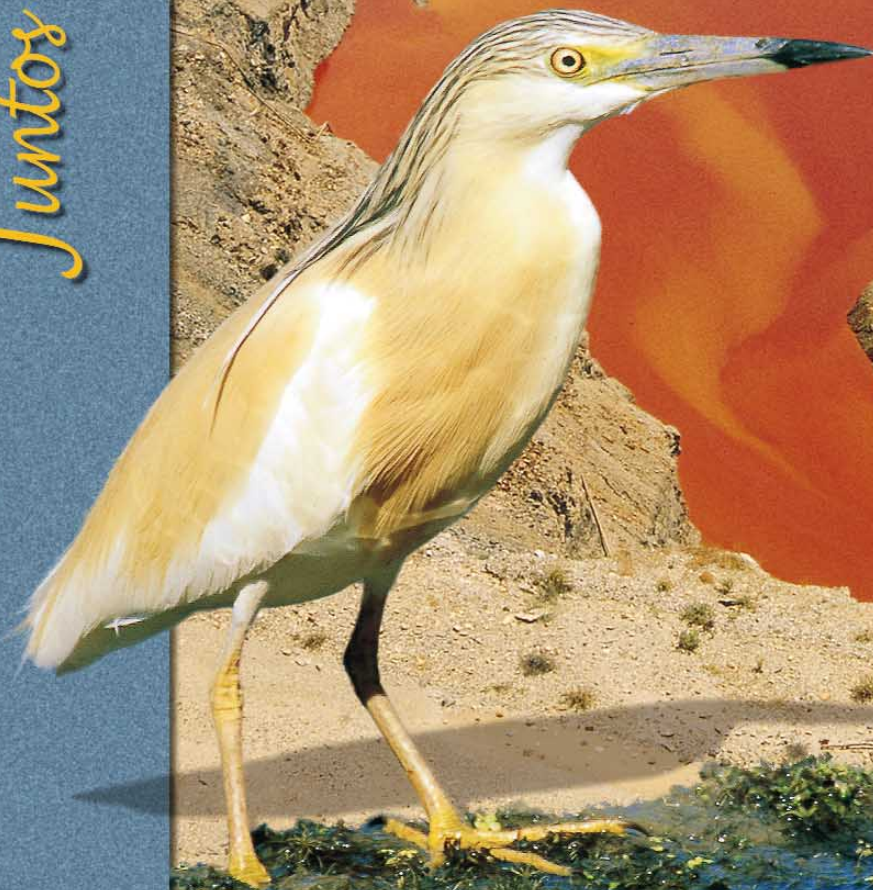




Mining in Doñana

Learned lessons

Juntos por Doñana



Mining in Doñana

Learned lessons

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WWF Spain thanks the divulgation and disclosure of the contents of this publication in the media as long as the source of information is mentioned.

It is my pleasure to present you the publication *Mining in Doñana. Learned lessons*. We hope this document will be an important contribution for a safer future, not only in Doñana but also in all those areas of natural interest which could be affected by the mining industry or other installations, high risk activities and, as a last resort, for mining industry itself.

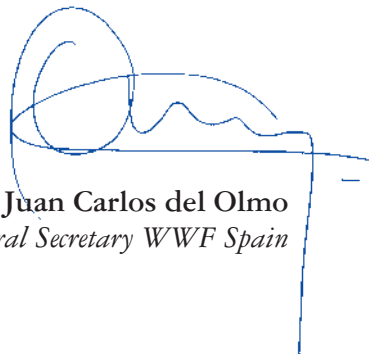
We know, from our experience, that the most common way to inform people and institutions about what really happened in Doñana four years ago—the dam's break— has been providing tons of different documents with diverse degree of credibility, to overwhelm people. Therefore, this publication intends to communicate clearly and in few pages the essence of such an important event, making efforts for achieving the highest degree of objectiveness.

On the other hand, we have tried to sum up the learned lessons in order to prevent future accidents. Not wanting to turn out hardly exhaustive in these lines it has to be recognised that in the case of Aznalcóllar, the alarm signs were ignored, a real chaos was produced after the catastrophe and, as a whole, it could have been done in a better way.

We have not only made the indispensable critical review of the failures, but we are also divulging the good practices produced in cleaning-up activities in Doñana and its surroundings as an authentic case of study, which will have to be analysed profitably all around the world.

Finally we have stated the necessity of going beyond the complacency with that has been correctly done and we want to alert about the current situation. The mine is not restored, the evolution of the pit has been stopped at random, the filtrations are not being monitored and there are high concentrations of heavy metals in the area.

We thank the co-operation of numerous institutions and people that, with their help, have made possible this publication and we hope this contribution is useful in order to prevent future catastrophes.



Juan Carlos del Olmo
General Secretary WWF Spain

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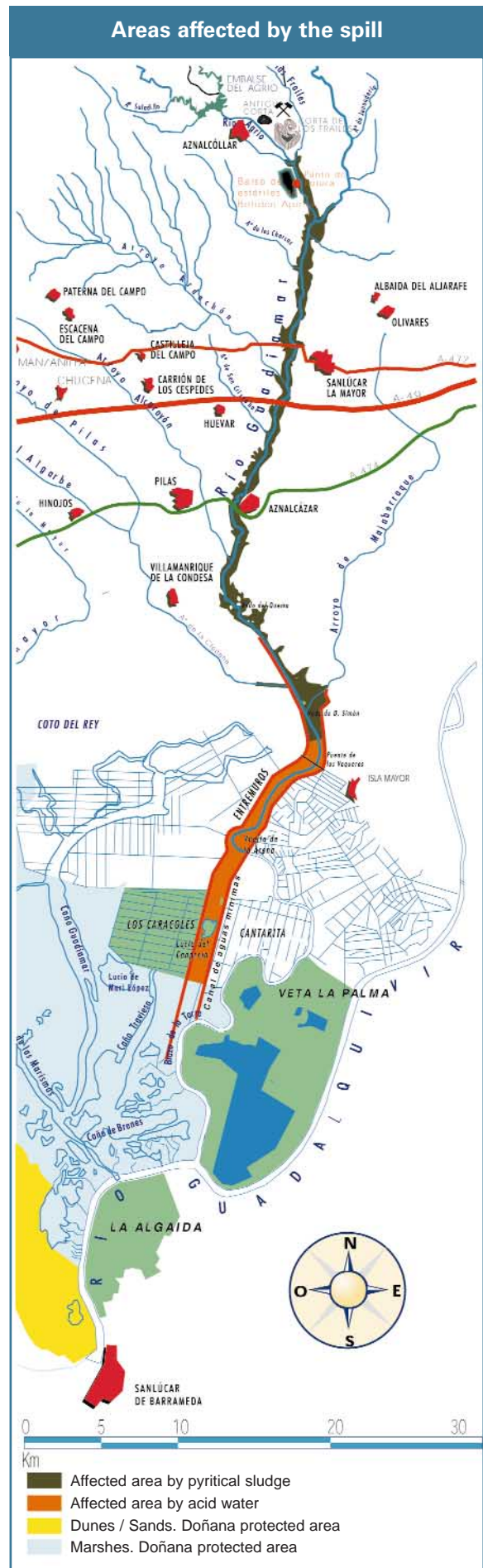
1 Doñana

The Doñana National Park is located in the western part of the Andalusia region, in the south of Spain, and was created in the 1960s by the conservation efforts lead by WWF. The National Park, co-managed by the Spanish Central Administration and the Regional Government of Andalusia, currently covers 50,720 hectares and is characterised by three main types of ecosystems: mobile dunes, Mediterranean bushland and marshland. In its northern part, it borders with the Doñana Nature Park (54,250 hectares), established in 1989 and belonging to the Andalusian Regional Government. It includes bushland with seasonal wetlands, dry and irrigation cultivated fields, and wetlands transformed into rice fields. The two Parks have nearly 40,000 hectares of pristine marshes, more than 5,000 hectares of rivers, ponds, channels and lagoons, 7,000 hectares of coast and sand dunes, 43,000 hectares of coniferous forests and 24,000 hectares of shrublands.

The Doñana area is the habitat for 875 plant and 226 bird species, apart from fishes, reptiles, amphibians and protected mammals such as the Iberian lynx. It is an important resting site for migrating birds (up to 6,000,000 individuals) and a concentration area for wintering birds (maximum census of 700,000 individuals).

