Biological and Bacteriological Baseline Report

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1 Scope of the Biological and Bacteriological Baseline Assessment

1.1 Introduction

The Roşia Montană Project is located in an inhabited area belonging to the *comuna* of Roşia Montană and the town of Abrud. Roşia Montană locality is the most impacted by historical and existing mining operations. In addition to pollution sources related to these mining activities, other contaminants derive from domestic activities, such as discharge of untreated domestic wastewater into Roşia Stream and uncontrolled disposal of household solid waste. The pollution sources related to the historical and existing mining activity have also impacted the biological factors of the surface waters. The inappropriate management of domestic wastewater and solid waste represents a common feature of rural environments in Romania.

Whereas the impact of contaminants related to historical and existing mining activities on aquatic environment is well known by the local environmental and water management authorities, the issue of biological and bacteriological factors being affected by industrial and domestic pollution has neither been assessed nor considered a matter of major interest.

1.2 Objectives

The objective of the current study concerning the biological and bacteriological baseline conditions of the aquatic environment is to assess the impact of the surface water contamination on biological indicators as well as the level of bacteriological contamination of surface and ground waters as a result of untreated domestic effluent discharges into Roşia Stream and uncontrolled disposal of household solid waste along the banks of this stream.

Additional domestic wastewater flows and solid wastes will be generated during the three development phases of the proposed mining Project. The Project design provides facilities for the proper management of industrial and domestic wastewater, as well as for municipal and production waste. Thus, the impact of these sources on the aquatic life and the bacteriological quality of the surface and ground water will be insignificant.

However, the collection and treatment of domestic wastewater, as well as the controlled disposal of household solid waste generated by the population of Roşia Montană locality, are the responsibility of the Local Council of Roşia Montană and do not fall within the scope of the proposed mining project.

1.3 Project Location

The Project area is located within the RMGC mining concession, approximately 80 kilometres northwest of the county capital of Alba Iulia, in the Metaliferi Mountains which belong to the southern part of Apuseni Mountains in Transylvania. The area is also located south of the Arieş River.

The Project area includes a portion of the Roşia, Corna and Saliste Valleys and is centred around the existing MINVEST mining operation. The local watersheds are generally steep sided, with human settlements developing in a linear fashion along the narrow valley floors.

Landscape of the Project area is diverse, featuring ridges, valleys and hillsides, and various land uses ranging from existing open-pit mining operations to traditional agricultural activities and dwelling areas. Areas degraded by historical and current mining operations dominate the landscape in the upper Corna and Roşia Valleys.

The Project area drains through the northwards flowing Abrud River, which receives five main right-bank tributaries from Buciumani, Abruzel, Corna, Saliste and Roşia Valleys, of which the last three are of importance to the Project. The ridges between these three valleys and the peaks to the east effectively delimitate a natural depression around Roşia Montană, isolating it from the areas to the east, north and south.

1.4 Document Layout

This report is organised as follows: Chapter 1 presents the scope of biological and bacteriological baseline assessment; Chapter 2 describes the methodology used for bio-assessment; Chapter 3 presents the results of the investigations and laboratory analyses, as well as their interpretation. The general conclusions of this report are contained in Chapter 4.

2 Methodology

This report regarding the biological baseline conditions study of the surface water and bacteriological baseline conditions study of the surface and ground waters has a limited territorial scope, focusing only the areas along Roşia Stream and its surrounding. At the time the study was conducted, the Project area of interest was limited to the target area of the geological exploration drilling program performed by Roşia Montană Gold Corporation S.A. (RMGC).

This report is based onto the 1998 precursory study prepared by a team co-ordinated by Agraro, as part of the preliminary Baseline Condition Study for Roşia Montană area.

In view of the totally inappropriate domestic wastewater and solid waste management identified in the Roşia Montană area, the initiators of the Roşia Montană Project also took into account the biological and bacteriological baseline conditions of surface water and bacteriological baseline conditions of ground water of future potentially impacted areas. The existence of a potable water supply system with no wastewater collection system or treatment plant, has suggested a potential bacteria pollution of surface and ground water.

During the water sampling events for biological/bacteriological indicators, samples were collected to determine the specific physical-chemical and biological indicators of water types under scrutiny.

A subsequent ecological baseline survey was performed (2003) for aquatic environments in the Project area (included in **Roşia Montană Project Baseline Reports: Report 7**, *Ecological Baseline Report*), which includes sampling and assessment of biotic communities at five locations in the Roşia Stream.

2.1 Water Pollution Sources

Within the limited area targeted by this study, the existing water quality is affected by various point and diffused pollution sources, of which the most important are:

- Wastewater discharge into local waterways with high levels of specific mining-related pollutants from historical and existing mining operations in the region;
- Direct discharge of domestic wastewater from the apartment blocks located in the central part of Roşia Montană locality into the environment; and
- Infiltration of contaminants from multiple diffused sources, such as household latrines, uncontrolled deposits of domestic waste and manure into the soil and groundwater.

2.2 Monitoring Network Extension

The biological and bacteriological baseline assessment had been performed prior to the water sources inventory for the Project area, based on which, a surface and ground water monitoring program has been developed. Water sampling locations for the biological and bacteriological baseline conditions assessment are not included into the current water monitoring network.

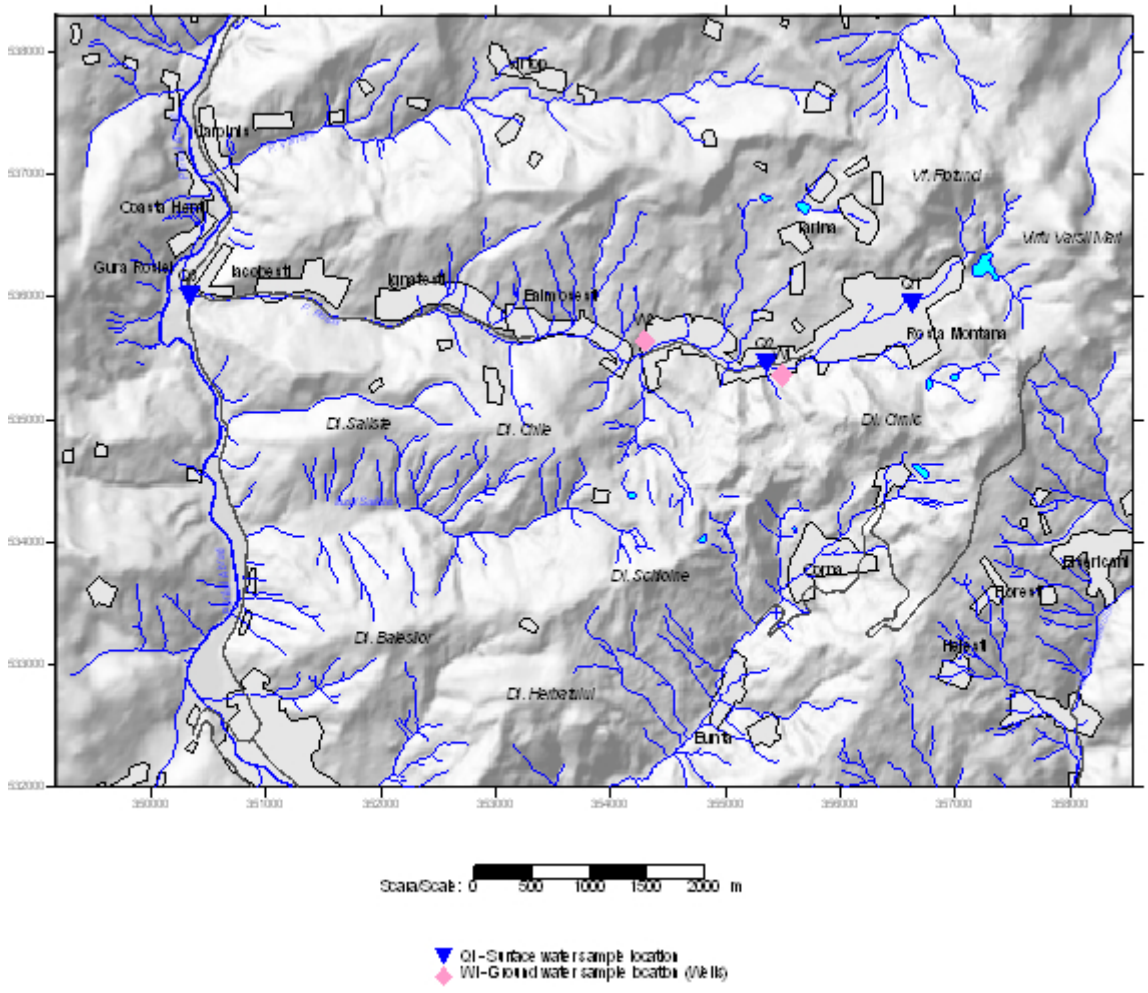
The location of the monitoring points for biological and bacteriological analysis of the aquatic environment took into account the lack of anthropogenic pollution sources upstream of Roşia Montană which are concentrated inside the locality or downstream of it, as well as the existing mining impacts on biologic conditions of surface water.

