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THE IMPACT OF FÂNAŢE TAILING POND UPON „CRIŞUL BĂIŢA" RIVER

Cristina CRIŞAN-FILIP[1], Ribana LINC[2], Stelian NISTOR[3]

Résumé: ***Aspects de l'impact du bassin de décantation Fânaţe sur la petite rivière Crişul Băiţa.*** Dans le département du Bihor, sur le territoire de la commune Câmpani, la S.C. BĂIŢA S.A. Ştei a construit le bassin de décantation de Fânaţe pour déposer le stérile humide résultat par l'extraction et l'usinage des minerais poli-métalliques non ferreux (cuivre, plomb, zinc). En cette article, on poursuit certains aspects de l'impact de ce bassin sur l'environnement par la présentation de la qualité de l'eau de Crişul Băiţa en quatre sections de surveillance (le tronçon source - Băiţa Plai - avale Ştei, environ 23 km) pour la période 2004 - 2006. Les analyses chimique ont été réalisé dans le Laboratoire de la Direction Rivières- Crişuri, Oradea, conformément à l'Ordre 1146 /2002 pour l'approbation du *Normatif concernant les objectifs de référence pour classifier les eaux de surface.* En 2008, la S.C. BĂIŢA S.A. Ştei a été achetée par la S.C. Mineral Mining S.R.L Ştei qui a commencé les démarches necessaires pour la projection d'un nouveau bassin de décantation.

Mots-clés : bassin de décantation, rivière Crişul Băiţa, indicateurs de qualité, impact

1. Introduction

Until 2008, S.C. BĂIŢA S.A. Ştei was a state-own commercial company with a prime activity goal the ore extraction and processing (lead, copper, zinc, molybdenum). From 2008 the state company was bought by S.C. Mineral Mining S.R.L. Ştei (private company) which run the same basic activity in the same development-exploitation perimeter, with the same technology. The transition period within which the private company will be able to use the Fânaţe tailing pond is 31. 12. 2009 so that the Mineral Mining S.R.L. started the necessary steps in order to find the location for the new tailing pond.

The preparing technology for ore preparation consists of several stages which, in general, are the following: the two-stage crushing process, the grinding process (several categories, 75-80% - 0,074 mm), collective flotation copper-lead, zinc flotation, molybdenum-copper collective flotation. Excepting the Na cyanide, the other used chemical reactive, are not considered toxic substances. The preparing factory is located 20 km from Ştei and the Fânaţe tailing pond is located 6 km downstream from preparing factory.

The industrial water, used during the flotation process of the collective concentration of copper-lead and copper-molybdenum, tined which cyanide, 60-240 mg/l concentration, 8.5-12.5 qm/h discharge (Horvath, C., 2002) are chemically treated using a fully automatic neutralization installation (installed in 200 with the financial support of GEF-USAID project). The water, from which cyanides were removed, are pumped in the Fânaţe tailing pond, together with the water used for washing the ore.

[1] Crisuri Waters Authority, 35, Ion Bogdan str., e-mail: cristina.filip@dac.rowater.ro
[2] University of Oradea, Department of Geography, Tourism and Territorial Planning, 1 University str., 410087, The Territorial Studies and Analyses Centre (CSAT), e-mail: ribanalinc@yahoo.com
[3] University of Oradea, Department of Geography, Tourism and Territorial Planning, 1 University str., 410087, The Territorial Studies and Analyses Centre (CSAT), e-mail: snistor@uoradea.ro

2. Short presentation of Fânațe tailing pond

Fânațe tailing pond is situated in Fânațe village, Câmpani commune, Bihor county, 1.4 km from Nucet town. Upstream, at 100 m, a cleansing station is located which clean the used water of Nucet town and downstream, at about 500m, starts the gardens of the inhabitants of Fânațe village.

The tailing pond was set working in the 1 st of June 1969 and was called „*Fânațe I tailing pond*" in the place of the former stadium by damming a gentle slope. The pond was put under conservation in 1983, the altitude of the dam being 390.01 m. From that altitude started to function „*Fânațe II tailing pond*", which is actually a prolongation of the initial tailing pond, thus the present day tailing pond being a junction of the former tailing ponds.

From november 1984, the extension of the Fânațe I and Fânațe II tailing ponds was toward the slope of the neighbouring hillside, up to the 390 m, in the first stage (1986-1990). In the second stage the reached height was 395 m, in the case of both tailing ponds.