Doñana has been declared wetland of international importance having extraordinary ecological value by the Ramsar Convention, Biosphere Reserve (1980) and World Heritage Site (1994) by UNESCO. In addition

Up to 80.000 geese meet in the marshlands of Doñana coming from Holland, Germany, Sweden and Denmark.



to the conservation status given by the existence of the National and Nature Park, Doñana is a Natura 2000 site, obtained the European Diploma for Protected Areas (Council of Europe) and it is surrounded by other Natural Areas and Reserves, especially in the coastal wetlands.

The lower part of the Guadiamar river – affected by the Aznalcóllar accident in 1998 – runs through the Nature Park and, more downstream, through the National Park, where it flows into Guadalquivir.

2 The Aznalcóllar mines and the accident

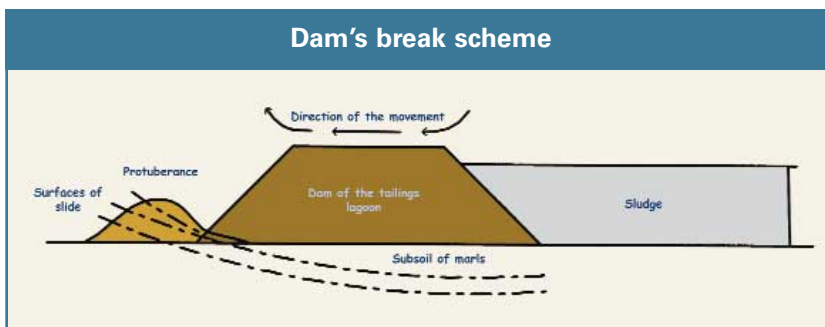
The mines of Aznalcóllar are located 35 km west of Seville and 50 km far from the Doñana National Park, within the Iberian Pyrite Belt of in the region of Andalusia. Large-scale mining started in 1976, when the Aznalcóllar open pit was developed for the extraction on the place of lead, zinc, and copper minerals by flotation of pyrite ore. In 1987 the Canadian-Swedish Company Boliden Limited purchased the property and started the exploitation of the Aznalcóllar open pit through its subsidiary Boliden Apirsa. In 1996, the Aznalcóllar pit was mined out and the company decided to begin the extraction activity in the closely located Los Frailes open pit. The mine and the concentrator (plant for minerals extraction from the pyrite ore) were designed for an annual extraction and treatment of 4.1 Mton of ore. Until April 1998, the tailings and the acid metal-rich water produced by the ore treatment were

deposited in a 160-ha pond (composed by two lagoons divided by a wall) located in the riverbank of the Agrio river, a tributary of the Guadiamar river, which is one of the historical affluent of the Doñana marshes.

In the night between April 24 and 25 April 1998, the downstream dam of the tailings lagoon broke down, creating a

breach through which water and tailings were flushed out. The break occurred in the intersection area of the frontal dam and the wall dividing the two tailings lagoons and the breach was approximately 60 metres wide and 30 metres high. In a few hours, 5.5 Mm³ of acid and metal-rich water flowed out of the dam together with a thick flood of toxic tailings (estimated to be between 1.3 and 1.9 Mton).

The spill flooded the riverbanks along the Agrio and Guadiamar rivers down to the Entremuros marshes, 40 km south of the mine, at the border of the Doñana Natural Park. 250-metres wide land strips at each side of the Guadiamar river were flooded with tailings and toxic water.



Dead fishes by acid water in the Entremuros area.



According to the estimates of the Regional Government of Andalusia, in total approximately 4,600 hectares of arable and wild land were affected by the toxic flood, out of which 2,616 hectares were covered by tailings. The thickness of the tailings layer was heterogeneous and varied from approximately 2 metres near the mine to few centimetres in the furthest areas. 10 municipalities (46,000 inhabitants) were directly affected by the accident.

During the first hours after the dam failure the water in the Agrio and Guadiamar rivers presented no dissolved oxygen and a very high amount of solids in suspension, which caused the death of all kind of sub-aqueous life.

Spatial distribution and thickness of the spilled tailings

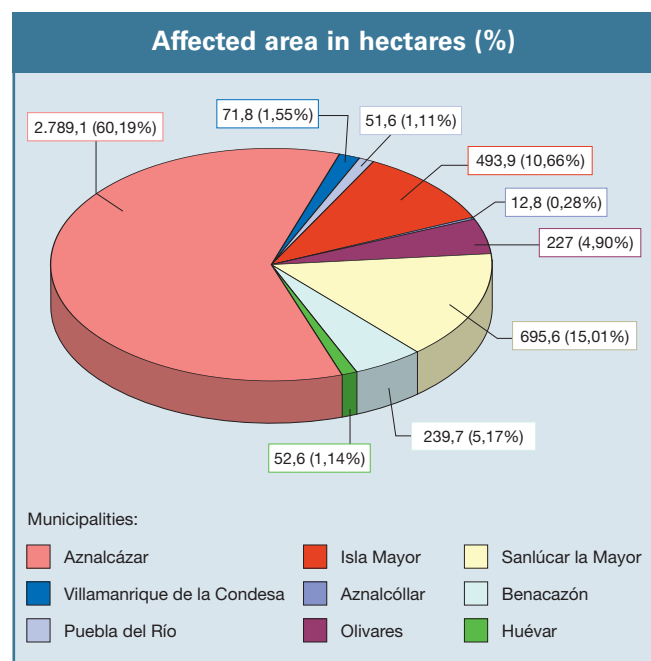
According to a tailings mapping carried out by the Spanish GeoMining Institute (IGME, formerly ITGE), at the beginning of May 1998 1,982,000 m³ of tailings were unevenly distributed on an area of 2,616 hectares within the Guadiamar watershed. The toxic flow left 62% of the spilled tailings in the first 13 Km downstream the broken dam, distributed on 30% of the area covered by the tailings.



Fruit trees were one of the most affected farming by the spill. Many harvests were lost.

In the days following the toxic spilling, 30 tons of dead fish and 170 kg of dead crabs and amphibia were collected. Adult birds living in the riverbanks could escape to the toxic flood, but the egg-laying of the season was severely affected.

The accident had a great impact in the Spanish society, since Doñana was considered as a "pearl" of the nature conservation in Southern Europe, protected by its status of Nature and National Park and recognised of exceptional ecological interest at an international level. The scientific and nature conservation communities immediately realised the significance of the long-term consequences of the spill, since heavy metals are easily absorbed by living organisms and accumulate in their tissues



The cause of the accident

The causes of the accident were assessed by three independent investigations. One was commissioned by Boliden Apirsa and conducted by the Spanish consulting company EPTISA. A second one was carried out by the governmental research organisation CEDEX on behalf of the regional authorities. The third investigation was initiated by the judge leading the legal procedures around the accident and carried out by the University of Barcelona. The three investigations agreed on that the direct cause of the accident were sliding-movements over the marls subsoil and which was the result of surplus pressure in the interstitial water of the clay, due to the weight of the dam and the tailings deposits.

On 20 April 1998, Boliden Apirsa had presented to the competent authorities a report elaborated by the private Company GEOCISA stating that the dam was fulfilling the stability requirements established by the Law. According to a study carried out in July 1998 by the consulting companies Buser & Finger and Roth & Partner GmbH for WWF, the monitoring network that was in place at the time of the accident could not have detected relative movements between the dam and the marbles because the sensors did not reach the marls subsoil itself.

provoking lethal and sublethal effects. The accident was affecting a protected area where survive, in a very delicate ecological equilibrium, several endangered species, and the strategic location of Doñana on the birds migratory route implied the uncontrolled diffusion of the toxic flood effects on a very wide territory.

3 Emergency measures

The toxic wave flowed out of the tailings lagoons released most of its solid content in the first kilometres of its trajectory. The contaminated water was stopped by retaining walls in the Entremuros area, an important resting site for migratory birds within the Doñana Nature Park. Entremuros is an hydraulic linear infrastructure built in the 1950ties to drain the marshlands and to cultivate the Guadiamar area. This wall consists of the deviation of the river into an area limited by two artificial 13 km-long banks ('Entremuros' in Spanish means 'between walls'). As soon as the emergency status was activated, the Andalusian authorities built a first dam in Entremuros to stop the toxic wave before its entrance into the Doñana Nature Park. The construction could not contain the water and was passed in the night between 25 and 26 April. Few hours afterwards also a second containing wall was overcome and

only a third stronger wall at the border of the National Park could prevent the toxic wave to enter. At the same time, the biggest rescue of birds, with an amount of 1.800 eggs was made in the affected area, in order to incubate them in captivity.