The location of surface water sampling locations may be described as follows:

- Roşia Stream – upstream of Roşia Montană locality, referred to as “Upstream” (Q1);
- Roşia Stream – inside the locality, upstream of the domestic wastewater discharge from the apartment blocks, referred to as “Centre” (Q2); and
- Roşia Stream – downstream of Roşia Montană locality and upstream of the confluence with Abrud River, referred to as “Downstream” (Q3).
- The ground water sampling locations are located as follows:
- Hand dug well located on the left bank of Roşia Valley, Raznei St no. 249 (W1);
- Hand dug well located on the right bank of Roşia Valley, Balmosesti St no. 116 (W2).

The location of the surface/ground water sampling locations are presented in the Figure 2-1.

Figure 2-1. Surface and Ground Water Sampling Locations



2.3 Monitoring Methodology

2.3.1 Monitoring Duration and Frequency

The biological and bacteriological monitoring of the surface and the bacteriological monitoring of the ground water has been carried out on a monthly basis, between March and May 1998.

2.3.2 Monitored Parameters

The water quality monitoring program of the Roşia Montană Project area includes a large number of physical-chemical parameters, in accordance with the applicable regulations regarding the surface water quality (STAS 4706-88 “Surface water” – Categories and technical quality conditions) and drinking water quality (Law no 311/2004 related to Quality of Drinking Water and Romanian standard STAS 1342-91 “Drinking Water” – both applicable for ground water quality).

For the surface water biological quality assessment, benthonic macroinvertebrates, phytoplankton and zooplankton were sampled for specific parameters, including identification (taxonomy), enumeration (count), and biomass. For both the surface water and ground water bacteriological quality assessments, the following parameters were studied: total number of bacteria developed at 37^{o} C (mesophillic bacteria) and the probable number of coliform bacteria (total coliforms).

2.3.3 Sampling and Laboratory Analyses

Sampling and laboratory analyses have been performed by the Hydrochemical Laboratory of the Targu Mures territorial branch of National Water Management Administration “Apele Romane”. The laboratory is certified by the Romanian Accreditation Association (RENAR) to perform such determinations.

2.3.4 Selected Indicators

The assessment process consisted of field data collection and specific sampling, as well as qualitative and quantitative laboratory analyses. The results have been processed in accordance with standard methodologies (the accredited laboratory in Targu Mures has to have procedures based on Romanian standards and regulations) and analytical methods fully complying with the legal requirements of the Romanian standards or regulations.

The laboratory is accredited for identification, counting and calculation of some indices only (total waster cleanness degree, water cleanness degree – macroinvertebrates, water cleanness degree – plankton, number of taxa, density). The calculation of Belgian Biotic Indices (BBI) and the assessment of biological data have been made by Agraro; BBI is not a Romanian standardised method but was considered appropriate by the expert.

The following biological parameters for surface water have been calculated:

- Bioindicators (“oligo”, “beta”, “alpha” and “poly”) – for both macroinvertebrates and plankton;
- Total water cleanness degree (C %) – for both macroinvertebrates and plankton;
- Water cleanness degree (C%) – macroinvertebrates;
- Water cleanness degree (C%) – plankton;
- Relative impurification (I%) – macroinvertebrates and plankton;

- Number of taxa – macroinvertebrates and plankton;
- Density – macroinvertebrates and plankton.

The following bacteriological parameters for surface and ground water have been analysed:

- Number of bacteria developed at 37 ^{o}C/ml; and
- Probable number of coliform bacteria - total coliforms/1000 ml for surface water and total coliforms/100 ml for ground water.

2.4 Criteria for Water Quality Assessment

The surface water biological quality assessment has been made using Knopp method. This method belongs to the saprobes system which is based on the observation that taxonomic composition and number of species differ in a range of self-purification after organic matter introduction. According to this system there are oligo-, beta-, alpha- and poli- saprobe organisms and each species has a saprobic value, which allows assessing the water quality.

The calculation of the cleanness or impurification degree is a step for the assessment of surface water quality. This is the level of knowledge by the time of the water quality assessment.

The applicable legislation (Romanian Standard STAS 4706-88) only provides limits for total coliform bacteria. Therefore, the evaluation of the surface water quality has been done on the basis of comparative analysis of results determined for different sampling locations along the stream, in addition to evaluating the total coliforms against the STAS 4706-88 limit of 100,000 total coliforms/1000 ml.

The criteria for the assessment of the bacteriological (microbiological) quality of the ground water are based on the maximal admissible limits provisioned by STAS 1342-91 ”Drinking Water”, as well as on the regulatory limits regarding the drinking water quality – Law of the Drinking Water no. 458/2002, modified and completed by Law no. 311/2004.

The water quality parameters for surface and ground water have been assessed with respect to the maximal admissible concentrations provisioned by the applicable legislation, at the time of writing this report:

- For surface water – STAS 4706-88;
- For ground water – Law of the Drinking Water no. 458/2002, modified and completed by Law no. 311/2004 and STAS 1342-91.

3 Investigation Results and Their Interpretation

3.1 Characterisation of Roşia Stream

3.1.1 Roşia Stream – Water Quality Characterisation

Water samples collected from the three sampling locations at Roşia Stream have been analysed for physical-chemical parameters, in order to correlate their degree of contamination with the biological and bacteriological quality.

The surface water results are given for each sampling location during each sampling event, as follows: Table 3-1 for the March 1998 sampling event, Table 3-2 for the April 1998 sampling event and **Table 3-3** for the May 1998 sampling event.

