and normative at work on working tools (Off. Jour. of SFRJ", No 18/91);
10) Rules on measures and normative for protection at work from the noise in working rooms (Off. Jour. of SFRJ", No 21/92).

C1.3 INTERNATIONAL AND EU LEGISLATION

C1.3.1 EU Requirements

An overview of the EU legislation and requirements applicable to the RTB Bor Group has been performed, in order to define the future legislative context within which the privatization and restructuring programme has to be developed.

EU standards applicable for each impacted media are described in the following sections.

Air Emissions

Directives/Regulations on air emissions management and monitoring considered in the assessment process are:

- Large Combustion Plants (LCPs) Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants.
- Sulphur Content of Liquid Fuels Directive 1999/32/ECEU relating to a reduction in the sulphur content of certain liquid fuels and amending Directive 93/12/EEC.
- IPPC (Integrated Pollution Prevention and Control) Directive 96/61/EC concerning integrated pollution prevention and control.

In particular, the LCPs Directive states that combustion plants with a net rated thermal input of 50 Megawatts (MW_t) or more are required to have conditions within their operating permits relating to compliance with emissions limits for SO_2, NO_X and particulate set out in Annexes to the Directive. Monitoring is also required, which may be at the operator's expense.

The EU Directive 1999/32/EC states that heavy fuel oils (HFOs) with sulphur content greater than 1.0 % by mass and light oils with a sulphur content greater than 0.2% (0.1% after 1 January 2008) are not to be used within EU Member States.

The so-called IPPC Directive sets common rules on permitting for industrial installations in order to minimise pollution from various point sources throughout the European Union. In particular, all installations covered by Annex I of the Directive are required to obtain an authorisation (permit) from the authorities in the EU countries. The permits must be based on the concept of Best Available Techniques (or BAT), which is defined in Article 2 of the Directive.

Air Quality

Directives/Regulations on ambient air quality considered in the assessment process are:

- Air Quality Framework Directive 96/62/EC on ambient air quality assessment and management.
- Council Decision 97/101/EC establishing a reciprocal exchange of information and data from networks and individual stations measuring ambient air pollution within the Member States.
- Directive 1999/30/EC relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air.
- Directive 2000/69/EC relating to limit values for benzene and carbon monoxide in ambient air.
- Directive 2002/3/EC relating to ozone in ambient air.
- Directive 2004/107/EC relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air.

The Air Quality Framework Directive covers the revision of previously existing legislation and the introduction of new air quality standards for previously unregulated air pollutants, setting the timetable for the development of daughter directives on a range of pollutants. The list of atmospheric pollutants to be considered includes sulphur dioxide, nitrogen dioxide, particulate matter, lead and ozone – pollutants governed by already existing ambient air quality objectives- and benzene, carbon monoxide, poly-aromatic hydrocarbons, cadmium, arsenic, nickel and mercury.

The Council Decision 97/101/EC introduces a reciprocal exchange of information and data relating to the networks and stations set up in the Member States to measure air pollution and the air quality measurements taken by those stations. The information exchange relates to the pollutants listed in Annex I of Directive 96/62/EC.

The Framework Directive was followed by "daughter directives", which set the numerical limit values, or in the case of ozone, target values for each of the identified pollutants, in order to harmonize monitoring strategies, measuring methods, calibration and quality assessment methods throughout the EU and to provide good public information.

In particular, the Directive 1999/30/EC sets the limit values for NOx, SO_2, Pb and PM_{10} in ambient air and states that up-to-date information on ambient concentrations of the contaminants shall routinely made available to the public. With regard to the deadline application of the limit values, the limit values for NO_x for the protection of vegetation must be met by 2001, the health limit values for SO_2 and PM_{10} must be met by 2005, while the other health limit values for NO_2 and Pb must be met by 2010.

The Directive 2000/69/EC establishes limit values for concentrations of benzene and carbon monoxide in ambient air and requires to assess concentrations of those pollutants in ambient air on the basis of common methods and criteria, as well as to obtain adequate information on concentrations of benzene and carbon monoxide and ensure that it is made available to the public. The limit value for carbon monoxide must be met by 2005, while the limit value for benzene must be met by 2010 unless an extension is granted.

The Directive 2002/3/EC sets long-term objectives equivalent to the World Health Organization's (WHO) new guideline values and target values for ozone in ambient air to be attained where possible by 2010. These targets follow Directive 2001/81/EC on national emission ceilings.
The directive includes also improved and more detailed requirements to monitor and assess ozone concentrations and to inform citizens about the actual pollution load. It sets alert thresholds and requires Member States' authorities to take short-term action if exceeded.

The Directive 2004/107/EC states that Member States shall ensure that, as from 31st December 2012, concentrations of arsenic, cadmium, nickel and benzo(a)pyrene, used as a marker for the carcinogenic risk of polycyclic aromatic hydrocarbons, in ambient air, as assessed in accordance with Article 4, do not exceed the target values laid down in Annex I.

Wastewater Management

Following Directives/Regulations have been considered:

- EU Directive 76/464/EEC on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community.
- EU Water Framework Directive 2000/60/EC (WFD, 2000/60).
- EU Decision No 2455/2001/EC establishing the list of priority substances in the field of water policy and amending Directive 2000/60/EC.

The EU Directive on water pollution originally covered discharges of chemicals to inland surface waters, territorial waters, inland coastal waters and groundwater. Later, requirements on groundwater protection were covered by the EU Directive 80/68/EEC. The Directive comprises List I and List II substances: List I includes those substances which are classified as persistent, toxic and bioaccumulative, and that should not be present in wastewater discharges, therefore a permit for their discharge is required, granted for limited time periods only and settling specific restrictions to their discharge; List II substances include substances which have a deleterious effect on the aquatic environment: their discharge is subject to a permit, defining maximum admitted emission levels.

Emission limit values at the European Community level are set out in a number of "daughter" directives, covering 18 substances including cadmium and mercury.

The provisions of Directive 76/464 have been integrated into the EU WFD although transitional provisions will apply for 13 years after entry into force of the Directive. It requires the designation of river basin management plans by member states. The Directive allowed for the production by the Commission of a list of priority substances, which was drawn up as Decision 2455/2001. This lists 33 priority substances, although environmental quality standards in relation to these substances have yet to be agreed.

Soil and Groundwater

Following EU Directives/Regulations have been considered:

- Council Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances
- Commission Communication "Towards a Thematic Strategy for Soil Protection" (COM(2002) 179 - C5-0328/2002 - 2002/2172(COS)).

As far as the soil quality is concerned, it has to be noted that no regulatory requirement has been yet set up at the European level.

In response to concerns about the degradation of soils, the European Commission published in April 2002 a Communication "Towards a Thematic Strategy for Soil Protection". This Communication outlined the first steps that lead to the development of a Thematic Strategy to protect soils in the European Union. The strategy is one of the seven 'thematic strategies' foreseen under the EU's 6th Environment Action Programme.

With regard to the protection of groundwater, the Directive 80/68/EEC is aimed to prevent the pollution of groundwater by substances belonging to the families and groups of substances in lists I or II in the Annex. Member States shall prevent the introduction into groundwater of substances in list I and limit the introduction into groundwater of substances in list II so as to avoid pollution of this water by these substances. List I includes those substances with high risk of toxicity, persistence and bioaccumulation (such as mercury, cadmium, mineral oils and hydrocarbons, cyanides, carcinogenic substances, etc.), while List II contains substances, which could have a harmful effect on groundwater (such as zinc, copper, nickel, chrome, lead, selenium, arsenic, biocides, etc.).

Water Quality

No absolute limits are set for water abstraction or consumption at the European level. As far as the water quality is concerned, the following two Directives define quality standards:

- Council Directive 98/83/EC on the quality of water intended for human consumption (Drinking Water Directive - DWD).
- Directive 76/160/EEC concerning the Quality of Bathing Water (1976 Bathing Water Directive).

The Drinking Water Directive concerns the quality of water intended for human consumption. Based on WHO guidelines for drinking water, the DWD sets standards for the most common substances, a total of 48 microbiological and chemical parameters, which can be found in drinking water (see for details the Table 5.10.

The 1976 Bathing Water Directive has set binding standards for bathing waters throughout the European Union. On 24 October 2002, the Commission has adopted the proposal for a revised Directive of the European Parliament and of the Council concerning the Quality of Bathing Water COM(2002)581.

Noise

Following EU Directives/Regulations have been considered:

- Directive 2002/49/EC relating to the assessment and management of environmental noise (EU Directive on Environmental Noise).
- EU Exposure to Noise Directive (2003/10/EC).

The Directive on Environmental Noise aims to provide a common basis across the EU for tackling the noise problem. It requires competent authorities in the Member States to produce "strategic noise maps" for major roads, railways, airports and agglomerations. Competent authorities are also required to draw up action plans to reduce noise where it is considered necessary, and to maintain environmental noise quality where it is considered to already be good. This EU Directive does not set out any limit values.

The Exposure to Noise Directive sets exposure limit values and exposure action values in respect of the daily occupational noise exposure levels and peak sound pressure (see *Table 6-2*). The exposure levels to which workers are subjected are calculated as being the time weighted average - over eight hours for the daily noise exposure and over five eight-hour days for the weekly noise exposure. Employers have a duty to undertake a risk assessment and, if considered necessary, measure the noise to which employees are subjected. Where the risks of damage from exposure to noise cannot be prevented by other means (such as removal or enclosure of the noise source, limiting the time of exposure), the employer is required to provide employees with adequate hearing protection.

Employers of workers exposed to occupational noise are required to provide health surveillance. Those workers exposed to noise levels above the upper exposure action value has the right to have his/her hearing checked by a doctor. Preventive hearing testing must also be available for those workers whose exposure exceeds the lower exposure action values where the risk assessment considers it necessary. The Directive must be implemented by Member States by 15 February 2006.

Solid Waste

Following EU Directives/Regulations have been considered with regard to solid waste management:

- Waste Framework Directive 75/442/EEC.
- Council Directive 91/689/EEC on hazardous waste (Hazardous Waste Directive).
- Waste list Decision 2000/532/EC.

- Council Directive 1999/31/EC on the landfill of waste (EU Landfill Directive).
- Directive 75/439/EEC on the disposal of waste oils (Waste Oil Directive).

Waste from extractive industries is subject to the general provisions of the Waste Framework Directive. More importantly, facilities for the disposal of waste from the extractive industries are also covered by the Landfill Directive (1999/31/EC).

The Waste Framework Directive lays down basic obligations with respect to waste management, aimed to ensure that it does not cause any risk to water, air, soil, and the natural environment, nor any nuisance to the public (e.g. due to noise, odours, or degradation of places of special natural interest). Specifically, the Directive states that uncontrolled dumping or disposal of waste is prohibited and waste treatment operations is allowed under a permit and periodical recording.

The Landfill Directive requires that:

- Sites will be classified into one of three categories: hazardous, non-hazardous or inert according to the type of waste they will receive;
- Hazardous liquids, flammable, corrosive, explosive, oxidising and infectious wastes are banned from landfill from July 2002;
- Non hazardous liquids will be banned from landfill between 2004 and 2007;
- Co-disposal of hazardous and non-hazardous waste will be banned from landfill from 16 July 2004;
- Waste will be required to be treated prior to landfilling;

The Hazardous Waste Directive provides the definition of hazardous waste, promotes environmentally-sound management of hazardous waste, and imposed specific controls to the handling and disposal of hazardous waste. The classification into hazardous and non hazardous waste is based on the system for the classification and labelling of dangerous substances and preparations, which ensures the application of similar principles over their whole life cycle. The properties which render waste hazardous are laid down in the Directive and are further specified by the Waste List Decision 2000/532/EC as last amended by Decision 2001/573/EC.

The Waste Oil Directive, as last amended by Directive 2000/76/EC, is designed to create a harmonised system for the collection, storage, recovery and disposal of waste oils, such as lubricant oils for vehicles, turbines, gearboxes and engines, hydraulic oils, etc. The Directive also aims to protect the environment against the harmful effects of illegal dumping and of treatment operations.

Hazardous Materials Management

Following EU Directives/Regulations have been considered with regard to hazardous materials management:

- Council Directive 96/59/EC on the disposal of polychlorinated biphenyls and polychlorinated terphenyls (PCB/PCT).
- EU Directive 83/477/EEC on the protection of workers from the risks related to exposure to asbestos at work (Asbestos EU Directive).

The Directive on PCBs/PCTs requires the decontamination or disposal of equipment containing PCBs, and/or the disposal of used PCBs so as to eliminate them completely. Member States are required to compile a register of equipment containing more than 5 dm^3 of PCBs. Equipment which is considered likely (or known) to contain PCBs of between 0.05% and 0.005% by weight are required to be labelled as containing <0.05%, and must be decontaminated to 0.005% by weight or disposed of at the end of their useful life. Following decontamination, the equipment must be labelled as containing <0.005% PCB. Under the directive, the use of PCBs for topping up transformers is prohibited. Prior to the disposal of PCBs and PCB-containing equipment (which must only be done via a licensed contractor), all precautions necessary must be taken to avoid any risk of fire.

The Asbestos EU Directive, amended in 2003, sets out the legislation protecting workers from both use of asbestos during operations, and work associated with Asbestos Containing Materials (ACMs) within the buildings or equipment. Under this directive, all work involving asbestos materials must be notified to the responsible authority of the Member State, and a plan of work is required prior to any demolition or removal work which involves ACMs. The Directive provides an exposure limit for workers of 0.1 fibre per cm^3 for airborne concentrations of asbestos. Measurements must also be taken regularly in order to monitor the airborne concentration and if found to exceed the stated concentration, work must cease until adequate protection measures have been taken. Asbestos must be stored and transported in sealed packaging, and all employees must be trained in the use and disposal of asbestos, including its health and safety implications. Employees must also undergo an initial health assessment, to be repeated on a 3-yearly basis. Due to the long period of time before asbestos-related diseases may become apparent, a register of workers involved in activities with asbestos must be retained for 40 years from the end of their exposure.

Mining Activities

With specific regard to mining activities, on 30th October 2000, the European Commission adopted a Communication on the safe operation of mining activities in response to recent mining accidents in Baia Mare, Romania and Aznalcollar in Spain. The Communication describes the actions that the Commission envisages to take as a follow-up to these and other mining accidents.

Furthermore, the Communication sets out three priority actions envisaged to improve the safety of mines:

1. an amendment of the Seveso II Directive to include in its scope mineral processing of ores and, in particular, tailings ponds or dams used in connection with such mineral processing of ores;
2. a Best Available Techniques reference document (BREF) describing the Best Available Techniques of waste management to reduce everyday pollution and to prevent or mitigate accidents in the mining sector; and
3. a legislative initiative on the management of mining waste in order to help prevent environmental damage.

In 2003 the Commission has presented a proposal for a Directive to regulate the management of waste from the extractive industries (mining and quarrying). The proposal seeks to introduce EU-wide rules designed to prevent water and soil pollution from long-term storage of waste in tailings ponds, waste heaps, etc. The proposal lists conditions to be attached to operating permits to waste management facilities, to ensure that sufficient environmental and safety measures are met. Among them, waste has to be classified before disposal and the method of management tailored to its particular characteristic; a closure plan is required as part of the operating plan as well as a proper monitoring during both the operational and post-closure phases.

C1.3.2 World Bank Environmental Guidelines

A survey of the IFC/ World Bank policies and guidelines was undertaken as part of the process to identify the requirements for environmental protection. These international standards were consulted for comparison or where no Serbian or EU standards were available.

The following World Bank/ IFC polices and guidelines were considered:

- Pollution Prevention and Abatement Handbook, 1998.
  - General Environmental Guidelines;
  - Base Metal and Iron Ore Mining;
  - Copper Smelting; and
  - Thermal Power: Rehabilitation of Existing Plants.
- Operational Procedures/ Directives/ Policy Notes:
  - Environmental Assessment (OP 4.01), October 1998;
  - Natural Habitats (OP 4.04), January 2001;
  - Forestry (OP4.36), January 2002;
  - Safety of Dams (OP 4.37), January 2001;
  - Indigenous Peoples (OP 4.10), January 2005;
  - Involuntary Resettlement (OP 4.12), January 2001;
  - Managing Cultural Property (OPN 11.03), 1999;
  - Child and Forced Labour, Policy Statement, March 1998; and
  - International Waterways (OP 7.50), January 2001.

- Environmental, Health and Safety Guidelines:
  - General Health and Safety;
  - Polychlorinated Biphenyls (PCBs);
  - Mining and Milling - Underground, August 1995; and
  - Mining and Milling - Open Pit, August 1995.

A summary of WB environmental standards applicable to the RTB Bor Complex, are reported in details for each environmental media in the following sections.

Air Emissions

The *WB Guidelines for Copper Smelting* give guidelines values for air emissions, as reported under *Section 5.1*.

Furthermore, the WB Guidelines give some operative recommendations for the reduction of air emissions and fugitive emissions from smelting plants:

- give preference to processes that are energy efficient and that produce high SO_2 concentrations (e.g. flash smelting);
- use oxygen for enrichment of sulfur dioxide to raise the SO_2 content of the process gas stream and reduce the total volume of the stream, thus permitting efficient fixation of sulfur dioxide. An added benefit is the reduction of nitrogen oxides (NO_x);
- use the double-contact, double-absorption process for sulfuric acid production. This plant should emit no more than 0.2 kg of sulfur dioxide per ton of sulfuric acid produced (based on a conversion efficiency of 99.7%);
- minimize fugitive emissions by encapsulation of process equipment and use of covered or enclosed conveyors. Furnaces should be enclosed and particulate from particulate control equipment should be returned to the process;
- give preference to dry particulate collectors over wet scrubbers;
- modern plants using good industrial practices should set as targets total particulate releases of 0.5-1.0 kg/t of copper and SO_2 discharges of 25 kg/t of copper;
- vapors of arsenic and mercury present at high gas temperatures are condensed by gas cooling and removed. Additional scrubbing may be required.

The *WB Guidelines Thermal Power: Rehabilitation of Existing Plants* define the following measures to be incorporated when rehabilitating thermal power plants:

- the energy conversion efficiency of the plant should be increased by at least 25% of its current level;
- baseline emissions levels for particulate matter, nitrogen oxides, and sulfur oxides should be computed;
- an analysis of the feasibility (including benefits) of switching to a cleaner fuel should be conducted. Gas is preferred where its supply can be assured at or below world average prices. Coal with high heat content and low sulfur content is preferred over coal with high heat content and high sulfur content, which in turn is preferred over coal with low heat content and high sulfur content;
- washed coal should be used, if feasible;
- low-NOx burners should be used, where feasible;
- either the emissions levels recommended for new plants, or at least a 25% reduction in baseline level, should be achieved for the pollutant being addressed by the rehabilitation project;
- the maximum emissions level for PM is 100 mg/Nm^3, but the target should be 50 mg/Nm^3. In rare cases, an emissions level of up to 150 mg/Nm^3 may be acceptable;
- SO_2 emissions levels should meet regional load targets. Cleaner fuels should be used, to avoid short-term exposure to sulfur dioxide.

Air Quality

The *WB Environment, Health and Safety Guidelines Mining and Milling - Open Pit* give guideline values for ambient air quality standards around the property boundary of the open mine sites. The same guideline values are reported in the *WB Environment, Health And Safety Guidelines Mining and Milling – Underground*.

Some operative measures for the reduction of particulate generation are given by the two above mentioned guidelines, together with the *WB Guidelines for Base Metal and Iron Ore Mining*:

- use of covers or control devices for crushing and milling and material handling equipment, such as belt conveyors;
- use of particulate suppression measures (wetting work areas, roads, and storage piles; installing equipment covers; minimizing drop distances by using adjustable height conveyors; and using particulate hoods and shields);
- use of particulate control equipment on dryers and of pressure-air dryers instead of fuel-based drum dryers to dry concentrations.

Concentrations of contaminants limit values, which have to be measured outside the project property boundary, are reported in *Section 2.7 in Table 2.14*. Guidelines values set for ambient air quality in the WB General Environmental Guidelines are also reported in *Table 2.14* for comparison.

Water Supply

No absolute limits are set for water abstraction or consumption.

Minimization of freshwater intake by means of recycling of tailings decant water and wastewater from the concentration process is recommended by the *WB Guidelines for Base Metal and Iron Ore Mining*. This measure will also act to minimize contaminated discharges to the extent feasible.

Waste Water Effluents

Emissions levels for effluents during operation and after mine closure are given in the *WB Guidelines Base Metal and Iron Ore Mining* (see *Table 5.12*).

Following operative recommendations are given to prevent and reduce acid mine drainage (AMD) generation:

- Minimization of AMD generation by reducing disturbed areas and isolating drainage systems.
- Diversion of leachates from waste heaps to avoid contact with and contamination of surface water and groundwater.
- Minimization of freshwater intake by means of recycling of tailings decant water and wastewater from runoff.
- Collection of leachates from tailings ponds and treatment before discharge, with sufficient residence time in the tailings pond to ensure thiosalt oxidation; provision of buffer capacity for the rainy season.
- Use of ditches to divert surface runoff from tailing ponds.

AMD and wastewaters are typically dealt with by using physical-chemical treatment techniques such as neutralization, precipitation, flocculation, coagulation, settling, and filtration. In some cases, cyanide oxidation and ion exchange may also have to be performed. Chrome reduction may be needed for floatation water.

The *WB Environment, Health and Safety Guidelines, Mining and Milling for Underground and Open Pit* give guidelines for liquid effluents discharged to surface waters from tailings impoundments, mine drainage, sedimentation basins, sewage systems and stormwater drainage (see *Table 5.12*).

The Guidelines give recommended target guidelines for discharge in which there is expected to be no risk for significant adverse impact on aquatic biota or human use:

- Residual heavy metals: in cases where natural background concentrations exceed the target levels, the discharge may contain concentrations up to natural background levels. Concentrations up to 110% of natural background can be accepted if no significant adverse impact can be demonstrated.
- Cyanide: in no case should the concentration in the receiving water outside of a designated mixing zone exceed 0.022 mg/l.
- Measures to prevent access by wildlife and livestock are required for all open waters (examples tailings impoundments and pregnant leach ponds) where WAD cyanide is in excess of 50 mg/l.

Regarding wastewaters generated from copper smelting plants, target guidelines for effluents discharge are given in the *WB Guidelines Copper Smelting* (see *Table 5.12*), together with the following operative recommendations:

- Reduce effluent discharge by maximizing wastewater recycling. Recycling should be practiced for cooling water, condensates, rainwater, and excess process water used for washing, dust control, gas scrubbing, and other process applications where water quality is not a concern.
- Yards should be paved and runoff water routed to settling ponds.
- Effluent treatment by precipitation, filtration, and so on of process bleed streams, filter backwash waters, boiler blow-down, and other streams may be required to reduce suspended and dissolved solids and heavy metals. Residues that result from treatment are sent for metals recovery or to sedimentation basins.
- Storm waters should be treated for suspended solids and heavy metals reduction.

Solid Waste Management

Following recommendations are set for management of waste generated from mine activities by *WB Environment, Health and Safety Guidelines Mining and Milling - Open Pit/Underground Mine*:

- Recycle or reclaim materials where possible. If recycling or reclaim is not practical, wastes must be disposed of in an environmentally acceptable way in compliance with local laws and regulations.
- Solvents and similar hazardous materials must not be disposed of in a manner likely to result in soil or groundwater contamination if groundwater is potentially useable for potable water or irrigation purposes.
- Waste rock dumps should be designed and engineered so that materials with high potential to generate acid leachate are isolated from oxidation or percolating water.

- Sewage sludge must be disposed of in an environmentally acceptable way in compliance with local laws and regulations. The use of sewage sludge in reclaiming tailings deposits, waste rock dumps, and mined out areas is encouraged, after the evaluation of the environmental and health implications.

Regarding wastes generated from copper smelting operations, the *WB Guidelines for Copper Smelting* give the following operative recommendations:

- Slag should be land filled or granulated and sold.
- Dust that is captured by fabric filters and is not recycled will need to be disposed of in a secure landfill or other acceptable manner.
- Maximize the recovery of dust and sludges.

Environmental Noise

The World Bank/ IFC guidelines recommend that noise levels, measured at receptors outside the project operations boundary, should achieve either the levels shown in *Table 5.35* or a maximum increase in background levels of 3 dB(A).

With regard to noise reduction, the *WB guidelines for Base Metal and Iron Ore Mining* recommend that operative measures for control of noise should be taken, such as the use of berms and mufflers for noise and sequenced blasting for noise and vibration reduction.

Hazardous Substances

The *WB Environment, Health and Safety Guidelines Mining and Milling - Open Pit* give the following recommendations for handling and storage of hazardous substances:

a) All hazardous (reactive, flammable, radioactive, corrosive and toxic) materials must be stored in clearly labelled containers or vessels.
b) Storage and handling of hazardous materials must be in accordance with local regulations, and appropriate to their hazard characteristics.
c) Fire prevention systems and secondary containment should be provided for storage facilities, where necessary or required by regulation, to prevent fires or the release of hazardous materials to the environment.

The avoidance of the use of toxic flotation agents is highly recommended by IFC/WB Guidelines. There are no specific guidelines in relation to storage of oil.

With regard to PCBs management, the *IFC Environmental, Health and Safety Guidelines for PCB* give the following recommendations for installment, maintenance and disposal of PCB transformers and PCB contaminated equipment:

- Labeling: all equipment containing PCB in concentration exceeding 50 ppm should be clearly labeled.
- Monitoring: regular inspections of all transformers and PCB storage sites must be conducted to check for leakages.
- Retrofilling: in certain applications, retrofilling may be preferred to replacement of a PCB transformer. In the servicing or maintenance of transformers, the dielectric fluid may be removed form the unit and filtered to remove moisture or particulate matter and returned to the same unit. If topping up is required, a non-PCB fluid must be used.
- Transport: transport of any PCB article containing more than 500g of PCB mixture required a leak proof inner packaging, an outer packaging, sufficient absorbent material placed between the inner and the outer packaging.
- Storage: wastes that contain 50 ppm or more PCBs require secure storage and monitoring until disposal. Storage facilities must meet the following criteria:
  - Adequate roof and walls to prevent rain water from reaching the stored materials;
  - A concrete floor having continuous curbing as to provide a containment volume equal to at least two times the internal volume of PCB article/container or 25% of the total volume of PCB containers stored;
  - No drains, sewer lines that would allow fluids to flow from the curbed area.
- Disposal: high temperature incineration is the preferred method; another option is chemical dechlorination. PCB articles may be disposed of in properly designed landfill.

No specific guidelines have been issued with respect to asbestos.

Soil and Groundwater Contamination

No WB Guidelines are available for soil, nor for groundwater.

C1.4 INSTITUTIONAL FRAMEWORK

C1.4.1 National Level

The institutional framework in the field of the environment is regulated by a numerous legal acts including the Constitution of the Republic of Serbia (Off. Jour. of RS, No. 1/90) [1] as well as:

- The Law on Ministries (Off. Jour. of RS, No 19/04, and 84/04);
- The Law on state administration (Off. Jour. of RS, No. 79/05);
- The Law on states servants (Off. Jour. of RS, No. 79/05, 81/05, corr. 83/05);
- The Law on Government (Off. Jour. of RS, No. 55/05, corr. 71/05);
- Rule of procedure of the Government (Off. Jour. of RS, No. 100/05);
- The Law on certain competences of the Autonomous Province (Off. Jour. of RS, No.6/2002);
- The Law on Local Self-Government (Off. Jour. of RS, No. 9/2002);
- The Law on general administrative procedure (Off. Jour. of RS, No. 33/97, 31/01), etc.

Two ministries have the main responsibilities for environmental issues: the Ministry for Science and Environmental Protection (art.14 of the Law on ministries), and the Ministry for Agriculture, Forestry and Water (Directorate for water, Directorate for veterinary, Directorate for plant protection, Directorate for forestry) (Article 7).