In the meanwhile, Boliden Apirsa had managed to close the breach in the lagoons, to prevent new possible collapses or the forecasted rainfall to provoke further spilling. The operations of ore extraction and milling were stopped and a significant part of the mine working force was laid off.

At the very beginning of May, a Co-ordination Body between the Regional Government of Andalusia and the National Administration was created with the objective to try to co-ordinate the disaster management efforts. Few days before, a scientific group made of experts of CSIC (Centro



Building of the second dam in Entremuros.

Superior de Investigación Científica), had been established ad-hoc to follow the evolution of the events and advise the Authorities on the most suitable solutions to implement.

The Spanish Authorities banned all forms of land use, pumping of wells for irrigation, grazing, hunting and fishing in the whole affected area. As a precautionary measure, fishing was forbidden in the Guadalquivir estuary too. Boliden Apirsa committed to buy the 1998 entire harvest of the affected area, to minimise the economic losses for the farmers and to calm down the increasing social concern for the existence of polluted agricultural products in the market.

The most urgent issue to be faced was the management of the significant volume (2.5 hm³ according to CSIC) of toxic water - containing high values of zinc, cadmium, thalium, cobalt, manganese and nickel - that had been retained within the Entremuros area. The initial project of the Spanish Authorities to directly release the water into the Guadalquivir estuary was discouraged by the fierce opposition of environmentalist NGOs and the strongly negative opinion of the CSIC scientific group, fearing for the future of wildlife and fisheries in the estuary and the Bay of Cadiz. According to the experts' opinion, prior to its flow into the Guadalquivir, the toxic water had to be submitted to chemical treatment for pH neutralisation and precipitation of heavy metals hydroxides, followed by physical separation of the solid substances.

The suggestions of the scientific advisory group were implemented at the end of July, when the toxic water started to be submitted to physical-chemical treatment in specific decanting ponds and diluted with non-toxic water before its release into the Guadalquivir estuary. The delay in the start of the operations was much criticised by the environmental NGOs because it permitted the oxidation and decanting of heavy minerals onto the bottom of the river and the return of birds that nested in the contaminated area of Entremuros.

On August 10, the Guadalquivir River Basin Authority put a treatment plant into work to reduce the levels of zinc, cobalt, nickel, manganese and iron, but the treatment was not fully efficient for other metals (very few concentration presented) such as arsenic, thalium and nitrogenous substances. According to the Ministry for Environment, the treatment of the accumulated toxic water was concluded on 31 August 1998.



Accumulated tailings close to the Aznalcóllar dam failure.



4 The Cleaning-up activities

Since the beginning of the emergency, the scientific experts stressed the importance of performing an efficient and rapid cleaning up of the material left by the toxic flood. This was the only way to prevent severe soil and ground water contamination, atmospheric pollution due to wind transportation of dried tailings, further surface water contamination due to soil lixiviation and further damages to the fauna living in the polluted area. The Scientific Council (CSIC) advisory group reported that it was of paramount importance to have most of the tailings removed before



Clean-up of Entremuros area.



Old Aznalcóllar mining pit before and after sludge deposal.

the onset of the autumn rains, which normally occurs in October, in order to avoid tailings transportation for rainfall infiltration or run-off.

The collection of the tailings started slowly on 3 May 1998 and was carried out by the main actors involved in the accident:

- **The mining company Boliden Apirsa** assumed the responsibility for cleaning the northern sector, close to the tailings lagoon and having an extent of 780 hectares. According to the company, the assigned area contained 80% of the tailings.

- **The Guadalquivir River Basin**

Authority (Ministry for Environment) had the responsibility to clean the riverbed, the zone located within the public hydraulic domain and Entremuros which summed up approximately 3000 hectares.

- **The Regional Government of Andalusia** took care of the removal of polluted soils in the remaining areas not belonging to the public domain, corresponding to 1,623 hectares. This surface does not include the Entremuros marshes, which required an intense cleaning up activity after the release of the accumulated water. According to the Guadalquivir River Basin Authority, this zone did not fall within its jurisdiction because it does not belong to the original Guadiamar riverbed, which, before the construction of the artificial banks in the 1950ties, flowed to the west of the Entremuros area.

As an emergency measure, it was decided to use the abandoned Aznalcóllar open pit for sub-aqueous disposal of the removed tailings and soils. This was supposed to be a provisional solution, but in the following months the competent authorities issued the permit to Boliden Apirsa for using the Aznalcóllar pit as the definitive deposit of the tailings. The tailings were excavated together with part of the underlying soils and trucked to Aznalcóllar. The clean-up left a completely barren landscape since almost all the vegetation had to be removed together with the tailings. The CSIC advisory group repetitively criticised the technical means employed to carry out the cleaning operations. Indeed, the use of heavy machinery and trucks left significant amounts of toxic material on the ground and favoured the mixing up of tailings and soil. Moreover, tailings adhered to the machinery hires and spread on the whole area involved in the operations. According to CSIC, these inconveniences could have been avoided by using manual methods for the tailings removal, except for those areas where the thickness of the toxic layer or the ground characteristics made the machinery employment necessary. Despite this fact it was decided using heavy machinery in order to avoid that the tailings were swept along by the autumn rainfalls.

Another problem linked to the operations was the atmospheric pollution with toxic dusts. Also in this case, CSIC repetitively advised to use manual methods and to avoid working during the day, when the soil



The fast intervention of the administration and the non-stop 7 month cleaning-up activities of the sludge have facilitated in a great measure the restoration of the riverside wetlands and the alluvial plain that were affected by the mining spill.



Demonstration organized by WWF Spain for a better and more effective clean up.

Costs of the disaster remediation

According to the figures given out by the company, the dam failure cost to Boliden Aprisa approximately 96 million euro. This amount included the cost of the cleaning up of the northern sector of Guadiamar (27 M €), the acquisition of the harvest of 1998 (11 M €), the operations of decommissioning of the tailings lagoon (41 M €) and the loss due to the stop of the mining activity during 1998.

The Regional Government of Andalusia made available 145 M € for the disaster remediation. This budget was employed mainly for the cleaning-up operations for and the acquisition of the polluted land (48 M €) and for land restoration (90 M €).

The Central Administration (Ministry for Environment) approved a budget of 136.7 M €, out of which about 13 M € were employed for the tailings removal and 15 M € for the treatment of the toxic water accumulated in the Entremuros marshlands. As a consequence of the Aznalcóllar accident, the Central Administration has approved a hydric regeneration plan for Doñana that includes also the Guadiamar riverbed and has a global budget of 93.7 M €.

The total costs sum up about 377.7 M €.

is drier and the clean-up operations mobilise high quantities of toxic dust. The study of the Swiss-German consulting group Buser & Finger and Roth & Partner GmbH corroborated this concern. Their report, issued in July 1998 by WWF, warned against the heavy atmospheric pollution by toxic dust in the area and suggested wetting the ground before the tailings removal to reduce the tailings dispersion in the air.

In spite of the Co-ordination Commission the cleaning up activities were surrounded by “information pollution”, since many contradictory data were given out by official sources, often without a clear explanation and interpretation to make them transparent to the public. For example, instead of providing figures about the extent of the cleaned area, the competent authorities used to give out information about the volume of the removed material, which was a mixture of soil and tailings. According to the environmentalist NGO Greenpeace, after three months only 10% of the affected area had been cleaned up and, in consequence, a major demonstration in Madrid forced the Administration to improve the clean-up efficiency.

In December, a soil-sampling was conducted to verify the efficiency of the clean-up and its results led to the re-cleaning of 65 hectares. Moreover, a survey led by the Regional Government of Andalusia showed that some areas of the northern sector, the river bed and the gravel areas would have required a new and more detailed cleaning up in summer 1999.

According to official sources, until April 1999 7 Mm³ of material had been removed from the Guadiamar area and brought to the Aznalcóllar open pit.

During summer 1999 a second clean-up was undertaken targeting areas where the residual metal concentration did not meet the established quality requirements. According to Boliden Aprisa, in this second clean-up, approximately 200 hectares were re-cleaned and 1 Mm³ of material taken to Aznalcóllar.