Table 3-1. Roşia Stream Surface Water Quality – March 1998

No	Quality parameter	M.U.	Upstream (Q1)		Centre (Q2)		Downstream (Q3)	
			Mean determined value	Quality category	Mean determined value	Quality category	Mean determined value	Quality category
1	pH	-	7.32	I	7.33	I	3.16	D
2	Dissolved oxygen	mg/L	10.9	I	10.2	I	10	I
3	BOD	mg/L	1.68	I	2.7	I	1.98	I
4	COD (Mn)	mg/L	1.54	I	15.1	III	6.31	I
5	COD (Cr)	mg/L	3.25	I	30.4	III	10.6	I
6	Total suspended solids	mg/L	6.8	-	441.4	-	167.4	-
7	Fixed residues (105^0C)	mg/L	102	I	342	I	970	II
8	Electric conductivity	µS/cm	144	-	472	-	1367	-
9	Na^+	mg/L	4.8	I	11.6	I	8.9	I
10	K^+	mg/L	0.9	-	5.9	-	5.9	-
11	Ca^{2+}	mg/L	20.04	I	64.13	I	129.3	I
12	Mg^{2+}	mg/L	4.86	I	13.38	I	65.1	II
13	Cl^-	mg/L	3.54	I	14.18	I	14.18	I
14	SO_4^{2-}	mg/L	9.3	I	187.3	I	681	III
15	Alk/HCO_3^-	ml HCl/mg/L	1.3/79.3	-	0.8/48.8	-	-	-
16	Acidity	ml NaOH	-	-	-	-	6.09	-
17	NH_4^+	mg/L	0.128	I	2.81	II	4.53	III
18	NO_2^-	mg/L	0.007	I	0.083	I	0.018	I
19	NO_3^-	mg/L	2.95	I	5.91	I	4.85	I
20	PO_4^{3-}	mg/L	0.137	-	0.049	-	0.051	-
21	Phenolic compounds	mg/L	0.003	II	0.009	II	0	I
22	CN^-	mg/L	0.0005	I	0.003	I	0.001	I
23	Detergents	mg/L	0	I	0	I	0	I
24	Fluorides	mg/L	0	I	0	I	0.049	I
25	Sulfides	mg/L	0.039	II	0.205	D	0.013	II
26	Total Fe	mg/L	0.202	-	5.06	-	82	-
27	Ionic Fe	mg/L	0.121	I	0.061	I	17.44	D
28	Mn tot/sol	mg/L	0.039/0.037	I	3.085/2.415	D	42.48/40.28	D

No	Quality parameter	M.U.	Upstream (Q1)		Centre (Q2)		Downstream (Q3)	
			Mean determined value	Quality category	Mean determined value	Quality category	Mean determined value	Quality category
29	Pb^{2+}	mg/L	<0.05	I	<0.05	I	<0.05	I
30	Cr tot	mg/L	0	I	0	I	0.006	I
31	Cu tot/sol	mg/L	0.059/0.012	I	0.327/0.015	I	0.391/0.046	I
32	Zn tot/sol	mg/L	0.099/0.066	D	0.314/0.086	D	5.32/2.90	D
33	Cd tot/sol	mg/L	-/<0.004	I	-/<0.004	I	0.028/0.022	D
34	Ni tot/sol	mg/L	0.065/0.06	I	0.07/0.013	I	0.154/0.147	D
35	Total hardness	^{o}G	5.49	-	12.04	-	33.04	-
36	Temporary hardness	^{o}G	3.64	-	2.24	-	-	-
37	Permanent hardness	^{o}G	1.85	-	9.8	-	-	-

M.U. – metric measure unit specific for each parameter

Tot/sol – total/soluble element

Table 3-2. Roşia Stream Surface Water Quality – April 1998

No	Quality parameter	M.U.	Upstream (Q1)		Centre (Q2)		Downstream (Q3)	
			Mean determined value	Quality category	Mean determined value	Quality category	Mean determined value	Quality category
1	pH	-	7.51	I	7.28	I	3.7	D
2	Dissolved oxygen	mg/L	7.31	I	8.45	I	8.84	I
3	BOD	mg/L	0.66	I	0.95	I	1.34	I
4	COD (Mn)	mg/L	2.01	I	2.65	I	3.25	I
5	COD (Cr)	mg/L	3.55	I	4.75	I	4.15	I
6	Total suspended solids	mg/L	16.4	-	37.2	-	93.8	-
7	Fixed residues (105^0C)	mg/L	138	I	191	I	520	I
8	Electric conductivity	µS/cm	160	-	270	-	730	-
9	Na^+	mg/L	5.44	I	6.41	I	6.61	I
10	K^+	mg/L	8.88	-	8.18	-	1.12	-
11	Ca^{2+}	mg/L	30.06	I	40.08	I	72.14	I
12	Mg^{2+}	mg/L	0.274	I	3.65	I	29.18	I
13	Cl^-	mg/L	5.32	I	5.32	I	8.86	I
14	SO_4^{2-}	mg/L	29.8	I	86.3	I	355	II
15	Alk/HCO_3^-	ml HCl/mg/L	0.9/54.9	-	0.65/39.7	-	0	-
16	Acidity	ml NaOH	-	-	-	-	2.75	-
17	NH_4^+	mg/L	0.229	I	1.19	II	5.34	III
18	NO_2^-	mg/L	0.054	I	0.053	I	0.032	I
19	NO_3^-	mg/L	15.59	II	10.24	II	9.29	I
20	PO_4^{3-}	mg/L	0.029	-	0.027	-	0.012	-
21	Phenolic compounds	mg/L	0.002	II	0.007	II	0.004	II
22	CN^-	mg/L	0	I	0	I	0	I
23	Detergents	mg/L	0	I	0	I	0	I
24	Fluorides	mg/L	0	I	0.089	I	0.135	I
25	Sulfides	mg/L	0.013	II	0.017	II	0.027	II
26	Total Fe	mg/L	0.21	-	2.24	-	35.97	-
27	Ionic Fe	mg/L	0.033	I	0.114	I	15.5	D
28	Mn tot/sol	mg/L	0.037/0.005	I	1.023/0.988	D	15.44/15.28	D
29	Pb tot/sol	mg/L	0.046/0.008	I	<0.05	I	0.031/0.014	I
30	Cr tot	mg/L	0	I	0	I	0	I
31	Cu tot/sol	mg/L	0.036/0.002	I	0.119/0.009	I	0.227/0.222	D
32	Zn tot/sol	mg/L	0.027/0.012	I	0.121/0.056	D	2.88/2.85	D
33	Cd tot/sol	mg/L	-/<0.004	I	-/<0.004	I	0.016/0.016	D
34	Ni tot/sol	mg/L	0.054/0.051	I	0.048/0.021	I	0.123/0.117	D
35	Total hardness	^{o}G	4.62	-	6.44	-	16.8	-
36	Temporary hardness	^{o}G	2.52	-	1.82	-	0	-
37	Permanent hardness	^{o}G	2.1	-	4.62	-	16.8	-

