



Symposium Proceedings

To the memory of
Francis Wojtkowiak

MINE WATER MANAGEMENT AND THE WATER FRAMEWORK DIRECTIVE

Wolkersdorfer Christian

Technische Universität Bergakademie Freiberg, Lehrstuhl für Hydrogeologie, Gustav-Zeuner-Str. 12, D-09596 Freiberg/Sachsen, Germany ; c.wolke@tu-freiberg.de

ABSTRACT: The European “Water Framework Directive” meant a significant change in the administration of many water catchment areas. That change also affected the administration of mine water discharges and in consequence the necessary measures of mine operators or regulatory authorities to manage those discharges. Due to the differences in the water and especially mine water legislation in the European countries the EU FW6 project ERMITE (Environmental Regulation of Mine Waters in the European Union) investigated those differences by addressing the many facets of Nations and disciplines involved.

KEYWORDS: mine water management; Water Framework Directive; European Union; mining

RESUME : La directive européenne sur l'eau a induit un changement significatif dans la gestion administrative des bassins captifs. Ce changement a aussi affecté la gestion des eaux d'exhaure et par conséquent les mesures à prendre par les opérateurs miniers et les autorités de régulation pour gérer ces rejets. En raison des différences de législation des pays européens dans ce domaine, le projet EU FW6 ERMITE (Environmental Regulation of Mine Waters in the European Union) a été lancé pour les étudier à travers les différentes politiques nationales et les disciplines impliquées.

MOTS-CLEFS : gestion des eaux de mines, directive européenne sur l'eau, Union européenne, activité minière

1. Introduction

Mine water are all waters emanating from active, abandoned, or closed surface or underground mines. This definition includes water draining through dewatering adits, mine dewatering pumps, open pit mines, or raw material handling facilities on the site of a mining operation (ERMITE Consortium et al. 2004). Some countries, such as Germany or Sweden, do not categorize mine water as waste water, whereas many other countries, such as Finland or Poland, categorize mine water as waste water (Wolkersdorfer 2001; Plinke and Wildhagen 2003) Under strict interpretation of the European waste legislation, mine water has to be considered as waste as long as it is not produced or pumped for a special purpose. The EU Council Directive 75/442/EEC on waste, amended 91/156/EEC states in Art. 1(a): “‘Waste’ shall mean any substance or object in the categories set out in Annex I which the holder discards or intends or is required to discard” and in Annex I, Category Q16: “any materials, substances or products which are not contained in the above categories”. Yet, this strict interpretation should be avoided as many mine waters are of good chemical and biological quality and can therefore directly be discharged into surface streams without further treatment.

On the other hand, polluted mine water is one of the largest single waste streams in the European Union. Though no comprehensive investigation of all mine water impacted surface streams or groundwater bodies in the European Countries exists so far, a total length of several thousands of kilometres of affected surface water can be assumed. As a result of the European Water Framework