Four years after the accident, a slow but continuous recovery of the flooded area can be registered in the Guadiamar area, although the very long-term accumulation of heavy metals and the appearance of lethal and sublethal effects in wildlife can not be ignored or underestimated. These damages to the wildlife are amplified by the fact that Doñana is habitat for a high number of protected species and by the fact that it is a very important resting site in the migratory routes that link Northern Europe and Africa. Some researchers have estimated that more than 5.000 geese have died since the accident. Thus the presence of heavy metals is going to be associated to the management of the area for many years. In addition to this,

the Agrio and Guadiamar rivers are still suffering from lixiviation of toxic material proceeding from the mining site, and from human activities that either alter the river recovery process (re-cleaning tasks) or contribute to further polluting the river (industrial wastewater).

5 Economical consequences

The area of Doñana is characterised by an economy strongly dependent on agriculture and tourism. Both activities have always taken advantage of the proximity of the Doñana Park, which transmits (or transmitted) an image of “ecological product” and unpolluted natural reserve to the consumers of agricultural products and tourists. For this reason, the Aznalcóllar accident had significant repercussions in the economy of all the Doñana surroundings.



Tourism: Guided visit to the National Park.



Agriculture: Abandoned irrigation area.

The Regional Government estimated that the indirect negative effects of the accident due to the distrust of the customers could be registered in several Andalusian provinces and affected important agricultural products such as the strawberry, the citrus and the rice.

The local association for tourism ACETA reported that in 1998 about 40% of the reservations for tourist visits were cancelled, which represented, solely for the visits within the National Park, a loss of approximately 480,000 €.

The agricultural sector was severely affected by the ecological damages, since more than a half of the contaminated lands were arable fields, declared as no more suitable for cultivation due to the residual soil pollution. After one year, the global losses estimated for the agricultural sector summed up 144.2 M €. Indeed, the accident implied the loss of the temporary employment related to the harvesting activities, the irrigation infrastructures inactivity, the expropriation of the arable land, as well as economical loss due to the cultivation prohibition.

Finally, the mining activity interruption at Los Frailes caused miners dismissals and significant economical losses to Boliden Apirsa, which could not meet mineral delivery obligations with its clients.

6 The mining operations

The private Spanish company Apirsa (Andaluza de Piritas, S.A.) started the exploitation of the Aznalcóllar mine in 1975, when it received the necessary permits by the Ministry of Industry. The project of the tailings lagoon, which was elaborated by INTECSA and approved by the Public Administration in 1978, planned the dam construction in 20 steps, according to the increasing amount of the tailings to be stored in. The first construction stage was 0.5 metre high, while the following ones had a height of about 1.5 metres each, up to 25 metres.

In 1994 Boliden Apirsa was accused by an environmentalist NGO to illegally use the mine tailings lagoon for the disposal of industrial waste produced in Huelva, but the local court dismissed the accusation for lack of evidence. In 1996 new accusations were presented against Boliden Apirsa: an ex-worker of the mine denounced negligence in the tailings disposal and the existence of toxic seepage from the lagoon into the Agrio river. Also in this case, the accusation was dismissed.

After the dam failure in the night of 25 April 1998, Boliden Apirsa had to stop the extraction and milling operation at the mine and, once the clean-up tasks had been organised, concentrated its effort in re-starting the mining activities as soon as possible.

On 10 October 1998 Boliden Apirsa asked the Regional Authorities for the permit to restart the works in Los Frailes. The authorisation was given on 26 October although the company had not yet presented a decommission plan for the failed tailings lagoon and no permit for the disposal of the tailings produced in the mining operations had been issued yet.

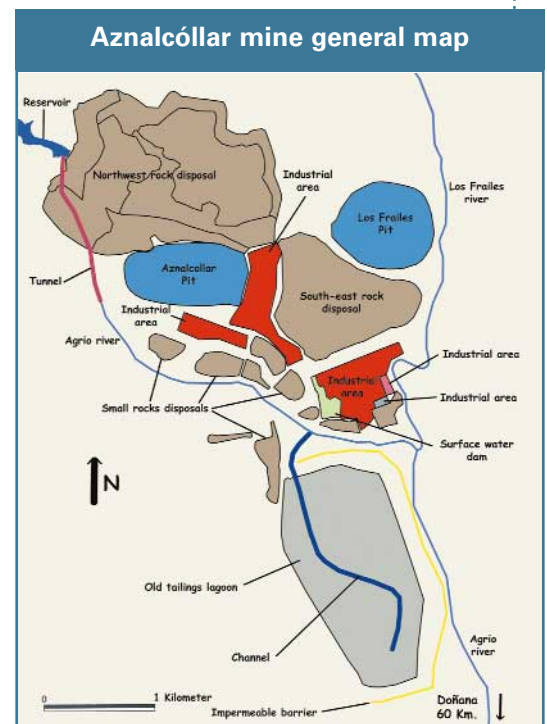
On 5 November 1998 Boliden Apirsa submitted an application to the Regional Government of Andalusia for authorisation for widening of the existing rock waste deposits and for using the depleted Aznalcóllar open pit as tailings disposal. The application was completed by a report by the Spanish company Aurensa and the US company Golder Associates stating the impermeability of the Aznalcóllar open pit and the suitability of the measures proposed to expand the waste rock piles and to decommission the failed tailings lagoon. As to a press release of Boliden Limited, the documents presented for the restart complemented and corrected the reports and studies presented for obtaining the permit in 1995.

The GeoMining Institute (IGME), the Guadalquivir River Basin Authority (CHG) and the Doñana National Park Board evaluated the scientific soundness of the application. The three bodies highlighted the low quality of the submitted documentation and, in some cases, asked for further studies. Surprisingly and in reference to the use of the depleted Aznalcóllar mine, both IGME and CHG considered the request viable, provided that the level of the materials within the pit (the tailings, sealed by 12 metres of water) would not pass the 0 level (a.s.l.), to prevent groundwater pollution.

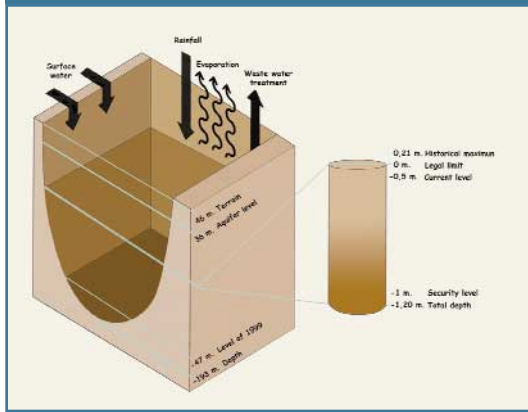
On the contrary, the first report of the Doñana National Park Board (January 1999) was against the request of Boliden Apirsa, being one of the reasons for this position the fact that the proposed restoration plan for the recovery of the area (once the mine is abandoned) was unsatisfactory. Nevertheless, an extraordinary session held at the end of February 1999 approved the re-start of the mine. The Director of the National Park, the Director of the Natural Park, the responsible for the Biological Station of CSIC, and WWF voted against this decision for considering the proposed approach as environmentally unsafe.

In February 1999 Boliden Apirsa asked for (and obtained) a temporary authorisation for using the pit for tailings disposal while the definitive permit was examined, since the Company needed to undertake restructuring in the mine before the operations re-start. In the document requesting for this temporary permit, Boliden Apirsa pointed out that it was the most important employer of the area and, if the mining activities could not be re-started soon, the region would have lost 400 direct jobs and 1,800 indirect jobs.

The final closure plan for the tailings lagoon was submitted for approval to the relevant Authorities in December 1999. The NGOs asked for a complete removal of the tailings from the sensitive riverine location. The company dismissed this solution due to its high cost and foresaw only the sealing of the lagoon, which still contained more than 13 Mm³ of tailings, through an impermeable seepage cut-off wall around the north and east side of the dam and a hydraulic barrier including a back-pumping system on the inside of the cut-off wall. The project was redrafted after some allegations and the company estimated to complete the decommissioning operation by October 2000.