M.U. – metric measure unit specific for each parameter

Tot/sol – total/soluble element

Table 3-3. Roşia Stream Surface Water Quality – May 1998

No	Quality parameter	M.U.	Upstream (Q1)		Centre (Q2)		Downstream (Q3)	
			Mean determined value	Quality category	Mean determined value	Quality category	Mean determined value	Quality category
1	pH	-	7.32	I	7.23	I	3.93	D
2	Dissolved oxygen	mg/L	8.73	I	8.80	I	8.58	I
3	BOD	mg/L	1.40	I	3.56	I	1.38	I
4	COD (Mn)	mg/L	2.04	I	4.10	I	4.27	I
5	COD (Cr)	mg/L	2.9	I	5.0	I	4.9	I
6	Total suspended solids	mg/L	20.4	-	44.6	-	126	-
7	Fixed residues (105^0C)	mg/L	140	I	268	I	495	I
8	Electric conductivity	µS/cm	196	-	334	-	687	-
9	Na^+	mg/L	5.1	I	7.0	I	6.2	I
10	K^+	mg/L	0.83	-	3.9	-	4.4	-
11	Ca^{2+}	mg/L	28.3	I	46.5	I	67.73	I
12	Mg^{2+}	mg/L	3.8	I	6.8	I	27.72	I
13	Cl^-	mg/L	7.09	I	8.86	I	8.86	I
14	SO_4^{2-}	mg/L	28.5	I	124	I	352	II
15	Alk/HCO_3^-	ml HCl/mg/L	0.98/60	-	0.84/51.24	-	-	-
16	Acidity	ml NaOH	-	-	-	-	3.29	
17	NH_4^+	mg/L	0.219	I	1.32	II	0.858	I
18	NO_2^-	mg/L	0.042	I	0.088	I	0.036	I
19	NO_3^-	mg/L	13.71	II	10.98	II	4.93	I
20	PO_4^{3-}	mg/L	0.063	-	0.071	-	0.047	-
21	Phenolic compounds	mg/L	0.001	I	0.001	I	0.003	II
22	CN^-	mg/L	0	I	0	I	0	I
23	Detergents	mg/L	0	I	0	I	0	I
24	Fluorides	mg/L	0	I	0	I	0	I
25	Sulfides	mg/L	0.0208	III	0.0112	III	0.0342	III
26	Total Fe	mg/L	2.7	-	20.91	-	34.0	-
27	Ionic Fe	mg/L	0.14	D	2.88	D	27.65	D
28	Mn tot/sol	mg/L	1.113/0.12	II	9.219/9.076	D	13.44/13.31	D
29	Pb^{2+}	mg/L	0	I	0	I	0	I
30	Cr tot	mg/L	0	I	0	I	0	I
31	Cu tot/sol	mg/L	0.152/0.016	I	0.221/0.189	D	0.248/0.170	D
32	Zn tot/sol	mg/L	0.167/0.031	D	2.055/2.041	D	2.9/2.7	D
33	Cd tot/sol	mg/L	0	I	0.009/0.008	D	0.011/0.009	D
34	Ni tot/sol	mg/L	0.021/0.012	I	0.018/0.009	I	0.110/0.098	I
35	Total hardness	^{o}G	4.82	-	8.06	-	15.85	-
36	Temporary hardness	^{o}G	2.74	-	2.35	-	-	-
37	Permanent hardness	^{o}G	2.08	-	5.71	-	15.85	-

M.U. – metric measure unit specific for each parameter

Tot/sol – total/soluble element

3.1.2 Roşia Stream - Biological Characterisation

Benthonic macroinvertebrates in running waters are representative communities for biological water quality assessment. Data provided by these organisms are completed by the data regarding plankton organisms: phytoplankton and zooplankton.

The tables below present the bioassessment results for each surface water sampling location during each sampling event. The results are presented by sampling location, as follows: Table 3-4 for sampling location Q1, Table 3-5 for sampling location Q2 and Table 3-6 for sampling location Q3.

Table 3-4. Water Quality Bioassessment for Roşia Stream – Upstream Of Roşia Montană Locality

Upstream (Q1)		
March 1998		
General description: Regardless of season, the headspring area conditions (gravel and pebble bed, clear, well oxygenated, colourless, odourless and fast flowing water, with low concentrations of organic matter and nutrients) are in favor of a rich bio-diversity, for both benthonic and planktonic populations.		
Benthos	**Phytoplankton**	**Zooplankton**
Density: 4420 organisms; Biomass: 17,788 g/m^2; Identified Groups: *Turbellaria*, *Crustacea* and *Insecta* (*Ephemeroptera*, *Trichoptera*, *Diptera*); Dominant organisms: insect larvae (72%); *Chironomus sp.* prevailed; Water cleanness degree (C%): 81%, beta-mesosaprobic zone, with low to moderate load of biodegradable organic matter; Belgian biotic indices (BBI): 7, water with low pollution.	Density: 539 organism/l; Identified Groups: *Cyanophyta*, *Bacillariophyta*, *Euglenophyta*, *Chlorophyta*;15 phytoplanktonic taxa; Dominant organisms: Diatoms (99%); Representative species: *Navicula radiosa*, *Diatoma hiemale*, *Navicula rhynchocephala*, *Nitzschia linearis*; Water cleanness degree (C%): 86%; relative impurification degree (I%): 14%; beta-mesosaprobic zone.	Density: 5 organisms/l; Identified Groups: *Rhizopoda* and *Rotatoria*; Dominant organisms: *Rhizopoda* group; Water cleanness degree (C%): 87.5%; beta-mesosaprobic zone.
Summary: By taking into account all values of bioindicator species which are present in benthic and planktonic communities, a water cleanness degree of 84% (impurification degree I=16%) was obtained, with prevailing beta and oligo bioindicators. The results point to a relatively high degree of biodiversity with in the sampling location, represented by several groups of organisms in different trophic levels, which use at their most the available resources.		

Table 3-4. Water Quality Bioassessment for Roşia Stream – Upstream Of Roşia Montană Locality (Continued)

Upstream (Q1)		
April 1998		
General description: Sampling was done in the same sampling location and under similar conditions (narrow banks, trees, pebble substrate, water temperature 10^{o} C, clear sky). Water was clear, colourless and odourless. Physical chemical characteristics of the samples classified the water in the first quality category. Water was well oxygenated (7.31 mg O_2/l), with low organic load (BOD - 0.66 mg O_2/l; COD (Mn) - 2.014 mg O_2/l; COD (Cr) - 3.55 mg O_2/l) and low nutrients load (0.229 mg NH_4^+/l; 0.054 mg NO_2^-/l). Recorded nitrate values were in excess of limits for the first quality category: 15.59 mg NO_3^-/l. Also cadmium (Cd^{2+}) exceeded the limit allowed by STAS 4706-88.		
Benthos	**Phytoplankton**	**Zooplankton**
Density: 2480 organisms/; Biomass: 16,226 g/m^2; Identified Groups: *Turbellaria*, *Oligochaeta*, *Crustacea*, *Ephemeroptera*, *Plecoptera*, *Trichoptera*, *Coleoptera*, *Diptera*; 14 taxa; Dominant organismS: *Ephemeroptera*, *Diptera*, *Coleoptera* and *Crustacea*; Water cleanness degree (C%): 85%, beta-mesosaprobic zone, with low to moderate load of biodegradable organic matter; Belgian biotic indices: 8, water with low pollution.	Density: 531 organisms/l; Identified Groups: *Cyanophyta*, *Bacillariophyta*, *Chrysophyta*, *Euglenophyta* and *Chlorophyta*; 19 taxa; Dominant organisms: Diatoms; Representative species: *Navicula radiosa*, *Dinobrzon sertularia, Trachelomonas sp.*; Water cleanness degree (C%): 86%; beta-mesosaprobic zone.	Density: 7 organisms/l; Identifies groups: *Rhizopoda*, *Rotatoria* and *Copepoda*; Water cleanness degree (C%): 83%, beta-mesosaprobic zone.
Summary: By taking into account all values of bioindicator species which are present in benthic and planktonic communities, a relative water cleanness degree (C%) of 85% (impurification degree I=15%) was obtained. Beta and oligo bioindicators represented 52% and 33%, respectively.		