The responsibilities of the **Ministry for Science and Environmental Protection - Directorate for Environmental Protection include the following**:

- Management of the system for environmental protection and sustainable use of natural resources (air, water, land, minerals, forests, fish, and wild plant and animal species);
- Preparation of strategic documents, plans and programmes or research work;
- Environmental protection measures in spatial planning and building;
- Environmental Impact Assessment and environmental permitting;
- Monitoring of the state of the environment, management of the information system for environmental protection;
- Inspection for environmental protection and sustainable use of resources
- Nature protection: identification of potential nature conservation areas; establishment and management of natural areas remarkable for the Republic;
- Climate change and ozone layer protection;
- Protection against noise and vibrations;
- Protection against ionizing and non-ionizing radiation, chemicals, waste and harmful materials in production, trade, transportation, storage and disposal;
- Preparation of geological research for sustainable use of resources and ground waters;
- Transboundary movement of wastes and endangered species of wild flora and fauna;
- Transboundary air and water pollution;

(1) And, to the some extend, provisions of Charter of the State Union of Serbia and Montenegro ("Off. Jour. of State union of SM", No. 1/2003), and Law for Implementation of the Charter of the State Union of Serbia and Montenegro ("Off. Jour. of State union of RM", No. 1/2003).

- International cooperation in the field of environment.

The Environmental Protection Agency has been established by Article 4 of the Law on Changes and Additions of the Law on Ministries (»Off. Jour. of RS«, no. 19/04, February 2004). The competence of the EPA is formulated by this law and it consists of the following: coordination and management of the national environmental information system; collection of environmental data and their systematisation, data processing, reporting on the state of the environment, participating in the practical implementation of national environmental policy; development of methods of environmental data processing and of their assessment; collection of data related to the BAT and their practical application; cooperation with the European Environmental Agency (EEA) and with the EIONET, as well as doing other assignments according to the Law.

Several other ministries and organizations also have competencies relevant to environmental issues.
These are:
Ministry for mining and energy (art. 9) [1]

- Ministry for capital investment (art. 10)
- Ministry for state administration and local self-government (Article 6 of the Law on ministry)
- Ministry for health (art. 17)
- Ministry for economy (art.8)
- Ministry for labour and social policy (art. 13), etc.
- Ministry for Internal Affairs (art. 3)
- Ministry for Foreign Economic Affairs (art.12)
- Ministry for Tourism, Trade and Services (art.11)
- Ministry for Culture (art.16)
- Ministry for Education (art.15)
- Hydro-meteorological Institute (art.25)
- Institute for Nature Protection
- Institute for Health
- Republican Statistical Institute
- Agency for Spatial Planning and Construction
- Agency for Recycling,
- Institute for Soil, Belgrade
- Institute for farming, Novi Sad
- Institute for Forest
- Institute for nuclear sciences, Vinca
- Institute"Karajovic"etc.

[1] The **Ministry for Mining and Energy** has responsibility in the field of mining, energy, geological investigations, approval for exploitation of mineral resources, except groundwaters, accomplishment of annual and mid-term programmes of detailed research works for the geological investigations related to the exploitation of the mineral raw materials. Basic sources of law in the field of mining are: Law on mining (Off. Jour. of RS, No. 44/95), Law on geological research (Off. Jour. of RS, No. 44/95), Law on classification of stores of mineral rows and presentation of geological research data (Off. Jour. of SRJ, No. 12/98, 13/98), Law on Energy (Off. Jour. of RS, No. 84/04), Law on concession (Off. Jour. of RS, No. 20/97, 22/97, 25/97). Besides that there are numerous bylaws.

C1.4.2 *Autonomous Province and Local Level*

The role of the autonomous province and local authorities in environmental management is a key aspect of the overall system of environmental policy. The Law on local self-government (Off. Jour. 9/ 02) and the Law on definition of certain competencies of the autonomous province (Off. Jour. 6/02) regulate their role.

The competencies of the Autonomous Province of Vojvodina, (Article 29) are:

- to adopt programs for environmental protection and sustainable development on the territory of autonomous province, including measures for their implementation, in accordance with the main goals determined at the republican level;
- to prescribe specific issues dealing with the protection, development and improvement of the environment on the interest of the autonomous province;
- to establish the Institute for Nature Protection, with public competencies and duties in the field of nature protection on the territory of autonomous province, delegated by the Republic;
- to establish public enterprises for management of national park on the territory of autonomous province;
- to monitor the environment and authorize competent institutions for monitoring at the territory of autonomous province;
- to issue consent on EIA activities, for which construction permits are issued by the competent authority of autonomous province;
- to issue consent on programs for protection and improvement of flora and fauna, forests and wasters, construction and agricultural land, and consent on urban plans for the territory of national park in the autonomous province;
- establish an information subsystem for environmental protection, as part of the information system of the Republic of Serbia;
- to monitor (inspection) each environmental protection issue, except in the field of hazardous substances and preservation of biodiversity (delegated duty).

The Law on Local Self-Government (Off. Jour. of RS", No. 9/2002) prescribes the responsibilities of municipalities as follows: to enact development programs, city plans, budget and an annual financial report; to organize and ensure performance and development of public services (urban sanitation, maintenance of deposit sites...) as well as to ensure organizational, financial and other conditions for their realization; to take care of environmental protection etc. (Article 18). The basic communal public income covers: local communal taxes, environmental protection compensation, returns from public services concessionaire compensations and from other concessionaire transactions which a unit of local self-government may conclude pursuant to the Law (Article 78, par. 1, points 2, 7, 10).

Municipalities thus have competencies in the field of urban planning, protection and improvement of the environment as well as communal activities. In municipalities, the competent environmental authorities are the secretariats for environmental protection (1) although not every municipality has one. In these cases, the duties are carried out by environmental inspectors of the Republic at district level.

(1) For example, in the case of Belgrade there are: Secretariat for Environmental Protection, Secretariat for communal activities, and Secretariat for Transportation, Secretariat for Urbanism, Secretariat for Construction, Secretariat for Economy, Secretariat for Culture, and Secretariat for Inspection. The Association of towns and cities of Serbia, an institution with headquarters in Belgrade, has a special committee for environment that also plays certain coordinative role in environmental policy decision making.

The municipal competent secretariats are also in charge of communal waste management (waste collection, locating of landfills and their operation, waste transport).

According to these acts outlined above, local authorities currently have significant competencies in the field of environment policy and decision-making but in practice this is the area where most strengthening is needed. There is a low level of cooperation among the different subjects and between different levels of government, a general lack of environmental awareness in society, a lack of financial and human resources and an urgent need for tools and training to help the authorities with the implementation of the large body of new environmental law.

The City Public Institutes for Health (Belgrade, Novi Sad, Sabac, Kragujevac, and Subotica) are responsible for monitoring of air, noise, water and groundwater. The Institutes have a role in the preparation of EIA documentation. The Institute in Belgrade is the competent authority for waste characterization in Serbia.

C1.4.3 Environmental Inspection

According to the provisions of Article 14 Point 2 of the Law on Ministries, the Ministry for science and environmental protection, performs activities of state administration and expert activities concerning: „... inspection control in the field of sustainable use of natural goods and environmental protection, as well as in other mention fields; environmental border inspection as well as other activities prescribed by the law."

Environmental inspection is organized at two levels. Inspection control is performed at the Republican level by the Ministry through its republican environmental inspectors (air, noise, ionizing radiation, chemicals, protected areas, flora and fauna, waste, industrial activities and fishing). The rights and duties of inspectors are defined by provisions of articles 109 -115 of the EPL. Besides that, the autonomous province and units of local self government also perform inspection control over activities transferred by law through their local municipal inspectors.

The inspectorate is divided into three divisions: Environmental Protection Inspection, Nature Inspection and Environmental Protection Inspection on Borders.

Differences between republican, provincial and local inspections stem from their competencies and authorities, i.e. upon the regulations whose implementation they supervise. Competence, authorities, and work of inspectorates are regulated by a number of legal acts.

More direct provisions related to the work of inspectorates are found in the following legal regulation:

- Law on state administration (Off. Jour. of RS", No. 20/92, 6/93 - decision of USRS, 48/93, 53/93, 67/93, 48/94 i 49/99) - articles 22-37 and 92;
- Law on state administration (Off. Jour. of RS, No. 79/05) (1)
- Law on Ministries (" Off. Jour. of RS, No. 19/04, 84/04) ;
- Law on certain competences of the Autonomous Province ("Off. Jour. of RS", No. 6/2002);
- Law on Local Self-Government (Off. Jour. of RS, No. 9/2002);
- Law on communal activities (Off. Jour. of RS, No. 16/97, 42/98)
- Law on general administrative procedure (Off. Jour. of RS, No. 33/97, 31/01),
- Law on administrative disputes (Off. Jour. of SRJ, No. 46/96), etc.,

The Law on state administration contains special provisions related to inspection control. Articles 22 - 33 set out that inspection control is performed by ministries through their inspectors and other authorized persons in accordance with law. Obligatory cooperation between inspectors from different domains is regulated by the law on state administration as well as by provisions of specific laws which regulate certain domains.

Certain activities concerning of inspection control can be transferred to organs of counties, city of Belgrade, other cities and autonomous provinces (Article of 22. of Law on state administration).

Inspection in the field of environmental protection is performed by the environmental inspectorate according to the Law on environmental protection ("Off. Jour. of RS", No. 135/04) (2). According to the provisions of the article 14 Point 2 of the Law on ministries, the Directorate for environmental protection, in capacity of administration within the Ministry for science and environmental protection, performs activities of state administration and expert activities concerning: „... inspection control in the field of sustainable use of natural goods and environmental protection, as well as in other mention fields; environmental border inspection as well as other activities prescribed by the law."

Autonomous province and units of local self government also perform inspection control over activities transferred by law and other regulation to autonomous province and units of local self-government.

According to the Article 18 (p.32) and Article 20 of the Law on local self-government, local self-government is responsible to organize inspection supervision over implementation regulations and other general acts in their competencies and carried out inspection supervision in the field which is transferred.

(1) According to the Article 18 of the new Law on state administration inspectors supervision will be regulated by special law. Until that relevant part of the old Law on state administration is still in force (article 93).

(2) Environmental inspectors performs their duties also according to some other regulations: **Law on national parks**, (Off. Jour. of RS, No.39/93, corr. 44/93, No. 53/93, 67/93, 48/94). Art. 26 regulates competencs and duties of inspectors; **Law on handling waste materials** (Off. Jour. of RS, No. 25/96, corr. 26/96). Article 25 - 27 of the Law regulate issues of the control over the implementation of the law and other regulations enacted on the basis of it.; **Law on protection from ionizing radiation** (»Off. Jour.of RS«, No 46/96); **Law on enviromental impact assessment** (»Off. Jour. Of RS«, No. 135/04) - Art. 35-39; **Law on integrated pollution prevention and control** (»Off. Jour. of RS«, No. 135/04) - Art 26- 28; **Law on production and circulation of poisonous substances** (Off. Jour. of FRY, No. 15/95, 28/96); **Law on business companies** (Off. Jour. of RS, No. 125/04) - Art. 6.

C1.4.4 *Institutional Capacity - Present state*

According to the assessment published in the National Environmental Strategy of the Republic of Serbia - draft (October, 2005) "institutional capacities in the field of environmental protection are generally insufficient to fully exercise the institutional competences". Institutional deficiencies in environmental policy and management include:

- Insufficient decentralization of competences in sectoral laws;
- Frequent institutional changes;
- Inadequate law enforcement, and supervision of law enforcement by inspection services;
- Limited capacity for monitoring, especially at the level of autonomous province and units of local government;
- Lack of coherent legislative framework, lack of personnel, financial and other capacities as the basis for efficient and operative functioning of the Environmental Protection Agency;
- Lack of mechanisms for development of institutional links between professional monitoring organizations with the Environmental Protection Agency in collection, processing and dissemination of environmental information;
- Insufficient capacity of most environmental institutions, especially regarding policy planning and appraisal, economic instruments and financing, project preparation and management;
- Lack of specialized educational institutions, special programs in the field of environmental protection at all levels of education."

Some key examples of institutional deficiencies include:

The existing status of the Directorate for Environmental Protection (1) does not enable effective coordination (horizontal and vertical) of environmental policy. There is lack of horizontal coordination between the Ministry for Capital Investments and the Directorate for Environmental Protection in the field of spatial and urban planning and construction. There is lack of consistent integration of environmental considerations and requirements in the process of adoption of spatial and urban plans and construction permitting.

There is an overlap of competencies between the Water Directorate and the Directorate for Environmental Protection in relation to water quality and water pollution.

(1) The total number of employees of the Directorate for Environmental protection is about 250 (In Environmental Protection Agency 25). A percentage of about 80% of the total number of employees have graduated from University (technological, biological, forestry, agriculture, chemicals, economic, legal etc), while about 20% have graduated from secondary education. There are seven divisions: Division for Policy and Strategic Development, Division for Legal and Economic Instruments, Division for EU Integration and International Cooperation, Division for Protection of Natural Resources, Division for Protection of the Environment, State Inspectorate for Environmental protection, Division for Administration and Corporate Management.

There is a potential conflict of responsibilities between the Forest Directorate, which is managing forests considered as economic sector and the Directorate which is charged with responsibility for protection of forest ecosystems. There is an uneven regime of protection of wild fauna in the field of hunting.

There is an inadequate division of competences between the Ministry of Mining and Energy and the Directorate in the field of geological research and exploitation of mineral resources, requiring a clear division of competences through amendment of the laws in the field of mining and energy.

There is insufficient institutional coordination and coverage of environmental monitoring activities in Serbia. Environmental monitoring is reasonably well covered in contrast to the lack of self monitoring by polluters. However, the existing environmental monitoring system suffers from limited accreditation of environmental laboratories and lack of rigorous QA/QC procedures for data collection, analysis and reporting.

Integrated environmental information system and the cadastre of polluters are still missing in Serbia. The main institutions providing the Directorate with environmental information and reporting include: the Hydro-meteorological Institute; the Institute for Nature Protection; the Institute for Water "Jaroslav Cerni"; the Institute for Soil; the Republic Institute for Public Health "Batut" and individual institutes for public health and the Recycling Agency. The Environmental Protection Agency is gradually taking a coordinating role in setting up an integrated environmental information system.

The current situation in the Republic of Serbia regarding the organisation of the response to minor or major chemical accidents is not satisfactory. (Insufficient number of mobile eco-toxicological units and intervention units, Inadequate training of the staff for the management of accident response, Insufficient institutional cooperation, etc).

At the local level there is need for capacity building to address statutory competences (strategic impact assessment, EIA, issue of integrated permits, monitoring, inspection services, financing local environmental infrastructure). There are about 200 environmental inspectors in place at local level, mostly with insufficient training and inadequate equipment to carry out their duties properly and to provide any assurance of effective enforcement. However, only about 20% of municipalities have environmental staff to carry out these tasks. The municipalities suffer also from underfunding and lack of financial decentralisation to cover their statutory tasks.

C1.4.5 Institutional Situation in Bor

The municipality of Bor currently has an environmental secretariat with four people. It developed out of the Local Environmental Action Plan (LEAP) project office during 2005. The other municipalities in the Bor District do not have their own environment secretariats but each have one municipal environmental inspector. Bor has two municipal environmental inspectors and 2 republican environmental inspectors at the district level.

A first LEAP was developed in Bor with support from UNEP in 2003 and sets out the key issues, data on the state of the environment, a vision for the future and a strategy for going forward.

This LEAP was updated in 2005 with support from the European Commission, includes an action plan and was officially adopted as the strategic document for environmental management in the municipality. The LEAP process has been an important catalyst for environmental awareness and capacity building within the municipality and has enabled them to prioritise necessary actions.

The staff within the environmental secretariat all have relevant backgrounds, are well aware of the environmental issues facing the municipality, have a clear understanding of their roles and responsibilities and have received some training in relation to the new environmental legislation. These new laws have clearly strengthened their position, especially the new EIA law, the implementation of which occupies much of their time. There are still a few problems in terms of conflicts between the new environmental laws and laws in other sectors such as the urban planning law, which currently doesn't refer to the EIA law and the necessity for EIA in the permitting process for construction. They fix this problem at the local level by actively engaging with the urban planning department in the municipality but it is something that should be addressed at a national level as well.

The municipality currently carries out an un-official air quality monitoring programme with equipment sponsored by UNEP. They have four stations, two fixed and two mobile and results are being published on a weekly and monthly basis in a number of public spaces and the media. The monitoring team meets once a month and includes representatives from the health center, the smelter, the environment secretariat from the municipality, the Copper Institute and a republican environmental inspector.

Implementation of the LEAP is the key objective in the municipality but the lack of human and financial resources is a major obstacle. Currently they can only implement the no/low-cost actions such as those on environmental education and awareness-raising. A draft regulation for the creation of a local environmental fund is waiting for adoption in April or May 2006. This would create a starting point for leveraging the financial resources needed for the environmental infrastructure investments identified in the LEAP.

The municipal inspectors carry out some 30/50 inspections a year, mostly based on individual complaints and only dealing with cases which fall within the municipal competencies which are mostly related to communal services. The inspectorate lacks a clear strategy and inspection plan. Cooperation with the republican inspectors, which are responsible for the larger developments in the district and inspection of the implementation of the national environmental laws, is weak.

RTB Bor was inspected in early February 2006 by the republican inspectorate (inspection reports are posted on the Ministry's website) after a hearing with NGOs in July 2005 in which concerns were raised on environmental issues.

The inspection report includes a number of actions for the company to undertake related to:

- limiting air pollution to the standards set out in the law;
- measuring of emissions and immissions;
- the need for development of an environmental protection plan and program (short term and long term measures) and submission of them to the Ministry;
- order elaboration and implementation of Rehabilitation plan, according to the article 66 and 67 of the EPL;
- a warning for potential closure of the smelter in the sulphuric acid factory if emissions are not being kept under control;
- undertake detailed inspection control of City heating plant and assess the impact of the plant to air pollution in Bor, by taking special attention to concentration of Nickel in suspended particles;
- the need for an additional air pollution monitoring site for SO_2;
- supervision of the Copper Institute which is carrying out un-official air pollution monitoring to see if it is in line with the official rules.

All actions have timeframes of between 30 and 90 days set out against them.

The key problems in the municipality from an institutional perspective include the following:

- A lack of accurate environmental data on the current state of the environment to be used as a baseline for e.g. the EIA process;
- A lack of environmental awareness within the other sectors in the municipality and amongst the public and decision makers: low priority of environment vis-à-vis other social issues;
- A lack of adequate resources to implement the actions set out in the LEAP;
- A lack of cooperation between the municipal environment secretariat and the republican inspectors;
- A lack of cooperation between the municipal environmental secretariat and organs relevant for urban planning and building;
- A lack of procedures and methods for coordination, communication, planning and management (including fund raising).

C1.5 *CONCLUSIONS AND RECOMMENDATIONS*

C1.5.1 *Conclusions*

The legal framework for environmental management has gone through an important phase of development over the past few years. Four key new environmental laws have been adopted including a new Environmental Protection Law which sets out the overarching structure for a modern environmental management system.

The new SEA and EIA laws are starting to work as a powerful tool for working towards more sustainable development and the IPPC law sets out a framework for a modern environmental permitting system.

A number of the necessary implementing regulations have been developed as well and more key regulations are expected to be adopted during 2006 including laws on air, waste, water and nature protection. They are all being developed according to EU standards and methodologies and aim to harmonise with EC Directives as much as possible.

The legal framework that is thus being built is of great significance as it provides for the establishment of an integral management system for natural resources, the introduction of the concept of sustainable development, prevention and control of pollution, informing the public and providing for participation in decision-making. These developments are addressing the previous problems related to the legal framework such as too many and conflicting laws, lack of regulation (e.g. for environmental permitting, environmental Fund, environmental management system), lack of public participation in decision-making, lack of clarity in terms of institutional responsibility etc.

In addition, autonomous province and local government are gaining more authority and a new and more important role in environmental management. There are still some problems connected to conflicts between the new environmental legislation and other laws such as the urban planning law which currently doesn't mention the need for EIA as part of the permitting process.

However, implementation and enforcement of this emerging modern legal framework is a great challenge and much remains to be done to make an impact on the ground.

Institutions at the local level cope with a lack of financial and human resources. The move towards creating greater financial independence such as through the set up of local environmental funds are a key step forward. Even though the funds expected to be collected are not nearly enough in comparison to the environmental infrastructure investment needed, they do provide a first step in the right direction and can serve as co-financing for attracting international funds. Much remains to be done in terms of training staff at the local level, set up stable coordination and cooperation mechanisms between different authorities and different levels of government, awareness raising on environment (outside as well as inside government), development of tools and guidance for the implementation of environmental laws, strengthening of the environmental inspectorate through training etc.

C1.5.2 *Recommendations*

Legislation

- Further development of the legal framework in line with EC directives as planned;
- Identification and removal of conflicts between new environmental legislation and other laws;
- Adoption of the new regulation on the environmental fund within the Bor municipality, as soon as possible.

Institutional Strengthening

EIA and Permitting

- Development of further tools and guidance documents to help better implementation of the EIA law.
- Training on implementation of the EIA law and IPPC permitting system at all levels;
- Strengthening of the local municipality environmental office (additional experts, additional trainings and necessary equipment, better coordination between the environmental secretariat and other offices in relevant sectoral policies and between environmental secretariat and local and republican inspections);
- Established Local Environmental Fund and training of the experts.

Inspection

- Creation of coordination mechanism between the republican inspectorate and the municipal environmental secretariats.
- Development of a strategic approach to inspection through the development of inspection plans at all levels;
- Further training for environmental inspectors;

Monitoring

- Further development of the monitoring system (clarify the role of certain elements in system and obligations of relevant subjects);
- Strengthening institutions relevant for monitoring system (especially the Agency for environmental protection);
- Solving the problem of further financing of the existing air monitoring system in Bor (guarantee will soon expire);
- Improvement of the self monitoring system in companies and coordination with local monitoring system.

CONTENTS

Annex D

Tailing Ponds Detailed Analysis

D1 TAILING PONDS

D1.1 WB GUIDELINES

The WB Environment, Health and Safety Guidelines Mining and Milling - Open Pit and Underground Pit and the WB Guidelines for Base Metal and Iron Ore Mining give some operative and designed recommendations for the proper and safe management of a tailing ponds and mine activities.

D1.1.1 *Development Plans*

Development plans define the sequence and nature of extraction operations and detail the methods to be used in closure and restoration. At a minimum, the plans must address the following:

- Removal, proper storage, and management of topsoil;
- Early restoration of worked-out areas and of spoil heaps to minimize the extent of open areas;
- Identification of potential areas for AMD generation, followed by planning for successive remediation of pyrites to reduce AMD generation;
- A water management plan focusing on the effective use of mine water for operations (with recirculation of process water) and for post closure;
- Extraction methods in relation to subsidence and to surface use;
- Development of restoration and vegetation methods that are appropriate to the specific site conditions;
- Blasting methods that minimize noise and vibrations.

D1.1.2 *Tailings Disposal*

In meeting the development plans as set out above the following objectives may be set for the planning, construction, operation, closure and rehabilitation of any tailings disposal facility (TDF).

Tailings must be disposed of in a manner that optimizes protection of human safety and the environment. On-land tailings impoundment systems must be designed and constructed in accordance with internationally recognized engineering practices, local seismic conditions, and precipitation conditions. On-land disposal systems should be designed to isolate acid leachate-generating material from oxidation or percolating water.

Marine and riverine discharges are normally not acceptable and should be considered only when on-land disposal would pose an environmental risk and it can be demonstrated that such discharges will not have a significant adverse effect on downstream coastal or riverine resources. Riverine discharges are acceptable only when justified on the basis of an environmental analysis of the alternatives and the effects on aquatic resources and downstream users of riverine resources.

The feasibility of using abandoned open pits for tailings disposal must be evaluated for mining and disposal operations.

In addition the design of the tailings management system must address postclosure issues such as the long-term geotechnical stability of the residue deposit , the chemical stability of the tailings, long-term surface and groundwater management (including provisions for long-term spillway and storm water decanting capacity requirements), and restoration to acceptable land use conditions.

D1.1.3 Erosion and Sediment Control Plan

An erosion and sediment control plan has to be prepared and implemented. The plan should include appropriate situational measures to intercept, divert, or otherwise minimise the stormwater runoff from exposed soil surfaces, tailings dams, and waste rock dumps. Integration of vegetative and non-vegetative soil stabilization measures in the erosion control plan are encouraged. Sediment control structures (e.g., detention/retention basins such as catchment paddocks) should be installed to contain and enable contaminated surface runoff water to be treated prior to being discharged to open surface water bodies. All erosion control and sediment containment facilities must receive proper maintenance during their design life.

D1.1.4 Mine Closure and Reclamation Plan

A mine reclamation plan should be prepared and implemented.
The plan should include reclamation of tailings deposits, any open pit areas, sedimentation basins, and abandoned mine, mill, and camp sites.

Mine reclamation plans should incorporate the following components:

a) Return of the land to conditions capable of supporting prior land use, equivalent uses, or other acceptable uses;
b) Elimination of significant adverse effects on adjacent water resources;
c) Determine feasibility of using any waste rock for backfilling with available topsoil (or other acceptable materials) for reclamation;
d) Contour slopes greater than 30% to minimize erosion and runoff;
e) Establishing indigenous vegetation and/or other species that are environmentally acceptable, to prevent erosion and to encourage self-sustaining development of a productive ecosystem on any disturbed mining land;
f) Postclosure management of AMD by possibly capping tailings enabling reducing the potential of AMD to form by sealing off pyrite-containing waste from oxidation and percolating water;
g) Determining budgets and schedules for pre- and postclosure reclamation activities;
h) Preparing plans for TDF's and open pits show areas disturbed, cleared, mined, refilled, and revegetated at 5 year intervals;
i) Closure of all mine shafts, adits and openings.

The necessary money should be reserved over the remaining life of the mine to cover the costs of mine closure and rehabilitation.
The amount of money and the type of financing required will depend on a number of factors such as the projected life of the mine, the nature of the operations, the complexity of environmental issues, the financial and environmental management capacity of the borrower or project sponsor, and the jurisdiction in which the mine is located. The mine reclamation and closure plan, the timing of its submission, and financing of activities under the plan should be discussed and agreed on with any potential lender or sponsor as early as possible once the appropriate budgets have been established. It must be noted that the appropriate rehabilitation measures will need to be instituted at a sooner or later stage.

D1.2 *OBJECTIVES, APPROACH AND METHODOLOGY*

An environmental assessment of the RTB Bor Group operations on the eastern side of Serbia is presently underway. As the tailings disposal facilities (TDF's) form an integral and large part of the mining operations it was identified at an early stage that they would require a more detailed review.

An assessment of the RTB Bor Group TDF's forms the subject of this report in support of the overall environmental assessment study underway. The objectives of this report may thus be set out as follows:

- Present an overview of the existing TDF's that fall within the control of the RTB Bor Group;
- Comment on the overall slope stability and surveillance currently being undertaken;
- Highlight the main environmental impacts resulting from the TDF's;
- Identify and comment on the associated hazards and risks;
- Identify any major short-comings of the operations being carried out on the TDF; this will include identifying incomplete or missing data;
- Present conclusion and recommendations on the findings of the investigation.

The compilation of this report was commissioned by Mr. Craig Miles acting on behalf of *CSA Group Ltd.* On his instructions Mr. Chris Groenewald carried out a site inspection at the beginning of March 2006 of the various TDF's in question. This report was compiled based on this site inspection and the information that was made available at the time.

Please note that the term tailings disposal facility (TDF) which is used extensively in this report encompasses the dam wall and field (surface area comprising the beach and pond) nomenclature used on site.

D1.3 ON SITE INVESTIGATION FINDINGS

The various tailing disposal facility (TDF) sites under the control of RTB Bor Group were visited over the period from 28 February to 3 March 2006 in the towns of Bor and Majdanpek in eastern Serbia. At the time of the inspection it was snowing and the terrain was covered in a blanket of snow. For the most part, the underlying surface was not visible. A number of small areas were however exposed where the wind had blown the snow away to expose either the underlying tailings or natural ground material. Only readily accessible portions of the sites were traversed and inspected within the allocated time and accessibility. This meant that only general observation could be made on the overall operations.

Both in Bor and in Majdanpek there are two tailing disposal facilities.
In Cerovo no TDF is present as ore from the Cerovo open pit fed the Bor Plant when operations were underway. Thus, the various TDF's under consideration serve the three processing plants listed in the following table *Table 1.1* together with the actual operational status of the tailing ponds.