Legal environment of mining in the acquis

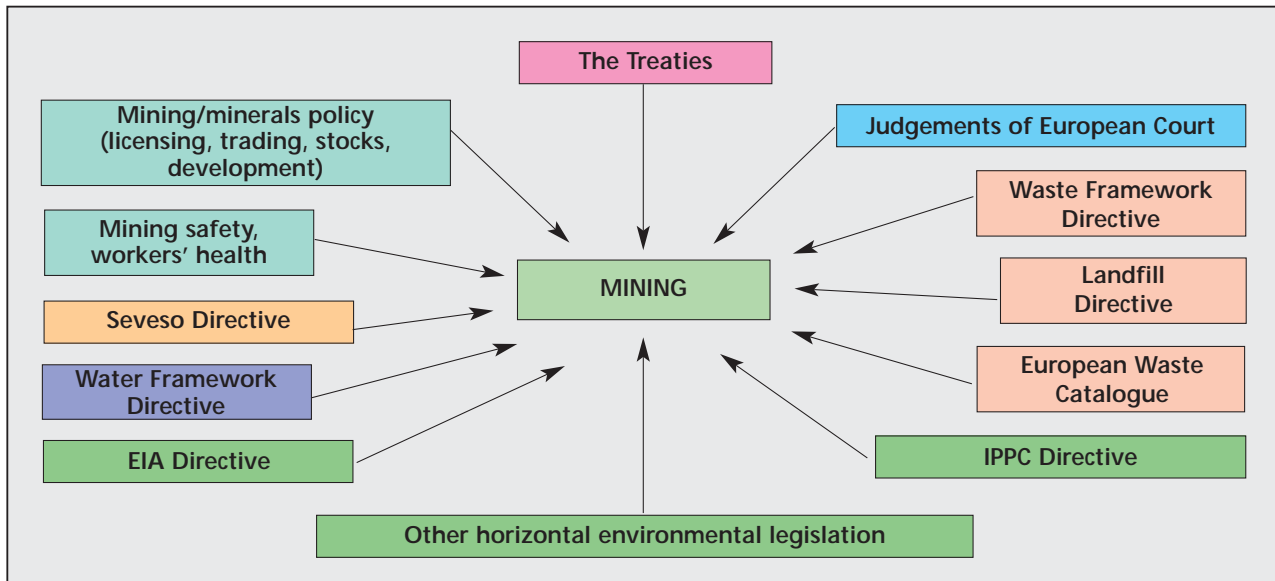


Figure 1. Legal framework of mining in the European Union (from Hámár et al. 2002).

Directive (2000/60/EC; European Commission 2000), which is meant to be a general framework for the protection of all waters including rivers, lakes, coastal waters, and groundwaters river basin management plans have to be set up until the year 2009. A key aim of the Water Framework Directive is to reach a good chemical and ecological status of all water bodies in the European Union. It is meant to be a framework and therefore does not regulate every issue into detail, but will be amended if necessary, one of those amendments being the proposed Groundwater Directive. Besides the Water Framework Directive, other regulatory elements affect European mining. They have been partly studied by Hámár et al. (2002) and shall not be further discussed here (Fig. 1). A thorough discussion of the EU regulations and legislative measures in the context of mine water and mine safety has been given by Kroll et al. (2002 a, b).

Mining, and consequently mine water, is not directly mentioned in the Water Framework Directive. The only reference to mining is article 11(3)j, which allows the injection of water for hydrocarbon exploration and exploitation and the reinjection of pumping water from mining or quarrying operations (European Commission 2000):

Member States may authorise

- *injection of water for technical reasons into geological formations from which hydrocarbons or other substances have been extracted or into geological formations which for natural reasons are permanently unsuitable for other purposes;*
- *reinjection of pumped groundwater from mines and quarries or associated with the construction or maintenance of civil engineering works;*

Nevertheless, because polluted mine water does affect surface water and ground water, mine water is covered by the Water Framework Directive and therefore need a thorough management in accordance with the targets set out by the directive.

2. Water Framework Directive – Some Insights

On December 12 2000 the European Water Framework Directive was set into force and after a timescale of 7—13 years this directive substitutes 7 other EU directives relating to water. As can be seen from table 1 the Water Framework Directive consists of different steps and monitoring procedures which shall ensure that the good chemical and ecological status of all European water bodies will be met in 2027. This stepwise approach includes to identify potential mine water related water quality problems within relevant coupled groundwater and surface water catchments and investigate all possible means of improving water quality in affected water environments. In consequence this means to choose the preferred economic decision rule for actual allocation of water quality improvement measures within each catchment. Furthermore, the coordination of policy programmes for mine water pollution abatement has to be based on economic principles aimed at making the best use of society's scarce resources for water quality protection and improvement. Finally, strategic steps for economically optimal management programmes have to be taken in mine water pollution abatement programmes (adopted from a presentation of Destouni, G.). Such management programmes, especially in remote areas or where no responsible mine operator can be allocated, can include the use of passive treatment options (PIRAMID Consortium 2003) as well as natural attenuation or enhanced natural attenuation options.

A basis for decision making is the priority list which is part of the Water Framework Directive and lists potentially dangerous substances. Furthermore, the Water Framework Directive mentions basic and supplementary measures to reach a good status of waters. Specifically, it refers to diffuse pollution and actions to address such diffuse pollution. In addition, all regulators and researchers must understand that under the Water Framework Directive it will become more important to manage chronic pollution from abandoned metal mines.

One of the first issues in most countries was to define the good ecological status of the river catchments in the single Member States. Furthermore, a list with heavily impacted or artificial waters had to be provided. The latter waters might be excluded from the Water Framework Directive if it has been proven that a good ecological or chemical status can't be reached. Such an example is the Rio Tinto area where any treatment options for cleaning the Rio Tinto are either impossible or would be economically not feasible. The French situation and the implementation of French water legislation by the "*Projet de Loi sur L'Eau*" has been described in Bongaerts (2002). But also other countries had to amend their water laws to mirror the context of the Water

Table 1. Time-line of the European Water Framework Directive.