Table 3-4. Water Quality Bioassessment for Roşia Stream – Upstream Of Roşia Montană Locality (Continued)

Upstream (Q1)		
May 1998		
General description: The sampling event in the head-waters area revealed well oxygenated water, low in organic matter nitrates, iron and other metals.		
Benthos	**Phytoplankton**	**Zooplankton**
Density: 2260 organisms/l; Biomass: 18.29 g/m^2; Identified Groups: *Turbellaria*, *Crustacea*, *Ephemeroptera*, *Trichoptera*, *Diptera*, *Hydracarina*; 9 taxa; Dominant organisms: *Baetis vernus*, *Chironomus sp.*, *Heptagenia sulfurea*; Water cleanness degree (C%): 91%, beta-mesosaprobic zone, with low to moderate load of biodegradable organic matter. Belgium biotic indices (BBI): 8, water with low pollution..	Density: 581 organisms/l; Identified Groups: *Bacillariophyta*, *Chlorophyta* and *Chrysophyta*; 16 taxa; Dominant organisms: Diatoms (97%); Representative species: *Cyclotella sp., Synedra acus, Gomphonema olivaceum*. Water cleanness degree (C%): 91%; beta-mesosaprobic zone.	Density: 18 organisms/l; Identified Groups: *Rhizopoda*, *Cladocera, Rotatoria* and *Copepoda*; 10 taxa; Dominant organisms: *Rotatoria* and *Copepoda*: Representative species: *Keratella quadrata*, *Eucyclops serrulatus*; Water cleanness degree (C%): 90%; beta-mesosaprobic zone.
Summary: Based on both macroinvertebrates and planktonic communities, the head-waters area was characterised by a relative water cleanness degree (C%) of 91% and impurification degree (I%) of 9%, pointing to a beta-mesosaprobic zone with low to moderate biodegradable organic load of water and a low water pollution. Beta and oligo bioindicators were best represented (66% and 24%), while alpha and poly bioindicators were low (5% for both cases).		

Table 3-5. Water Quality Bioassessment for Roşia Stream – Centre of Roşia Montană Locality

Centre (Q2)		
March 1998		
General Description: In this section, the Roşia Stream has a high velocity flow; it is 1-1.5 m in width, has low banks, and a pebble floor with mud deposits. The water had no particular colour or odour. Physical-chemical parameters pointed to a degradation of water quality compared to the upstream sampling location; however, most parameters were still within the limits of the first water quality category, according to STAS 4706-88. Some parameters, such as organic matter, ammonia, phosphorus (phosphates), phenols, iron, manganese, lead, zinc, cadmium, were in excess these limits, but within the second or third water quality category. Due to sampling conditions, only plankton organisms were used for biological characterisation.		
Benthos	**Phytoplankton**	**Zooplankton**
No samples collected.	Density: 8 organisms/l; Identified Groups: *Cyanophyta*, *Bacillariophyta*, *Chlorophyta*. Dominant organisms: Diatoms; Water cleanness degree (C%): 83%; beta-mesosaprobic zone.	Density: 4 organisms/l; Identified Groups: *Rhizopoda* and *Copepoda*; Water cleanness degree (C%): 75%; beta-mesosaprobic zone.
Summary: Based communities of the two biotic communities (phytoplankton and zooplankton), an average value of relative water cleanness degree of 80% was obtained. Beta-bioindicators amounted 70%, alpha-indicators 15% and oligo indicators 10%.		

Table 3-5. Water Quality Bioassessment for Roşia Stream – Centre of Roşia Montană Locality (Continued)

Centre (Q2)		
April 1998		
General description: The physical-chemical characteristics of water were roughly similar to the ones recorded during the previous sampling event, but with small differences: the organic matter content decreased to the limits of first water quality category, nitrates reached the values of second quality category (10.24 mg NO_3-/l), whereas contamination with heavy metals was maintained.		
Benthos	**Phytoplankton**	**Zooplankton**
Density: 880 organisms; Biomass: 0.384 g/m^2; Identified Groups: *Oligochaeta*, *Ephemeroptera*, *Coleoptera* and *Diptera*; 4 taxa; Water cleanness degree (C%): 25%, alpha-mesosaprobic zone with high organic load of biodegradable organic matter; Belgian biotic index (BBI): 4, polluted water.	Density: 48 organisms/m^2; Identified Groups: *Bacteriophyta*, *Mycophyta*, *Cyanophyta*, *Chrysophyta*, *Bacillariophyta* and *Chlorophyta*; 13 taxa; Dominant organisms: Diatoms (52%); Water cleanness degree (C%): 81%; beta-mesosaprobic zone.	Identified Grpups: *Rhizopoda* and *Copepoda*,; 3 taxa. Water cleanness degree (C%): 67%; beta-mesosaprobic zone. .
Summary: The total water cleanness degree calculated by accumulating the values of all identified forms was 64%, characteristic for the beta-meso-alpha-mesosaprobic zone, indicating a moderate to high biodegradable organic load. Benthos and plankton in the sampling location had 46% beta indicators, 23% poly indicators, 18% oligo indicators and 13% alpha indicators.		

Table 3-5. Water Quality Bioassessment for Roşia Stream – Center Roşia Montană Locality (Continued)

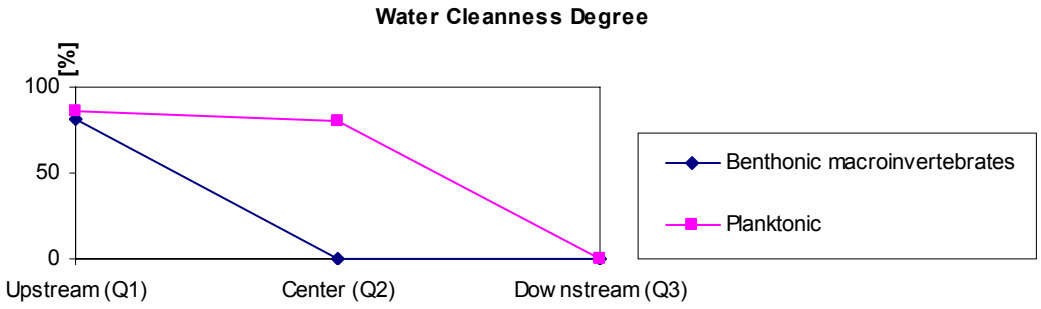
Centre (Q2)		
May 1998		
General description: Water was well oxygenated (8.8 mg O2/l), with low organic load (COD (Mn) - 4.1 mg O_2/l), but with a higher content of nitrates, ammonia, phosphorus and metals (Fe, Mn, Cu, Zn). For all these parameters there were exceeding from the limits of second and third quality categories.		
Benthos	**Phytoplankton**	**Zooplankton**
Density: 1840 organisms; Identified Groups: *Oligochaeta*, *Turbellaria*, *Collembola*, *Ephemeroptera*, *Trichoptera* and *Diptera*; 6 taxa; Dominnat organisms: *Oligochaeta* (*Tubifex sp*.) and *Diptera* (*Chironomus sp*.); Water cleanness degree (C%): 58%, beta-meso-alpha-mesosaprobic zone, with a moderate to high biodegradable organic matter load. The Belgian biotic index (BBI): 6, moderately polluted water.	Density: 110 organisms/l; Identified Groups: *Bacteriophyta*, *Mycophyta*, *Cyanophyta*, *Chrysophyta*. Dominant organisms: Diatoms (93%); Representative species: *Oscillatoria brevis*, *Synedra acus*, *Cyclotella sp*., *Dinobryon sertularia*, *Nitzschia linearis*. Water cleanness degree (C%): 83%: beta-mesosaprobic zone.	Density: 14 organisms/l; Identified Groups: *Rhizopoda* and *Rotatoria*; 8 taxa; Water cleanness degree (C%): 87%; beta-mesosaprobic zone.
Summary: Cumulating the values of all identified taxa in the three biotic communities, an average value of water cleanness degree of 75% was obtained. The rest to 100% is the impurification degree. Both values are specific to beta-mesosaprobic water, which is moderately loaded with biodegradable organic matter. Beta bioindicators prevailed (56%).		