Table 1.1 ***Tailing Ponds in Bor and Majdanpek***

Item	Processing Plant	Ore Source	TDF	Status
1	Bor	Jama Underground Mine and Bor Open Pit operation	RTH	In operation
2	Bor	None as TDF operations have stopped	Bor	Closed
3	Veliki Krivelji	Veliki Krivelji Open Pit operation	Veliki Krivelji	In operation
4	Cerovo		None, processing was previously done at the Bor Plant	None
5	Majhanpek	North and South Open Pit Mines	Valja Fundata	In operation
6	Majhanpek	Emergency use only	Saski Potok	Stand by use

Layouts of the various TDFs are presented in the various figures in *Annex A*.

D1.4 INFRASTRUCTURE OVERVIEW

Evaluation of the actual TDF conditions has been carried out by considering individual components that comprise the TDF.

These components are listed below for which an evaluation has been undertaken in terms of the objectives set out above.

- Access to the TDF;
- Storm water diversion works;
- Roadways;
- Solution trenches;
- Catchment paddocks;
- Initial Starter;
- Tailing dam walls;
- Under drainage;
- Field and pool control;
- Decant pumping system and access;
- Transfer pump station;
- Site office and storage yard.

D1.4.1 Access

Unauthorised access needs to be restricted on any TDF. This is normally achieved by providing controlled access points at a main gate and erecting fences around the outer perimeter. To keep fences in working order, periodic inspections and well-timed reparations should be arranged.

D1.4.2 Storm Water Diversion

Any free surface water originating upstream and above the TDF should be diverted around the TDF. This is required to keep uncontaminated water apart from the operation ensuring that the minimum amount of water is possibly bought into contact with the mining process. Storm events as well as normal rain-flows will need to be taken into consideration for the diversion planning.

D1.4.3 Roadways

Suitable all weather access must be provided at all times for authorised vehicles and personnel to ensure that maintenance and operations may be undertaken effectively under all operating conditions.

D1.4.4 Solution Trenches

Solution trenches are normally provided to convey seepage water and decanted water away from the TDF in a controlled manner. Once installed any solution trench and collection system will need to be maintained and kept in good order.

D1.4.5 *Catchment Paddocks*

Catchment paddocks are normally provided on the perimeter toe of any TDF where the deposited residue material has risen above any inert containment wall (e.g. earth starter wall). These paddocks allow silt wash off from the external side slopes to be contained on site in dedicated areas under controlled conditions. In addition it allows potentially contaminated water (free water such as storm water that has been in contact with the residue material) to be temporarily stored before it's conveyed away in a controlled manner or allowed to dissipate naturally (e.g. evaporate or seep away).

Seepage or storm water must also not be allowed to pond directly against the toe of the TDF. Care must be taken when pumping or gravitating this water away that may have accumulated over a long period of time. The importance of ensuring the dissipation of interstitial water within the slope is crucial to prevent a drawdown situation which may result in a localised slope failure.

D1.4.6 *Initial Starter or Impoundment Walls*

A starter wall or initial impoundment wall would have been constructed from earth or natural materials before commissioning any TDF located on surface. These would have been designed to impound the initial placed residue material until the placed residue material could drain and consolidate to reach sufficient inherent strength.

D1.4.7 *Tailings Dam Walls and Side Slopes*

The main requirement for building and maintaining the level of the outer dam wall is to create freeboard of a sufficient height difference between the pool water level and the outer perimeter so as to contain any accumulation of water that may arise from a storm event, normal precipitation (rain and melting snow) and the normal process water. The required freeboard may be calculated so that sufficient capacity is provided to contain this process water, normal precipitation and storm water with an acceptable factor of safety against overtopping. The catchment area above the TDF will impact on the TDF. In determining the required freeboard, consideration must be given to the beach freeboard as well as the required vertical freeboard that needs to be created with the dam wall construction.

Another requirement is for the outer slope to be stable while it is being constructed. The following factors control the stability of any TDF dam wall:

- The slope geometry which relates to the height and slope angle.
- The phreatic surface within the placed tailings which can be determined from piezometer readings.
- The strength properties and categorisation of the placed tailings.
- The underlying soils and rock strength properties and their categorisation.

Once these data are known, a slope stability analyses may be undertaken using conventional methods of analysis to confirm the factor of safety against slope failure. The calculated value must exceed the industry norms to consider the slope satisfactorily stable. Alternatively, a probabilistic analyses may be undertaken which will present the chance of a failure occurring. Deep seated and localised failure should be considered for the different analytic methods used.

Side slope erosion must be minimised. This may be achieved by controlling surface run off as well as providing a vegetation cover once deposition has stopped on the outer slopes. This will reduce wind and surface water erosion. Alternatively, consideration may be given to cladding the outer slope with a suitable inert material.

Broad cost for rehabilitation of side slope areas and flat areas have been estimated to present as an indication. Thirdly side slope erosion from wind and water must be minimised. This may be achieved by controlling surface run off by shaping or contouring the slope to an acceptable slope angle (ie sya flattening slopes greater than 30degrees) and providing berms or benches as well as providing a vegetation cover to assist in controlling water and wind erosion. Owing to the manner in which the TDF are being operated these measures may only be implemented once deposition has stopped on the outer slopes. Alternatively consideration may be given to cladding the outer slope with suitable graded inert material. Broad rehabilitation costs as described above for side slope areas and flat areas have been estimated. These are presented in *Table 1.2* and are expressed as a cost per hectare which will then just need to be multiplied out for the applicable area.

D1.4.8 Under Drainage

Under drains are normally installed at the time of constructing the TDF before deposition starts. These measures allow seepage water to be extracted from the placed residue and thereby assisting in the side slope stability by depressing the phreatic surface.

D1.4.9 Field and Pool Control

The surface area provided by the field determines the deposition capacity of the TDF as this is where (with the exception of the material placed in the dam walls) the tailings material is mostly placed. A limitation to the rate of surface areas rising is normally set for the tailings depending on the residue materials characteristics and the generally condition of the TDF.

In addition the pool water on any field must be controlled so that it is located away from any outer Dam Wall. This will assist the overall stability by ensuring that the phreatic surface remains depressed and that there is no accumulation of fine material on near the outer perimeter.

Dust originating off the top of any abandoned TDF may be controlled by establishing a vegetation cover. Side slope erosion must be minimised. This may be achieved by controlling surface run off as well as providing a vegetation cover once deposition has stopped on the outer slopes.

D1.4.10 Decant Pumping System and Access

Sufficient pumping or decanting capacity must be maintained at all times to ensure that excess supernatant water that ultimately forms the pool does not become unmanageable.
The capacity of the pumping decant system must be sufficient to enable the process and storm water to be drawn off in a reasonably short period of time maintaining a small as possible pool on the TDF.

Safe access must be provided to the decant pump station under all conditions to ensure their efficient operation.

D1.4.11 Delivery System

The slurry generated must be able to be delivered to any point along the outer walls to ensure continued uninterrupted dam wall building. This requires a slurry delivery system on the outer Dam Walls.

D1.4.12 Transfer Pump Station

Water being decanted off the TDF may need to be boosted. Normally a transfer pump station serves this purpose.

D1.4.13 Site Office and Storage Yard

Generally a site office and storage yard is required at each TDF to facilitate the operation. Good housekeeping must be maintained at these premises as well as on and around the TDF.

D1.5 TAILING DEPOSIT FACILITY ASSESSMENT

D1.5.1 RTH TDF

Access

Generally access is restricted to unauthorised persons at this TDF as it is located in close proximity to the process plant within the confines of the plant itself. As such there is no need to setup an independent system. A low risk is presented.

Storm Water Diversion

A storm water diversion system is not required at this TDF as it has been constructed to an elevation higher than the surrounding area. No risk is presented.

Roadways

Roadways are generally good in the vicinity as the TDF is located within the confines of the plant area. Some restriction exists on the access road to the back of the TDF. This road is used by the municipal refuse services as well as the Mine. The road is narrow and is not surfaced with suitable material. In areas the road is in danger of failing as steep slopes exist above and below the road. Owing to this, a moderate risk is presented.

Solution Trenches

Except where seepage water is canalised from a major seepage discharge point on the south-eastern side and one on the north-western side no solution trenches serve this TDF. Seepage water should be collected in a sump and pumped back for treatment within the plant area as these points are of major concern owing to the reagentised water that is being released uncontrollably off the site. This single action if satisfactorily addressed will solve a major negative environmental impact and lower the high risk evident at the moment. No risk is perceived in respect to the performance of any solution trenches however as discussed with the under drainage seepage water presents a significantly high risk.

Catchment Paddock

No catchment paddocks are in place. Again catchment paddocks should be installed to arrest silt wash off from the site. Its implementation will go a long way to addressing surface runoff problems. The cost of implementing a catchment paddock system is small in relation to the benefits that may be achieved as it is a simple earthmoving exercise that may be undertaken with relatively light earthmoving equipment. No risk is perceived in respect to the performance any catchment paddocks.

Starter Wall / Impoundment Wall

As this TDF was constructed within the confines of an existing worked-out open pit, no starter walls were required initially. No risk in terms of stability is considered in terms of any impoundment wall.

Tailings Dam Walls and Side Slopes

Presently deposition is continuing on the outer wall that is located on the north, west and southern sides. An overburden or waste stockpile forms a high wall on the eastern side onto which the TDF butts against.

The outer wall on the remaining sides is constructed by cyclones that are periodically relocated as the wall is raised. Owing to the restrictions placed by the existing infrastructure and the toe of the TDF some sections of the outer slope appears to be to constructed too steep. In addition the downstream method of wall building cannot be adopted there, as coarse tailings would engulf or encroach over it. It was stated that the field elevation is only about 2 to 4 meters above the surrounding terrain level. Stability of the outer Dam wall is not considered an issue. However on the eastern side in the area immediately above the river course a number of slips and sloughs are visible. The slopes in this area are failing on a continual basis. The situation must be stabilised and remediated as such a high risk is considered to be applicable here.

Freeboard appears to be adequate for the given area. This will however need to be confirmed with the necessary survey and calculations. A low risk is perceived with respect to the available freeboard.
Once operations stop, the side slopes could either be clad or vegetated.

Under Drainage

No under drainage appears to have been installed as the TDF has been located in the worked out open pit. However significant seepage is occurring on the eastern side where seepage water is allowed to gravitate directly into the open system. This practice must stop, as a significantly high risk is presented with the current situation. Except for the localised area on the north western side a low risk is perceived.

Field and Pool Control

The pool on this TDF is relatively large and should be reduced in size. Again the pool is located against the outer wall and should be relocated away against the overburden stock pile. This will lessen the effect of the finer material that has been placed in the present pool position. Long term stability will be affected as the fine material has a lesser strength. Future slope stability calculations must take this into consideration. A low to moderate risk is presented.

The deposition capacity has been stated as 4 to 5 years at the present deposition rate. This will need to be confirmed; however a low risk is perceived.

Once deposition stops, consideration may be given to either capping the surfaces with inert overburden material, alternatively vegetation could possibly be established on the surfaces

Decant System and Access

A barge with a pumping system is located alongside the outer wall on the western side. Standby facilities are present. Consideration could be given to providing protection from the elements in the form of a shed that could possibly be located over these pumps. A low risk is presented.

Delivery System

Presently, slurry is pumped onto the TDF. Two residue streams are deposited onto this TDF. The normal tailings are cycloned forming the wall building material. While a slag type material arising from the smelter is discharged at a singe point on the north western side. This arrangement presents a low risk, however the situation may change over time.

Transfer Pump Station

Process water is pumped directly off this TDF and no transfer-pumping facility appears to be in place. No risk is attributed here.

Site Office and Storage Yard

No site office was observed however the area around the electrical transformer appears to be neat. A low risk is presented.

D1.5.2 Bor (Town) TDF

This TDF has been abandoned. Its various components are however assessed similarly to the others as this dump does not have final closure and still presents a environmental hazard with the corresponding risk.

Access

Generally access is restricted to unauthorised persons at this TDF as it is located in close proximity to the existing plant within the confines of the plant itself. It is however in very close proximity to the town of Bor and easy access will be possible. Particular attention should be paid to this. A low risk is presented.

Storm Water Diversion

The TDF appears to be higher in elevation than the surrounding area and the need for a storm water diversion system may not be required. The surrounding area is relatively flat. A low risk is presented.

Roadways

Road access appears to be only possible on the northern side adjacent to the plant area. As the area is abandoned this may not present an immediate and direct difficulty. A low risk is presented.

Solution Trenches

No solution trenches serve this TDF.

Catchment Paddock

No catchment paddocks are in place. Catchment paddocks should be installed around the perimeter as they will assist in arresting silt wash off from the site. Large erosion gulleys were observed at the time of the site visit. The implementation of catchment paddocks will go a long way to addressing surface run off problems at a minimum cost.

Starter Wall / Impoundment Wall

The TDF was constructed within the confines of an existing worked out open pit and no initial starter walls appear to have been installed.

Tailings Dam Walls and Side Slopes

Tailings deposition has stopped on this TDF. However process water is placed onto the surface on an ongoing basis. This is done in order to reduce the potential for dust owing to the close proximity of the township.

The outer walls were constructed by means of cyclones as is common for the area.

Freeboard appears to be minimal for the given area. This will however need to be confirmed with the necessary calculations. A moderate risk is perceived.

Significant side slope erosion was observed in localised areas. A high risk is perceived and these areas will need to be rectified.

Under Drainage

No under drainage appears to have been installed as the TDF has been located in the worked out open pit. However, a municipal sewer pipeline is located below the Field of this TDF. No problems were reported with this installation. A moderate risk remains that this sewer pipeline may be affected over an extended period.

Field and Pool Control

Process water is pumped directly on the three fields of the TDF. These areas appear extensive but shallow. In carrying out this exercise great care must be taken that excessive water is not stored onto the surface area. In addition it must be ensured that the pool that is created does not continually encroach onto any outer wall. A real danger exists for supernatant water to overtop with a TDF that has been abandoned and used to store water. This presents a high risk.

Measures should be determined to vegetate the top surfaces of the TDF, alternatively the surface could be covered with a suitable thick and graded overburden material. A high risk exists for dust to originate off the TDF.

Decant System and Access

No decant facilities appear to serve this TDF.

Delivery System

As the TDF has been closed no slurry delivery system is in place.

D1.5.3 *Veliki Krivelj*

Conditions at Veliki Krivelj TDF are discussed as follows:

Access

Unauthorised access is not restricted to this TDF. Consideration must be given to the cost and implications (risk) of not providing adequate restriction to uncontrolled access.

Storm Water Diversion

The Veliki Krivelj TDF is constructed across a river. A river diversion tunnel (collector) has therefore been constructed to lead upstream water past the TDF. The first portion of this tunnel has been constructed in the hillside passing Field 1 while the second portion is located directly beneath the deposited residue in Field 2. The second portion is showing considerable distress with the real possibility of the tunnel failing. The performance of the tunnel over the different sections is obviously related to the protection that the rock or natural material that it passes through gives in comparison to the direct loads that are applied to it from the placed residue material on the lower sections. In any future designs consideration must be given to buoyant forces that result periodically when the pipe is in an empty state. Extensive repair work has been undertaken on portions of the tunnel to reinforce it. Ongoing distress is still evident in other sections in the vicinity of Field 2 and these sections will also need to be suitably upgraded in the near future. Failure of the tunnel may lead to a catastrophic failure of the TDF as residue material may exit uncontrollable from the deposit. This in turn will significantly affect downstream and upstream user of the river and valley system as well as the possibility of directly stopping mining activities. This presents a major environmental risk.

Presently seepage is occurring into the tunnel, which is allowed to exit off the site in an uncontrolled manner. This presents a moderate risk.

Alternatives to upgrading or replace the existing river diversion tunnel system are being considered. In the event that the existing tunnel is abandoned it must be ensured that it is closed off and sealed adequately so that no failure may occur whilst it is not under surveillance. Mass concrete may need to be placed along a significant length.

Under certain situations (when excessive water accumulates on Field 2) an existing tunnel that is connected to the river diversion tunnel serves to decant water off Field 2. Any alternative measures that may be implemented with the replacement of the river diversion tunnel will need to ensure that this capability of drawing water off Field 2 is not lost.

Consideration should also be given to constructing a surge dam upstream. This will enable water to be decanted (or pumped) to bypass the TDF at a reduced but controlled rate yet allowing for storm water arising upstream. A surge dam may still incorporate the existing tunnel once it has been suitably reinforced.

Storm water diversion trenches above the TDF on the side slopes of the valley should be installed so as to minimise the storm water coming onto the surface area of Field 1 and 2. A suitable design will need to be undertaken to determine the size, location and grade as well as provide suitable erosion protection measures. Once installed this trench will need to be maintained to ensure its long-term performance.

Roadways

At the time of the inspection, despite a significant snow fall, access was possible onto Dam 1 and up to Dam 3. Access to other relevant arrears must be assessed and upgraded if required. Regular maintenance must be undertaken on the roads to ensure continued all weather access. A low to medium risk is presented at the time of non emergency and emergency situations arising.

Solution Trenches

No solution trenches were observed at the time of the site visit. Some seepage must however be emerging from the toe or underdrains. It was indicated in the literature that seepage areas have occurred on the outer side slope at times. Water arising from these points must be controlled and dealt with. Satisfactory water quality to set standards must be ensured before it is passed on downstream; alternately seepage water must be collected and returned to the Plant for re use in the process. This may also require some form of treatment in order to get the water quality up to required standards. Any solution trench and collection system will need to be maintained. A moderate risk is presented as contaminated water is exiting off the site.

Catchment Paddocks

Catchment paddocks were not observed at the time of the visit and no mention was made of them in the meetings attended. It would appear that the practice of installing catchment paddock on the toe perimeter is not being followed. It is recommended that these be installed at a suitable location on ground level and the correct distance away from the side slope taking into consideration that the outer toe is always encroaching away from the TDF, owing to the cyclone deposition method being utilised.

Again any erosion of catchment paddock walls must be maintained and repaired immediately when required. Catchment paddocks must be kept in an acceptable condition at all times to ensure that silt wash-off and surface storm water run off is contained in the paddocks with additional capacity to contain storm water coming off the side slopes.

These paddocks will thus need to be cleaned periodically to prevent a silt build-up over time; alternatively their walls may be raised to ensure and provide further or sufficient capacity over the life of the TDF. A moderate risk is presented as contaminated material is able to exit off the site.

Initial Starter or Impoundment Walls

All the initial starter dam walls have now been covered owing to maturity of the TDF and the manner in which the outer dam walls are being constructed in a downstream building method with the placing of the coarse cycloned tailings material. As such these initial starter walls do not affect the present operations.

No risk is perceived or relatable to the present function or original starter wall.

Tailings Dam Walls and Side Slopes

Tailings dam wall building is undertaken in a downstream manner where coarse tailings is placed incrementally on the outer slopes. This method normally presents a fairly stable outer wall. Presently deposition is only continuing on Field 2 along Dam Wall 3. Cyclones on this dam wall are however not in operation at the moment and the residue is just being open ended or spigotted from the end of the outer Dam Wall 3. Residue material beaches from the wall with the material settling and the slurry water gravitating into the extensive pool. The section of wall where Dam Wall 3 buts against the far side of the valley needs to be raised urgently as no vertical freeboard has been created with the most recent building of the cycloned wall that forms Dam Wall 3. In this section beach freeboard only remains between the pool and the lowest elevation on the outer wall. As stated Dam Wall 3 has to be urgently raised in this area to provide sufficient vertical freeboard that the cycloned wall would normally attain. This situation presents a major risk in the event of overtopping.

Dam Wall 1 appears to have sufficient vertical freeboard and is not the primary concern. Actual requirements will however need to be confirmed with the appropriate calculations to ensure that this site perspective is reasonable.

Some concern is expressed with the height and corresponding freeboard that Dam Wall 2 provides. This dam wall forms the division wall between Field 1 and 2. Deposition generally occurred off Dam Wall 1 onto Field 1 forcing the pool on Field 1 to be located away from the discharge point and towards Dam Wall 2. Little beach exists off Dam Wall 2 on Field 1. Thus the freeboard provided by Dam Wall 2 must be confirmed, as any overtopping here will detrimentally affect Field 2 with the corresponding low freeboard that exists on Dam Wall 3. This situation presents a moderate to high risk.

In addition to maintaining the freeboard the erosion on the outer slope must be minimised. Owing to the manner of downstream construction, the outer slope cannot be vegetated now as more residue material is still to be placed on the outer slope.

When undertaking storm water calculations consideration must be given to the decanting capacity of the decant tunnel (collector) that joins the river diversion tunnel located below Field 2. Owing to the significance of an overtopping event on downstream users in the closed off valley, consideration should be given when designing and maintaining sufficient freeboard in the event of an occurrence of the maximum probable flood.

A number of piezometers have been installed and phreatic readings are being taken on a regular basis. Several of these are however malfunctioning and must be replaced. Although the piezometers are being recorded no slope stability analyses was made available. This analysis must be undertaken as a matter of urgency and this is considered a major risk until confirmation of a stable slope.

Under Drainage

Both Dam Wall 1 and 3 have an under drainage system. Some remedial work has been undertaken to under drainage system that was installed beneath Dam Wall 3. Seepage water from both these under drainage systems are allowed to gravitate into the open environment presenting a risk to the environment. This presents a high environmental risk.

Field and Pool Control

Presently both the pools are large on Field 1 and 2 and should be reduced to an acceptable minimum. In addition the pool on Field 1 lies too near the Dam Wall 2, while the pool on Field 2 lies well away from Dam Wall 3 in a satisfactory position. A moderate risk is presented with this situation.

The capacity of Field 2 is said to be another 6 or so months before the final height (as determined from LEAP) is reached. Further deposition capacity will then be required. Consideration is being given to re-establishing Field 1 by constructing a mechanical Wall along Dam Wall 2. Physically constructing a new Dam Wall on top of Dam 2 is problematic. This will be difficult to do as the outer base that is required, comprises mainly inundated fine tailings material with little strength properties. A very high risk is presented should the raising of this wall be defective. A thorough analysis is required.

Decant Pumping System and Access

A dedicated pumping system is located on the pool on Field 2. No difficulties were reported with its operation. The period over which storm water and process water can be drawn off needs to be confirmed. A low risk is presented.

Delivery System

Presently slurry is gravitated to the TDF by means of an open channel. The slurry is fed onto the dam walls via energy dissipating chambers until the last chamber enables the slurry to be fed into a pipe which in turn serves the clones (or cluster of cyclones) that are located along the dam wall that is being lifted or built. The pressure is apparently sufficient to ensure that the cyclones operate under correct pressures. Should the trench breach or the slurry pipe line break a moderate low to moderate risk is presented.

Transfer Pump Station

A transfer pump house is located to the south west of Field 1. Return water is transferred back to the process plant from here for reuse. The pump house must be kept in good working order. Ongoing maintenance of the electrical and mechanical equipments must be ensured. A low risk is presented.

Site Office and Storage Yard

A site office and storage yard is located at the one end of Dam Wall 3. The area appears to be neat, however good housekeeping must be maintained. Material must be stacked neatly and safely. Walkways and travel ways must be adequately demarcated. A low risk is presented.

D1.5.4 Cerovo

No tailings disposal facility was in use at Cerovo. However a number of environmental issues may be related to this mining facility. This includes the four pipelines that connect this operation with the facility at Bor some 14km away. At the time when operations were underway these pipelines were required to transport ore slurry, return water, industrial water and potable water. At present these pipelines convey water that is collected in the surge dam and poor quality water originating from the open pit. The conditions of these pipes linking the two operations are now in question as numerous leakages and breakages have been reported and encountered respectively.

Consideration is being given to replacing the pipes and an alternative proposal has been presented.

In addition, consideration should also be given to concrete lining the existing pipes in situ. The possibility may exist to either rubberline or plastic line the pipes. Both of these will need to be assessed by specialists, obviously being dependant on existing conditions. Once costing has been carried out, the feasibility may be assessed.

As a short term measure, the areas where pipe breakages have occurred or seepage noticed, catchment paddocks may be constructed to collect water. Once collected the water may be suitably treated and depending on the water quality either discharged into the open environment or returned to the plant for further treatment or use in the process.

Consideration is also being given to utilising the existing open pit at Cerovo as a new tailings disposal site with the exploitation of further ore bodies that have been identified. In the design of an in-pit tailings disposal system the following must be considered:

- In pit dewater requirements must be carefully determined. This may include paste deposition technology, where the residue stream is dewatered to a minimum before pumping and deposition.
- The impact on the ground water as the placed material may well oxidize over time leading to adverse acid mine drainage.
- The effect on the water table when the residue comes into contact with it. The resultant in or outflow must be assessed.
- Residue discharge system to effectively control the pool water and residue placement.
- Available storage capacity as the material will not drain initially leading to a lesser volume capacity owing to the additional water that has to be retained and the resultant lower densities.
- Rehabilitation measures that will need to be implemented when the pit is full.

Either way this TDF will need to be carefully designed as it is not just a straight forward matter of discharging slurry directly into the open pit.

D1.5.5 Majdanpek - Valja Fundata

Valja Fundata TDF forms the main residue disposal site at Majdanpek.

Access

Even though the TDF is located in a remote area, unauthorised access is not restricted. This is applicable to both wildlife and humans. Again this may normally be achieved by ensuring control access points at a main gate and providing fencing around the outer perimeter. Ongoing maintenance will need to be provided once any perimeter fence has been installed. The costs in relation to the risk must be evaluated. A low risk is perceived.

Storm Water Diversion

Consideration should be given to installing storm water diversion trenches above the TDF on the side slopes of the enclosing valley so as to minimise storm water coming onto the surface area or field. Owing to the shape and area, benefits will need to be evaluated against the installation costs in relation to the additional water that is handled. A suitable design will need to be undertaken to size, locate, grade and provide suitable erosion protection measures, once installed this trench will need to be maintained to ensure its long-term performance. A moderate to low risk is perceived.

Roadways

Roadways around the TDF appear to be limited as direct access is not possible to all the areas where operations are underway. Access to other relevant areas must be assessed and upgraded if required to provide a functional access. Regular maintenance must be undertaken on the roads to ensure continued all-weather access, presenting a low to moderate risk if there is a state of emergency.

Solution Trenches

No solution trenches were observed at the time of the site visit. These will only be required at areas where seepage exits onto the surface where it will be possible to collect, control and manage any contaminated water. The occurrence of seepage must be fully evaluated.

Catchment Paddocks

Catchment paddocks have not been installed at the toe of the TDF. It is highly recommended that they be installed to arrest side slope erosion and contaminated water. Excessive erosion was observed on the side slopes - paddocks will assist in preventing erosion run off at a relatively low cost. A moderate risk is presented.

Initial Starter or Impoundment Walls

All except one initial starter wall has been covered with placed tailings material. This exception is the concrete retaining wall located on the southern side of the TDF. The area behind this wall has now been filled and a dam wall is being constructed from cycloned tailings material on the inside to increase the freeboard and capacity in this area.

Tailings Dam Walls and Side Slopes

Presently deposition is continuing at various points on the perimeter of the field, where the tailings do not encroach onto the sides of the valley. Cyclone wall building will continue in the spring and summer months.

Presently freeboard appears to be adequate however storm water calculations will need to be undertaken to confirm actual conditions. Ongoing wall building will continue.

In addition to maintaining the freeboard, the erosion on the outer slope must be minimised. Use could be made of the numerous tyres found on the mine by placing them on the crest, as this will enable the slope to be stabilised against wind erosion.

Under Drainage

The western side of the TDF is underlain by limestone. It has been reported that seepage is evident some distance downstream from the TDF. As the limestone is fairly porous, seepage water will most likely penetrate the limestone from the TDF. A high risk of this occurring is presented.

No under drainage system appears to have been installed beneath the TDF.

Field and Pool Control

An extensive pool of water is located on the top of the TDF. It would appear that this pool is located to close to the far dam walls around the return water pump station.

The deposition capacity must be confirmed. However the surface looks extensive and it would appear that a number of years remain before a new TDF would be required. A low risk is perceived.

Decant Pumping System and Access

Water is returned to the plant for reuse in the process. It was reported that there is a steady build up of surface water. This may be problematic in the long term. As such a moderate risk must be assigned.

Delivery System

Slurry is pumped onto the TDF. The pumping system observed appears to be adequate with a low risk of failure to the open environment

Transfer Pump Station

A transfer pump house is not in use as water is pumped directly back to the plant.

Site Office and Storage Yard

The site office and storage yard appears to be neat, presenting a low risk of contamination. Good house keeping must be maintained.

D1.5.6 *Majdanpek - Saski Potok*

Access

Access is restricted to the TDF by a fence and gate off the main road. A low risk may be assigned.