The hydro-geological stability study, conducted for Fânațe I and Fânațe II tailing ponds, shows that the tailing ponds could be elevated with more 5 m (*Simbol 86/23-48,mai 1990*).

Up to now the tailing pond deposited the sterile from the Preparation Factory, resulted from the complex ore processing (copper, lead, and zinc). The slurry containing the sterile was transported gravitationally (8/1 dilution) to the tailing pond where mechanical cleansing was made. For the evacuation of the waters, both industrial and pluvial, the tailing pond has two systems of inverse wells (Horvath, C. 2002).

From geological point of view the tailing pond is situated on deposits with good permeability.

Fig.1. Fânațe tailing pond - upper section
(photo: Cristina Crișan-Filip)

From geomorphological point of view, the tailing pond is located on a stabile fluvial terrace of Crișul Băița River.The main hydrographical collector of the area is Crișul Băița River, which is a tributary of Crișul Negru River.

The Crișul Băița River, on which the tailing pond is located, is a permanent river and collects the pluvial waters of the area. Up to the present there were no records of situations when rainfall affects the tailing pond.

For avoiding water infiltration in the base of the tailing pond, for preventing the slide of the base, a channel was built, on the slope side and on the downstream side, the channel which needs permanent declogging (Horvath, C. 2002).

The tailing pond was built as a *slope pond*, closed on three sides with dams and, on the forth side, by the slope of Crișul Băița River. After few years on the south-western part of the pond (towards the slope) a closing dam and a channel were built, for erasing the pond, through consecutive withdraws. The tailing pond has three water evacuation systems, two being operational.

The surveillance of the tailing pond is permanent the following elements being watched: water flows from the slope of the pond, wet areas, cracks on the slope and on the dry beach, falls, swellings on the slope or on the dam, water bogging in the vicinity of the tailing pond, muddy evacuated waters, any unusual phenomena, the functioning of the water evacuation system every 4 hours.

3. The impact of used waters upon the quality of the water from Crişul Băiţa River

In general, the discharges of residues from mining activity in tailing ponds could generate different impact from upon the environment, the most important being the following: the long term effect upon the soil, soil pollution, ground water pollution, surface water pollution with different compounds which infiltrates from the liquid fraction or are render soluble, air pollution (through deflation of small particles), visual impact upon the landscape.

An other important problem could be related to the damage of the installations, which could be amplified by natural causes (earthquakes, floods, landslides).

As far as concerning the Fânațe tailing pond, in 1974-1975, on the NE and NW slopes of the pond, a series of cracks appeared, which causes exfiltrations, *endangering the stability of the pond.* The repairing and consolidations were made in 1975. In 1995, due to corrosion and breaking down of the inverse wheels in the NW part of the pond (S3, S4) some *fall cones* appeared on the beach of the pond. The damaged system was abandoned and the pond is working with the other two evacuation systems (S1, S2). During dry seasons, the wind is blowing fine sterile particles and affects the neighbouring localities, Fânațe and Nucet.

In order to evaluate the general impact of the used waters of Fânațe tailing pond upon the water of Crişul Băiţa River, four *monitoring point* were set into place (fig. 2):

- the *Băiţa Plai point* (situated upstream from the tailing pond) as a comparising point between the natural state course and the tained section caused by the mining activity;
- *Nucet point*, where the waters from the mine gallery are evacuated, also upstream from the tailing pond;
- *Fânațe point*, where the waters from the tailing pond are evacuated in the river;
- *Ştei point* (downstream from the tailing pond) in order to evaluate the impact of mining activity.

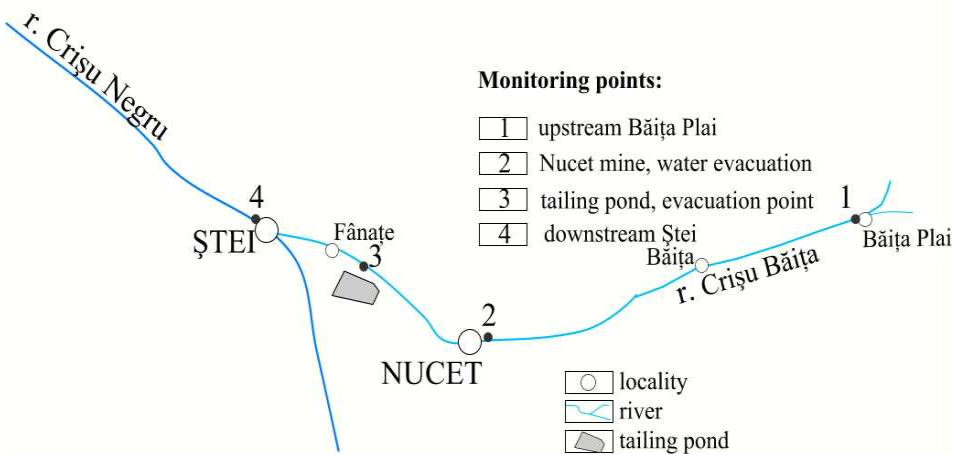

Fig.2. The monitoring points along Crişul Băiţa River

(sketch without scale)