Table 3-6. Water Quality Bioassessment for Roşia Stream – Downstream of Roşia Montană Locality

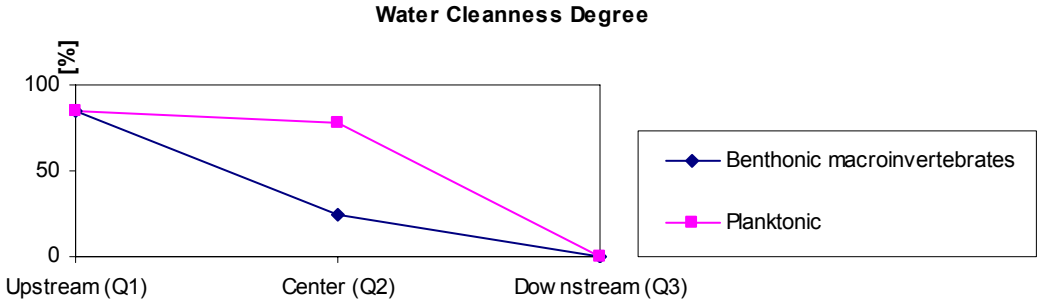
Downstream (Q3)
At this sampling location, the river banks are low, regularised, river bed is rocky, with high-velocity water flow. Due to the natural and anthropogenic impact, the water is yellow-reddish and contains large quantities of mineral suspensions. Mineral depositions on the river floor sublayer were present, too. The biotope conditions preclude the development of either benthonic or planktonic communities.
March 1998
Only 5 planktonic organisms have been found. No sampling has been made for benthos. Physical-chemical parameters point to acidic water with low organic load (COD (Cr) - 10.6 mg O_2/l), sulfates and ammonia concentrations above the limits of the third quality category, high total iron concentration (82 mg/l), and manganese, lead, zinc, cadmium, nickel concentrations characteristic to degraded water. These factors hindered the development of biotic communities in the area.
April 1998
The same situation was identified as in the preceding month. The identified organisms were: few *Oligochaeta* forms (benthonic macroinvertebrates), 5 phytoplanktonic organisms/l and one zooplanktonic organism/l. The reason behind this deficit is the anthropogenic impact. Water pH was acid, total iron concentration reached 35.97 mg/l and precipitated on the river floor. Ammonia concentration was above the limit for third quality category. Other metals (manganese, copper, zinc and nickel) were also present in considerable concentrations characteristic to degraded water.
May 1998
The water quality also indicated an acidic water, with metal concentrations of manganese, copper, zinc and nickel characteristic to degraded water. As with the previous sampling events, benthos was scarcely represented. Eight planktonic taxa were identified, with a density of 13.992 organisms/l. The highest development was observed for a diatom algae: *Synedra acus*. The water cleanness degree calculated on the basis of planktonic forms was 77%, which is characteristic for beta-mesosaprobic quality. The Planktonic biocenosis is of allochthonous origin.

Thus, the Roşia Stream which is a tributary of the Abrud River within the hydrographic subsystem Arieş, is influenced by natural and anthropogenic impacts in the catchment area. The least influence was observed in the head-waters section, where the biocommunities were very well represented during all sampling events. The bioindicator organisms identified belonged to oligosaprobic and beta-mesosaprobic zones of quality. Water cleanness degree reached the highest values and was specific to the beta-mesosaprobic zone, with low water pollution (Figure 3-1).

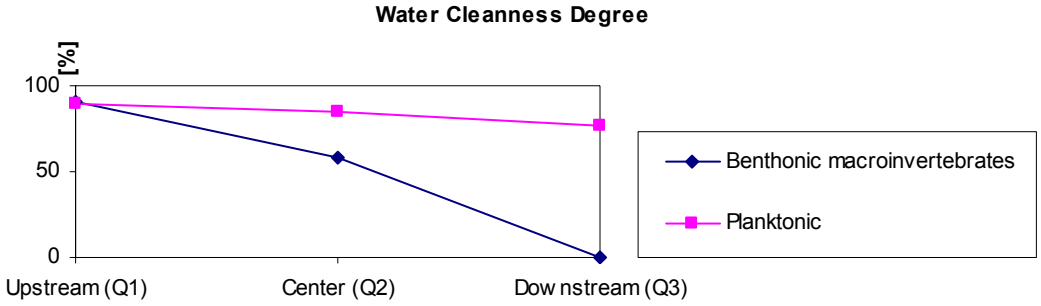
Figure 3-1. Water Cleanness Degree Based on Benthonic and Planktonic Communities



March 1998



April 1998



May 1998

Downstream of Roşia Montană, the water quality decreases, with planktonic and especially benthonic biocommunities being affected. Compared to the upstream sampling location, the numbers of the oligo-bioindicators - which point to a better water quality - are decreasing against increasing alpha and beta bioindicators. The number of taxa in the biotic communities is decreasing, as well as the numeric density of organisms, as shown in Table 3-7.

Table 3-7. Roşia Stream - Variation of Biological Indicators (1998)

Biological Indicators	M.U.	Sampling Location								
		Upstream			Centre			Downstream		
		March	April	May	March	April	May	March	April	May
Oligo bioindicators	%	41	33	24	10	18	19	0	0	9
Beta bioindicators	%	43	52	66	70	46	56	0	0	68
Alpha bioindicators	%	6	7	5	15	13	8	0	0	18
Poly bioindicators	%	10	8	5	5	23	17	0	0	5
Water cleanness degree (C)	%	84	85	91	80	64	75	0	0	77
Water cleanness degree (Macroinvertebrates)	%	81	85	91	0	25	58	0	0	0
Water cleanness degree (Plankton)	%	86	85	90	80	78	85	0	0	77
Impurification degree (I)	%	16	15	9	20	36	25	0	0	23
Macroinvertebrates taxa	no.	6	14	9	0	4	6	0	1	1
Phytoplankton taxa	no.	15	19	16	6	13	15	2	4	5
Zooplankton taxa	no.	5	6	10	4	3	8	1	1	3
Macroinvertebrates numeric density	no./m^2	4420	2480	2260	0	880	1840	0	60	40
Phytoplankton numeric density	no./l	539	531	581	8	48	110	4	5	13988
Zooplankton numeric density	no./l	5	7	18	4	4	14	1	1	4

Based on the biological determinations, the Roşia Stream sector located upstream of the confluence with Abrud River, is affected by anthropogenic impacts which led to a drastic reduction or even disappearance of the biological communities, and to a major disturbance of the aquatic ecosystem balance (*e.g.* development of *Synedra acus* as recorded in May 1998). Sometimes, due to the scarce presence of benthonic and planktonic organisms, the water cleanness degree (C%) and Belgian biotic index (BBI) could not be calculated.

The depreciation of the water quality from upstream toward downstream is illustrated by the reduced number of macroinvertebrates (benthonic), phytoplankton and zooplankton taxa. For instance, during all three sampling events: 26-39 taxa were identified in the upstream sampling location (Q1); inside the centre sampling location (Q2): 10-29 taxa, and, in the downstream sampling location (Q3): 3-9 taxa. The species deficit is due to human impact. The deficit was calculated using the Kothe method, by comparing the number of taxa in the upstream sampling location (Q1) and in the downstream sampling location (Q3) located at confluence with of Roşia Stream with the Abrud River. Thus, the species deficit was 88% in March 1998, 84.6% in April 1998 and 74.2% in May 1998. The more this value tends to reach 100%, the bigger the disturbing effects upon the organisms.