Storm Water Diversion

Inadequate storm water diversion trenches have been provided. These appear not to be badly set out and therefore present a fairly high risk as the catchment above this TDF is fairly large.

Roadways

A roadway is located up to the impoundment wall that forms this TDF. A low risk is presented as this road appears to be in fairly good condition.

Solution Trenches

No solution trenches are in place.

Catchment Paddocks

No catchment paddocks are in place.

Initial Starter or Impoundment Walls

A starter wall or initial impoundment wall was formed or extended following the overtopping accident in 1996. The outer slope to this wall is very steep. In addition the crest width is narrow providing a minimum width for vehicles. The freeboard formed on the inside of this impoundment dam wall has decreased. Of concern is that no decant system appears to exist enabling water to be drawn off. Accumulated water is apparently only able to seep or evaporate off the TDF. It is unacceptable that a decant-positive system is not in place. The storage volume is filling up behind the impoundment wall and a minimum of storage space is now available to contain storm water or tailings material. Storm water calculations will provide the actual freeboard required with the necessary factor of safety against overtopping A significantly high risk is presented and the situation must be remedied as soon as possible.

Tailings Dam Walls and Side Slopes

This paddock is used as an impoundment system only and no wall building is undertaken. The side slopes appear to have vegetation.

Under Drainage

This dam is not under drained.

Field and Pool Control

Pool control is poor as pool water is allowed to pond against the outer impoundment wall. This has resulted over time as residue material is discharged only on the upstream side in the valley near the plant. This presents a significantly high risk and the situation must be remedied.

Decant Pumping System and Access

Decant pumping facilities are not provided off the impoundment.

Delivery System

No delivery system directly serves TDF as residue material is allowed to gravitate from the plant that is located upstream in the event of emergencies.

Transfer Pump Station

The pump station located below the impoundment wall serves as a transfer - pumping station. This facility is neat in appearance and appears to be functioning adequately. Water is transferred from here back onto Valja Fundata TDF. Permission to undertake this pumping is going to expire shortly. Until new authorisation is in place, a high risk must be assigned.ù

Site Office and Storage Yard

A site office and storage yard is located at the one end of Dam Wall 3. The area appears to be neat, however good housekeeping must be maintained. Material must be stacked neatly and safely. Walkways and travel ways must be adequately demarcated.

D1.6 PROPOSED SHORT TERM MITIGATION MEASURES AND MONITORING

D1.6.1 Proposed Short Term Mitigation Measures

Shortcomings on the tailings disposal facilities (TDF) comprising the tailings dams and ponds (fields) and related supporting infrastructure have been identified as previously discussed and for which proposed action plans and remedial measures have been set out with the corresponding costing. In the interim, prior to these being implemented it must be ensured that that the tailings disposal facilities are operated in accordance with their current designs.

Essentially the following main areas of concern are to be dealt with satisfactorily and appropriately for each TDF considered in the total complex:

Freeboard

It is imperative that the necessary freeboard must be provided and maintained at all times to ensure that overtopping does not occur under any circumstance. This requires the outer dam walls to be raised sufficiently to contain any accumulation of water on the fields or ponds as well as providing a sufficient factor of safety. Sufficient freeboard must be provided to contain normal precipitation, storm water and process water that may be diverted or directed onto the field or pond surface areas. Consideration must also be given to minimising the catchment areas. This may entail installing temporary storm water diversion trenches or bund walls at appropriate positions. The outer dam walls may be constructed with the normal cyclone method presently in use to maintain the dam wall level sufficiently higher than the field or pond surface level. Alternatively should this not be possible the outer wall must be raised mechanically with the importation, placement and compaction of suitable material from an outside source. The cost for these will need to be undertaken under normal operating costs as they relate to normal dam wall building.

Slope Stability

The stability of all the outer slopes must be ensured. Appropriate slope stability analyses must be undertaken to ensure and reconfirm that the slopes are stable under the present and anticipated future conditions. Previously determined parameters must be confirmed, such as underlying and placed tailings, material engineering and strength properties, slope geometry and phreatic levels. In addition variable parameters such as the slope angle, total height and phreatic levels within the slope must be monitored to ensure that they do not exceed previous design parameters. Trends for these variable properties must be established to ensure that conditions do not deteriate unsatisfactorily.

Infrastructure

It must be ensured the condition of the existing components comprising the TDF are maintained or bought up to satisfactory condition. An on-site appraisal must be done with the operational staff, shortcomings must then be identified and appropriate remedial measures with the available resources implemented timeously. Additional resources may need to be applied. Consideration must be given to all aspects extending from good housekeeping to ensuring that the infrastructure components are in sound order and that operations are undertaken effectively in an economical manner.

Rehabilitation

Small scale rehabilitation measures should be initiated. As much work should be undertaken under normal operational costs as far as possible. This will ensure that final closure measures and their associated costs are minimised. It also establishes the mindset for undertaking future rehabilitation measures that will be necessary.

Liaison

Existing forums in place should be used to liaise with all interested and affected parties. These communication channels should be used to enlighten the interested and affected parties setting out the present situation with constraints as well as putting forward proposed actions that will be undertaken in due course. An open relationship should be maintained and developed. Any shortcoming where expectations are not going to be met must be dealt with the appropriate negotiations.

D1.6.2 Proposed Monitoring Measures

End objectives in terms of the operation, rehabilitation and final closure must be determined and set. This encompasses the above mentioned issues. Once these have been established then a monitoring system must be initiated and institutionalised to ensure that the standards that have been set are met and adhered too. Essentially this will just mean an extension of the existing systems.

To facilitate this and to focus efforts it is proposed that a Code of Practice (CoP) for the TDF operation is compiled with the intention to inform and guide management, operational and maintenance personnel in their duties for the safe and efficient operation of the TDF giving an overall management plan, whereby the management and operational procedures for the residue disposal/storage facility may be implemented easily with effective control. It should set out and provide the controlling objectives, principles and minimum requirements to effectively manage and operate the various TDF's in a safe and controlled manner. In compiling this CoP consideration must be given to the following for its overall successful operation.

- General Background
- Infrastructure
- Deposition Operations
- Maintenance
- Management
- Relevant Environmental Aspects
- Possible Closure Objectives

Typically the objectives and issues to be determined with the compilation of any TDF CoP within the current operational phase may be set out or summarised as follows:

- To identify and assess the risks and hazards relating to the TDF's.
- To implement an appropriate hazard management system for controlling the TDF's ensuring that it is developed and maintained in a safe and stable state in accordance with prescribed risk management specifications.
- To ensure that the disposal/storage facility is operated in accordance with the requirements of the design and operating standards that may have been set and within the constraints of the industry norms of good practice.
- To provide a means to undertake short-term, intermediate and long-term planning.
- To ensure that appropriate daily, weekly, monthly, quarterly, bi-annual, annual inspections as well as any necessary audits are carried out and reported upon in the correct manner.
- To ensure minimum legal requirements are met and maintained.
- To maximise and minimise negative and positive environmental impacts respectively.
- To enable relevant information to be presented in an accessible form for all parties involved with the operation of the disposal/storage facility and allowing effective interaction and communication to take place.
- To provide a basis to ensure compliance with predetermined criteria.
- To determine or confirm the organisational structure for operating the TDF's.
- To set out and confirm the duties of management and operational personal as well as outside consultants and any expertise needed.
- To ensure that the necessary training is undertaken and that the required competencies are maintained on site.
- To set out any emergency procedure in the event of an unforeseen incident.
- In addition, this CoP may be used to assist with an investigation or inquiry in the event of an accident to ascertain compliance.
- And to ensure continual improvement in the operation and systems.

1. GENERAL

The immediate areas of concern are set out above for which mitigation measures will need to be assessed and the appropriate mitigation measures undertaken. In addition a proposal is presented to institutionalise a monitoring or surveillance system to effectively manage and control the various TDF's through out and beyond their life. These measures should be implemented for each, operational and closed, TDF in the complex of BOR. We remain available to discuss the above further and to be of assistance in implementing any of the envisaged systems.

D1.7 CONCLUSION AND RECOMMENDATIONS

Based on the above discussion the following conclusions may be set out in regard to the various TDF under consideration. Emphasis is placed on the more critical issues which will require urgent attention as identified by the perceived risk. Estimated associated costs are presented as far as possible to implement measure to reduce this perceived risk.

D1.7.1 *Veliki Krivelj*

In order of significance the following is concluded with recommendations presented.

For this operating TDF the future limited capacity may be identified as the most critical issue. Owing to height restrictions imposed by environmental constraints only a further 6 months or so deposition capacity remains on Field 2. Time is short and measures to provide further capacity will need to be addressed very soon. A design will need to be undertaken immediately followed on by the appropriate construction before deposition may continue past this time limitation . Alternatively negotiations may be entered into with the authorities so as to relax the environmental constraints imposed. Engineering calculations will need to support these discussions in any event.

It is proposed by the Mine that Field 1 is reinstated. The design to reinstate this Field is problematic as it calls for a new wall to be constructed mechanically on the existing Dam Wall 2. The base or foundation that will be provided by residue material is very weak as saturated fine unconsolidated material lies on both the downstream and upstream side of this wall. Little initial support will be provided by this material. Therefore the manner in which this wall will need to be lifted must be carefully considered. (see item 1.01 #1 and #2 of *Table 1.2*).

The freeboard that was observed on Dam Wall 3 is inadequate. This outer wall must be lifted urgently with normal operations. (see item 1.02 #1 and #2 of *Table 1.2*).

The stability of the outer slopes must be confirmed with a conventional slope stability analysis. (see item 1.03 #1, #2 and #3 of *Table 1.2*).

The tunnel (collector) beneath the TDF remains in distress over sections. Suitable measures must be implemented to remediate this situation. Various options have been proposed and the optimum one should be implemented. However further consideration should be given to a surge dam in combination to these. (see item 1.04 #1, #2, #3 and #4 of *Table 1.2*).

Contaminated water, either in the form of seepage or decanted must be curtailed. This water will need to be collected and either treated to acceptable levels before discharging into the open environment or it must be passed back for reuse in the process so as to provide a closed circuit for the water system. (see item 1.05 #1 of *Table 1.2*).

Silt wash off must be arrested. This may be achieved with the installation of catchment paddocks (see item 1.06 #1 of *Table 1.2*)

Dust exiting off the site must be curtailed. Rehabilitation measures may however only be implemented once deposition stops and an ongoing problem will remain until final closure. (see item 1.07 #1 and #2 of *Table 1.2*).

D1.7.2 RTH TDF

The main concern with this TDF is the uncontrolled seepage and surface water that is being allowed to exit uncontrollable off the site on the eastern side of the site. This must be stopped. An under drainage system and surface water containment system will need to be installed to help alleviate the situation. Once collected the water will either have to be treated or returned for use in the Plant. (see item 2.01 #1 and item 2.02 #1 of *Table 1.2*).

The slope stability on the eastern side is of major concern A comprehensive analyses must be undertaken. This area is not under any form of surveillance or monitoring as these efforts are mainly being carried out around the operational TDF. A slope failure will prevent access to the municipal dump.

Silt wash off must be arrested. This may be achieved with the installation of catchment paddocks.

Dust exiting off the site must be curtailed. Rehabilitation measures may however only be implemented once deposition stops and an ongoing problem will remain until final closure. (see item 2.03 #1 and #2 of *Table 1.2*).

The operation of the municipal dump must be evaluated and appropriate remedial measure initiated (see for details section 6.4 of the present report).

The pool must be relocated away from the outer wall to prevent stability problems in the long term. This will require the return water pump station to be relocated against the overburden dump that forms the eastern boundary. (see item 2.05 #1, #2 and #3 and item 2.06 #1 of *Table 1.2*).

D1.7.3 Bor (Town) TDF

The main issues identified include the following.

The required freeboard must be confirmed especially as water is continually being pumped onto the TDF. The slope stability is of concern with the continued placing of water on the TDF. A comprehensive analysis must be undertaken. This area is not under direct surveillance or monitoring as efforts are mainly centred out around the operational TDF. As such an appropriate slope stability analyses should be undertaken to verify the stability of the outer slopes for this TDF that has been closed. (see item 3.01 #1, #2 and #3 of *Table 1.2*).

Rehabilitation measures should be initiated to obtain full closure on this abandoned TDF. This will mitigate dust and seepage issues. (see item 3.02 #1 and #2 of *Table 1.2*).

The condition of the sewer buried below the TDF must be assessed to determine the possibility of any adverse impact. (item 3.03 #1 and #2 of *Table* 1.2).

D1.7.4 *Cerovo*

Two main issues were identified with this TDF.

The conditions of the pipes connecting to Bor are in a poor state. Until they are repaired or replaced ongoing breakages and seepage will occur into the open environment. Consideration for this interim period may be to install catchment paddocks and seepage collection points at identified position. (for temporary measures, see item 4.01 #1 and #2 of *Table 1.2;* pipeline repair is addressed under section 6.3 of this report).

In the event that further mining continues at Cerovo (Cerovo 2 to Cerovo 4), the design for any in pit residue system that may be considered will need to be undertaken to confirm the necessary capacity. (item 4.03 #1 and #2 of *Table* 1.2).

D1.7.5 *Valja Fundata*

The main issues relating to risk are presented as follows.

The slope stability of all the outer walls needs to be confirmed with a comprehensive slope stability analysis. All the factors affecting stability must be taken into consideration as set out above. (item 5.01 #1, #2 and #3 of *Table* 1.2).

The freeboard capacity must be confirmed as there is a reported steady increase in the build up of water on the TDF. This will entail undertaking storm water holding capacity analyses for the TDF. This would generally be carried out at the time of an slope stability analysis.

Silt wash off and seepage from the TDF must be arrested. The installation of catchment paddocks and seepage collection areas with collector trenches will assist in this regard. (item 5.02 #1, and 5.03 #1 of *Table 1.2*).

At the end of the life of the TDF rehabilitation measures will need to be implemented. This will be a combination of implementing earthworks and vegetating measure on surfaces. (item 5.04 #1 and #2 of *Table 1.2*).

D1.7.6 Saski Potok

The discussion above indicates that a relative high risk is relevant to this TDF. It is commonly found that an emergency or standby facility, as this one, surveillance is reduced which in turn increase the possibility of some mishap to occur. The following must be taken into account.

The storm water holding capacity appears to be inadequate for the catchment area that impacts on this valley. Freeboard is low and continually decreasing with the ongoing deposition in the event of emergencies in the Plant. The freeboard or other wall is not being lifted as for normal TDF under conventional construction. Without any action this TDF will overtop again. The situation is exuberated as no decant capacity exists on this TDF. (item 6.01 #1, #2 and #3 of *Table 1.2*).

The impoundment wall's outer wall is steep and concern is expressed with the walls stability. A full analysis must be undertaken to confirm the actual situation taking into account the identified factors as set out above. (item 6.02 #1 and #2 of *Table 1.2*).

With the installation of a decant (penstock type) system an adequate storm water diversion works or trenches should be installed within the valley that this TDF is located in. These may be optimised by suitably locating, sizing and grading them. (item 6.03 #1 and #2 and item 6.4 #1 of *Table 1.2*).

Again at final closure of the TDF rehabilitation measures will need to be implemented. This will be a combination of implementing earthworks and vegetating measure on surfaces. (item 6.05 #1 and #2 of *Table 1.2*).

D1.8 ESTIMATED COSTING OF CRITICAL ISSUES

A very broad estimate has been undertaken for the cost of recommendations for critical issues as identified above. It must be noted that these costs are provided as a very rough estimate and no degree of confidence may be placed in them as they are only presented as an order of magnitude.

Table 1.2 Cost Estimate

Item		Description	Unit	Qty	Unit Cost	Total Cost	Timing
1		**Veliki Krivelj**					
1.01		*New Disposal Facility*					
	1	New Dam Design	Lump sum	1	100,000	100,000	6 months
	2	New Dam Construction	Lump sum	1	1,000,000	1,000,000	12 months
1.02		*Increasing Freeboard*					
	1	Lifting Dam Wall 3	Lump sum	1	Operation Cost		ongoing
	2	Lifting Dam Wall 2	Lump sum	1	Operation Cost		ongoing
1.03		*Stability Analyses*					

Item		Description	Unit	Qty	Unit Cost	Total Cost	Timing
	1	Geotechnical Investigation	Lump sum	1	17,000	17,000	3 months
	2	New Piezometer Installation	Lump sum	1	40,000	40,000	4 months
	3	Stability Analyses	Lump sum	1	10,000	10 000	2 months
1.04		*Repair Tunnel (Collector) as per the costing provided by RTB Bor*					
	1	Option 1	Lump sum	1	7,000,000	7,000,000	
	2	Option 2	Lump sum	1	14,550,000	14,550,000	
	3	Option 3	Lump sum	1	5,500,000	5,500,000	
	4	Option 4	Lump sum	1	7,050,000	7,050,000	
1.05		*Seepage Containment*					
	1	Cut Off Drain	Lump Sum	1	167,000	167,000	6 months
1.06		*Silt Wash Off Containment*					
	1	Catchment Paddocks	Lump Sum	1	85,000	85,000	3 months
1.07		*Rehabilitation*					
	1	Side Slopes	Hectare	100	20,000	2,000,000	6months earthworks + 6months veg establishment + min 3yr aftercare period
	2	Flat Surfaces	Hectare	300	4,000	1,200,000	6months earthworks + 6months veg establishment + min 3yr aftercare period
2		**RTH TDF**					
2.01		*Seepage Containment*					
	1	Cut Off Drain	Lump Sum	1	167,000	167,000	6 months
2.02		*Silt Wash Off Containment*					
	1	Catchment Paddocks	Lump Sum	1	85,000	85,000	3 months
2.03		*Rehabilitation*					
	1	Side Slopes	Hectare	50	20,000	1,000,000	6months earthworks + 6months veg establishment + min 3yr aftercare period
	2	Flat Surfaces	Hectare	200	4,000	800,000	6months earthworks + 6months veg establishment + min 3yr aftercare period
2.04		*Muncipal Land Fill Site*				*see section 6.4*	
2.05		*Stability Analyses*					
	1	Geotechnical Investigation	Lump sum	1	17,000	17,000	3 months
	2	New Piezometer Installation	Lump sum	1	40,000	40,000	4 months
	3	Stability Analyses	Lump sum	1	10,000	10,000	2 months
2.06		*Pumping Station Relocation*					
	1	Relocate pumping station	Lump sum	1	Operation Cost		
3		**BOR Town TDF**					
3.01		*Stability Analyses*					
	1	Geotechnical Investigation	Lump Sum	1	17,000	17,000	3 months
	2	New Piezometer Installation	Lump Sum	1	40,000	40,000	4 months

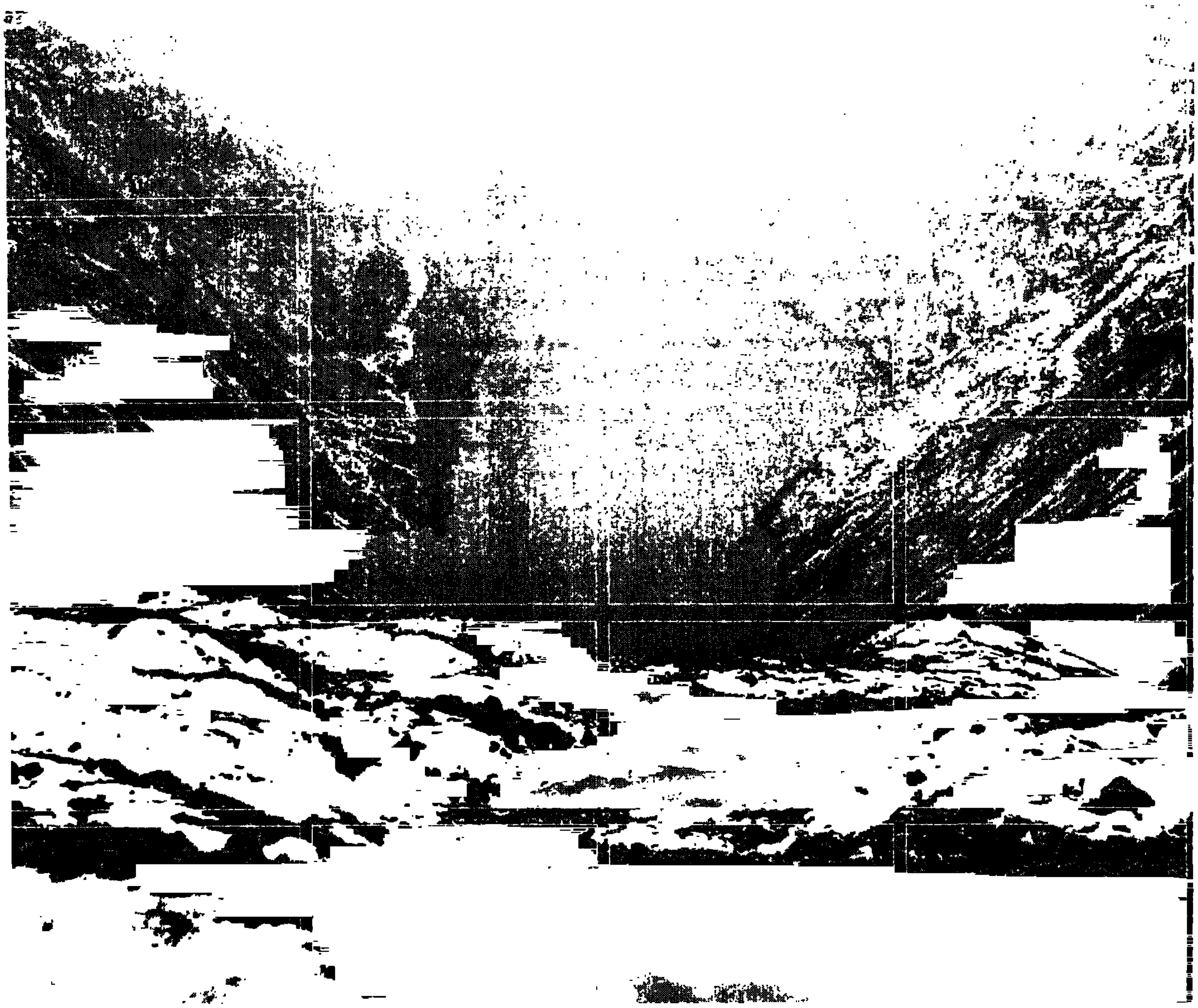
Item		Description	Unit	Qty	Unit Cost	Total Cost	Timing
	3	Stability Analyses	Lump Sum	1	10,000	10,000	2 months
3.02		*Rehabilitation*					
	1	Side Slopes	Hectare	25	20,000	500,000	6months earthworks + 6months veg establishment + min 3yr aftercare period
	2	Flat Surfaces	Hectare	200	4,000	800,000	6months earthworks + 6months veg establishment + min 3yr aftercare period
3.03		*Sewer*					
	1	Remedial Work Analyses	Lump Sum	1	50,000	50,000	
	2	Sewage Pipe Remedial Work	Lump Sum	1	500,000	500,000	
4		**Cerovo**					
4.01		*Temporary rehabilitation work*					
	1	Cut off Under drains	Lump Sum	1	167,000	167,000	6 months
	2	Catchment Paddocks	Lump Sum	1	85,000	85,000	3 months
4.02		*Pipe Line Upgrade*				*see section 6.3*	
4.03		*New Disposal Facility (in case of further exploitation of Cerovo)*					
	1	New Dam Design	Lump Sum	1	100,000	100,000	6 months
	2	New Dam Construction	Lump Sum	1	500,000	500,000	12 months
5		**Valja Fundata**					
5.01		*Stability Analyses*					
	1	Geotechnical Investigation	Lump Sum	1	17,000	17,000	3 months
	2	New Piezometer Installation	Lump Sum	1	40,000	40,000	4 months
	3	Stability Analyses	Lump Sum	1	10,000	10,000	2 months
5.02		*Seepage Containment*					
	1	Cut Off Drain	Lump Sum	1	85,000	85,000	6 months
5.03		*Silt Wash Off Containment*					
	1	Catchment Paddocks	Lump Sum	1	42,000	42,000	3 months
5.04		*Rehabilitation*					
	1	Side Slopes	Hectare	100	20,000	2,000,000	6months earthworks + 6months veg establishment + min 3yr aftercare period
	2	Flat Surfaces	Hectare	700	4,000	2,800,000	12months earthworks + 6months veg establishment + min 3yr aftercare period
6		**Saski Potok**					
6.01		*Stability Analyses*					
	1	Geotechnical Investigation	Lump Sum	1	17,000	17,000	3 months
	2	New Piezometer Installation	Lump Sum	1	40,000	40,000	4 months
	3	Stability Analyses	Lump Sum	1	10,000	10,000	2 months
6.02		*Lifting Impoundment Wall*					
	1	Design	Lump Sum	1	42,000	42,000	3 months
	2	Construction	Lump Sum	1	167,000	167,000	6 months

Item		Description	Unit	Qty	Unit Cost	Total Cost	Timing
6.03		*Storm Water Cut Off Trench*					
	1	Storm Water Design and Analyses	Lump Sum	1	42,000	42,000	4 months
	2	Installation of S Water Cut Off Trench	Lump Sum	1	167,000	167,000	6 months
6.04		*Installation of Penstock Decant*					
	1	Penstock Decant	Lump Sum	1	250,000	250,000	4 months
6.05		*Rehabilitation*					
	1	Side Slopes	Hectare	50	20,000	1,000,000	6months earthworks + 6months veg establishment + min 3yr aftercare period
	2	Flat Surfaces	Hectare	700	4,000	2,800,000	12months earthworks + 6months veg establishment + min 3yr aftercare period

In the above analysis, consideration has not been given to any radioactive contamination that may be present. In addition the potential for earthquakes has not been investigated. Both of these must be considered further.

Annex E

Local Consultation Reports



First Consultation Report: Bor and Majdanpek

February 2006

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REPORT

The Privatization Agency - Republic of Serbia

First Consultation Report: *Bor and Majdanpek*

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The Privatization Agency – Republic of Serbia

First Consultation Report: *Bor and Majdanpek*

14 February 2006

Reference 0041869

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Riccardo Corsi
Project Director

Chiara Sacco

Chiara Sacco
Project Manager

1 INTRODUCTION

The Consortium led by Environmental Resource Management (ERM) Ltd, and supported by Fideco d.o.o. and CSA Group Ltd was commissioned by the *Privatisation Agency of the Republic of Serbia* (PA), to undertake the assignment "Environmental Assessment of the Environmental Damages from Past Operations of RTB Bor" in November 2005. The Project is aimed at the preparation of an Environmental Assessment for RTB Bor operations including an assessment of environmental damages from past operations, determining the environmental issues and the required clean-up measures.

This document represents the First Local Consultation Report for the study and describes the Local Consultation meetings undertaken on 1st and 2nd February, 2006 respectively in Bor and Majdanpek.

1.1 BACKGROUND AND OBJECTIVES

As stated in the Terms of Reference (ToR), the main objectives of this project are to:

- prepare an Environmental Assessment of the RTB Bor operations, including an assessment of environmental damages from past operations, determining the environmental issues and the required clean-up measures;
- describe in detail the major (potential) environmental impacts associated with the existing assets and activities of RTB Bor and after implementation of the restructuring and privatization program;
- carry out public consultations and coordination with government agencies on the environmental impacts and proposed mitigation measures;
- assess the preferred technical design standards, and site-specific preliminary designs to mitigate environmental risks;
- prepare a prioritized environmental management plan for the clean-up/closure activities and upgrading/privatization activities; and
- ensure compliance to the environmental guidelines of all relevant agencies and institutions.

As outlined in the Technical Proposal/Contract, the proposed methodology for undertaking the Environmental Assessment consists of four phases:

I. *Inception/EA Preparation*: preliminary data gathering process, development of focused checklists and auditing protocols to ascertain completeness of information to be collected on site; first contacts with the local authorities and the site contacts provided within the RTB Bor. The public/NGO Participation and Assistance with Government Agencies Coordination shall also be initiated.

II. *Technical development of the project*, analysis and assessment of baseline of the area including all environmental key aspects and the regulatory framework; the proposed restructuring and privatization program for the RTB Bor shall be analysed.
III. *Evaluating process:* potential environmental impacts of the Restructuring and Privatization Program of RTB Bor shall be identified and assessed and alternatives to the proposed program shall be analysed.
IV. *Findings and Recommendations*, based on findings of the environmental assessment, the environmental management plan shall be developed including definition of: (i) mitigation/remedial interventions and related prioritisation; (ii) institutional training and strengthening needs and (iii) environmental monitoring plan. This phase shall also include the conclusion of the public/NGOs participation process in order to have all stakeholders involved in conclusions drafting.