Increasing levels of the Aznalcóllar mining pit



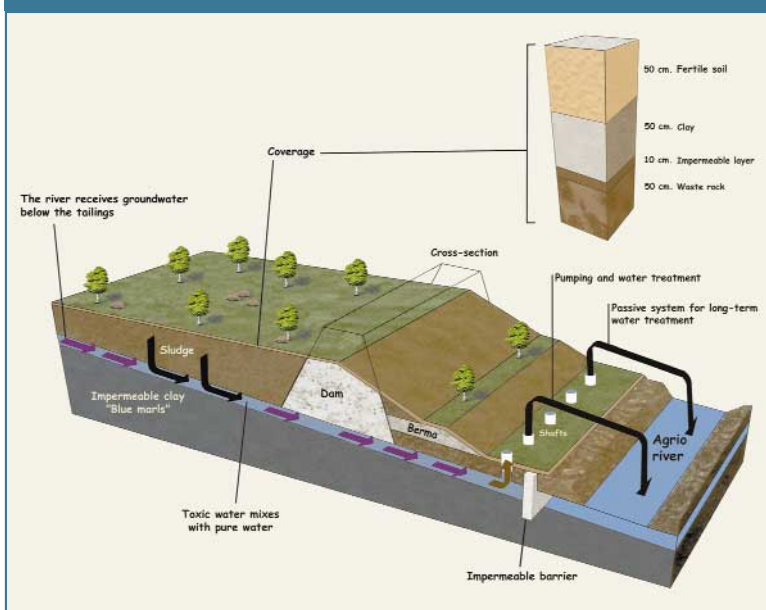
On 1 April 1999 Boliden Apirsa announced the restart of full operations at its Los Frailes mine. Apirsa had received all the necessary permits on March 24th. The Spanish Authorities had set as a condition for the use of the Aznalcóllar pit as tailings disposal, the deposit by Boliden Apirsa of a warranty for meeting environmental responsibilities.

In February 2000 Boliden Apirsa presented an application for raising the tailings level in the open pit to +35 metres a.s.l. (with the water seal, the level would have reached level +41 a.s.l.) and, for extending the rock waste dump, in order to be able to continue to exploitation of the mine until 2009. On suggestion of

WWF, Boliden Apirsa decided to build a plant to treat the toxic water produced by the milling operations and “allegally” stored in the Aznalcóllar pit. This operation cost about 2.4 M € and permitted to reduce the water level in the pit by releasing the treated water into the Guadiamar river.

At the beginning of October 2000 Boliden Limited made public that its Spanish subsidiary had decided to interrupt its mining operations on 31 October 2001, when it expects to have completed the mining out of Los Frailes pit. A press release issued by Boliden Limited informed that Apirsa had filed a claim for bankruptcy protection, in order to preserve assets, pay creditors and reach an agreement with its current employees. The same source informed that the pushback of a new pit would have required the expenditure of 28.9 M € and Apirsa had no financial

Transverse cut of the restored tailings lagoons



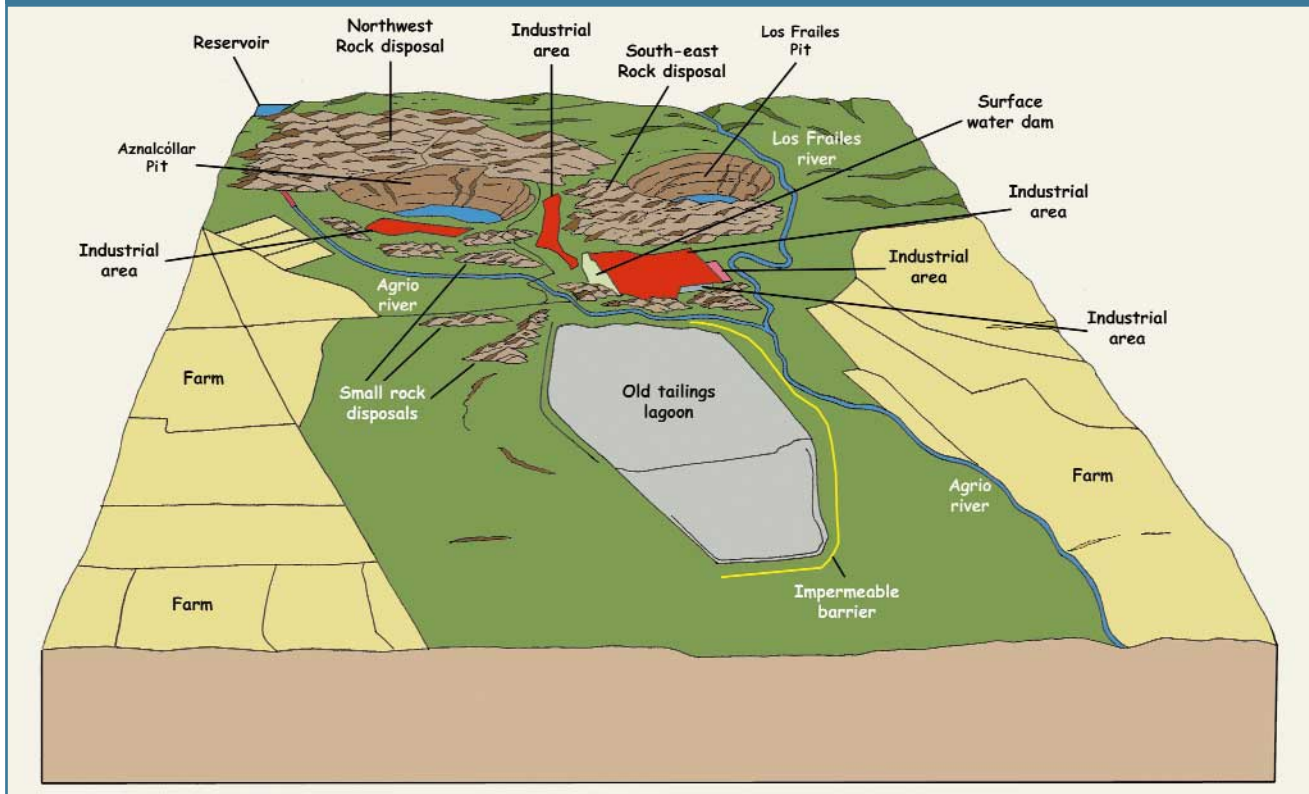
resources to undertake such expenditure, nor Boliden Limited was prepared to make any further investment in Apirsa. According to the figures given out by Boliden Limited, the losses of the Company for the period 1997-2000 summed up to 118 M €.

In the meantime, Boliden Apirsa has been reducing effectively its ecological footprint in the area by reclaiming approximately 30% of the 780 hectares covered by the mine. This includes the decommissioning of the old tailings lagoon, the covering of the east dump (80 hectares) and the covering and revegetation of a larger number of small dumps, mostly those close to the Agrio river and that could have a higher impact on the downstream aquatic environment due to the washout of metals.

Anyway, there are severe doubts about the restoration plan that Boliden Apirsa launched in July 2001. All involved institutions – Guadalquivir River Basin Authority, National Park Board, Environmental Bureau – criticised the lack of data and concrete projects. Environmental risks will still continue due to the insufficient sealing of the old tailings dam (southern borders) and the rock dumps especially. A report made by the Madrid Mining University Department for WWF criticised the management of the sludge and acid water in the old mining pit that might pollute the aquifer of Seville in about 75 years time. There lack about 42 M € for effective restoration.

In February 2002, the Department of Employment and Technology has approved a provisional Plan of Desertion and Security of the mine. This plan expects to avoid new environmental disasters and its execution has been assumed in a subsidiary way by the Regional Government of Andalusia during a limited period of time.

Three-dimensional scheme of the mine



Regarding the mine, Boliden Apirsa had received several offers but none concluded with success. The mining company abandoned Aznalcóllar in December 2001, suspending payments, sacking 425 workers and leaving behind an environmental deficit of 298 M € without undertaking the appropriate mine closure. At the current moment measures such as the early retirement of 72% of the staff and the employment of the remaining 121 miners in the restoration tasks are being considered.

The role of the Aznalcóllar mine in the local economy

The mine of Aznalcóllar is located in an economically deprived area and it is the main employer in the zone. At the time of the accident, it employed about 400 persons and, according to the estimates of Boliden Apirsa, it indirectly permitted the employment of 1,800 people. Undoubtedly, this dependence of the local economy on the mining operations had an important weight during any negotiation of the company with the Public Administration, since hampering the mining activities meant the dismissal of a high number of workers.

Due to this economical dependency, Boliden Apirsa could benefit from important amount of public subsidies ensuring, in exchange, the employment of its miners. In 1992, when Boliden Apirsa informed that the Aznalcóllar pit was going to be mined out and abandoned within few years, the Public Administration funded 20% (37.6 M €) of the works needed to open the Los Frailes pit and ensure the future of the mine.