Year	Issue	Reference
2000	Directive entered into force	Art. 25
2003	Transposition in national legislation	Art. 23
	Identification of River Basin Districts and Authorities	Art. 3
2004	Characterisation of river basin: pressures, impacts and economic analysis	Art. 5
2006	Establishment of monitoring network	Art. 8
	Start public consultation (at the latest)	Art. 14
2008	Present draft river basin management plan	Art. 13
2009	Finalise river basin management plan including programme of measures	Art. 13 & 11
2010	Introduce pricing policies	Art. 9
2012	Make operational programmes of measures	Art. 11
2015	Meet environmental objectives	Art. 4
2021	First management cycle ends	Art. 4 & 13
2027	Second management cycle ends, final deadline for meeting objectives	Art. 4 & 13

Framework Directive, such as Germany. Sweden, for example, has already changed their water law to meet most of the issues addressed in the Water Framework Directive (Salmon and Destouni 2001).

Before the Water Framework Directive came into force, most discharges or polluters were seen individually, but not within a catchment scale and transboundary impacts or consequences were usually not taken into account, some exceptions as the Rhine or the Oder/Neiße catchments being a nice example of what could be done. This was true for most European countries. According to the Water Framework Directive all countries within a specific water catchment have now to work together in a transboundary approach, whereas the use of GIS applications is an integrated part of this approach (Timmermann and Langaas 2004). Some of those water catchments, such as the Elbe or Rhine river water catchment, include one of the intensively mined European regions (Fig. 2). In the case of the Rhine River those are – to name some of them – the Swiss mountains, Black Forest, Vosges, Saar Basin, Rhenish lignite mining, Ruhr valley coal mining, and the Rhenish Schiefergebirge (Wolkersdorfer and Howell 2005).

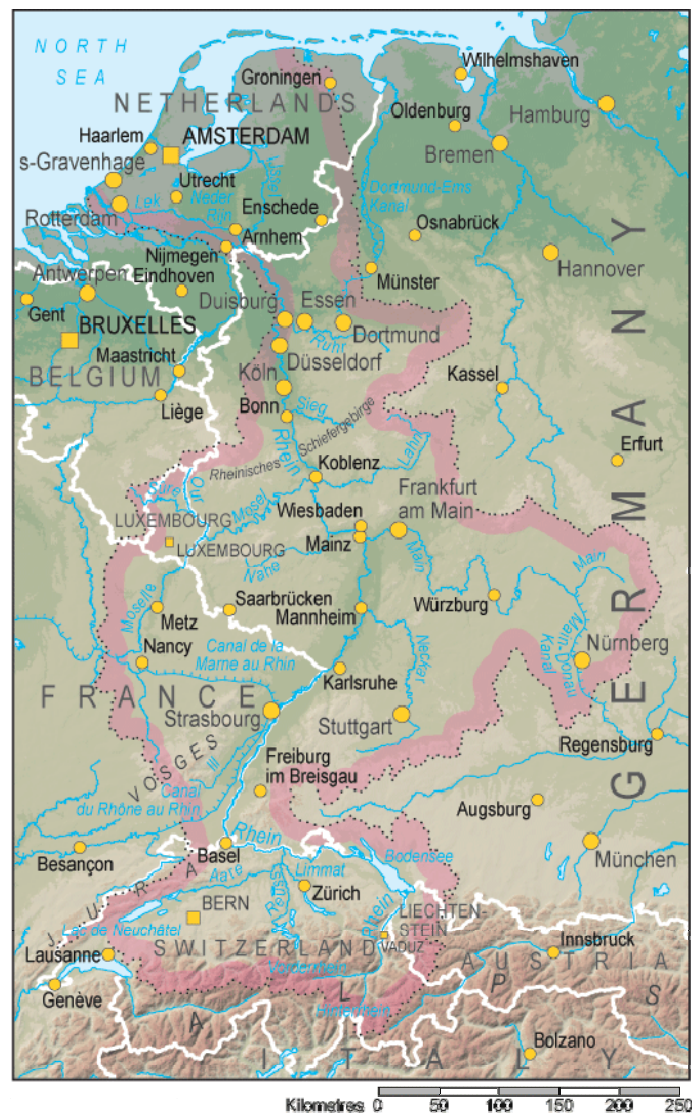


Figure 2. The borders of the river Rhine catchment which lies partly in Switzerland, Austria, Vaduz, France, Germany, Luxembourg, Belgium, and the Netherlands.



Figure 3. Untreated, polluted mine water discharging from the abandoned Gernrode/Germany (Harz Mountains) fluorspar mine.

3. Mining in Europe

Within the last decades many European mines had to close as a result of economic or environmental pressures on the metal market and due to national or European legislation. Nonetheless, there are still many hundreds of mining and thousands of quarrying operations with potentially polluted mine water discharges (Wolkersdorfer and Bowell 2005). All of those mining operations have to meet the standards outlined in the Water Framework Directive or as a result of national legislation. As long as a mining operation is active, the mine operator has to guarantee that the quality standards of the discharged water are met at all times. Even after mine closure water treatment has to be conducted as long as the mine water could cause negative impacts on the receiving water course. Yet, as has been seen from the Aznacollar and Baia Mare accidents, large scale pollution of our environment can only be reached if all parties involved in mining inform each other within short notice. Furthermore, everybody has to work according to the highest standards available, as has been outlined by the BATNEEC principle, which means “best available technology not entailing excessive costs” (Environmental Protection Agency of Ireland 1997).