3.1.3 Roşia Stream - Bacteriological Characterisation

Bacteriological analyses of Roşia Stream focused on the contamination level caused by microflora of exogenous, anthropogenic origin. Two bacteriological parameters were determined: total number of bacteria developed at 37^o C (total germs) and probable number of coliform bacteria (total coliforms).

The sampling locations were the same as for the previous biological determinations.

The tables below present the bacteriological results for each surface water sampling location during each sampling event. The results are presented by sampling location, as follows:

Table 3-8 for sampling location Q1, Table 3-9 for sampling location Q2, and Table 3-10 for sampling location Q3.

Table 3-8. Bacteriological Results – March 1998

Bacteriological Parameter	Upstream (Q1)	Centre (Q2)	Downstream (Q3)
Number of bacteria developed at 37° C (total number of germs)/ml	10	207	0
Number of coliform bacteria (total coliforms)/1000 ml	450	17,000	<2,000

Table 3-9. Bacteriological Results – April 1998

Bacteriological Parameter	Upstream (Q1)	Centre (Q2)	Downstream (Q3)
Number of bacteria developed at 37° C (total number of germs)/ml	10	25	30
Number of coliform bacteria (total coliforms)/1000 ml	<2,000	49,000	2,000

Table 3-10. Bacteriological Results – May 1998

Bacteriological Parameter	Upstream (Q1)	Centre (Q2)	Downstream (Q3)
Number of bacteria developed at 37° C (total number of germs)/ml	11	280	10
Number of coliform bacteria (total coliforms)/1000 ml	7,000	140,000	2,000

The maximal allowed limit for the total number of the coliform bacteria/1000 ml, provisioned by STAS 4706-88, is 100,000. This limit is exceeded only by the sample collected in May from the centre of Roşia Montană locality, where the bacteriological contamination is maximal.

The Roşia Stream sector located inside the village is affected by bacterial contamination, especially coliform bacteria of anthropogenic origin. The heavy metal content and low pH hinder the development of bacterial flora in the river section located upstream of the confluence with Abrud River (Q3). Bacterial load in the stream sections located upstream of Roşia Montană (Q1) and inside the village (Q2), has increased from March to May.

3.2 Ground Water Characterisation

3.2.1 Ground Water Quality

The ground water samples collected from two private wells located within the area of influence of Roşia Stream were analysed for physical-chemical parameters in order to correlate their contamination with their bacteriological quality.

The laboratory results are presented below, for each sampling event and each sampling location as follows: Table 3-11 for the March 1998 sampling event, Table 3-12 for the April 1998 sampling event, and Table 3-13 for the May 1998 sampling event.

Table 3-11. Ground Water Quality – March 1998

No	Physical - chemical parameter	M.U.	Determined values		Allowed limits Law 311/2004	Allowed limits STAS 1342-91
			W1	W2		
1	pH	-	7.13	7.26	6.5 – 9.5	6.5 - 7.4
2	Dissolved oxygen	mg/L	8.86	7.26	-	min. 6
3	BOD	mg/L	1.3	0.84	-	-
4	COD (Mn)	mg/L	1.06	1.93	-	max. 2.5
5	COD (Cr)	mg/L	2.15	**4**	-	max. 3
6	Total suspended solids	mg/L	3.4	6.4	-	-
7	Fixed residues (105^0 C)	mg/L	**878**	264	-	max. 800
8	Electric conductivity	µS/cm	1067	361	max. 2500	max. 3000
9	Na^+	mg/L	2.6	15.8	max. 200	-
10	K^+	mg/L	2	4	-	-
11	Ca^{2+}	mg/L	**220.4**	52.1	-	max. 100
12	Mg^{2+}	mg/L	21.89	7.29	-	max. 50
13	Cl^-	mg/L	7.1	17.72	max. 250	max. 250
14	SO_4^{2-}	mg/L	***545***	49	max. 250	max. 200
15	Alc/HCO_3^-	ml HCl/mg/L	1.3/79.3	2.3/140	-	-
16	NH_4^+	mg/L	**0.2**	***0.638***	max. 0,50	0
17	NO_2^-	mg/L	**0.001**	**0.027**	max. 0.50	0
18	NO_3^-	mg/L	7.78	16.74	max. 50	max. 45
19	PO_4^{3-}	mg/L	0.035	**0.192**	-	max. 0.1
20	Sulfides	mg/L	**0.008**	**0.02**	max. 0.1	0
21	Total Fe	mg/L	**0.102**	**0.224**	max. 0.250	max. 0.1
22	Ionic Fe	mg/L	0.012	0.038	-	-
23	Mn^{2+}	mg/L	0.026	***1.97***	max. 0.50	max. 0.05
24	Pb^{2+}	mg/L	<0.05	<0.05	max. 0.01	max. 0.05
25	Cr tot	mg/L	0	0	max. 0.05	max. 0.05
26	Cu tot/sol	mg/L	0.048/0.019	0.051/0.013	max. 0.1	max. 0.05
27	Zn tot/sol	mg/L	0.032/0.031	0.04/0.038	max. 5	max. 5
28	Cd^{2+}	mg/L	<0.004	<0.004	max. 005	max. 0.005
29	Ni^{2+}	mg/L	0.002	0.002	max. 0.02	max. 0.1
30	Total hardness	^oG	**35.84**	8.96	min. 5	max. 20
31	Temporary hardness	^oG	3.64	6.44	-	-
32	Permanent hardness	^oG	32.2	2.52	-	-

M.U. – metric measure unit specific for each parameter

Tot/sol – total/soluble element

Note: in text bold means exceeds Law 311/2004, bold and underline exceeds STAS 1342-91 limits, and bold & underline & italics exceeds both limits.

Table 3-12. Ground Water Quality – April 1998

No	Physical & chemical parameter	M.U.	Determined values		Allowed limits Law 311/2004	Allowed limits STAS 1342-91
			W1	W2		
1	pH	-	7.28	**7.77**	6.5 – 9.5	6.5 - 7.4
2	Dissolved oxygen	mg/L	7.04	**4.09**	-	min. 6
3	BOD	mg/L	0.31	0.26	-	-
4	COD (Mn)	mg/L	1.41	**3.08**	-	max. 2.5
5	COD (Cr)	mg/L	2.7	**4.65**	-	max. 3
6	Total suspended solids	mg/L	11.6	9.8	-	-
7	Fixed residues (105^0 C)	mg/L	784	266	-	max. 800
8	Electric conductivity	µS/cm	500	374	max. 2500	max. 3000
9	Na^+	mg/L	2.61	17.7	max. 200	-
10	K^+	mg/L	2.1	8.88	-	-
11	Ca^{2+}	mg/L	**180.9**	52.1	-	max. 100
12	Mg^{2+}	mg/L	39.4	6.08	-	max. 50
13	Cl^-	mg/L	3.5	19.5	max. 250	max. 250
14	SO_4^{2-}	mg/L	***484***	32.9	max. 250	max. 200
15	Alc/HCO_3^-	ml HCl/mg/L	1.0/61	2.4/146.4	-	-
16	NH_4^+	mg/L	**0.152**	***0.251***	max. 0,50	0
17	NO_2^-	mg/L	**0.003**	**0.031**	max. 0.50	0
18	NO_3^-	mg/L	18.13	21.3	max. 50	max. 45
19	PO_4^{3-}	mg/L	0.034	**0.206**	-	max. 0.1
20	Sulfides	mg/L	**0.003**	**0.009**	max. 0.1	0
21	Total Fe	mg/L	**0.124**	**0.348**	max. 0.250	max. 0.1
22	Ionic Fe	mg/L	0.072	0.054	-	-
23	Mn^{2+}	mg/L	0.005	0.006	max. 0.50	max. 0.05
24	Pb^{2+}	mg/L	<0.05	<0.05	max. 0.01	max. 0.05
25	Cr tot	mg/L	0	0	max. 0.05	max. 0.05
26	Cu tot/sol	mg/L	0.046/0.003	0.058/0.007	max. 0.1	max. 0.05
27	Zn tot/sol	mg/L	0.029/0.004	0.029/0.027	max. 5	max. 5
28	Cd^{2+}	mg/L	<0.004	<0.004	max. 005	max. 0.005
29	Ni^{2+}	mg/L	0.003	0.002	max. 0.02	max. 0.1
30	Total hardness	^oG	**31.64**	8.68	min. 5	max. 20
31	Temporary hardness	^oG	2.8	6.72	-	-
32	Permanent hardness	^oG	28.84	1.96	-	-