In order to check the water quality we analysed the samples for the period 2004-2006, in the Laboratory of Crisuri Water Authority, Oradea. The evaluation of water quality classes are made according to physical and chemical point of view.

In *2004*, according to Order 1146/2002 for approving *Normative for reference objectives for classification the quality of surface waters* (spring-Băiţa Plai-Ştei sector) a 23 km sector of Crişul Băiţa River can be included in the following quality classes: according

to *oxygen, nutrients and general ions indicators* – the Ist quality class on all length of the analysed sector; according to *organic and un organic micro-pollutant indicators* – in the IIIrd quality class due to the presence phenols; according to *metal indicators* – in the IVth quality class on a 9 km sector (between spring and Băița Plai), Vth quality class on a 14 km sector (between Băița Plai - Ștei, confluence with Crișul Negru) due to the presence of Copper and Zinc either from natural sources and as a result of mining activity. According to *general features*, the Crișul Băița River was included in the IInd quality class.

In *2005*, Crișul Băița River (on the same sector) was included in the following quality classes: according to *oxygen, nutrients and general ions indicators* – the Ist quality class on all lenght; according to *organic and un organic micro-pollutant indicators* – in the IIrd quality class; according to *metal indicators* – in the IVth quality class on a 9 km sector (between spring and Băița Plai), Vth quality class on a 14 km sector (between Băița Plai - Ștei, confluence with Crișul Negru) due to the presence of Copper and Zinc either from natural sources and as a result of mining activity.According to *general features*, the Crișul Băița river was included in the IInd quality class.

In *2006*, Crișul Băița river (on the same sector) was included in the following quality classes: according to *oxygen, nutrients and general ions indicators* – the Ist quality class on all lenght; according to *organic and un organic micro-pollutant indicators* – in the IIrd quality class; according to *metal indicators* – in the IVth quality class on a 9 km sector (between spring and Băița Plai), Vth quality class on a 14 km sector (between Băița Plai - Ștei, confluence with Crișul Negru) due to the presence of Copper and Zinc either from natural sources and as a result of mining activity. According to *general features*, the Crișul Băița River was included in the IInd quality class.

As far as concerning the variation of *Copper concentrations* (minimum, maximum and mean values) measured for the period 2004-2006 in Băița Plai and Ștei points, one could notice the increasing of the values in downstream points, as could be seen in figure 3 and 4.

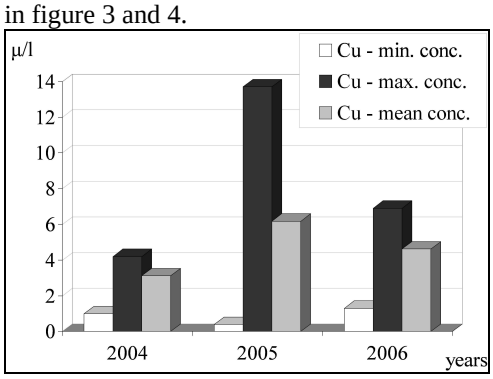

Fig. 3. The variation of **Copper** concentrations in *Băița Plai* point
(upstream Fânațe tailing point)

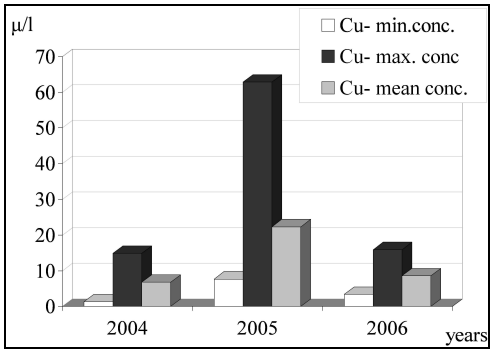

Fig. 4. The variation of **Copper** concentrations in *Ştei* point
(downstream Fânațe tailing point)

According to the Department of Integrated Monitoring of Water Resources within the frame of Crisuri Water Authority, in *2004*, Crișul Băița river was included in the IIIrd quality class upstream the Fânațe tailing pond and in the IVth quality class in the downstream sector (according to Copper indicator). In *2005-2006*, the quality of the river decreased either upstream or downstream, the water being included in the IVth quality class upstream Fânațe tailing pond and Vth quality class downstream Fânațe tailing pond.