The first round of consultation was arranged in Bor and Majdanpek to present the Project, the Team and to collect any feedback from the stakeholders with regard to the current environmental situation in the area.

The objective of this report is to reflect the wide range and diversity of ideas, opinions and suggestions made in the contributions received. Without claiming to be exhaustive, the report tries to identify, as objectively as possible, the main trends, views and concerns arising from the contributions.

In order to ensure full transparency, the report is complemented with Question/Answers sessions presented. This allows interested parties to examine the responses to the consultation in full detail.

The document presents an analysis of the contributions received. It should be noted that the purpose of this document is to report on the public consultation. It does not aim to draw political conclusions from the consultation process as such.

1.2 CONTENT AND STRUCTURE OF REPORT

The remainder of this Report is structured as follows:

Section 2 - Public Consultations held in Bor and Majdanpek

Annexes to the report include:

Annex A: List of participants in Bor
Annex B: List of participants in Majdanpek
Annex C: Presentation in Bor
Annex D: Presentation in Majdanpek

2 FIRST PUBLIC CONSULTATION MEETINGS

2.1 CONSULTATION OBJECTIVES AND METHODOLOGY

The consultation process is aimed at setting environmental priorities within the on-going privatisation process of the RTB Bor Complex. Main objectives of the process are:

- to collect public opinions/views/perception on current state of the environment and expectations for the future.
- to give stakeholders some information with regard to the environmental aspects of the privatisation process.

The consultation process will run over two sessions:

- *Session 1*: first meeting at the beginning of the environmental assessment process, in order to present the activities to be developed and the related timing and to collect public concerns about the environment.
- *Session 2*: final meeting at the completion of the process in order to present the final results of the project (expected timing: May 2006).

This first consultation meeting is aimed at:

- presenting project activities and objectives;
- presenting project timing and expected results;
- evaluating public environmental awareness and perception;
- collecting feedback from key stakeholders and relevant parties regarding the project;
- collecting concerns and expectations on the future asset of the RTB Bor Complex.

2.2 CONSULTATION PROCEDURE

The presentations were prepared by ERM specialists and shown at the public consultations held in Bor and Majdanpek, in order to raise debate. Copies of the projected slides were provided to the attendees. A list of participants was filed including provenience and contacts reference for each participant.

It was decided by the Consortium to hold two different local consultation sessions for Bor and Majdanpek since the key problems are considered quite different and since people from Majdanpek would most probably not have been able to attend to the local consultation meeting in case it was held in Bor.

The presentations were structured around three blocks addressing the goals of public consultation and the project (See *Annex C* and *Annex D*):

- consultation scope and goals;
- presentation of the Project: Objectives, Foreseen Activities and Timeframe;

- preliminary Findings.

Interested parties were invited to raise the questions and suggestions regarding the environmental damage caused by past operation of RTB Bor Complex. They were also invited to submit the studies that would be relevant for the project development.

2.3 *MINUTES OF PUBLIC CONSULTATION*

2.3.1 *Bor Meeting*

The Public Consultation in Bor was held on 1st February 2006 in the building of the Municipal Assembly.

There were 50 registered participants at the public consultations that were representing various stakeholders:

- RTB Bor Complex;
- Local communities;
- Public health centres;
- Non-governmental organisations;
- Municipal authorities;
- Republican authorities;
- The World Bank;
- Secondary Schools;
- Public Utility Company.

Vice President of the Municipal Assembly - Nebojsa Popovic opened the public consultation by welcoming the attendees, and saying that he wished that the discussion would be helpful. He suggested that this process should have been initiated a long time ago but it is never too late. Mr. Popovic shortly introduced the project and the team. He also said that the Municipality Assembly is giving the full support to the project.

Mr. Riccardo Corsi (ERM Italia) welcomed the participants as well and he briefly presented the scope of the project and consultation process and objectives. (See *Annex C* for the presentation)

1st intervention: Mr. Dragomir Dragic representative of NGO Ekoagenda 7/1935 raised the question of the presence of the representatives from the Privatisation Agency. Then, he introduced that his organization prepared a 21 Agenda report stating all the problems arising from RTB Bor operation.
Mr. Dragic reported that he and Mr. Milijc from RTB Bor visited the Ministry for the Environment on 23rd July 2003 Mr. Milijc of RTB Bor. They were informed by the Minister (at the time) that all the environmental damage has to be listed in order to get the support from the Government of Serbia. Mr. Dragic concluded that privatization process is ongoing and that no environmental assessment is being so far anticipated. He proposed to sort the ownership issues before the privatization. The representatives of ERM and

FIDECO thanked for the contribution and asked for the material to be submitted.

2nd intervention: Mr. Miroslav Pajic proposed to use existing LEAP document as the baseline for the project. The actions that were foreseen by the LEAP through the Statute of the Local environmental Parliament was to establish and environmental fund, but it was not implemented.
Mr. Pajic suggested that it is needed to elaborate the Strategy for the development of the Eastern Serbia and to place RTB Bor as national (governmental) priority. He raised two questions: the relocations of the Bor and if the Smelting industry is needed in the first place.

Mr. Riccardo Corsi responded to Mr. Pajic by stating that environmental problems were here due to past activities regardless future privatization. His opinion is that environmental problems could be solved if the funds for environmental improvement would be allocated. He urged that there is a need for stopping further environmental damage and that this is a good chance to highlight environmental and economic problems. This project is aimed to be the first step towards an environmental compatible industrial site.

3rd intervention: Mr. Slavisa Karabasevic founder of the Ekoagenda (eco parliament of 6 rural and 1 city local communities) and representative from Local community Brezonik. Agenda 21 ecoparliament instituted working with endangered local communities, holding meetings every 6 months to discuss environmental problems. Mr. Karabasevic raised two questions. The first one regarding the contamination of the human tissue. The second one regarding the nickel emission in Bor. He stated that Smelting industry is processing wastes and that it causes the increased emission of substances, e.g. nickel. He also asked how the pollution trend not declining. The final statement was a call to stop further pollution.

4th intervention: Branko Petrovic (Ekoagenda 7/1935) suggested that 100 years of the RTB Bor operation will have adverse effect on the future generations as well. He suggested that there are the pollution issued that can not be seen without some careful analysis. He suggested to do the public health analysis as the part of the project. Mr. Petrovic stated that in study elaborated by Ekoagenda members there are proposed mitigation measures and that the tailing ponds are the most sever sources of pollution. However, there is a strong resistance by the polluter.

Riccardo Corsi (ERM Italia) responded that there is no time for an epidemiological study to be included in environmental assessment. However, he is aware that some studies are ongoing and we will try to implement a Risk Assessment on human health deriving from pollution.

5th intervention: Dragoslav Nikolic (local community Krivelj) asked what would be the obligations of the future owner. He suggested that new abatement technologies have to be installed for air pollution as otherwise it would not be clean ever.

Mr. Nikolic informed the public that collector under the Veliki Krivelj tailing pond is well known problem that can have major adverse effect on the region. It is one of hotspots that can damage the Black Sea and pollute the whole Timok valley. Mr. Nikolic raised the questions of the responsibility in the case of the accident and if the complex stops to operate. He suggested that this area is very attractive from nature point of view.

Mr. Popovic responded that all of them were aware of the situation. The public health is an issue to be elaborated in the future. He reported that in the past people were encouraged to move and to find another job somewhere else. However, he would prefer if people would stay in Bor. He asked for giving the outputs to the discussion. The positive outputs in his view would be to have environmental compatible technology introduced and RTB kept alive. The goal of this Environmental Assessment is to identify the situation and make a picture to the future owner, his responsibility and consequences on the environment, and to establish clear rules for the future owner whoever he is.

6th intervention: Novica Zurkic (president of local community Krivelj) informed that apart from sanitation of collector Veliki Krivelj, it is urgent to rehabilitate the pipeline from Cerovo, as it is in a very poor state and contaminating the environment.

7th intervention: Stevan Radulovic (urban local community Mladost) asked for the final solution as the main polluter is Smelting industry but there are other polluters as well. He asked about the solutions for rural part of the Municipality of Bor.

Dobrila Simic (FIDECO) clarified that the other polluters are not included in the scope of this environmental assessment.

Nikola Ille (The World Bank) explained the privatization procedure in terms that the Government of Serbia has elaborated a programme for RTB Bor restructuring. Before the tender for privatisation is launched, it is needed to do an environmental assessment in order to separate past contamination from the future one. Mr. Ille explained that legal obligation of the state is to take over all past environmental damages.

8th intervention: Bosko Antonijevic (local community Bor 2 / Metalurg) suggested that the most burning issues are the collectors and they should be rehabilitated as soon as possible. He also noted that the young population is missing and the funds have to be allocated for the solution of the problem.

Mr. Dragic warned that rural settlements have to be involved in the planning process in order to prevent corruption. He asked again how the Government has not yet started any measures for improving the existing state.

9th intervention: Aleksa Radulovic (Local Community Ostrelj) informed that until 1905 the local community was big and well developed. However, once the RTB Bor activities started it was the beginning of depletion and damage.

He stated that the community is constantly endangered as the dust from tailing pond dam is airborne to this village and that the water is highly contaminated as there is no non-contaminated water supply source.

10th intervention: President of local community Sever[1] introduced to the problem of this community which is wide space distribution as it is located on the edge of open pits. This leads to wild dumping of the municipal waste by the inhabitants and illegal dumping of the companies.

11th intervention: Zoran Veljkovic (Department for Environmental protection / Ministry for Science and Environment) presented himself and suggested that the problems of environment degradation need time to be solved.

12th intervention: Budimir Kostic (local community Staro Seliste) suggested that the legal framework has to be enforced in a more stringent manner.

13th intervention: Biljana Golubovic (Professor of the logic, Gymnasium) suggested that the LEAP document made a very good analysis and it could be useful source for the environmental baseline. She finds the specific objectives of the environmental assessment project acceptable in terms of the methodology.

14th intervention: Zvonimir Milijic (RTB Bor) informed the public that programme of the government over the privatization involved so far 3 consulting teams with different scopes: financial and technical due diligence, technical due diligence of the smelting industry and environmental assessment. The projects are to be elaborated by the end of March when first draft would be attached to the tender documents for the privatization of RTB Bor. He noted that common goals for the RTB Bor and the citizen's expectations are the same.

Mr. Milijic called the participants to submit their available studies.
Closing the first local consultation, Mr. Milijc considers FLC positive and he is confident that we will be able to get the documents mentioned as follows:

1) Study from Agricultural Institute of Zajecar
2) Study mentioned by the local communities.

The main conclusions that can be made out of the first consultation in Bor are:

- The public is concerned about the future responsibilities on past environmental damages;
- The main issue that was raised is the public health;
- Key problems are the collectors and emission of dust and gases;
- There is a study on the damages caused by past RTB Bor operation that could be provided by NGO Ekoagenda.

(1) [1] He has not signed the participation list.

2.3.2 *Majdanpek Meeting*

The Public Consultation in Majdanpek was held on 2nd February 2006 in the building of the Municipal Assembly. There were 18 registered participants at the public consultations that were representing various stakeholders:

- RTB Bor Complex;
- RBM;
- Local communities;
- National park Djerdap;
- Non-governmental organisations;
- Municipal authorities;
- Secondary Schools;
- Public Utility Company.

Ms. Branka Karavidic (Vice president) introduced the project and the subject of the local consultation to the participants.
Mr. Riccardo Corsi (ERM Italia) welcomed the participants as well and he briefly presented the scope of the project and consultation process and objectives. (See *Annex D* for the presentation).

1st intervention: Dejan Zlatic (Radio and TV Majdanpek) addressed the issue of LEAP Majdanpek. He recalled that there were four public consultations as the part of the development of LEAP document and that the problems were identified and the priorities determined. He suggested that the document should be valuable source of the information.

2nd intervention: Gorcilo Potpara (Gymnasium, Majdanpek) stated that after being introduced to the brief article on public consultation in Bor he thinked that the pollution would always be an issue no matter on the ownership. He asked if there is a reliable source of data on environmental state (provided by some competent organization) in order to make people see the true status.

Riccardo Corsi (ERM) responded that it is the project objective to identify the environmental state and to propose the remediation measures. The future owner would need to operate in compliance with environmental standards and the responsibility for the past damage is yet to be determined.

Mr. Potpara suggested that the inhabitants of Majdanpek have never been introduced to the real state of the pollution level. He noted that different information regarding the radioactivity, heavy metals presence in water and similar subject have been spread. It would be important to know the truth.

Mr. Corsi stated that the team has being collected reliable data and that there is a way to determine damages according to past operation. He also stated that for the time being is important to prevent any further pollution.

Dobrila Simic (FIDECO) informed the participants that the Environmental Protection Agency will provide transparent data in the future.

3rd intervention: Zvonimir Milijic (RTB Bor) informed the public that programme of the government over the privatization involved so far three consulting teams with different scopes: financial and technical due diligence, technical due diligence of the smelting industry and environmental assessment. There are projects that have been elaborated within RTB Bor and some of them would be used in the future. Mr. Milijic informed that the Government would be responsible for the past damages.

4th intervention: Tihomir Todorovic (Public Utility Company Komunalac) informed on problem with water supply due to the small storage tanks and very old filters. Analysis done by an institute in Zajecar are being sent once a month. The pretreatment is needed to ensure good quality water at the moment. The distribution of water is a problem since it goes over tailing ponds area. An upgrading project started in 1990s and is currently at a 40% completion. This is a problem of organic pollution according to the municipality.

5th intervention: Nebojsa Petkovic (Technical school) stated that reliable information could be provided from RBM, Public Health institute Zajecar and National park Djerdap.

The main conclusions that can be made out of the first consultation in Majdanpek are:

- The public is interested in having access to reliable data with regard to environmental situation;
- There are some institutions that could provide useful data for the Project (e.g. Public Health Institute in Zajecar and National park Djerdap).

Annex A

List of Participants, Bor

Table.1 ***List of Participants Bor***

No.	Name	Institution/Organisation	E-mail	Telephone
1	Miroslav Pajic	Ekološki pokret u Boru Ecological movement in Bor		063 7489 793
2	Borka Petkovic	Ekološki pokret Jugoslavije - Novi Sad / Opštinski odbor u Boru Ecological movement Yugoslavia - Novi Sad / Municipal board in Bor		030 77 102 064 1711 910
3	Dragomir Dragic	Ekoagenda 7/1935	boreag@ptt.yu	030 434 159 064 2610 440
4	Vukasin Radulovic	Ekoagenda 7/1935		030 47 9026
5	Miljana Golubovic	Gimnazija Bora Stankovic Gymnasium Bora Stankovic	gimbor@ptt.yu	030 441 276 030 432 271
6	Elizabeta Rasic	Zdrastveni centar - Bor Health center Bor		030 456 911 063 8581 631
7	Novica Stalefovic	Komisija za planove Commission for planning	nomstale@ptt.yu	063 8866 698
8	Zivorad Milicevic	Tehnicki fakultet Technical faculty		030 424 565
9	Maja Stojadinovic	Livnica Foundry		063 7063 247
10	Slavisa Petkovic	Elektroliza Electrolysis		064 381 7780
11	Toplica Marjanovic	Topionica i Rafinacija Smelting and Refining Industry	ekobor@ptt.yu	030 422 775
12	Tatjana Geocelovic	MZ Sarbanovac Local community Sarbanovac		030 72 410
13	Novica Zurkic	MZ Krivelj Local community Krivelj		030 73 350
14	Zlata Markovic	Zdrastveni centar - Bor Health center Bor		030 432 899
15	Branislav Petrovic	Ekoagenda 7/1935		030 436 678
16	Danijela Luleic	Zavod za zastitu zdravlja Timok - Zajecar Public Health Institute Timok - Zajecar	za_timok@ptt.yu	019 422 477
17	Zoran Veljkovic	Uprava za zastitu zivotne sredine Directorate for Environmental Protection	zoran.veljkovic@ekoserb.sr.gov.yu	011 3131 356
18	Nikola Ille	Svetska Banka, Beograd The World Bank, Belgarde	nille@worldbank.org	011 3023 728
19	Zvonimir Milijic	RTB Bor	rtbbot@ptt.yu	063 480 924
20	Blaza Lekovski	Topionica i Rafinacija Smelting and Refining Industry		030 425 576
21	Ljiljana Lekic Dzamic	Opštinska uprava Municipal managemen	leapbor@ptt.yu	030 427 313
22	Miodrag Nedeljkovic	Opštinska uprava Municipal management	minedal@ptt.yu	063 436 297
23	Novica Milosevic	Institut za bakar Bor Copper Institute Bor	novmil@ibb-bor.co.yu	030 435 216

No.	Name	Institution/Organisation	E-mail	Telephone
24	Dragan Djokic	Opštinsko veće Municipal council	dragancom@sezampro.yu	063 447 331
25	Stevan Radivojevic	MZ Mladost Local Community Mladost		030 432 162
26	Igor Mitrovic	JKP 3. Oktobar - bor Public Utility Company 3. Oktobar	jkp3.oktobar@neobee.net	030 432 224
27	Slavisa Smiljkovic	MZ Mladost Local Community Mladost		030 437 548
28	Simeon Zinovijev	Topionica i Rafinacija Smelting and Refining Industry		030 427 488
29	Slobodanka Cotic	RTB Bor - list Kolektiv RTB Bor - magazine Kolektiv		030 421 473
30	Slavisa Simonovic	MZ Novo Seliste Local Community Novo Seliste		030 421 973
31	Budimir Portic	MZ Novo Seliste Local Community Novo Seliste		030 421 973
32	Ivica Milicevic	MZ Stari centar Local Community Stari centar		030 423 277
33	Aleksa Radulovic	MZ Ostrelj Local Community Ostrelj		030 39 084
34	Drujosa Dulkonovic	MZ Krivelj Local Community Krivelj		030 73 387
35	Srboljub Milosevic	MZ Staro Seliste Local Community Staro Seliste		030 423 853
36	Budimir Kostic	MZ Staro Seliste Local Community Staro Seliste		030 423 913
37	Bosko Antonijevic	MZ Bor 2/Metalurg Local Community Bor 2/Metalurg		030 431 811
38	Dimca Jenic	RTB Bor - RBB Copper Mines Bor		030 422 788
39	Katarina Milosevic	Odeljenje za urbanizam Urban Planning Department		030 423 255
40	Milan Trumic	Tehnicki pokret Bor Technical movement Bor		030 424 555
41	S. Simonic	Opstinsko vece Bor Municipal Council Bor	bornes@espserbia.org	030 423 255
42	Dusan Kukolj	Uprava za zastitu zivotne sredine/ Inspekcija u Boru Directorate for Environmental Protection/ Inspection dep. in Bor		030 424 382
43	Dragoslav Vaskic	MZ Bucje Local Community Bucje		030 73 403
44	Dijana Miljkovic	Zavod za zastitu zdravlja Timok - Zajecar Public Health Institute Timok - Zajecar	za_timok@ptt.yu	019 422 477
45	Branislav Jovanovic	Opstinska uprava Bor Municipal management Bor		030 423 749
46	Slavisa Morabasevic	Vece SO Bor Council Municipal Assembly Bor		063 8001 801

No.	Name	Institution/Organisation	E-mail	Telephone
47	Dragoslav Nikolic	MZ Krivelj Local community Krivelj		063 480 965
48	Dragan Jankucic	Ekoagenda 7/1935		063 8163 621
49	Vinko Madanovic			064 389 6895
50	Zaklina Jovanovic			064 2273 484

Annex B

List of Participants, Majdanpek

Table.1 List of Participants Majdanpek

No.	Name	Institution/Organisation	E-mail	Telephone
1	Slobodanka Ristic	RBM Copper Mines Majdanpek		030 581 160 /ext.199
2	Zvonimir Milijic	RTB Bor	rtbbot@ptt.yu	063 480 924
3	Vitomir Miladinovic	RBM Copper Mines Majdanpek	rbmvita@ptt.yu	030 581 755
4	Vesna Cepenjor	SO Majdanpek Municipal Assembly Majdanpek	oumpek@ptt.yu	030 581 217
5	Ljiljana Vasiljevic	OU Majdanpek Municipal Management Majdanpek		030 581 240
6	Aleksandar Srbulovic	Nacionalni park Djerdap National Park Djerdap	npdjerdap@hotmail.com	030 86 788
7	Nenad Kornesko	RTV Majdanpek Radio and TV Majdanpek		
8	Branka Natasijevic	Nacionalni park Djerdap National Park Djerdap		030 86 778 030 86 788
9	Gorcilo Potpara	Gimnazija Majdanpek Gymnasium Majdanpek		
10	Nebojsa Petkovic	Tehnicka skola Technical school		030 583 141
11	Biljana Vasiljevic	OU - Odeljenje za privredu, javne delatnosti i zajed. poslove Municipal management/ Department for economy, public activities and common business		030 582 291
12	Sima Mladenovic	MZ Leskavi Local community Leskavo		030 85 199
13	Sinisa Filipovic	Presednik Skupstine opstine Majdanpek President of Municipal Assembly Majdanpek		030 581 240
14	Elizabeta Filipovic	OU - Odeljenje za urbanizam Municipal management - Department for urban planning		030 581 641
15	Dejan Zlatic	RTV Majdanpek Radio and TV Majdanpek	rtvmpek@ptt.yu	030 581 502
16	Bojan Mihajlovic	NGO Resur centar Majdanpek	rchs@ptt.yu	030 581 155
17	Biljana Jovanovoc	NGO Resur centar Majdanpek	rchs@ptt.yu	030 581 155
18	Tihomir Todorovic	JKP Komunalac Public Utility Company Komunalac		030 582 382

Annex C

Presentation in Bor

Environmental Assessment of the Environmental Damages from Past Operations of RTB Bor

PUBLIC CONSULTATION MEETING

Bor, February 1st 2006

Delivering sustainable solutions in a more competitive world

FIDECO

Contents

- Consultation scope and goals
- Presentation of the Project: Objectives, Foreseen Activities and Timeframe
- Preliminary Findings
- Discussion and questions.

Background

- The Project is aimed at the preparation of an Environmental Assessment for RTB Bor operations within the on-going privatisation process of the RTB Bor Complex.
- The Project is financed by the *World Bank* through the *Privatisation Agency of the Republic of Serbia.*
- The Consulting Team is composed by *ERM* - Environmental Analysis and Remediation Consulting Company - *CSA Group Ltd of Ireland:* Mining/engineering Experts - *Fideco d.o.o.:* Local Environmental Consulting Company.

Consultation Scope and Goals

The consultation process is aimed at setting environmental priorities within the on-going privatisation process of the RTB Bor Complex. In particular:

- To collect public opinions/views/perception on current state of the environment and expectations for the future.
- To give stakeholders the opportunity to influence the policy priorities that affect this process.

Consultation Process Description

The consultation process will run over two sessions:

1. ***Session 1***: first meeting at the beginning of the environmental assessment process, in order to present the activities to be developed and the related timing and to collect public concerns about the environment.
2. ***Session 2:*** final meeting at the completion of the process in order to present the final results of the project (expected timing: May 2006).

First Meeting Specific Goals

This first consultation meeting is aimed at:

- Presenting project activities and objectives.
- Presenting project timing and expected results.
- Evaluating public environmental awareness and perception.
- Collecting feedback from key stakeholders and relevant parties regarding the project.
- Collecting concerns and expectations on the future asset of the RTB Bor Complex.

Project Objectives 1

The Project is aimed at the preparation of an Environmental Assessment for RTB Bor operations including:

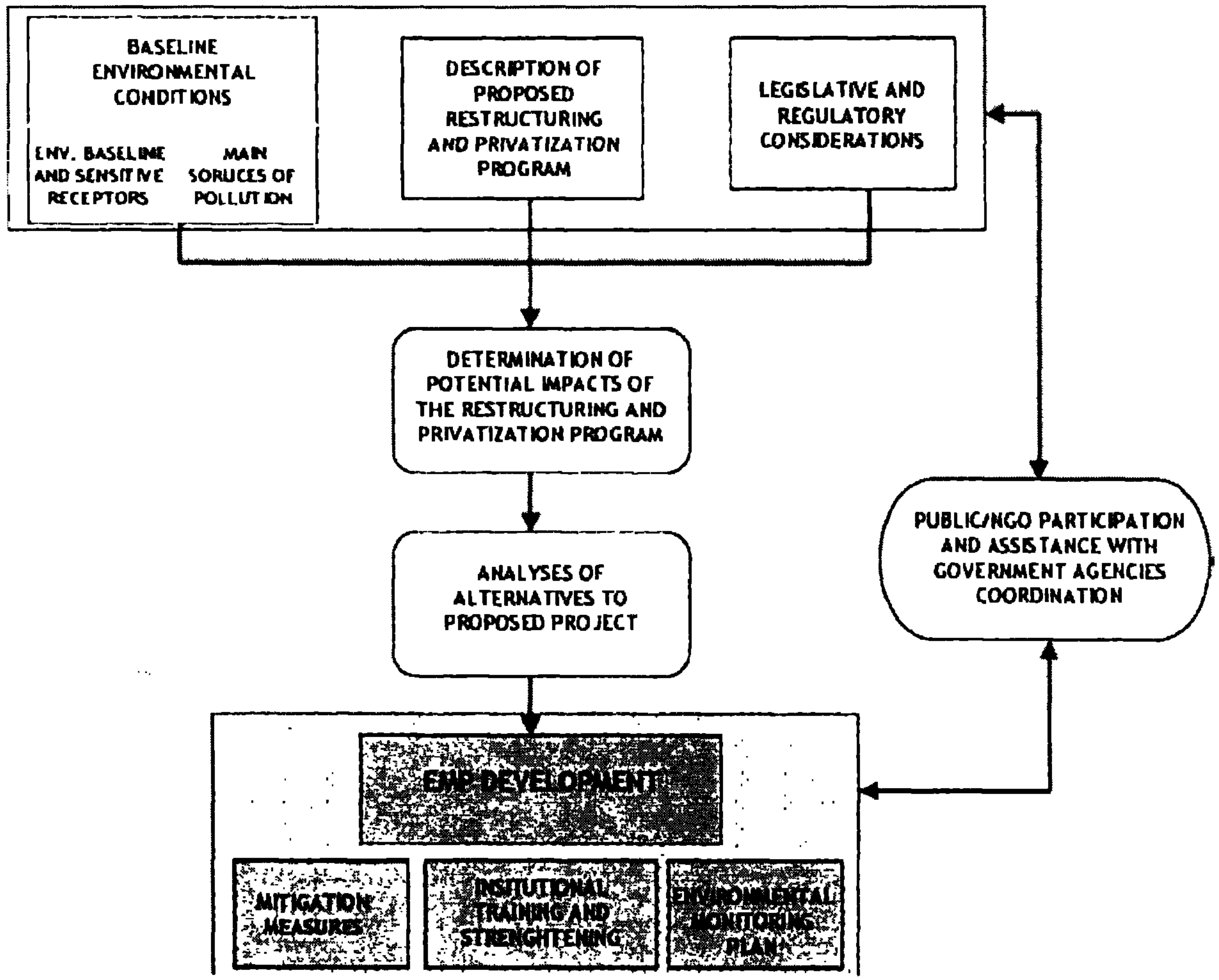
- An assessment of environmental damages from current and past operations.
- The determination of the environmental issues and the required clean-up measures.

Project Objectives 2

Specific Goals are:

- To describe the major environmental impacts associated with:
    - Past and on-going activities
    - The new restructuring and privatization program.
- To prepare a prioritized environmental management plan for environmental remediation and monitoring activities after privatization process has occurred; and
- To ensure compliance to the environmental guidelines of all relevant national and international agencies and institutions.

Project Activities



Project Activities

Phase 1: *Environmental Characterisation of the Area.*

1. Evaluation of the Environmental Baseline:

- Physical environment: climate; air quality; surface water quality and use; soil and groundwater quality.
- Biological environment: flora; fauna; rare or endangered species; sensitive habitats.
- Socio-cultural environment: population; land use; planned development activities; community structure; employment; public health; cultural properties.

2. Identification of major sensitive receptors: population, drinking water wells, protected areas/natural reserves, etc..