From a water perspective view, those active mining operations can’t be seen as a problem. Other the polluted discharges from abandoned mines, for which in many, but not all, cases, no one can or will be made responsible. Currently, no exact number of those “uncontrolled” discharges is known, but on the basis of several local studies, it must be assumed, that those point or diffuse discharges can be counted by tens of thousands (ERMITE Consortium et al. 2004). Furthermore, most European key mining regions are within the boundaries of metallogenetic provinces where surface and ground water have already naturally enriched concentrations of metals or metalloids. For those regions it might be problematic to define the pre-mining good ecological status and Neitzel et al. (2002) have discussed, if those regions would need special consideration within the Water Framework Directive. Cave et al. (2003) described how the Water Framework Directive might affect the management of a metal-rich catchment and its coastal area.

4. Mine Water Management and the Water Framework Directive

Mine water management, according to the Berlin guidelines (United Nations Department of Technical Co-operation for Development and Development Policy Forum of the German Foundation for International Development (1992) and their amendments in 2002) and the recommendations of the ERMITE Consortium et al. (2004), has to start before any exploitation on the mine site starts. Already during the exploration, and especially during the planning phase mine operators must bear in mind the post-mining situation. That means that mine water management and the mine closure as well as the post-closure phase have to be conducted in that way that no unacceptable negative effect on the water catchment will be encountered. During the active mining phase, water treatment is usually no problem, because in accordance with the “polluter pays” principle the mine operator can be forced to treat his discharged water. This is slightly more complicated for the thousands of untreated discharges from abandoned mines (Fig. 3), because the legal owner often is not able to cover the treatment costs. Younger (2002) claimed that all mine operators closing down their mine should “[pass] prior to the closure of the mine ... certain minimal information to those authorities which are responsible for implementing the Water Framework Directive”. In Germany, according to the Bundesberggesetz (Federal Mining Law, its relation to water legislation is discussed in Reinhardt 1999) and in Austria according to the Mineralrohstoffgesetz (Mineral Raw Material Law, see discussion in Randl 1998/99) every mine operator has to pass those information to the regional mining authorities where it is available even decades, and sometimes centuries after the mine’s closure.

For abandoned mines the UK Coal Authority and the Environment Agency gave examples of how to minimize the impacts caused by abandoned mines. They constructed several tens of passive treatment plants in order to reduce the pollutant load into the receiving streams (Brown et al. 2002, Younger 2002, Wolkersdorfer and Younger 2002). Not all of those treatment plants clean the water down to the commonly used discharge standards for most metals, but at least they reduce the negative impacts on the receiving water courses and consequently the whole catchment area. Because it is economically impossible to treat all mine water discharges from abandoned mines to values accepted by all regulators, the installation of passive treatment plants for abandoned mines is therefore a valuable means to meet the demands of the Water Framework Directive.

As can be seen from those demands, the protection of our water catchments from polluted mine discharges could be a costly matter for the authorities involved. Baresel et al. (2003) investigated the necessary measures for the calculation of different rehabilitation procedures on the basis of the Swedish Dal river catchment. Though the measures discussed therein are not applicable for all cases of mine water discharges, the investigation clearly shows that a thorough understanding of the site and potential remediation options is necessary to calculate the potential remediation costs.

5. Concluding remarks

As has been shown above – and only a small aspect of the interaction between mine water issues and the Water Framework Directive has been addressed – a key issue of today’s mining is the water management from the first day of exploration and mine planning. Taking into consideration the potential impacts of polluted mine water after the mine’s lifetime guarantees in most cases a thorough protection of the river catchment, in which the mine operations are situated.

Concerning the thousands, possible tens of thousands of point or diffuse pollutions from abandoned mines, for which no one wants to take over responsibility, the situation is still unclear. As long as those sources of pollution are not treated or at least minimized in their impact, a good ecological and chemical status of some river catchments can’t be reached within the timeframe given by the

Water Framework Directive. The example of the UK, where the responsible authorities invest in passive treatment schemes – at least to minimize the impacts of mine water discharges – is a good example of how such problems might be solved in other Member States.

In conclusion, the Water Framework Directive – though it does not mention mining or abandoned mine voids in particular – can be seen as a sufficient tool to manage such sources of stress on our water environment. For the still unclear situations with either naturally elevated metal concentrations or, especially, abandoned mine voids further actions seem to be necessary.

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