In 1994, the Public Administration assigned 37.7 M € to the company for the period 1994-1998. The funds were provided by the Ministry of Finance (20.7 M €), the Ministry of Industry (9.4 M €), the Regional Government of Andalusia (7.5 M €). To receive the subsidies, Boliden Apirsa had to commit to employ its 420 workers, continue its mining activities and justify the expenditures of the public funds. The deadline for the subsidy payment was 31 December 1998, when Los Frailes had to be open and active. At the time of the accident, Boliden Apirsa had already received 18 M €, but it could receive the remaining amount only in 1999, after the reopening of the mine.

7 The legal actions

The stability and the impermeability of the dam of Los Frailes had been submitted to administrative and judicial investigations already before the accident of April 1998.

In 1995 a mining engineer, former responsible for loading and transport at the Aznalcóllar mining site, and a former contractor of Boliden Apirsa filed to the competent authorities a document about the status of the Los Frailes tailings lagoon. They reported the existence of toxic water seepage from the lagoon which were causing severe pollution of the Guadiamar river and pointed out the worrying stability conditions of the tailings pond. According to the mining engineer, there had been severe errors and deficiencies in the works for the increase of the dam height, such as the use of non-adequate material, the lack of filters and drainage network and the use of not suitable machines for performing the works.

The competent authorities appointed IGME to investigate about the soundness of the accusations and asked Boliden Apirsa for clarifications about this issue. In January 1996 the environmentalist NGO



Accumulation of tailings in the Aznalcóllar old mining pit.

Ecologistas en Acción presented an accusation based on the 1995 report. In March 1996, the mining company submitted a report elaborated by GEOCISA stating that the pond was safe and the case was closed for lack of evidence.

After the accident of 25 April 1998, a number of persons were asked for penal responsibility and the preliminary investigation was opened at the court of Sanlúcar La Mayor (Seville). The accused were six employees of Boliden Apirsa, twelve technicians of the Spanish company GEOCISA, two civil servants of the Industry Department of the Andalusian Regional Government and one of IGME. Today it belongs to the Ministry of Science and Technology.

The choice of the court of the Sanlúcar La Mayor village was severely criticised by the plaintiffs and environmentalist NGOs. Indeed, this court is at the lowest jurisdiction level, which implies that any decision taken at that level can be appealed in several higher-ranked courts. The court of Sanlúcar La Mayor lacked administrative and logistic resources for hosting the case due to the significant amount of documents to be analysed and the number of lawyers that needed to access the documentation of the case. Trivial practical problems such as having 7-volume expert reports photocopied for all the involved lawyers or making available enough place for the lawyers to analyse the documentation slowed down all the activities of the preliminary investigation. Another source of concern related to the Sanlúcar La Mayor court was the fact that the judge in charge of examining the case was the same that had closed for lack of evidence the investigation related to the accusation filed by Ecologistas en Acción in 1996.

The lawyers of Boliden Apirsa submitted the result of the investigation carried out by the Spanish company EPTISA to the examining magistrate. This report stated that the cause of the accident was an unforeseeable slide in the marl layer under the collapsed dam. According to EPTISA, this was due to calculation errors in the construction of the original lagoon by GEOCISA in 1978.

The investigation of the judicial experts partially confirmed the report submitted by Boliden, although it specified that the original project followed the techniques of the civil engineering of the 1970ties and the project for the dam height growth of 1996 had implemented no technical improvement to it.

On 22 December 2000, after almost two years of preliminary investigations and just at the beginning of the Christmas holidays period, the examining magistrate of the Sanlúcar La Mayor court dictated that the accident had been not fraudulent nor was it due to negligence. This implied that there was no crime to be attributed to and, consequently no penal responsibility to be identified.

The representative of Boliden Apirsa welcomed the result of the preliminary investigation by underlining that the ruling had confirmed that the Company was “innocent of wrongdoing”. WWF pointed out that this solution was favourable for the Public Administration. Indeed, it avoided searching any other subsidiary responsibility regarding the mining permits and authorisations given by the Competent Authorities disregarding several formal complaints and accusations filed by individuals and ecologist organisations in the years prior to the Aznalcóllar accident.



Boliden mine area.

Several organisations and institutions have already appealed against the ruling, but a court decision from November 2001 closed the door on further criminal proceedings against Boliden. Presently, the opening of a civil responsibility process is expected soon.

Legal Responsibilities in the Spanish Environmental Law

- **Penal Responsibility.** This type of responsibility can be attributed only to a physical person. The result of the preliminary investigation issued by the Sanlúcar La Mayor court states that there is no crime to be attributed to.
- **Civil Responsibility.** This implies the reparation of damages and financial compensation of the affected people. To be recognised, it is necessary to have fault or fraud. If the accident is due to force major, there is no civil responsibility. This type of responsibility is called “subjective civil responsibility”, since it is necessary to demonstrate the fraud. For this reason, only if the appeals to higher-ranked courts succeed in identifying fraud in the Aznalcóllar accident it will be possible to start the process for the identification of civil responsibilities.

In 1998 a new law considering the environmental civil responsibility as objective (no need to demonstrate the fraud) was proposed, but after two years, it is still a draft proposal. The legal representative of WWF believes that until this change in the penal responsibility ruling is not implemented, it not possible to have a real application of the “who pollutes pays” principle.

- **Administrative Responsibility.** The penal stopped the sanctioning process opened by the Guadalquivir River Basin Authority. Once the penal process has been stopped, this institution has re-started the administrative process where the “happened” has been typified as heinous crime. Thus the most elevated fine will be imposed allowed by the Water Law. In addition to these facts, Boliden will have to indemnify for the damage provoked to the public hydraulic domain and will be demanded the payment of the cleaning-up activities’ costs.

8 Overview of the main actors

Boliden Apirsa S.L. is a subsidiary of Boliden Limited that was established in 1987, when Boliden Limited acquired the Aznalcóllar mine and the Spanish private Company Andaluza de Piritas S.A. At present, the Swedish industrial group Trelleborg owns 42% of Boliden Apirsa, but the company is under suspension of payments. **Boliden Limited** is a Swedish-Canadian company that presently carries out mining activities in 14 mines on four continents and it employs close to 6,000 employees.



Vehicle used by the Regional Government of Andalucía as supporting for emergency situations.

The **Ministry for the Environment** generally intervenes through the Guadalquivir River Basin Authority, the National Parks Administration and the Department of Environment. The three of them co-manage the Doñana National Park. The Ministry is responsible for the clean-up operations of the public hydraulic domain, the “Doñana 2005” marshland restoration project.

The **Guadalquivir River Basin Authority**, is a public body belonging to the Ministry for the Environment, and is in charge of the management of water resources in the Guadalquivir river basin. Its territorial responsibility is on the public hydraulic domain and it regulates surface water and

groundwater protection, being one of the main regulators of the mining activity. It is responsible of monitoring the waters’ quality of all the rivers belonging to the Guadalquivir basin, including the authorisation of the spill of the mining activity.

In relation with the Aznalcóllar accident, the **Regional Government of Andalusia** acts mainly through three different Departments. The Department of Employment and Technology (formerly Industry and Employment) is the supervising authority for all mining activities and the main permits. The Department of Environment has jurisdiction on the Doñana Nature Park and the Environmental Impact Studies concerning the mining activity. It also launched the Guadiamar “Green Corridor” restoration project to ensure environmental rehabilitation. Finally, the Department of Agriculture has actively participated in the clean-up of agricultural land.

The **Doñana National Park Board** is the participatory board of the National Park. It is composed by 39 representatives from National, Regional and Local authorities, Universities, Scientists, Conservation NGOs and landowners, and it approves non-binding preliminary reports on all the projects linked with the National Park and its surroundings.

The **GeoMining Institute** (IGME), is a scientific-technical body specialised in geological, geochemical and mining issues and belonging to the Central Administration. In relation to the Aznalcóllar mine, it issued reports regarding the dam stability before the accident and it advised the public Administration about the use of the Aznalcóllar depleted pit as waste disposal.

The **Spanish Research Council** (CSIC), is a research body belonging to the Central Administration and covering a wide range of scientific fields. CSIC co-ordinates the scientific advisory group created ad-hoc for the follow-up of the mine disaster. Up to now, this group has produced 13 reports about the spill and its consequences on the environment. All these reports are available in Spanish at the CSIC web site. The **Doñana Biological Station** (EBD) is part of the CSIC. Its Director co-ordinates the research in Doñana National Park.

9 The restoration actions

As a consequence of the accident, in 1999 the Regional Government and the Central Administration have launched of two important restoration programmes aiming at repairing the damages of the toxic flood and improving the ecological conditions in the whole Doñana area: the Guadiamar Green Corridor and the Doñana 2005 Plans.