Project Activities

Phase 2: *Identification of main sources of pollution arising from current/past activities at RTB Bor and related major environmental impacts.*

Environmental assessment of impacts deriving from the RTB Bor complex with regard to:

- Current and past activities undertaken at the site.
- Material storage and handling, and
- Industrial process effluents/waste generation and discharge/disposal practices.

Project Activities

Phase 3: ***Analysis of current legal framework and comparison with relevant regulatory requirements in the EU.***

1. Review of current environment legal framework at international, national, regional and local levels.
2. Development of recommendations for strengthening the legal and institutional framework with regard to environmental management of mining, clean-up projects and implementation of the restructuring and privatization program.

Project Activities

Phase 4: ***Evaluation Process:***

(i) Analysis of the Restructuring and Privatization program.

(ii) Determination of related potential Impacts.

(iii) Analysis of Alternatives to the proposed Project.

Project Activities

Phase 5: *Preparation of an Environmental Management Plant (EMP) including:*

I. Definition of mitigation/remedial interventions and prioritisation:
   - Immediate measures/interventions
   - Medium-term measures
   - Long-term measures.

II. Institutional Training and Strengthening.
   - Review of the institutional framework, including analysis of authority and capability of institutions at local, provincial/regional, and national levels, and
   - Development of recommendations for institutional strengthening and training needs.

Project Activities

III. Development of an environmental monitoring plan.

- MP will monitor the implementation of mitigating measures and the impacts of the project during construction and operation.
- MP will include:
  - Environmental media to be investigated (air, soil, groundwater, etc.)
  - Parameters to be monitored, frequency, analytical methodology.
  - A list of resources and capabilities needed and a preliminary cost estimate of monitoring.

Preliminary Findings/Impressions

- Poor air quality in the surrounding of the Bor industrial complex (huge SO2 and dust emission).
- Direct discharge of untreated waste waters from the smelter facility in to the rivers.
- Run-off from mining operations, mining pits, dumps and tailings ponds.
- Potential risk of heavy contamination of the Kriveljska River due to failure of the underground collector.
- Soil contamination and underground water pollution likely to be occurred over a wide area around the facility and the mines.

Expected Time Scheduling

- Duration: 6 months – December 2005 / May 2006
- Completion of the EA process: end of March.
- Development of the EMP: end of May.

Discussion and Questions

Environmental awareness

- What is the major environmental problem for Bor?
- What interventions/actions could be carried out to solve/minimize the problem?
- Who has to solve it?

Discussion and Questions

RTB Bor Complex Privatization Process:

- What is your opinion on the restructuring/privatization process for the RTB Bor?
- Are there any previous study/proposals to be utilized?

Contacts

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Annex D

Presentation in Majdanpek

Environmental Assessment of the Environmental Damages from Past Operations of RTB Bor

PUBLIC CONSULTATION MEETING

Majdanpek, February 2nd 2006

FIDECO

ERM

Delivering sustainable solutions in a more competitive world

Contents

- Consultation scope and goals
- Presentation of the Project: Objectives, Foreseen Activities and Timeframe
- Preliminary Findings
- Discussion and questions.

Background

- The Project is aimed at the preparation of an Environmental Assessment for RTB Bor operations within the on-going privatisation process of the RTB Bor Complex.
- The Project is financed by the *World Bank* through the *Privatisation Agency of the Republic of Serbia.*
- The Consulting Team is composed by *ERM* - Environmental Analysis and Remediation Consulting Company - *CSA Group Ltd of Ireland:* Mining/engineering Experts - *Fideco d.o.o.:* Local Environmental Consulting Company.

Consultation Scope and Goals

The consultation process is aimed at setting environmental priorities within the on-going privatization process of the RTB Bor Complex. In particular:

- To collect the public opinions/views/perception on current state of the environment and expectations for the future.
- To give stakeholders the opportunity to influence the policy priorities that affect this process.

Consultation Process Description

The consultation process will run over two sessions:

1. ***Session 1***: first meeting at the beginning of the environmental assessment process, in order to present the activities to be developed and the related timing and to collect public concerns about the environment.
2. ***Session 2:*** final meeting at the completion of the process in order to present the final results of the project (expected timing: May 2006).

First Meeting Specific Goals

This first consultation meeting is aimed to:

- Present the project activities and objectives.
- Present the project timing and expected results.
- Evaluate public environmental awareness and perception.
- Collect feedback from key stakeholders and relevant parties regarding the project.
- Collect concerns and expectations on the future asset of the RTB Bor Complex.

Project Objectives 1

The Project is aimed at the preparation of an Environmental Assessment for RTM Majdanpek operations including:

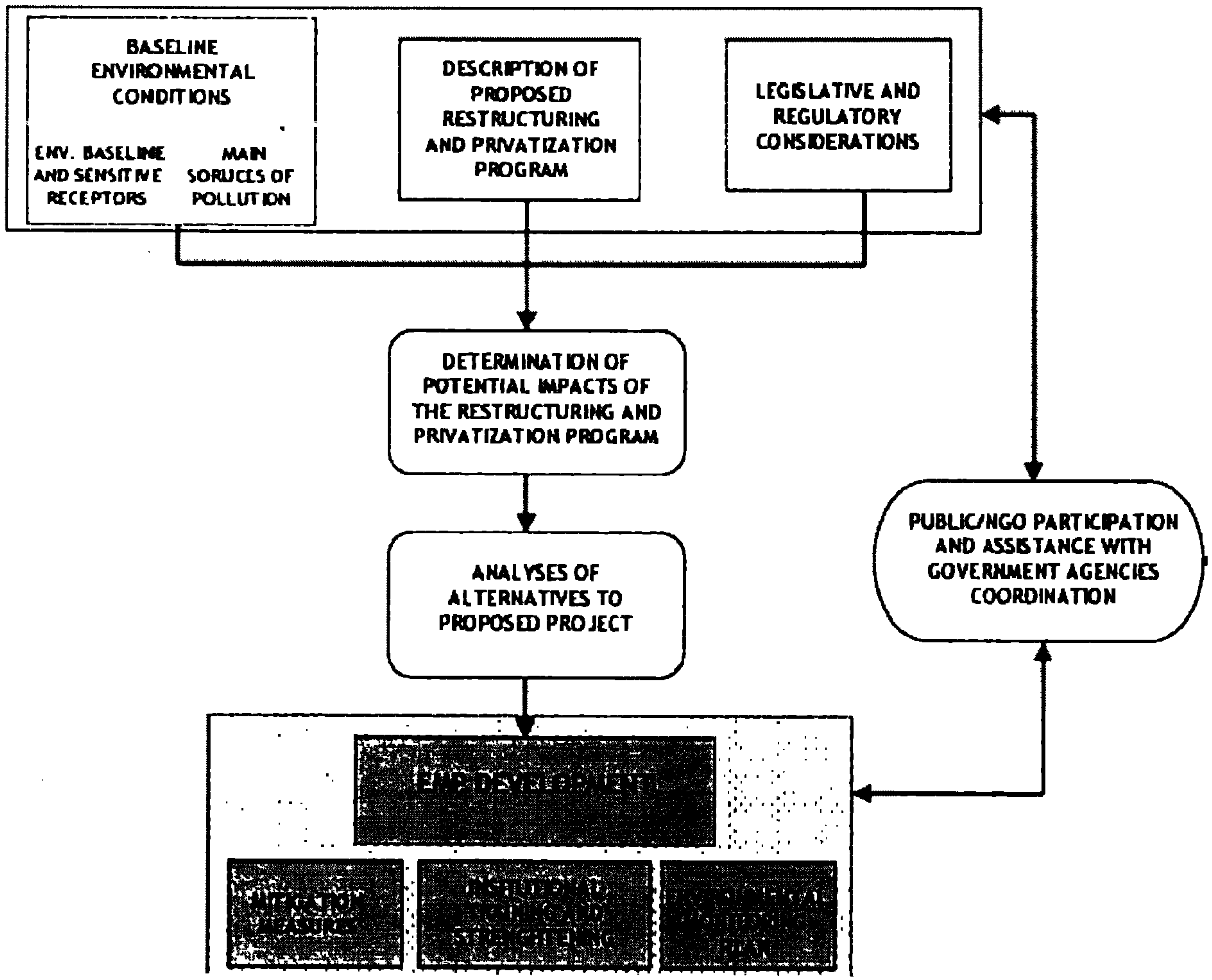
- An assessment of environmental damages from current and past operations.
- The determination of the environmental issues and the required clean-up measures.

Project Objectives 2

Specific Goals are:

- To describe the major environmental impacts associated with:
  - Past and on-going activities
  - The new restructuring and privatization program.
- To prepare a prioritized environmental management plan for environmental remediation and monitoring activities after privatization process has occurred; and
- To ensure compliance to the environmental guidelines of all relevant national and international agencies and institutions.

Project Activities



Project Activities

Phase 1: *Environmental Characterisation of the Area.*

1. **Evaluation of the Environmental Baseline:**
   - Physical environment: climate; air quality; surface water quality and use; soil and groundwater quality.
   - Biological environment: flora; fauna; rare or endangered species; sensitive habitats.
   - Socio-cultural environment: population; land use; planned development activities; community structure; employment; public health; cultural properties.
2. **Identification of major sensitive receptors: population, drinking water wells, protected areas/natural reserves, etc..**

Project Activities

Phase 2: *Identification of main sources of pollution arising from current/past activities at RTM Majdanpek and related major environmental impacts.*

Environmental assessment of impacts deriving from the RTM Majdanpek with regard to:

- Current and past activities undertaken at the site.
- Material storage and handling, and
- Industrial process effluents/waste generation and discharge/disposal practices.

Project Activities

Phase 3: ***Analysis of current legal framework and comparison with relevant regulatory requirements in the EU.***

1. Review of current environment legal framework at international, national, regional and local levels.
2. Development of recommendations for strengthening the legal and institutional framework with regard to environmental management of mining, clean-up projects and implementation of the restructuring and privatization program.

Project Activities

Phase 4: ***Evaluation Process:***

(i) Analysis of the Restructuring and Privatization program.

(ii) Determination of related potential Impacts.

(iii) Analysis of Alternatives to the proposed Project.

Project Activities

Phase 5: ***Preparation of an Environmental Management Plant (EMP) including:***

I. Definition of mitigation/remedial interventions and prioritisation:
- Immediate measures/interventions
- Medium-term measures
- Long-term measures.

II. Institutional Training and Strengthening.
- Review of the institutional framework, including analysis of authority and capability of institutions at local, provincial/regional, and national levels, and
- Development of recommendations for institutional strengthening and training needs.

Project Activities

III. Development of an environmental monitoring plan.

- MP will monitor the implementation of mitigating measures and the impacts of the project during construction and operation.
- MP will include:
  - Environmental media to be investigated (air, soil, groundwater, etc.)
  - Parameters to be monitored, frequency, analytical methodology.
  - A list of resources and capabilities needed and a preliminary cost estimate of monitoring.

Preliminary Findings/Impressions

- Bad condition of the flotation plant.
- Evidence of soil contamination in the area around the plant.
- Run-off from mining operations, mining pits, dumps and tailings ponds.
- Stability problems likely to occur in the tailing ponds and at the old open pit mine.

Expected Time Scheduling

- Duration: 6 months – December 2005 / May 2006
- Completion of the EA process: end of March.
- Development of the EMP: end of May.

Discussion and Questions

Environmental awareness

- What is the major environmental problem for Majdanpek?
- What interventions/actions could be carried out to solve/minimize the problem?
- Who has to solve it?

Discussion and Questions

RTM Majdanpek Privatisation Process:

- What is your opinion on the restructuring/privatization process for the RTM Majdanpek?
- Are there any previous study/proposals to be utilized?

Contacts

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Annex E

Photolog

Figure 1 *Local Consultation Bor – 01st February 2006*

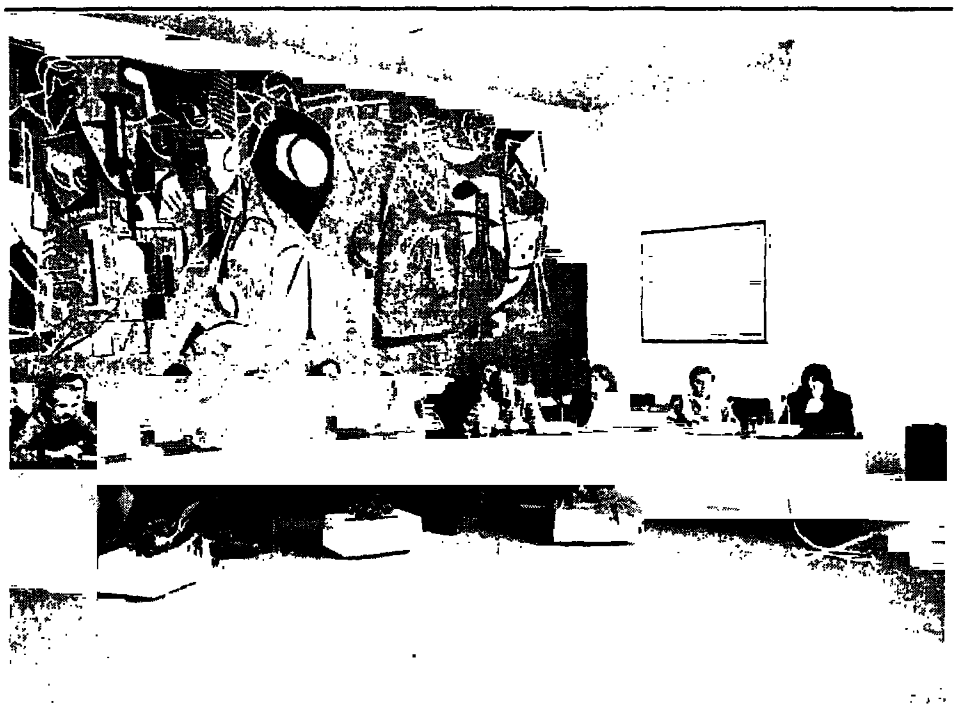
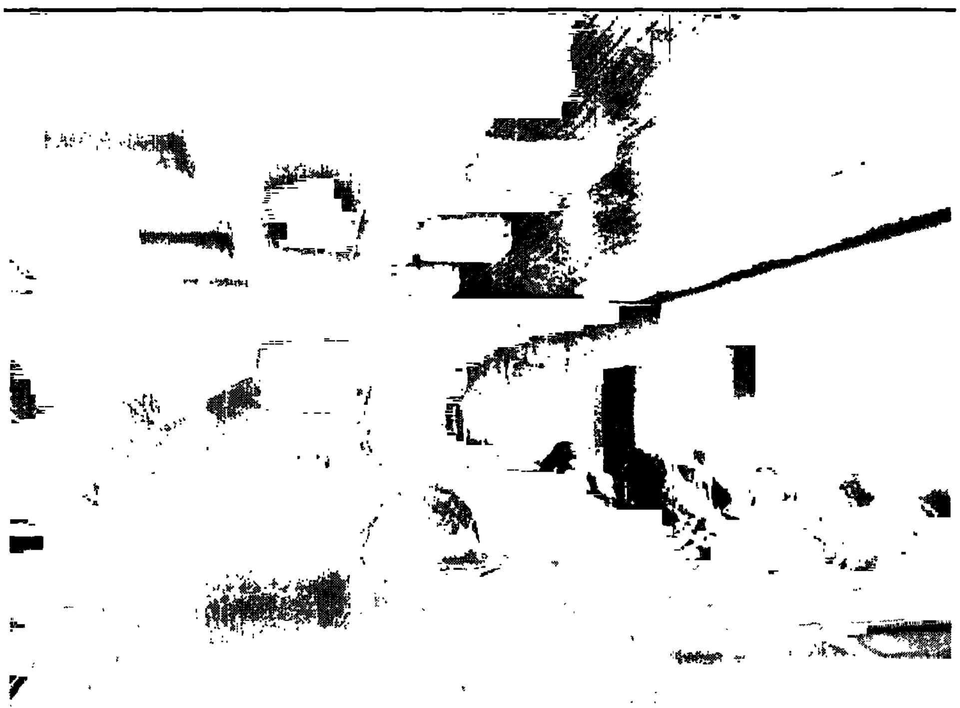
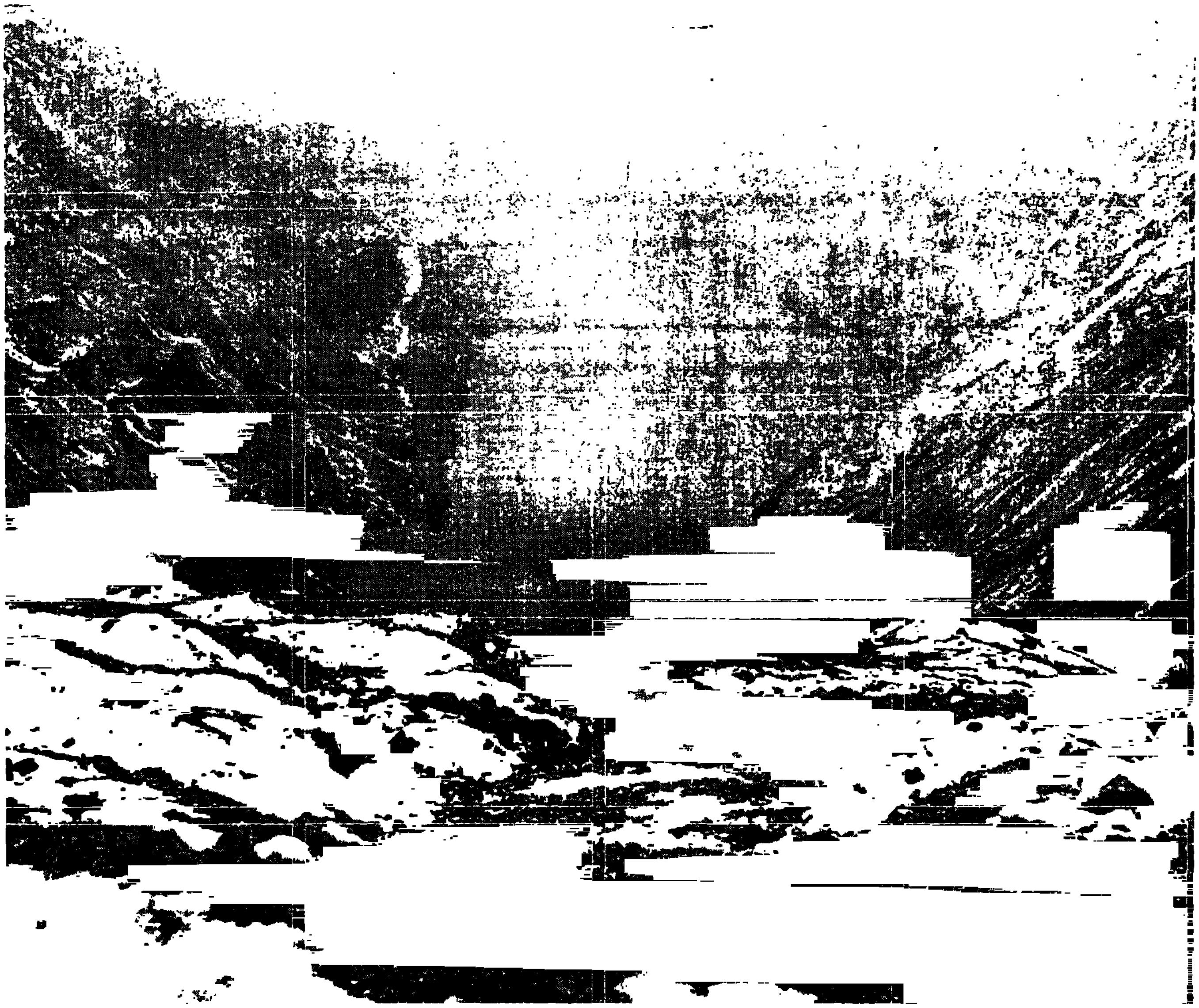


Figure 2 *Local Consultation Bor – 01st February 2006*

Figure 3 *Local Consultation Majdanpek – 02nd February 2006*

Figure 4 *Local Consultation Majdanpek – 02nd February 2006*





Final Consultation Report: Bor and Majdanpek

June 2006

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REPORT

The Privatization Agency - Republic of Serbia

Final Consultation Report: *Bor and Majdanpek*

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Final Consultation Report: *Bor and Majdanpek*

23 June 2006

Reference 0041869

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Chiara Sacco

Riccardo Corsi
Project Director

Chiara Sacco
Project Manager

1 INTRODUCTION

The Consortium led by Environmental Resource Management (ERM) Ltd, and supported by Fideco d.o.o. and CSA Group Ltd was commissioned by the *Privatisation Agency of the Republic of Serbia* (PA), to undertake the assignment "Environmental Assessment of the Environmental Damages from Past Operations of RTB Bor" in November 2005. The Project is aimed at the preparation of an Environmental Assessment for RTB Bor operations including an assessment of environmental damages from past operations, determining the environmental issues and the required clean-up measures.

This document represents the Final Local Consultation Report for the study and describes the Local Consultation meetings undertaken on 20th and 21st June, 2006 respectively in Bor and Majdanpek.

1.1 BACKGROUND AND OBJECTIVES

As stated in the Terms of Reference (ToR), the main objectives of this project are to:

- prepare an Environmental Assessment of the RTB Bor operations, including an assessment of environmental damages from past operations, determining the environmental issues and the required clean-up measures;
- describe in detail the major (potential) environmental impacts associated with the existing assets and activities of RTB Bor and after implementation of the restructuring and privatization program;
- carry out public consultations and coordination with government agencies on the environmental impacts and proposed mitigation measures;
- assess the preferred technical design standards, and site-specific preliminary designs to mitigate environmental risks;
- prepare a prioritized environmental management plan for the clean-up/closure activities and upgrading/privatization activities; and
- ensure compliance to the environmental guidelines of all relevant agencies and institutions.

As outlined in the Technical Proposal/Contract, the proposed methodology for undertaking the Environmental Assessment consists of four phases:

I. *Inception/EA Preparation*: preliminary data gathering process, development of focused checklists and auditing protocols to ascertain completeness of information to be collected on site; first contacts with the local authorities and the site contacts provided within the RTB Bor. The public/NGO Participation and Assistance with Government Agencies Coordination shall also be initiated.

II. *Technical development of the project*, analysis and assessment of baseline of the area including all environmental key aspects and the regulatory framework; the proposed restructuring and privatization program for the RTB Bor shall be analysed.
III. *Evaluating process:* potential environmental impacts of the Restructuring and Privatization Program of RTB Bor shall be identified and assessed and alternatives to the proposed program shall be analysed.
IV. *Findings and Recommendations*, based on findings of the environmental assessment, the environmental management plan shall be developed including definition of: (i) mitigation/remedial interventions and related prioritisation; (ii) institutional training and strengthening needs and (iii) environmental monitoring plan. This phase shall also include the conclusion of the public/NGOs participation process in order to have all stakeholders involved in conclusions drafting.

The first round of consultation was arranged in Bor and Majdanpek at the beginning of February 2006 to present the Project, the Team and to collect any feedback from the stakeholders with regard to the current environmental situation in the area. The report describing main outcomes of the First Local consultation is reported in *Annex E1*.

The main objectives of the local consultation were to provide information to stakeholders and wider public on the assessment of past and future activities in the Bor area to determine the appropriate environmental strategy for future development.

1.2 *CONTENT AND STRUCTURE OF REPORT*

The remainder of this Report is structured as follows:

Section 2 - Public Consultations held in Bor and Majdanpek

Annexes to the report include:

Annex A: List of participants in Bor
Annex B: List of participants in Majdanpek
Annex C: Presentation in Bor
Annex D: Presentation in Majdanpek

2 *FINAL PUBLIC CONSULTATION MEETINGS*

2.1 *CONSULTATION OBJECTIVES AND METHODOLOGY*

The main objectives of the local consultation were to provide information to stakeholders and wider public on the assessment of past and future activities in the Bor and Majdanpek area to determine the appropriate environmental strategy for future development of RTB Bor Complex.

In particular, key goals of this second (and final) round of consultation were to:

- inform stakeholders of environmental issues related to the RTB Complex;
- collect public opinions/views/perception on the proposed mitigation measures and monitoring plan.

The consultation process was run over two sessions:

- *Session 1*: first meeting at the beginning of the environmental assessment process, in order to present the activities to be developed and the related timing and to collect public concerns about the environment.
- *Session 2*: final meeting at the completion of the process in order to present the final results of the project and collect public perception on the proposed mitigation measures and monitoring plan.

2.2 *CONSULTATION PROCEDURE*

The presentations were prepared by ERM specialists and shown at the public consultations held in Bor and Majdanpek, in order to raise debate. Copies of the projected slides were provided to the attendees. A list of participants was filed including provenience and contacts reference for each participant.

It was decided by the Consortium to hold two different local consultation sessions for Bor and Majdanpek since the key problems are considered quite different and since people from Majdanpek would most probably not have been able to attend to the local consultation meeting in case it was held in Bor.

The presentations were structured around three issues addressing the project and the methodology that was used in its development (See Annex C and Annex D):

- to describe the major environmental impacts associated with past and on-going activities;
- to propose mitigation measures and clean-up;
- to define an environmental monitoring plan aimed at completion of the environmental baseline and at verification of the effectiveness of mitigation measures.

Each of the three major issues was addressed for each of the different media: air, wastewater, water generation, soil and ground water quality.

The present stakeholders were invited to express their views and comments regarding the presented study, as well as to discuss the possible improvements regarding the proposed mitigation measures and environmental management plan.

2.3 *MINUTES OF PUBLIC CONSULTATION*

2.3.1 *Bor Meeting*

The *Final Public Consultation in Bor* was held on 20th June 2006 in the building of the Municipal Assembly. There were 30 registered participants, representing various stakeholders:

- RTB Bor Complex;
- Local communities;
- Non-governmental organisations;
- Municipal authorities;
- The World Bank;
- Secondary Schools;
- Public Utility Company.

Mr. Slavisa Karbasevic as the Municipal Council Member opened the Final Public Consultation by welcoming all present stakeholders. He introduced the audience that the main aim of the presentation was to present proposed mitigation measures and environmental management plan as the tools to improve the current state within the Municipality. After noticing that the study involved the findings presented in LEAP of Bor, Mr. Karbasevic gave the word to Mr. Riccardo Corsi (ERM Italia).

Mr. Riccardo Corsi welcomed the audience, and presented the project that was developed by the consultants. He first of all thanked all the people who actively contributed to the project providing information and support. See for details the presentation attached as *Annex C*.

After the presentation, Mr. Karabasevic opened the discussion by asking the audience to comment.

1st intervention: Mr. Miroslav Pajic (Ecological movement Bor) started the discussion by commenting the given presentation. Mr. Pajic stated that the environmental issues should be analysed in a broad manner, as it is expected for ownership structures to be changed. The environmentalists in Bor have been looking on the problem broader as the state was exploiting this region for a period of time. However, he felt that the problem was not related only to citizens of Bor. Nevertheless, he remembered the suggestion of dislocating the city which was one of the major proposals for improving the state of the environment in the city. Mr. Pajic thought that although the presented measures are systematic are not completely thorough.

He noticed that as the priority 2 was assigned to groundwater analysis. Whatsoever, he thought that it needed a greater rank because of the gravity of the problem and the fact that it was time demanding task especially if it would be done along the Timok River. He thought that the thorough soil quality analysis would need to be done and that this activity should be financed by the government.

The other comment related to the control system as he noticed that no time frame was proposed for the mitigation measures no matter that the methodology proposed step by step approach. These issues was especially important as the municipality has had developed LEAP document where priorities were defined but the implementation and monitoring was lacking by the local government side.

He anticipated that the remark was made on the cost of the new smelting facility (150 mil EUR), but he thought that the new pyro metallurgical process would be the liability of the new owner. Therefore, it might happen that the hydro metallurgical process would be introduced that would have a significant impact regarding the contamination of groundwater, soil, and polluted by products. He raised the question how the consultants had chosen the technologies that could be involved.

He informed the audience that he was aware of the fact that sanitation of the flotation tailings ponds and the collector were financially demanding and on the other hand important issues considering airborne particulates from the dams. He stated that the Technical Faculty of Bor and Copper Institute conducted some research on using this material for ceramics production. However, there was no indication why the project was stopped and in which phase.

He underlined that it was important to define the time frame for the obligations to be fulfilled and to comply with European environmental standards.