As far as concerning the variation of *Zinc concentrations* (minimum, maximum and mean values) measured for the period 2004-2006 in Băița Plai and Ștei points, one

could notice the increasing of the values in downstream points, as could be seen in figures 5 and 6.

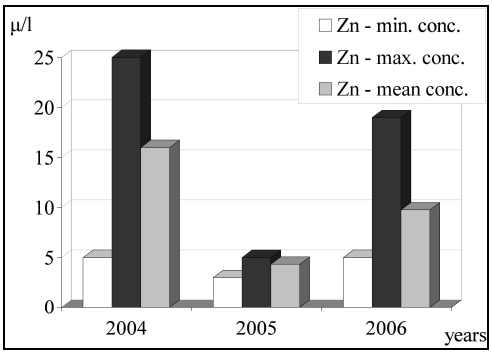

Fig. 5. The variation of **Zinc** concentration in *Băița Plai* point (upstream from Fânațe tailing pond)

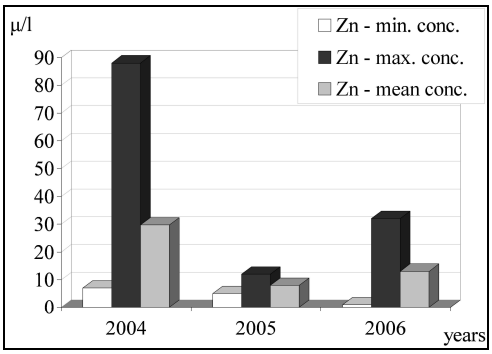

Fig. 6. The variation of **Zinc** concentration in *Ştei* point (downstream from Fânațe tailing pond)

On the basis of Order 1146/2000, according to the Zinc indicator, in 2004, Crisul Băița River, could be included in the IVth category upstream and in Vth category downstream the tailing pond. In 2005 the water quality improved and the river was included in the IInd category but in 2006 the water quality decreased and the river was included in the IIIrd category.

Figures 7 and 8 shows that the (*CN*) *cyanide concentrations*, measured at Băița Plai and Ştei points, have very slight variations, almost insignificant. Crişul Baita River, according CN indicators, could be included in the Ist quality class either upstream and downstream from the tailing pond.

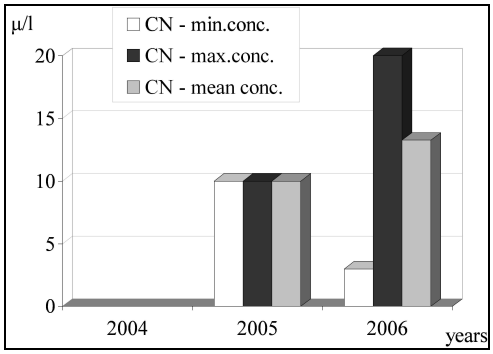

Fig. 7. The variation of **CN** concentration in *Băița Plai* point (upstream Fânațe tailing pond)

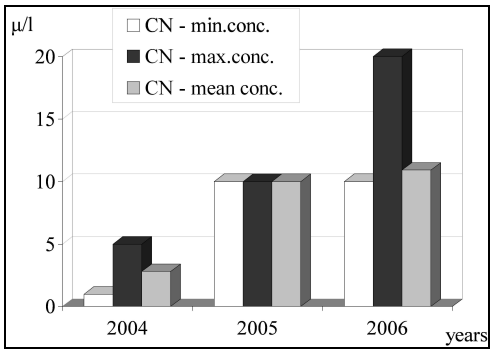

Fig. 8. The variation of **CN** concentration in *Ştei poin* (downstream Fânațe tailing pond)

The normative which establish the discharge conditions in water environment of used waters is the Technical Normative NTPA-001/2002 („*Normative regarding the charging values with pollutants of industrial and urban used waters in natural receptors*" H.G. 188/2002, modified and completed with H.G. 352/2005). The application domain of the Order includes the used industrial and urban waters which were not cleansed and the maximum allowed concentrations are represented in mg/dmc. The values of these concentrations are used for momentary samples.