M.U. – metric measure unit specific for each parameter

Tot/sol – total/soluble element

Note: in text bold means exceeds Law 311/2004, bold and underline exceeds STAS 1342-91 limits, and bold & underline & italics exceeds both limits.

Table 3-13. Ground Water Quality – May 1998

No	Physical - chemical parameter	M.U.	Determined values		Allowed limits Law 311/2004	Allowed limits STAS 1342-91
			W1	W2		
1	pH	-	7.46	**7.65**	6.5 – 9.5	6.5 - 7.4
2	Dissolved oxygen	mg/L	8.18	6.02	-	min. 6
3	BOD	mg/L	1.38	0.75	-	-
4	COD (Mn)	mg/L	1.0	1.75	-	max. 2.5
5	COD (Cr)	mg/L	2.0	2.2	-	max. 3
6	Total suspended solids	mg/L	12.0	5.8	-	-
7	Fixed residues (105^0 C)	mg/L	**810**	266	-	max. 800
8	Electric conductivity	µS/cm	980	333	max. 2500	max. 3000
9	Na^+	mg/L	2.3	12.6	max. 200	-
10	K^+	mg/L	2.0	3.4	-	-
11	Ca^{2+}	mg/L	**212.4**	50.5	-	max. 100
12	Mg^{2+}	mg/L	16.05	3.89	-	max. 50
13	Cl^-	mg/L	3.54	14.18	max. 250	max. 250
14	SO_4^{2-}	mg/L	***510***	23.6	max. 250	max. 200
15	Alc/HCO_3^-	ml HCl/mg/L	1.18/72	2.37/145	-	-
16	NH_4^+	mg/L	**0.031**	***0.154***	max. 0,50	0
17	NO_2^-	mg/L	**0.003**	**0.010**	max. 0.50	0
18	NO_3^-	mg/L	10.12	13.47	max. 50	max. 45
19	PO_4^{3-}	mg/L	0.045	**0.217**	-	max. 0.1
20	Sulfides	mg/L	0	**0.0118**	max. 0.1	0
21	Total Fe	mg/L	**0.164**	**0.121**	max. 0.250	max. 0.1
22	Ionic Fe	mg/L	0.052	0.048	-	-
23	Mn^{2+}	mg/L	0.012	0.0251	max. 0.50	max. 0.05
24	Pb^{2+}	mg/L	0	0	max. 0.01	max. 0.05
25	Cr tot	mg/L	0	0	max. 0.05	max. 0.05
26	Cu tot/sol	mg/L	0.037/0.021	0.049/0.041	max. 0.1	max. 0.05
27	Zn tot/sol	mg/L	0.098/0.069	0.061/0.052	max. 5	max. 5
28	Cd^{2+}	mg/L	0	0	max. 005	max. 0.005
29	Ni^{2+}	mg/L	0	0	max. 0.02	max. 0.1
30	Total hardness	^{o}G	**31.64**	7.95	min. 5	max. 20
31	Temporary hardness	^{o}G	2.8	6.63	-	-
32	Permanent hardness	^{o}G	28.84	1.32	-	-

M.U. – metric measure unit specific for each parameter

Tot/sol – total/soluble element

Note: in text bold means exceeds Law 311/2004, bold and underline exceeds STAS 1342-91 limits, and bold & underline & italics exceeds both limits.

3.2.2 Bacteriological Characterisation of Groundwater

The Roşia Montană potable water supply network develops to approximately 35 km length. For this reason, only a small number of wells are still used in the village. Well water is not used for drinking, but for other household necessities. Ground water samples have been collected from two wells located in Roşia Montană, on Raznei and Balsmosesti streets.

Bacteriological analyses of water samples collected from the private wells focused on the level of contamination with bacterian microflora of exogenous, anthropogenic origin. Two bacteriological parameters were determined: total number of bacteria developed at 37^{o} C (total germs) and probable number of coliform bacteria (total coliforms).

The laboratory results are given in the tables below, for each sampling event and for each sampling location as follows: Table 3-14 for Raznei Street sampling location (W1) and Table 3-15 for Balmosesti Street (W2).

Table 3-14. Bacteriological Results for the Ground Water on Raznei St. (W1)

Bacteriological Parameter	March 1998	April 1998	May 1998	Allowed Limits Law 311/2004	Allowed Limits STAS 1342-91
Number of bacteria developing at 37^{0} C (total number of germs)ml	**90**	6	5	below 20	below 300
Number of coliform bacteria (total coliforms)/100 ml	**<2**	**5**	**5**	0	below 10

Note: in text bold means exceeds Law 311/2004, bold and underline exceeds STAS 1342-91 limits, and bold & underline & italics exceeds both limits.

Table 3-15. Bacteriological Results for the Ground Water on Balmosesti St. (W2)

Bacteriological Parameter	March 1998	April 1998	May 1998	Allowed Limits Law 311/2004	Allowed Limits STAS 1342-91
Number of bacteria developing at 37^{0} C (total number of germs)/ml	**21**	**29**	**23**	below 20	below 300
Number of coliform bacteria (total coliforms)/100 ml	**8**	***17***	***54***	0	below 10

Note: in text bold means exceeds Law 311/2004, bold and underline exceeds STAS 1342-91 limits, and bold & underline & italics exceeds both limits.

According to the statutory limits which were applicable at the time of evaluation (1998), the ground water W1 is drinkable from a bacteriological point of view, for all samples.

During the three sampling events, several exceeding values have been determined for chemical indicators such as: calcium, fixed residues (105^{o} C), sulphates, several nitrogen forms, sulphides, total iron, and total hardness.

On the basis of the same standards, the ground water W2 is not drinkable. Two samples contained coliforms in excess of the limits. Chemical limits were also exceeded for other parameters such as: dissolved oxygen, COD, several nitrogen forms, phosphates, sulphides, total iron, and manganese.

According to the new legislation regarding the drinking water quality – Law no 456/2002, amended and completed by Law no 311/2004, none of the samples collected from these two wells does not meet the bacteriological criteria for potable water quality.

4 Conclusions

As a preliminary conclusion and in view of the limited extension of the aquatic baseline bioassessment, the depreciation of surface and ground water quality within the study area is not only due to the historical and current mining operations, but also due to the improper management of domestic waste water, solid waste and animal dejection.

In addition to the physical-chemical pollution of the surface and ground water, a depreciation of the biological and bacteriological quality of surface water and bacteriological quality of ground water has been identified, with a direct negative impact upon the use of the water.