Mr. Corsi replied to this comment reminding the audience that this assignment was to develop a study on environmental issues related to current technologies. As there was no data on the orientation of the future owners in terms of their introduced technologies, there was no data on possible impacts either. This issue especially referred to the comment on hydro metallurgical process.

As the main task was to assess the current environmental state and there was lack of data regarding the groundwater quality, the future analysis of groundwater and soil quality was set as priority 1. That was the reason of setting this as the mitigation measure as deep analysis would be long in terms of time.

2nd intervention: Dragoslav Ninkovic (village Krivelj) found the consultants' approach correct and reminded the audience on the first consultation (held in February) and the fact that study was developing in this direction. He found the proposed measures regarding TIR modernisation or closure, pipeline Cerovo - Bor replacement, collector sanitation and wastewater treatment as feasible and reasonable. However, he was more interested in finding about the instruments by which the citizens would be able to make the new owner to modernise the TIR or new concession owners not to pollute surface waters. The other issue he raised was how to make the government invest in the region. He asked if the consultants were aware of the practice implemented in other countries.

Mr. Corsi answered that the best practice would be to implement some performance bond in terms of limiting the operating permit if the compliance would not be reached. Mr. Corsi reminded that the basic business strategy is to make profit and that there was a resource in Bor region that could lead to that.

Mr. Corsi also informed the audience that creating performance bond would be determined by negotiations between government and future owner but it would need to provide future development and environmental protection.

3rd intervention: Mr. Dragomir Dragic (Ekoagenda 7/1935) asked about the mean values if the whole range was averaged (including maximal values) or if average values were fitted.

He expressed his opinion that the study was good, in terms of the approach and including the previous comments. He informed the public that Ekoagenda provided the consultants with a range of studies that were referring to explicit succession of the environment by the state. He did not approve that the committee that would monitor the implementation process did not include the public. Therefore, he would suggest to include public from the affected settlements in the proposed board (from Bucje, Brezonik, Krivelj, Slatina, Ostrelj, Donja Bela reka and Brestovac).

Mr. Dragic was interested if the proposed wastewater treatment plants involved the river Cerovo as there was a request in Spatial Plan that the pH of this river should not change for more than 0,1.

Mr. Corsi replied that all analytical data were taken by Copper Institute and that they present standard statistical data given for these kinds of measurement. The results are official and are average annual values.

As far as committee was considered, Mr. Corsi underlined that in the presentation was a proposal and that members would have to be elected by interested parties. There could stand two committees: one dedicated to industrial development and the other to environmental protection.

Mr. Corsi suggested that at least three wastewater treatment plants should be installed, but the main decision should be made on the basis of the project.

4th intervention: Zvonimir Milijic (RTB Bor) thanked the consultants and stated that the RTB Bor and the municipality share the interests. Mr. Milijic underlined that the important issue is the dynamic (time and manner) of the projects implementation that were proposed by consultants.

Mr. Milijic stated that one of the most important issues is the air quality as presented in consultant's study as it was set as priority 1. Modernisation or closure of TIR was proposed as the mitigation measure. However, this issue would be the part of business sector as well as construction of electrostatic precipitators for the power plant. The other issue would be the historical contamination, e.g. tailings pond. The successor of this pollution would be the government and it would need to be sorted in the shortest possible time. The construction projects for all tailings ponds sanitation would be developed during this year. This projects would be funded by World Bank through the credit to the government. One of the main steps would be foundation of the company, employing 100 to 200 people, to supervise and be involved in the sanitation.

Nevertheless, the problems could be faced with the issues in the business sector as there would be grace period of three years for compliance with appropriate standards. However, Mr. Milijic felt that this would be too much in the sense that they had been waiting for solutions for the last period. He was aware of different practices that could help to overcome the situation, e.g. in Bulgaria where the state was involved in sorting the most urgent matters before the facilities had been sold to the new owner. He proposed to implement similar practice in Serbia, funding it through different financial mechanisms such as environmental loans, donor funds, etc.

5th intervention: Mr. Dimca Jenic (RBB - copper mines Bor) stated that he would like to highlight the water pollution due to mining activities and agreed on proposed measures by the study. He wanted to discuss the replacement of the pipeline Cerovo to Bor, as he proposed in earlier discussion setting it as urgent matter as it was contaminating local areas. He informed the audience that RBB managed to push this project and to provide a new solution of pumping the water from the Cerovo to Veliki Krivelj tailings pond. He announced that this project should start within two weeks, and the whole investment was about 300.000 EUR.

Mr. Jenic agreed on priorities set for rehabilitation of dams 1, 2 and 3, as well as sanitation of collector. However, he noticed that the permanent solution for deviation of the Krivelj River through the hard rock was not mentioned.

He also informed the audience about the INTREAT project that would provide the solution for mining wastewaters that are being discharged to Saraka creek.

6th intervention: Mr. Nikola Ille (World Bank) thanked the present stakeholders for taking a part in the public consultation and he explained that World Bank was giving support to RTB Bor privatisation process and whose part this environmental assessment was. He also stated that not all the comments could be included in the Final report as the consultants were bounded by the ToR.

Mr. Ille informed the presents that there were a lot of mechanisms to protect investment projects regarding environmental protection. One of the mechanisms would be performance bond where the state would be in position of withdrawing available funds if the owner would not comply with standards after the grace period. He also informed that the second phase of the project would be elaboration of construction projects and its implementation. He called stakeholders to actively take part in the future as well.

7th intervention: Mr. Toplica Marjanovic (TIR – smelting and refinery plant) stated that it was hard to give any comments regarding the study based on one presentation. He thought it would be necessary to make all documents developed in the process compatible. This remark especially referred to TIR and it would be necessary to coordinate documents issued by the government, valid spatial plans, etc. He warned that it would be necessary to do translation proof reading in order to eliminate all errors due to wrong translations.

The presentation did not meet Mr. Marjanovic expectations as he thought he would be informed on implementation practice, and supervision. He would expect to see in the Final document costs relating to proposed measures, time frame and deadlines recommendation, as well as, practice of programme realisation (who would be in charge).

He also suggested including public in the proposed committee, as it would comply with Aarhus convention. He asked why the privatisation options were not included in the oral part of presentation no matter that they were announced by first slides.

Mr. Riccardo Corsi replied that all translation mistakes could be overcome by being more specific and that the Final report would include costs as well. He also suggested that the time frame was mostly dependent on privatisation process and the roles to be assigned. However, he would suggest to implement mitigation measures with priority 1 as soon as possible.

8th intervention: Borka Petkovic (Ecological movement Yugoslavia – Novi Sad, board in Bor) intervened with the question on radioactivity in this region. Ms. Petkovic commented that apart from continuous measurement of SO_2, NO_X and particulates on the most critical stacks, it would be important to set a measurement system for SO_3.

Mr. Corsi replied that radioactivity had not been raised as an issue until the moment. However, he explained that proposed devices for continual measurement of SO_2, NO_X and particulates are the standard devices and that additional measurements could include periodic testing of SO_3 where needed.

9th intervention: Mr. Karbasevic joined the discussion by stating that he was one of the founders of Ekoagenda 7/1935 as he lives in local community Brezonik that is the most polluted in the region. He claimed that the inhabitants of Brezonik live in gas chamber as the existing process of smelting and mining is completely unsustainable. Mr. Karbasevic stated that according to statistics from 58 deaths in Brezonik, only two cases had a medical history. The rest died from the cancer, heart attack and cerebral stroke. He commented that he would expect of a future successor to provide free medical care to the inhabitants due to the impact on public health.

10th intervention: Mr. Dragic asked for the list of attendants as he felt that only two parties were present: Ekoagenda and RTB Bor. He thought that presence of municipal authorities would be needed. He asked if it would be possible for consultants to meet rest of the eco parliament.

Mr. Corsi explained that the purpose of the public consultation was to hear the comments from the public and that all parties should have come if they needed to state something since all relevant stakeholders were invited. However, the meeting would need to be scheduled / requested officially with specified objectives.

11th intervention: Mr. Branko Petkovic (local community Slatina and Ekoagenda) did not approve of the non-presence of the municipal authorities. He felt that it would be necessary to involve current operating of RTB Bor and to elaborate project implementation plans that already exist. However, he noticed a lack of information regarding the public health. He asked Mr. Corsi how he would react if the arsenic concentration would be high in his place of origin. He was afraid that this study would end up as LEAP projects - with no implementation.

Mr. Corsi expressed his personal opinion that pollution needs to be stopped. However, implementation of mitigation measures implementation is time and cost demanding activity. Especially, as it takes some time to change the existing technology.

12th intervention: Mr. Pajic came with a question how this project would be realised and that is needed by the local authorities to pay some attention to this issue. He informed the audience that there is no spatial plan for this part of the country.

His opinion was that the study must be coordinated with LEAP studies and that there are some key issues missing, e.g. public health.

13th intervention: Mr. Miroslav Radisavljevic (president of Ekoagenda) found the study as well elaborated. However, he noticed the absence of government representatives that could moderate the discussion between public and RTB

Bor. He thought it would be necessary to assess the feasibility of copper exploitation. He would like the consultants as independent part to test radioactivity of imported copper concentrate.

He claimed that not only the land was the issue, but primary the health.

Mr. Petkovic added that radioactive elements are always a part of the ore.

Mr. Corsi explained that consultants would need a special approval for this kind of testing. Mr. Corsi closed the discussion by saying that meeting minutes would be available and that he felt that this was the first step towards sustainable development.

The key issues that were raised as the comments on the presented study are:

- need of elaboration of time frame as a part of proposed mitigation measures planning;
- include public in proposed scheme for environmental advisory committee;
- lack of government authorities representatives at the consultation.

2.3.2 *Majdanpek Meeting*

The *Final Public Consultation in Majdanpek* was held on 21st June 2006 in the building of the Municipal Assembly. There were 6 registered participants at the public consultations that were representing four interested parties :

- RTB Bor Complex
- RBM
- Municipal authorities
- Secondary Schools.

Ms. Branka Karavidic (vice president of Municipal Assembly) opened the Final Public Consultation by welcoming all present stakeholders and gave the word to Mr. Riccardo Corsi (ERM Italia).

Mr. Riccardo Corsi welcomed the audience, and presented the project that was developed by the consultants (reported as *Annex D*)and asked for the comments once he finished the presentation.

1st intervention: Mr. Gorcilo Potpara (Gymnasium in Majdanpek) noticed that there was obvious absence of various interested parties. He felt this as the consequence of business non-responsibility. He thought that medical centres representatives, Forestry management company representatives could contribute by commenting on the current state. However, the presence of RBM and gymnasium showed that there is an obvious need for public education. Especially, as after the privatisation process different technologies could be introduced. He was interested in knowing if after elaboration of the zero state there would be a system for monitoring control and if the data would be available to the public.

Mr. Corsi explained that there would be a performance bond to make a future owner to comply with Serbian environmental standards. Otherwise, his operation may be stopped. The owner would be obliged to take regular measurements as well.

2nd intervention: Nebojsa Petkovic (biology teacher at Gymnasium) asked if there would be proposed some target monitoring system parallel to factor monitoring systems.

Mr. Corsi replied that consultants proposed installation of fixed monitoring station that would measure SO_2, NO_X, and particles. Nevertheless, the monitoring of the groundwater quality was proposed to determine if there is any contaminated water infiltration.

3rd intervention: Mr. Zvonimir Milijic (RTB Bor) expressed his pleasure regarding the inclusion of their comments in the consultants' study and that the opinions were compatible. However, he thought it would be necessary to explain what is about to happen in Majdanpek regarding the mining activities and privatisation process. He stated that the most probable option would be that some assets, e.g. tailings ponds and overburden disposal sites would not be bought and would be left as the state owned. Therefore, it would be needed to define mitigation measures for these areas to reduce/ eliminate the impacts.

He introduced the public about the activities of World Bank regarding the sanitation of tailings pond. The World Bank started the activity of elaborating construction projects and representative of World Bank (Mr. Frank van Woerden) visited the area.

However, they do not have any data regarding the costs for rehabilitation of overburden disposal sites. It would be needed to define the time and investments for this activity. Especially, as wide areas are discussed and he felt that this issue was not covered in the presented study.

The discussion on this matter lead to agreement that RBM would supply the data on areas and the consultant would include it in the Final Report.

The key issue that was raised as the comment on the presented study was to include additional costs associated with rehabilitation of overburden disposal sites on the bases of the area provided by RBM to the consultants.

Annex A

List of Participants in Bor

	Name and Family Name	Organisation	email	Phone/Fax
1	Vesna Keskinobic	Mesna zajenica Brestovacka Banja Local community Brestovacka Banja		030 37 147
2	Dragan Jankucic	Ekoangenda 7/1935		064 481 63 521
3	Srdjan Jankucic	Mesna zajenica Brezonik Local community Brezonik		064 135 11 64
4	Miljana Golubovic	Gimnazija Bora Stankovic Gymnasium Bora Stankovic	gimbor@ptt.yu	030 441 276
5	Mariora Petrovic	Mesna zajednica Sever Local community Sever		030 423 314
6	Nenad Markovic	Ekoangenda 7/1935		030 428 000
7	Branislav Petrovic	Ekoangenda 7/1935		030 436 678
8	Ukovic	Evo		030 439 026
9	Djordje Anteic	Ekoangenda 7/1935		030 38 682
10	Dragomir Dragic	Ekoangenda 7/1935	boreas@ptt.yu	030 434 159
11	Miroslav Radisavljevic	Ekoangenda 7/1935		063 74 22 030
12	Borka Perkovic	EP Jugoslavije Novi Sad - Bor Ecological movement Novi Sad - Bor	ekoloskipokretbor@yahoo.com	030 77 102
13	Dragoslav Vajkic	Ekoangenda 7/1935 & MZ Bucje Local community Bucje and Ekoagenda 7/1935		030 73 403
14	Dane Vojinovic	Ekoangenda 7/1935 & MZ Bucje Local community Bucje and Ekoagenda 7/1935		064 2434 639
15	Miroslav Pajic	Ekoloski pokret Bor Ecological movement Bor		063 74 89 793
16	Zvonko Milijic	RTB Bor		063 480 924
17	Saiba Milanovic	TIR (RTB Bor) Smelting and Refinery (RTB Bor)	tirrazvoj@ptt.yu	030 423 185
18	Nenad Velkovic	TIR (RTB Bor) Smelting and Refinery (RTB Bor)		
19	Vlada Ivanovic	TIR (RTB Bor) Smelting and Refinery (RTB Bor)	tirrazvoj@ptt.yu	030 421 270
20	Anic Bubica	JKP 3. Oktobar Public Utility Company 3. Oktobar		030 445 042
21	Jovan Manic	JKP 3. Oktobar Public Utility Company 3. Oktobar		030 441 669
22	Slobodanka Cosic	List "Kolektiv" Magazine "Kolektiv"		030 421 473
23	Dejan Djordjevic	SRIF Bor	dejandj@ptt.yu	
24	Dimca Jenic	RBB Bor Copper Mines Bor		030 422 788
25	Toplica Marjanovic	TIR (RTB Bor) Smelting and Refinery (RTB Bor)	ekobor@ptt.yu	030 412 775
26	Milena Prica	TC koordinator TC coordinator	bornes@espserbia.org	030 457 020
27	Dragan Kanakovic	TC RTB koordinator TC RTB coordinator	draganrtb@neobee.net	030 427 423
28	Ljiljana Dzamic Lekic*	OU Bor/ sektor za zastitu zovotne sredine Municipal council/ environmental department	leapbor@ptt.yu	030 427 313
29	Nikol Ille*	Svetska Banka World Bank	nik.ille@worldbank.org	
30	Slavisa Karbasevic*	Opstinsko vece Bor Municipal Council Bor		

* added by consultants, as they were present but not signed in

Annex B

List of Participants in Majdanpek

Name and Family Name	Organisation	email	Phone/Fax
Gorcilo Potpara	Gimnazija Majdanpek Gymnasium Majdanpek	gimmpek@ptt.yu	063 458 62 61 030 581 408
Nebojsa Petkovic	Gimnazija Majdanpek & Tehnicka skola Gymnasium Majdanpek & Technical High School	gimmpek@ptt.yu	063 708 81 22 030 581 408
Vesna Cepenjor	Opstinka uprava Majdanpek Municipal management Majdanpek	oumpek@ptt.yu	030 588 515
Nikola Ille	Svetska Banka World Bank	nille@worldbank.org	011 3023 700
Slobodanka Ristic	RBM Copper Mines Majdanpek		030 581 166
Branka Karavidic	Municipal Assembly Majdanpek	majdanpekso@ptt.yu	064 368 85 87
Vitomir Miladinovic	RBM Copper Mines Majdanpek	rbmvita@ptt.yu	030 581 775
Zvonimir Milijic	RTB Bor	zvonkoqm@ptt.yu	063 480 924
Nenad Kornemo	Radio Televizija Majdanpek Radio Television Majdanpek		063 368 346

Annex C

Presentation in BOR

Environmental Assessment of the Environmental Damages from Past Operations of RTB Bor

FINAL PUBLIC CONSULTATION MEETING

Bor, June 20th 2006

Delivering sustainable solutions in a more competitive world

ERM

Contents

- Final consultation scope and goals
- Presentation of the Project: Objectives, Activities and Methodology
- Project Results: Environmental Impacts, Mitigation Measures and Monitoring Plan
- Next steps of the Privatisation Process
- Discussion and questions.

Final Consultation Scope and Goals

The consultation process is aimed at providing information to stakeholders and wider public on the assessment of past and future activities in the Bor area to determine the appropriate environmental strategy for future development. In particular:

- To inform stakeholders of environmental issues related to the Privatisation/restructuring process;
- To collect public opinions/views/perception on the proposed mitigation measures and monitoring plan.

Background

- The Project is aimed at the preparation of an Environmental Assessment for RTB Bor operations within the on-going privatisation process of the RTB Bor Complex.
- The Project is financed by the *World Bank* through the *Privatisation Agency of the Republic of Serbia.*
- The Consulting Team is composed by *ERM* - Environmental Analysis and Remediation Consulting Company - *CSA Group Ltd of Ireland:* Mining/engineering Experts - *Fideco d.o.o.:* Local Environmental Consulting Company.

Presentation of the Project - Objectives

Specific Goals of the Projects are:

- To describe the major environmental impacts associated with:
  - Past and on-going activities
  - The new restructuring and privatization program.
- To propose mitigation measures and clean-up;
- To define an environmental monitoring plan aimed at completion of the environmental baseline and at verification of the effectiveness of mitigation measures.

Presentation of the Project - Methodology

1. Environmental Baseline

- Data collection with regard to environmental setting and available monitoring data related to air, water, soil, public health, flora, fauna, rare or endangered species and sensitive habitats.
- Environmental baseline has been defined relying on data supplied by site management, municipalities, universities and other entities; no additional monitoring has been undertaken.

Presentation of the Project - Methodology

2. RTB Bor Complex Analysis

- Data collection;
- Site inspections;
- Interviews with site management;
- Local consultation.

Presentation of the Project - Methodology

3. Impact Assessment

- Comparison of environmental data with Serbian regulatory requirements and WB/EU standards;
- Gap analysis with regard to existing international standards of good practice management;
- Analysis of privatisation options/alternatives.

Presentation of the Project - Methodology

4. Mitigation Measures and Monitoring

- Preliminary identification of mitigation measures;
- Prioritisation of mitigation measures (MM) based on an "urgency criterion";
- Preparation of an Environmental Monitoring Plan with the aim of completing environmental data collection and of verifying effectiveness of MM.

Project Results – Air Emissions - Sources

Main sources of emissions to air include:

- **particulate from mining activities - underground and crushing/milling processes;**
- **dusts from vehicle movement;**
- **wind blown particulate from tailing ponds and spoil heaps;**
- **particulate, sulphur dioxide, nitrogen oxide, arsenic from smelting process;**
- **particulate, sulphur dioxide, nitrogen oxide, from power plant.**

Major emission sources are recognised to consist of stacks from the smelting complex

Project Results – Typical Emission Values

Source	Parameter	Year	Emission (mg/m^3)	Serbian limits (mg/m3)
mining activities (Jama VO4)	particulate	2004	75.7*	50
wind blown particulate	particulate	n.a.	n.a.	n.a.
smelting complex (smelting furnace)	sulphur dioxide	2005	16,000**	1,200
	particulate	2005	1,200**	20
power plant (boiler n.7)	sulphur dioxide	2006	940**	2,000
	particulate	2006	70**	150

* spot sampling

** average annual concentration

Project Results – Air Quality – Monitoring

- **Current Air Quality Monitoring is undertaken by means of four stations:**
  1. Gradski-Park, approximately 500 m from the smelter stack;
  2. Copper Institute, about 1 km from the smelter complex;
  3. Electroistok Yugopetrol, about 2 km SE of the smelter;
  4. Brezonik, a community about 2.5 km N of the smelter.
- **Parameters monitored include sulphur dioxide and particulate;**
- **In addition, spot sampling is undertaken for particulate deposition rate and heavy metals.**

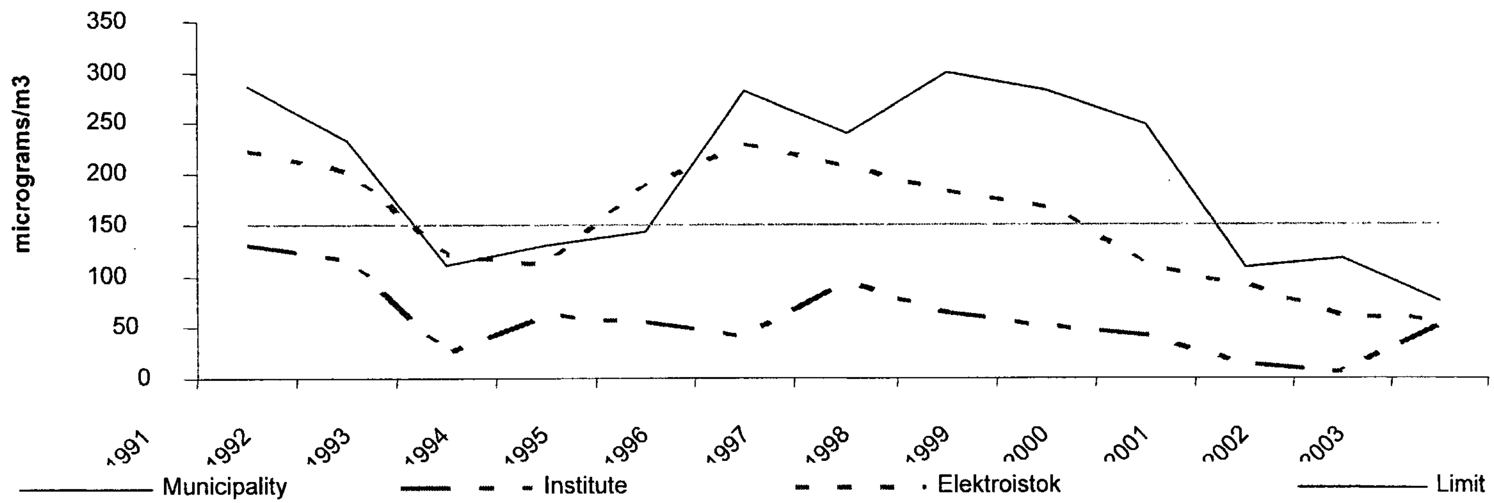
Project Results – Air Quality

Parameter	Location of sampling point	Concentration detected* ($\mu g/m^3$)	Serbian limits ($\mu g/m^3$)
particulate	Copper Institute	10 (max 63)	50
sulphur dioxide	Electroistok Yugopetrol	126 (max 1,508)	50
arsenic	all stations	ranging between 4,5-224	2.5

* annual average 2004

Project Results – Air Quality

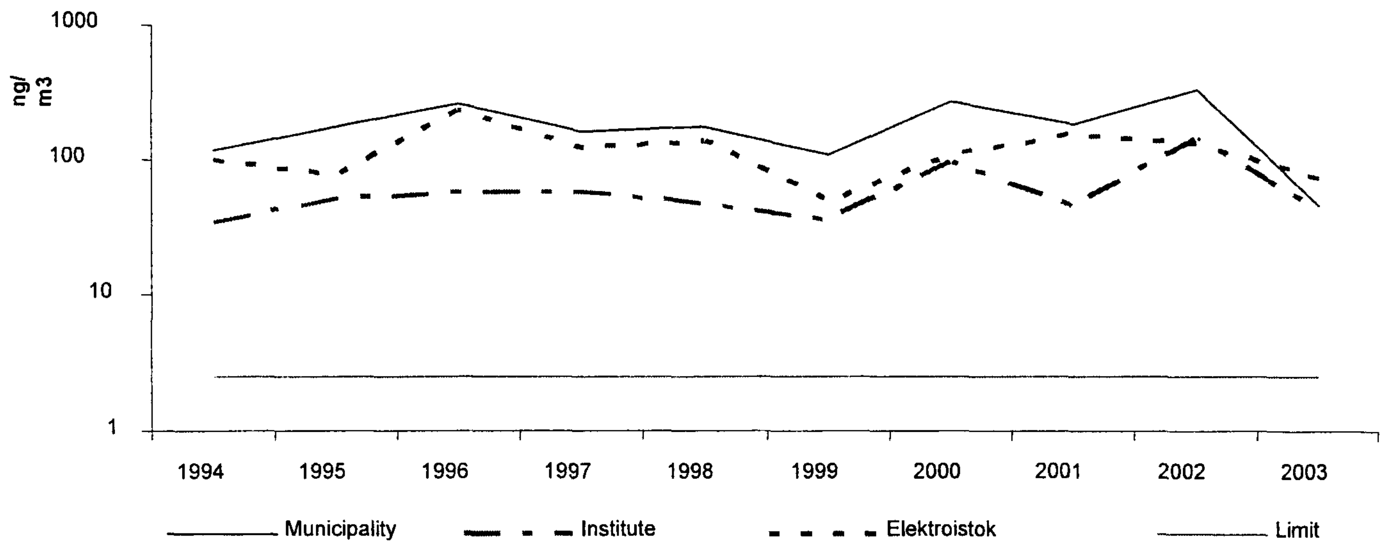
Daily Average Annual Concentrations of SO_2 in Bor



Source: Copper Institute, Bor

Project Results – Air Quality

Average Annual Concentrations of Arsenic in Bor



Source: Copper Institute, Bor

Project Results – Air Emissions – Mitigation Measures

Recommended Mitigation Measures

- crushing/milling plants to be fitted with ventilation&particulate abatement devices;
- revegetation of tailing ponds and spoil heaps;
- smelter modernisation plan (different options) or closure;
- power plant to be equipped with electrofilters.

Project Results - Air Emissions - Monitoring Plan

Proposed Monitoring to be undertaken on air emissions and air quality include:

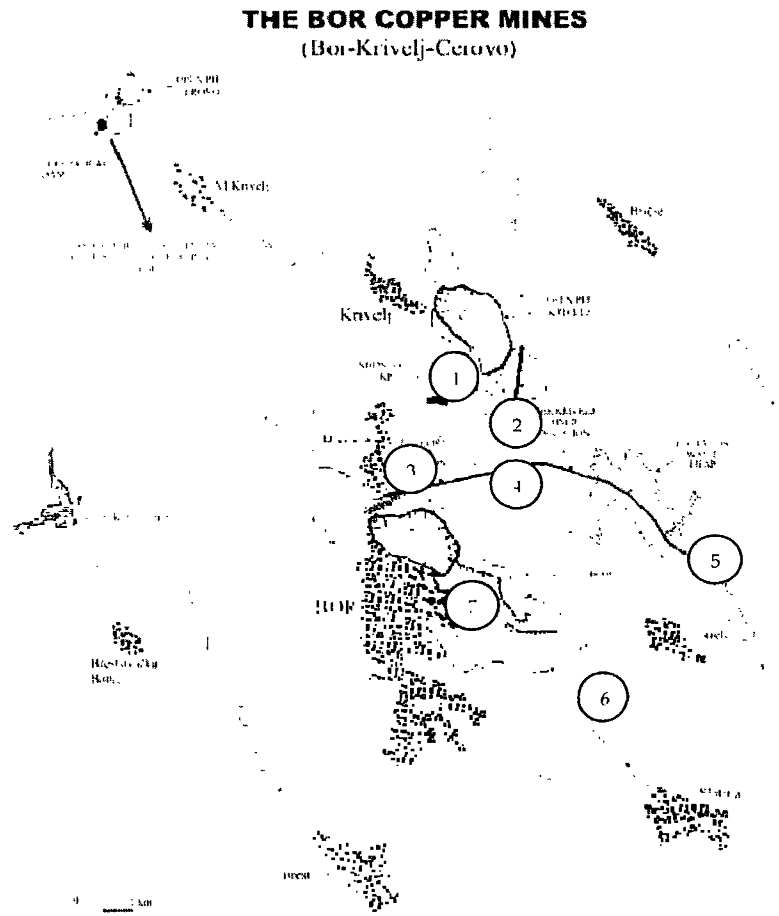
- continuous monitoring devices to be installed at most critical stacks (particulate, SO_2 and NO_X);
- spot monitoring (quarterly) of all stacks (heavy metals including arsenic and dioxins);
- upwind and downwind monitoring of air quality in the area of tailing ponds/spoil heaps;
- installation of 1-2 additional monitoring stations for continuous detection of particulate, SO_2 and NO_X at selected locations; equipment of all stations with fine particulate (PM_{10}) monitoring devices.