The water from Nucet mine are evacuated into Crişul Băița River without any cleansing. As far as concerning the pollution of the water (Copper, Zinc, Lead indicators)

(figures 9, 10, 11) one can notice that the results are within the maximum allowed limits stipulated in Technical Order NTPA 001/2002.

The used industrial water resulted from flotation process, after a *chemical treatment* using a compact neutralization automatic installation are transported, using a single 6.1 km pipe, to the *Fânaţe tailing pond*.

Figures 9, 10, 11 shows the influence of the Zinc, Copper and Lead concentrations from the Fânaţe tailing pond upon the water of Crişul Băiţa River, using mean values compared to the maximum allowed values.

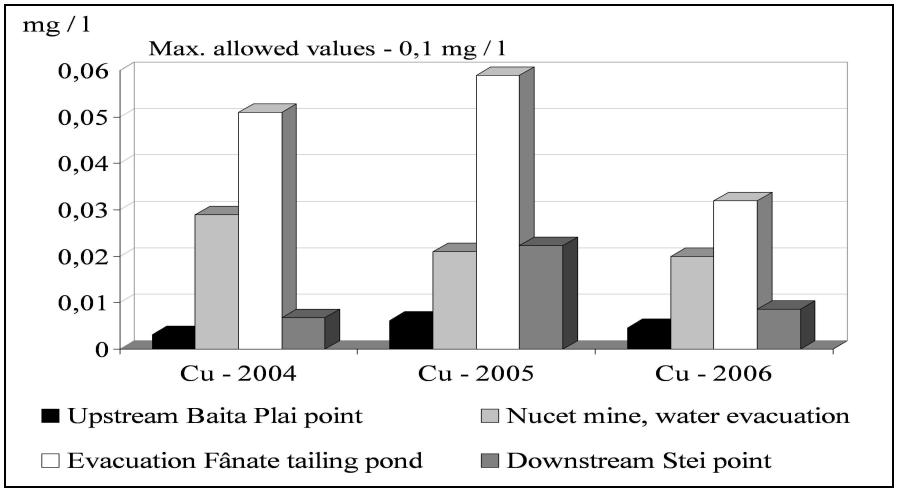

Fig. 9. The **Copper** concentration from the used waters evacuated from Fânaţe tailing pond and Nucet mine in the Crişul Băiţa River

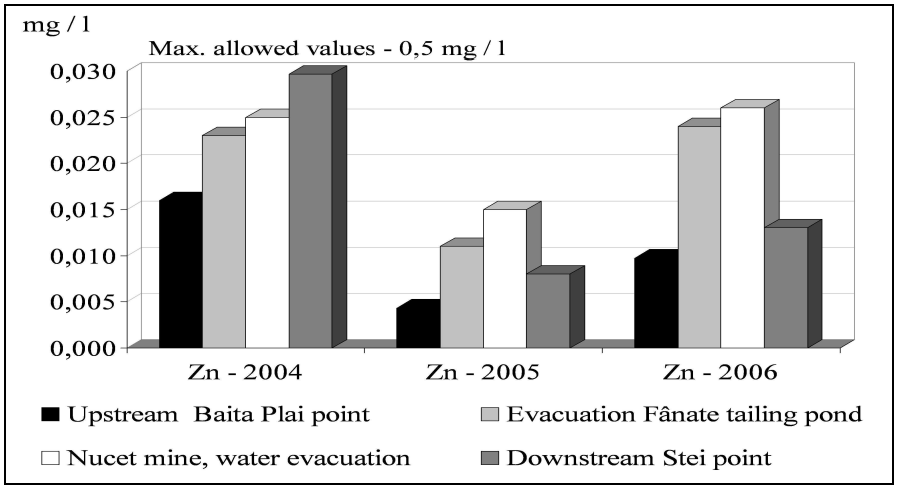

Fig. 10. The **Zinc** concentration from the used waters evacuated from Fânaţe tailing pond and Nucet mine in the Crişul Băiţa River