The Guadiamar Green Corridor promoted and funded by the Andalusian Regional Government, aims at the restoration of the Guadiamar basin and the reestablishment of an ecological corridor between the



Restoration works of the vegetation affected by the sludge in the Guadiamar area.



Pupils from a school visiting the Green Corridor in the third anniversary of the dam failure.

mountainous area of Sierra Morena and the littoral systems of Doñana. At the same time, the programme seeks the improvement of the quality of life of the Guadiamar basin inhabitants, by developing a socio-economical system that is environmentally sustainable and integrated into the natural context. The programme has received the support of the American Agency for Environmental Protection, the European Council, the International Union for Conservation of Nature, the Environmental European Agency and conservation NGOs, due to its integrated and scientifically sound approach and to the importance given to the public participation for the achievement of the programme objectives.

WWF fully supports the Green Corridor because, in line with the European Water Framework Directive, it covers the whole riverine system – from the source to the river month -, and it strives to respect the natural dynamics of the riverine ecosystems. Nevertheless, WWF is aware that that the programme success is threatened by several factors: the to-date deficient decommissioning plan for the tailings deposits in Aznalcóllar, the continuous seepage of lixiviation liquids from the mine, the uncontrolled industrial waste water discharged into the Guadiamar river and the current delay in the establishment of a legal protection status for the area.

The Marshlands Restoration Project “Doñana 2005” funded by the Ministry for Environment promotes the restoration of huge extension of degraded areas (the *Galician Marshlands* and *Caracoles* among them). It aims at the hydric regeneration of the watershed and river bed flowing into the marshland of the

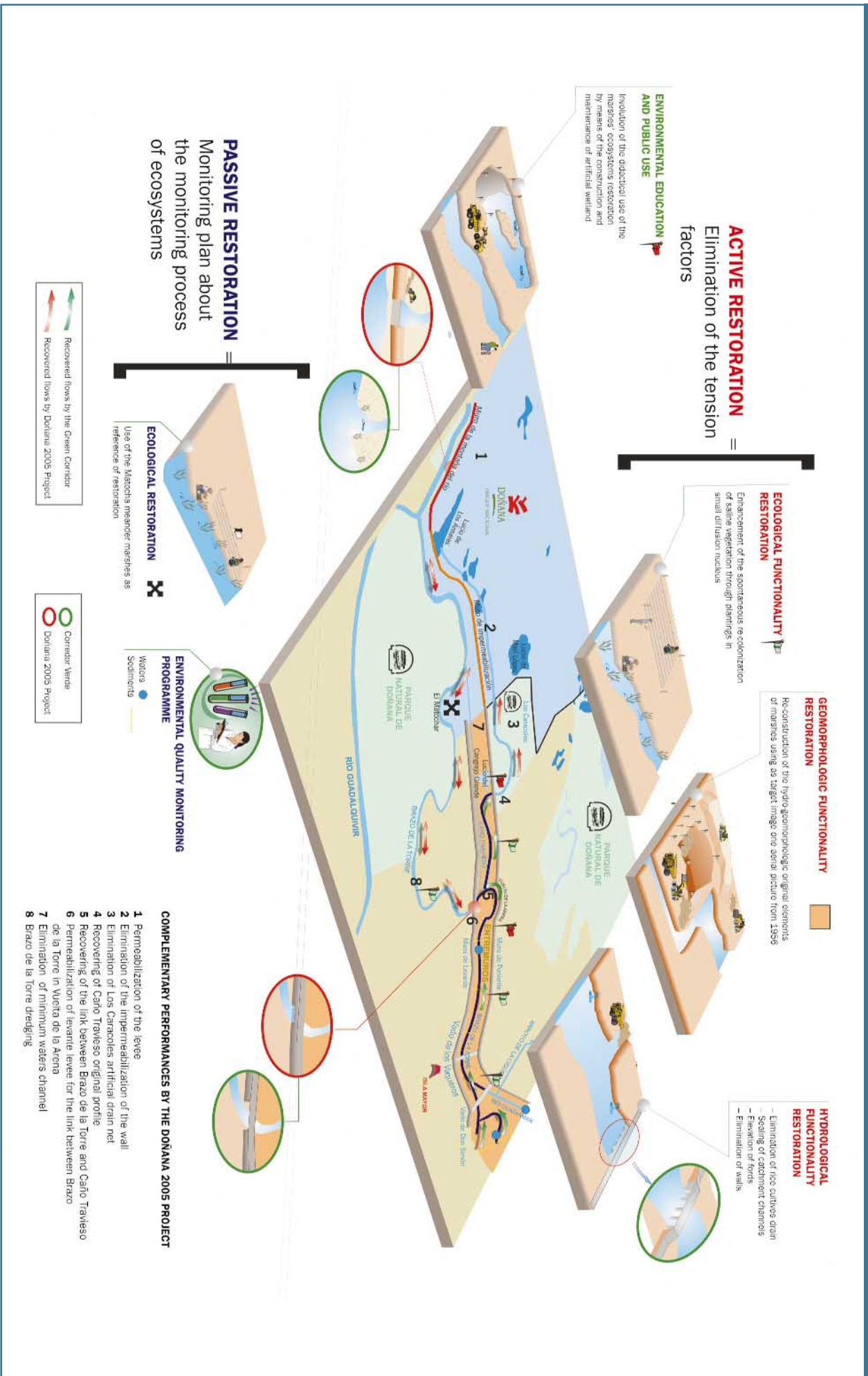
Doñana National Park, in order to recover the hydric supply to the marshlands, ensure the needed quality and quantity of the water and stop

the degradation of the wetlands. Eight concrete actions are planned in this project which four of them have already been successfully carried out. The project is advised by the scientific group of experts which is also approaching presently other issues linked such as the situation of the groundwater body, the public participation and the monitoring.

WWF supports the initiative and considers it as a great opportunity to improve the environmental situation in Doñana. **Doñana 2005** is the most important wetland restoration Project ever undertaken in Spain, both for its budget (93.7 M €) and for the extent of its target area.



Esquema de la restauración ecológica



The two restoration plans – Green Corridor and Doñana 2005 – are deeply interrelated, especially in the Guadiamar river, where they pretend to restore the two main ecological functions of the river: to be an ecological corridor and the main water provider of the Doñana marshland. Unfortunately, political divergences hampered the necessary collaboration of the two programmes, which undermined the success of the whole restoration initiative. At the end of March 2001 an encouraging step towards the co-ordination improvement was taken, by creating a Co-ordination Commission and the establishment of a joint scientific assessment board

10 Mining's legal framework in Europe

The Report on “Toxic waste storage sites in EU countries” (1999) commissioned by WWF and elaborated by the Free University Amsterdam in 1999, shows that the mining activity management is an issue having a European dimension. Indeed, significant metal mining activity is being carried out in four EU Member States (Finland, Greece, Sweden and Spain), while minor mining sites are active in Austria, France Ireland and Portugal. In other Member States, the past mining activities have left abandoned mines and waste disposals that need to be monitored and managed to avoid environmental damages.

Undoubtedly, the most delicate aspect of the metal mining is the management of the resultant toxic waste (tailings and water) and the decommissioning of the depleted sites. The World Bank's 1998 “Environmental Assessment of Mining Projects” points out the potential detrimental impact of metal mining in general, both on human health and the environment, and rates the management of tailings as one of the most significant environmental threats from mining operations. Solely in Europe, evidence of significant accidental pollution problems caused by leakage and spillage from mine tailings lagoons and by abandoned mines (acid mine streams) can be found in at least five Member States (Spain, Italy, Portugal, Sweden and United Kingdom).

In spite of the significance of the problem and of the existence of active or inactive mining site throughout the European territory, no inventory of active and abandoned metal mining sites exists at a European level, nor common guidelines for the national mining legislation have been defined so far.

In this context, WWF presented an Action Plan (April 1999) to prevent unregulated, accidental pollution from metal mining activities. It asked to draw up an EU comprehensive public inventory of



Aquatic fauna affected by the mining accident in Baia Mare, Rumania.





The toxic flood reached more than 2 m above the water in several places, as can be appreciated in the picture for the darker tone of the plants.

(active and abandoned) metal mines, to develop a Community Action Programme on “Responsible Mining Waste Disposal” in partnership with the mining industry and environmental organisations and to set up a specific Community legislative framework on “Mining Waste Management”.