Project Results – Wastewater Discharges - Sources

Sources of wastewaters include:

- mining activities – effluents from underground mine (blue waters) and drainage waters collected at the bottom of open pits (Bor, Veliki Krivelj and Cerovo);
- smelting process – sulphuric acid plant WW, spent electrolyte solutions and blowdowns;
- runoff from overburden disposal sites and waste heaps leaching.

Project Results – Wastewater Sources



1: Effluents from open pit Veliki Krivelj

2: Run-off from overburden storage discharged in to the water stream Saraka

3: Effluents from Jama underground mine (blue water)

4: Drainage waters from the tailing dam 1A

5. Drainage waters from the tailing dam 3A

6. Wastewater from lake Robule, collecting stormwater runoff from overburden disposal sites

7. Mixed effluents including drainage water from open pit Bor and from smelter

Project Results – Wastewater Quality (2005)

Effluent	Parameter	Concentration detected	Unit	Serbian limits (mg/m3)
Blue waters*	pH	2,7	-	6÷9
	Cu	522,6	mg/l	0,1
	As	0,214	mg/l	0,05
	Zn	54,23	mg/l	1
Open pit effluents**	pH	4,4	-	6÷9
	Cu	127,5	mg/l	0,1
	Zn	3,1	mg/l	1
Smelter effluents***	pH	2,35	-	6÷9
	Cu	54,04	mg/l	0,1
	Fe	322,5	mg/l	1
	Ni	1,046	mg/l	0,1
	Zn	1,92	mg/l	1
Leachates****	pH	2,97	-	6÷9
	Cu	55,16	mg/l	0,1
	Fe	895	mg/l	1
	Zn	26,5	mg/l	1

* from Jama **Veliki Krivelj *** mixed with open pit Bor effluent ****Robule lake

Project Results – Wastewater – Mitigation Measures

Recommended Mitigation Measures

- Chemical-physical wastewater treatment to be provided prior to discharge into surface water courses of effluents from Jama and from the smelter;
- Treatment of drainage water collected in the open pits and final rehabilitation of the pits;
- Treatment of leachates from spoil heaps and overburden and final requalification of waste heaps.

Project Results – Wastewaters – Monitoring Plan

Proposed Monitoring to be undertaken on wastewater effluents include:

- detailed evaluation of effluents flow rate and rainwater generation;
- characterisation of related water effluents quality to adequately design the WWTPs;
- periodical monitoring of generated effluents to ascertain efficiency of installed WWTPs (pH, heavy metals, suspended solids).

Project Results – Waste Generation

Main waste generated include:

- mining activities – overburden and tailings;
- smelting process – slags from blast furnace and insulating materials;
- other wastes including waste tyres, scrap metals, lubricating oils and spent accumulators.

Project Results – Waste Generation

Waste Stream	Destination
overburden and tailings	tailing ponds and waste heaps
slags from blast furnace and insulating materials	open pit Bor
other wastes	open dumped at the sites

Project Results – Waste Generation – Mitigation Measures

Recommended Mitigation Measures with regard to waste generation include:

- Future Waste Generation - open dumping of waste must be stopped and an adequate temporary storage area should be provided;
- Existing solid waste - Open dumps have to be immediately secured; an inventory of dumped waste and related risk assessment must be undertaken; waste capping/removal to be carried out.

Project Results – Waste Generation – Monitoring Plan

Proposed Monitoring to be undertaken with regard to waste generation include:

- Future waste generation – a detailed evaluation of waste generated at the sites should be undertaken to allow design of the temporary storage area;
- Waste management system at the site to be implemented including periodical inspections;
- Existing waste - periodical groundwater monitoring to ascertain effectiveness of open dumps remediation.

Project Results – Soil&Groundwater

Sources of soil and groundwater contamination include:

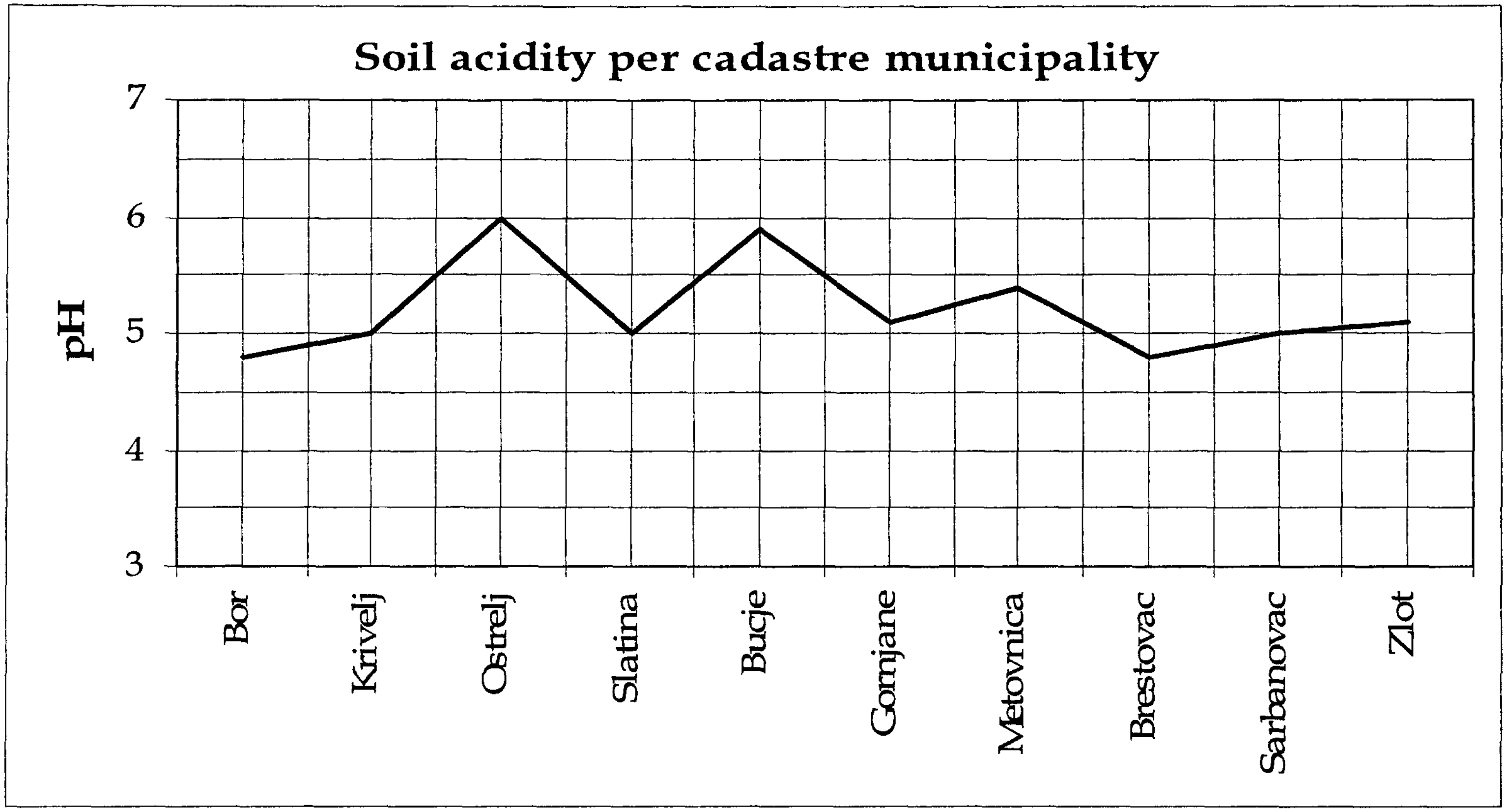
- wet/dry deposition of air pollutants deriving from the smelter and dusts from tailing ponds, open dumps and waste heaps;
- historical and current waste dumping and contaminated stormwater infiltration into the ground and leakage from the underground pipeline connecting Cerovo open pit to Bor;
- Historical and current discharge of contaminated effluents into surface watercourses and consequent sediments contamination.

Project Results – Soil&Groundwater – Heavy metals (Agricultural Research Centre, 1997)

Parameter	Location	Concentration detected (mg/kg)	Serbian limits (mg/kg)
Copper	Ostrelj	125	100
	Slatina	135	100
	Bucje	120	100

Arsenic concentrations are detected close to the limit of 25 mg/kg; concentrations of Zinc and Lead are below regulatory standards

Project Results – Soil&Groundwater – Soil Acidity (Agricultural Research Centre, 1997)



Project Results – Soil&Groundwater – River Sediments (UNEP Study*, 2002)

Parameters/Sample ID	sample1	sample2	sample3	Serbian standards (mg/kg)
pH	7,69	4,56	6,39	n.a.
Lead (mg/kg)	38,3	**105**	41,2	**100**
Zinc (mg/kg)	133,5	92	101,2	300
Copper (mg/kg)	**2.937**	**3.257**	**2.688**	**100**
Arsenic (mg/kg)	**315**	**291**	**310**	**25**

No groundwater impact has been detected (very limited data available)

* UNEP Assessment of Existing Environmental Monitoring Capacities in Bor, September 2002

Project Results - Soil&Groundwater - Mitigation Measures and Monitoring

No soil remediation can be recommended at this stage except for the replacement/repair of Cerovo-Bor underground pipeline.

Soil monitoring should be implemented as follows:

- Surface soil sampling in an area of 5 km around the smelter - 80 sampling points individuated by concentric rings and radial vectors.
- Soil monitoring plan in the open dumps area with a 20*20 grid.
- River sediments' sampling every 250 m on the two banks.

Project Results – Soil&Groundwater – Mitigation Measures and Monitoring

- Investigation of local geology and hydrogeology.

  To complete the environmental baseline regarding geology and hydrogeology, new piezometers are foreseen to have more site-specific information.

  In particular, the aim is to further investigate on geological sections, stratigraphy, depth of shallow aquifer and flow direction.

Project Results - Soil&Groundwater - Mitigation Measures and Monitoring

Groundwater monitoring is proposed as follows:

- groundwater quality down stream the open pit mines to verify the influence of the open pit mine on groundwater quality (upstream and down stream in flow direction);
- general groundwater quality - monitoring wells are foreseen for GW sampling and analysis (once a year).

Project Results – Tailing Ponds - Issues

Main findings related to the tailing ponds include:

- Stability analysis to be performed at all TP including geotechnical investigation, new piezometers installations and stability evaluation;
- Urgent measures to be undertaken, e.g. seepage containment and silt wash containment;
- Final rehabilitation of tailing ponds including side slopes and flat surface and revegetation.

Project Results – Tailing Ponds - Issues

Main findings related to the underground collectors include:

- Underground collector beneath Veliki Krivelj tailing ponds needs urgently intervention as already stated in a number of studies;
- Bor collector needs remedial work analysis and design of potential options for intervention.

Project Results – Prioritisation of Mitigation Measures - Methodology

- **Due to the complexity of the environmental situation at RTB Bor Complex, a phased approach is proposed: mitigation measures have been prioritised by means of an urgency criterion.**
- **Identified environmental issues have been classified as follows:**
    - *Immediate, high risk issues both with regard to the people and the environment.*
    - *Chronical high risk issues both with regard to the people and the environment.*

Project Results – Prioritisation of Mitigation Measures - Methodology

- **Proposed mitigation measures have been prioritised according to the following criteria:**
  - *Immediate, high risk issues both with regard to the people and the environment have been classified as priority 1.*
  - *Chronical high risk issues both with regard to the people and the environment have been classified as priority 1, 2 or 3 based on gravity of consequences.*

Project Results – Prioritisation of Mitigation Measures - Methodology

- Priority 1 - Immediate, high risk issues both with regard to the people and the environment and chronical high risk issues that pose a real, actual threat with regard to the people;
- Priority 2 - Chronical high risk issues with regard to the environment;
- Priority 3 - Chronical high risk issues mainly related to environmental liabilities

Project Results - Prioritisation of Mitigation Measures

Issue	Mitigation Measure	Priority
Air Quality	crushing/milling plants to be fitted with ventilation & particulate abatement devices;	2
	revegetation of tailing ponds and spoil heaps;	1
	smelter modernisation plan (different options) or closure;	1
	power plant to be equipped with electrofilters.	1
Waste water effluents	chemical-physical wastewater treatment to be provided prior to discharge into surface water courses of effluents from Jama and from the smelter	2
	Treatment of drainage water collected in the open pits and final rehabilitation of the pits	2
	Treatment of leachates from spoil heaps and overburden and final requalification of waste heaps	2

* Assuming there is no connection to the drinking water network

Project Results – Prioritisation of Mitigation Measures

Issue	Mitigation Measure	Priority
Waste	Future Waste Generation - open dumping of waste must be stopped and an adequate temporary storage area should be provided,	3*
	Existing solid waste - Open dumps have to be immediately secured, an inventory of dumped waste and related risk assessment must be undertaken, waste capping/removal to be carried out.	3
Soil Quality	Surface soil sampling in an area of 5 km around the smelter - 80 sampling points individuated by concentric rings and radial vectors	1
	Soil monitoring plan in the open dumps area with a 20*20 grid	1
	River sediments sampling every 250 m on the two banks	1
	Urgent replacement of the underground pipeline from Cerovo to Bor	1

* Assuming that risk assessment results will not evidence any threat for human health or the environment

Project Results – Prioritisation of Mitigation Measures

Issue	Mitigation Measure	Priority
Tailing ponds	Stability analysis to be performed at all TP including geotechnical investigation, new piezometers installations and stability evaluation;	1
	Urgent measures to reduce the risk of failure of the dams, e.g. seepage containment and silt wash containment;	1
	Final rehabilitation of tailing ponds including side slopes and flat surface and revegetation.	1
	Underground collector beneath Veliki Krivelj tailing ponds needs urgently intervention as already stated in a number of studies;	1
	Bor collector needs remedial work analysis and design of potential options for intervention.	1

Project Results – Environmental Monitoring Plan - Objectives

- **Environmental Monitoring Plan has been developed with the aim to:**
  - acquire new elements to complete and update the environmental data collection;
  - provide an outline of a tool which will help to monitor the environmental data and assess the implementation and the efficiency of the agreed environmental mitigation measures.

Project Results – Environmental Monitoring Plan - Contents

- **Technical Monitoring (as presented under each section)**

1. Air quality (1-2 additional stations and PM10 monitoring at existing and new stations);
2. Air emissions monitoring (continuous monitoring devices and periodical spot sampling);
3. Wastewater effluents monitoring;
4. Waste generation and management;
5. Soil and groundwater monitoring.

Project Results – Environmental Monitoring Plan - Contents

- **MM Implementation Monitoring**
  - An Environmental Advisory Committee (EAC) is proposed to monitor the implementation of the agreed mitigation measures and monitoring activities;
  - The members of the EAC will include representatives from Municipality of Bor, Privatisation Agency, the new owner, Ministry for the Environment;

Project Results – Environmental Monitoring Plan - Contents

- **MM Implementation Monitoring**

  The EAC members will:

  - analyse monitoring data, evaluating the trend and comparing new data with previous ones;
  - discuss and interpret monitoring results;
  - suggest eventually corrective actions;
  - check the implementation of foreseen mitigation measures and suggest further measures eventually required;
  - report on monitoring results and mitigation work in progress; the periodic reports will be available for the population on the Municipality's Web site.

Privatisation Process - Background

- **The Project "Restructuring and Privatization of RTB Bor" encompasses RTB Bor (Parent Company), RB Bor (RBB), RB Majdanpek (RBM) and Smelter and Refinery (TIR).**
- **The Project consists of three phases:**
  - Company Analysis and Privatization Strategy;
  - Restructuring;
  - Privatization.
- **The consortium in charge of the Project on behalf of the Privatization Agency of the Republic of Serbia ("PA") is constituted by CA IB, Deloitte, Harrisons Solicitors and the subcontracted IMC.**

Privatisation Process - Findings

- After thorough consideration of various options, Sale of Assets has been recommended as the most appropriate privatization/restructuring method.
- The subject recommendation was made upon the cross-assessment of the social, financial and legal implications, as well as the expressed market interest.
- Special consideration was given to the required time for the implementation of each possible option, and the Sale of Assets is obviously the fastest method.

Privatisation Process – Next steps

- The Consortium anticipates that the assets will be sold as part of the following groups:
  - **RBB core assets;**
    - **Veliki Krivelj, flotation and Cerovo assets; Jama assets (including Borska Reka deposit) and flotation;**
  - **TIR core assets;**
  - **RBM core assets.**
- **The structure and time frame of the sale process will be presented in the Action plan, which will encompass specific activities, responsible parties and define certain deadlines.**

Conclusions and next steps

One of the main objectives of this Project is to include environmental issues into the Privatisation Process and in particular:

- to define mitigation measures to be implemented and related monitoring tools;
- to evaluate implementation timing;
- to estimate related costs.

Roles and responsibility to address environmental issues will be defined in the frame of the Privatisation Contract.

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Annex D

Presentation in Majdanpek

Environmental Assessment of the Environmental Damages from Past Operations of RTB Bor

FINAL PUBLIC CONSULTATION MEETING

Majdanpek, June 21st 2006

Contents

- Final consultation scope and goals
- Presentation of the Project: Objectives, Activities and Methodology
- Project Results: Environmental Impacts, Mitigation Measures and Monitoring Plan
- Next steps of the Privatisation Process
- Discussion and questions.

Final Consultation Scope and Goals

The consultation process is aimed at providing information to stakeholders and wider public on the assessment of past and future activities in the Majdanpek area to determine the appropriate environmental strategy for future development.

In particular:

- To inform stakeholders of environmental issues related to the Privatisation/restructuring process;
- To collect public opinions/views/perception on the proposed mitigation measures and monitoring plan.

Background

- The Project is aimed at the preparation of an Environmental Assessment for RTB Bor operations within the on-going privatisation process of the RTB Bor Complex.
- The Project is financed by the *World Bank* through the *Privatisation Agency of the Republic of Serbia.*
- The Consulting Team is composed by *ERM* - Environmental Analysis and Remediation Consulting Company - *CSA Group Ltd of Ireland:* Mining/engineering Experts - *Fideco d.o.o.:* Local Environmental Consulting Company.

Presentation of the Project - Objectives

Specific Goals of the Projects are:

- To describe the major environmental impacts associated with:
  - Past and on-going activities
  - The new restructuring and privatization program.
- To propose mitigation measures and clean-up;
- To define an environmental monitoring plan aimed at completion of the environmental baseline and at verification of the effectiveness of mitigation measures.

Presentation of the Project - Methodology

1. Environmental Baseline

- Data collection with regard to environmental setting and available monitoring data related to air, water, soil, public health, flora, fauna, rare or endangered species and sensitive habitats).
- Environmental baseline has been defined relying on data supplied by site management, municipalities, universities and other entities; no additional monitoring has been undertaken.

Presentation of the Project - Methodology

2. RBM Site Analysis

- Data collection;
- Site inspections;
- Interviews with site management;
- Local consultation.

Presentation of the Project - Methodology

3. Impact Assessment

- Comparison of environmental data with Serbian regulatory requirements and WB/EU standards;
- Gap analysis with regard to existing international standards of good practice management;
- Analysis of privatisation options/alternatives.

Presentation of the Project - Methodology

4. Mitigation Measures and Monitoring

- Preliminary identification of mitigation measures;
- Prioritisation of mitigation measures (MM) based on an "urgency criterion";
- Preparation of an Environmental Monitoring Plan with the aim of completing environmental data collection and verification of effectiveness of MM.

Project Results – Air Emissions - Sources

Main sources of emissions to air include:

- particulate from mining activities - crushing/milling processes;
- dusts from vehicle movement;
- wind blown particulate from tailing ponds and spoil heaps.

Project Results - Air Quality

- Ambient air monitoring has not been carried out at Majdanpek since 1995, so no updated data are available. No monitoring is undertaken on air emissions.
- In the period 1978-1981 air quality in the region was mainly affected by particulate: recorded deposition rate was in the range 268-389 mg/m^2/day (compared with a limit of 100 mg/m^2/day), with maximum values of 630-1,300 mg/m^2/day.
- Particulate was present both in winter and summer (92.1% of days with presence annually); in winter, concentration detected up to 161 mg/m3.
- Concentrations of SO_2 were, on the contrary, low.

Project Results - Air Emissions - Mitigation Measures

Recommended Mitigation Measures

- crushing/milling plants to be fitted with ventilation&particulate abatement devices;
- revegetation of tailing ponds and spoil heaps.

Project Results - Air Emissions - Monitoring Plan

Proposed Monitoring to be undertaken on air emissions and air quality include:

- Periodical monitoring (quarterly) of all stacks (particulate);
- upwind and downwind monitoring of air quality in the area of tailing ponds/spoil heaps;
- installation of at least 1 monitoring station for continuous detection of particulate.

Project Results – Wastewater Discharges

Sources of wastewaters include:

- mining activities – drainage waters collected in open pits (North and South);
- flotation activities - water from filtration;
- wastewater from the light workshop and heavy service;
- runoff from overburden disposal sites and waste heaps leaching.

Project Results – Wastewater (2005)

Parameters	Unit	Crushing effluents	Filtration wastewaters	Workshop (HV)	Workshop (LV)	Serbian Limit
pH		8,13	7,84	8,32	8,35	6.0-9.0
Iron	**mg/l**	**2,51**	**5,43**	**0,44**	**0,14**	**0.50**
TDS	**mg/l**	**984,00**	**2,312.0**	**476,00**	**468,00**	**< 1,500**
TSS	mg/l	n.d.	8,40	0,20	14,00	< 80
Zinc	mg/l	0,21	0,35	n.d.	n.d.	1.00
Copper	**mg/l**	**0,14**	**4,99**	n.d.	n.d.	**0.01**
Chromium	mg/l	0.006	0.004	n.d.	n.d.	0.01
Arsenic	mg/l	0.001	0.001	n.d.	n.d.	0.05

No monitoring data are available with regard to open pits drainage water and leachates from overburden/waste heaps

Project Results – Wastewater – Mitigation Measures

Recommended Mitigation Measures

- The opportunity of recycling the effluents from the filtration process and crushing into the flotation should be ascertained since provision of a dedicated treatment plant is considered not economically sustainable.
- Based on results of monitoring of drainage water collected in the open pits and of leachates from spoil heaps and overburden (to be analysed for acidity, heavy metals including arsenic), need of treatment should be assessed.

Project Results – Waste Generation

Main waste generated include:

- mining activities – overburden and tailings;
- other wastes including waste tyres, scrap metals, lubricating oils and spent accumulators.

Project Results – Waste Generation

Waste Stream	Destination
overburden and tailings	tailing ponds and waste heaps
other wastes	open dumped at the sites

Project Results – Waste Generation – Mitigation Measures

Recommended Mitigation Measures with regard to waste generation include:

- Future Waste Generation - open dumping of waste must be stopped and an adequate temporary storage area should be provided;
- Existing solid waste - Open dumps have to be immediately secured; an inventory of dumped waste and related risk assessment must be undertaken; waste removal to be carried out.

Project Results – Waste Generation – Monitoring Plan

Proposed Monitoring to be undertaken with regard to waste generation include:

- Future waste generation – a detailed evaluation of waste generated at the site should be undertaken to allow design of the temporary storage area;
- Waste management system at the site to be implemented including periodical inspections.

Project Results - Soil&Groundwater

Potential sources of soil and groundwater contamination include:

- wet/dry deposition of air pollutants mostly deriving from dusts from tailing ponds;
- historical and current waste dumping and contaminated stormwater infiltration into the ground;
- historical and current discharge of contaminated effluents into surface watercourses and consequent sediments contamination.

Project Results – Soil&Groundwater – Mitigation Measures and Monitoring

No soil remediation can be recommended at this stage due to lack of monitoring data

Monitoring should be implemented as follows:

- Surface soil sampling in an area of 2 km downwind the tailing ponds in the prevailing wind direction – about 40 sampling points individuated by radial vectors;
- River sediments' sampling every 250 m on the two banks;
- Groundwater sampling upstream and downstream tailing ponds.

Project Results – Soil&Groundwater – Mitigation Measures and Monitoring

- Investigation of local geology and hydrogeology.

  To complete the environmental baseline regarding geology and hydrogeology, new piezometers are foreseen to have more site-specific information.

  In particular, the aim is to further investigate on geological sections, stratigraphy, depth of shallow aquifer and flow direction.

Project Results – Tailing Ponds - Issues

Main findings related to the tailing ponds include:

- Stability analysis to be performed at all TP including geotechnical investigation, new piezometers installations and stability evaluation;
- Urgent measures to reduce the risk of failure of the dams, e.g. seepage containment and silt wash containment;
- Final rehabilitation of tailing ponds including side slopes and flat surface and revegetation.

Project Results – Prioritisation of Mitigation Measures - Methodology

- **Due to the complexity of the environmental situation at RTB Bor Complex, a phased approach is proposed: mitigation measures have been prioritised by means of an urgency criterion.**
- **Identified environmental issues have been classified as follows:**
  - *Immediate, high risk issues both with regard to the people and the environment.*
  - *Chronical high risk issues both with regard to the people and the environment.*

Project Results – Prioritisation of Mitigation Measures - Methodology

- **Proposed mitigation measures have been prioritised according to the following criteria:**
  - *Immediate, high risk issues both with regard to the people and the environment have been classified as priority 1.*
  - *Chronical high risk issues both with regard to the people and the environment have been classified as priority 1, 2 or 3 based on gravity of consequences.*

Project Results – Prioritisation of Mitigation Measures - Methodology

- Priority 1 - Immediate, high risk issues both with regard to the people and the environment and chronical high risk issues that pose a real, actual threat with regard to the people;
- Priority 2 - Chronical high risk issues with regard to the environment;
- Priority 3 - Chronical high risk issues mainly related to environmental liabilities.

Project Results – Prioritisation of Mitigation Measures

Issue	Mitigation Measure	Priority
Air Quality	crushing/milling plants to be fitted with ventilation& particulate abatement devices;	2
Air Quality	revegetation of tailing ponds and spoil heaps.	1
Waste water effluents	The opportunity of recycling the effluents from the filtration process and crushing into the flotation should be ascertained since provision of a dedicated treatment plant is considered not economically sustainable.	2
Waste water effluents	Based on results of monitoring of drainage water collected in the open pits and of leachates from spoil heaps and overburden (to be analysed for acidity, heavy metals including arsenic), need of treatment should be assessed.	2

Project Results – Prioritisation of Mitigation Measures

Issue	Mitigation Measure	Priority
Waste	Future Waste Generation – open dumping of waste must be stopped and an adequate temporary storage area should be provided.	3*
Waste	Existing solid waste – Open dumps have to be immediately secured, an inventory of dumped waste and related risk assessment must be undertaken, waste removal to be carried out.	3*
Soil Quality	Surface soil sampling in an area of 2 km downwind the tailing ponds in the prevailing wind direction – about 40 sampling points individuated by radial vectors.	1
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* Assuming that risk assessment results will not evidence any threat for human health or the environment

Project Results – Prioritisation of Mitigation Measures

Issue	Mitigation Measure	Priority
Tailing ponds	Stability analysis to be performed at all TP including geotechnical investigation, new piezometers installations and stability evaluation;	1
	Urgent measures to reduce the risk of failure of the dams, e.g. seepage containment and silt wash containment;	1
	Final rehabilitation of tailing ponds including side slopes and flat surface and revegetation.	1

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