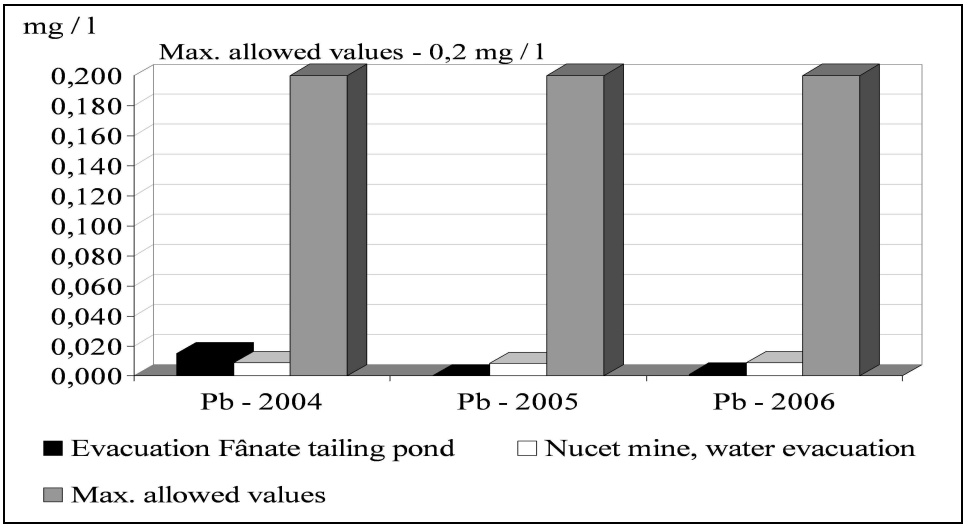

Fig. 11. The ***Lead*** concentration from the used waters evacuated from Fânațe tailing pond and Nucet mine in the Crişul Băița River

Taking into account the distance between the point in which the used waters are released and the monitoring point one *could not state that the degradation of the water quality could be related only to mining activity.*

4. Conclusions

In case of *average values* of the quality of evacuated used waters from the Fânațe tailing pond, measured between 2004 - 2006, no exceeding could be found comparising with maximum allowed values from technical standard NTPA 001/2002, *the standard related to the overcharging with pollutants of used industrial and urban waters evacuated in natural receptors*. In case of *maximum values* one could notice slight exceeding for pH, suspensions and residues indicators.

According to Order 1146/2002 for approving *The standard regarding reference objectives for classification the quality of surface waters*, Crişul Băița River monitored in sections spring, Băița Plai and Ștei, could be included in the *IInd quality class*, as far as concerning the *general features.*

On the basis of the analysed parameters, one could notice that in period 2004-2006, the quality of the waters of Crişul Băița River is better upstream while in the lower section of the river water quality is *slightly* poor due to the increasing concentrations of Copper and Zinc.

In 2004, according to Order 1146/2002, a 14 km sector (Băița Plai - Ștei, the confluence with Crişul Negru) of Crişul Băița River was included in Vth category of quality, in 2005 the water was included in the IVth category of quality and in 2006 in the Vth category of quality, due to the presence of Copper and Zinc from the natural environment and also due to the evacuation of waters from S.C. Băița S.A. Ștei – Fânațe tailing pond.

Taking into account the distance between the point in which the used waters are released and the monitoring point one could not state that the degradation of the water quality could be related only to mining activity.

The Fânațe tailing pond have a small influence upon the quality of the water, the influence being significant mainly in the evacuation point, downstream, due to natural self-cleaning process the quality of water is improving significantly.

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*** *Legea 458/2002 privind calitatea apei potabile* şi *Legea 311/2004* pentru modificarea si completarea Legii 458/2002 privind calitatea apei potabile

*** *OU 244/2000 şi Legea 466/2001* pentru aprobarea Ordonanței de Urgență a Guvernului nr. 244/2000 *privind siguranța barajelor*

*** *H.G. nr. 349/2005 privind depozitarea deşeurilor,*

*** *Directiva 1999/31/CE privind depozitarea deşeurilor*

*** *H.G 188/2002* pentru aprobarea unor *norme privind condițiile de descărcare in mediul acvatic a apelor uzate,* modificată şi completată prin *H.G. 352/2005*- Anexa nr. 3.

*** *NTPA-001/2002, Normativul privind stabilirea limitelor de încărcare cu poluanți a apelor uzate industriale si urbane la evacuarea în receptorii naturali,*

*** *Ordinului 1146/2002* pentru aprobarea *Normativului privind obiectivele de referință pentru clasificarea calității apelor de suprafața*

*** *NTLH- 021- privind stabilirea categoriilor de importanță a barajelor*

*** *Date de monitorizare calitativă a cursului de apă Crişul Băița*, din arhiva Direcției Ape Crişuri Oradea,

***Sinteza anuală privind calitatea apelor din bazinul hidrografic Crisuri 2004, vol. I*

*** *Sinteza anuală privind calitatea apelor din bazinul hidrografic Crisuri 2005, vol. I*

***Sinteza anuală privind calitatea apelor din bazinul hidrografic Crisuri 2006, vol. I*