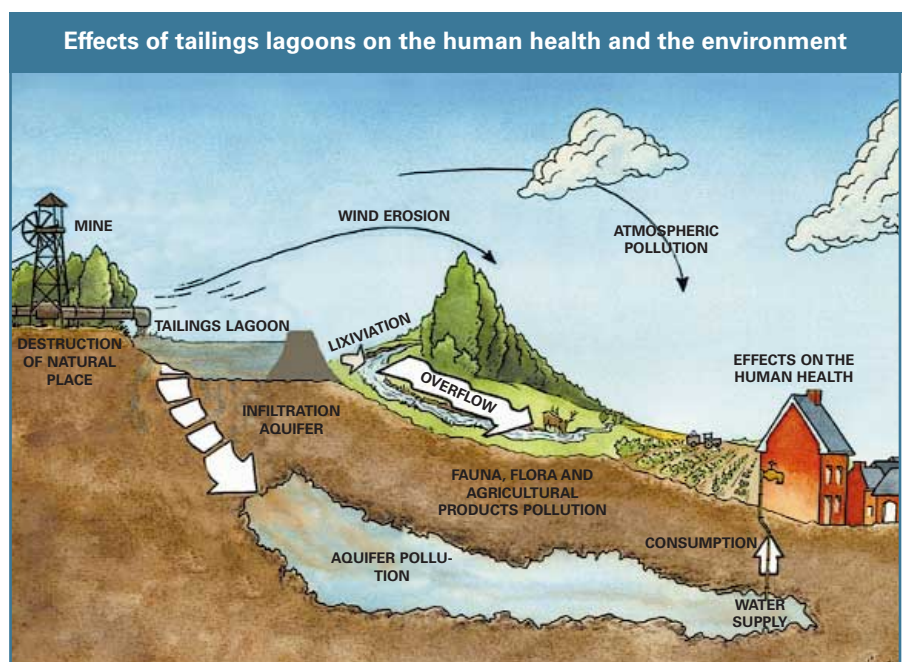
Bearing in mind the global footprint of mining activities and the existing network of multinational companies, WWF also required ensuring that any standard developed at a EU level is transferred to mining activities carried out by European mining companies elsewhere in the world.

Since then and moved by further tailings dams failures in Europe¹, the European Union has developed specific work plans, including DG Enterprise and DG Environment. The “Raw Materials Supply Group” (lead by DG Enterprise) has been defining how the “sustainability” concept can be applied in mining operations. In March 2001 the debate about the Communication on “Safe operation of mining activities: a follow-up to recent mining accidents” (COM (2000) 664 final) has begun, in order to amend existing pieces of EU environmental legislation. The objective of the debate is the definition of measures that can prevent the negative impacts of mining activities, and the development of a new piece of EU environmental legislation regulating all the aspects of mining waste management, in particular the use of tailings lagoons. The European Parliament supported all these new legislation proposals of the European

Union in order to increase the environmental protection related to mining activities. One of them, the forthcoming Directive about Management of Mining Tailings is in draft phase at the current moment. The other one, the revision of the Directive about the monitoring of industrial accidents (Seveso Directive II) was introduced by the European Commission to the Parliament and the European Board at the end of 2001. New law is estimated to be in force in the European Union from 2003 on.



Dead fishes found in Baia Mare, Rumania.



11 The role of WWF

The World Wide Fund for Nature started working at Doñana in 1961, when the marshlands were recognised as outstanding wetlands of international importance and, in 1964, it acquired 6,704 hectares of land, forcing the creation of the National Park. At present WWF is still owner of the Guadiamar Reserve at the Doñana's National Park core.

Since the establishment of the Park, WWF has been active in conservation and implementing solutions to avoid further desiccation of wetlands and uncontrolled tourism development. Today's project objective is to establish Doñana as a model for ecological restoration, nature conservation and sustainable development.

Since the Aznalcóllar accident, WWF has deployed its efforts in monitoring and advising the remediation of the damages and in avoiding that similar disasters can occur again in the future, in Doñana or elsewhere. Thus, WWF has striven to establish a constructive collaboration with all the actors involved in the disaster, assessing and improving the technical solutions to be implemented in the Guadiamar basin. In addition to this, WWF has forwarded questions in Parliament and mining legislation proposals both at a national and a European level.



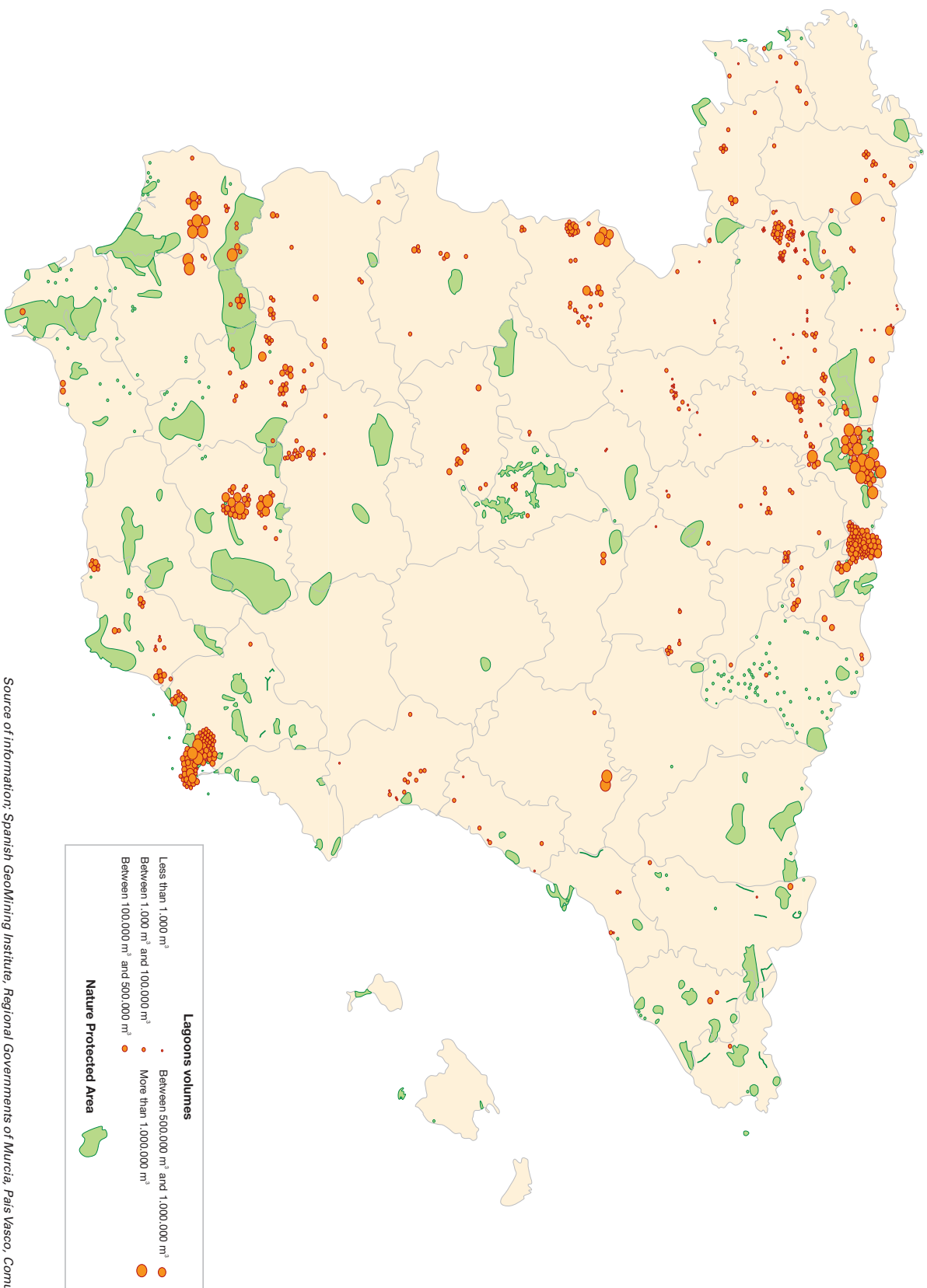
Experts from WWF and the Regional Government of Andalucía in Entremuros.

Immediately after the Aznalcóllar mining disaster, WWF requested the Spanish Prime Minister for the logistical support of the army to ensure the clean up of tailings and gathered 30,000 signatures asking for a rapid and efficient intervention. Further on, WWF asked the European Commission to create a group of experts from DG Environment verify how the cleaning-up works were being performed.

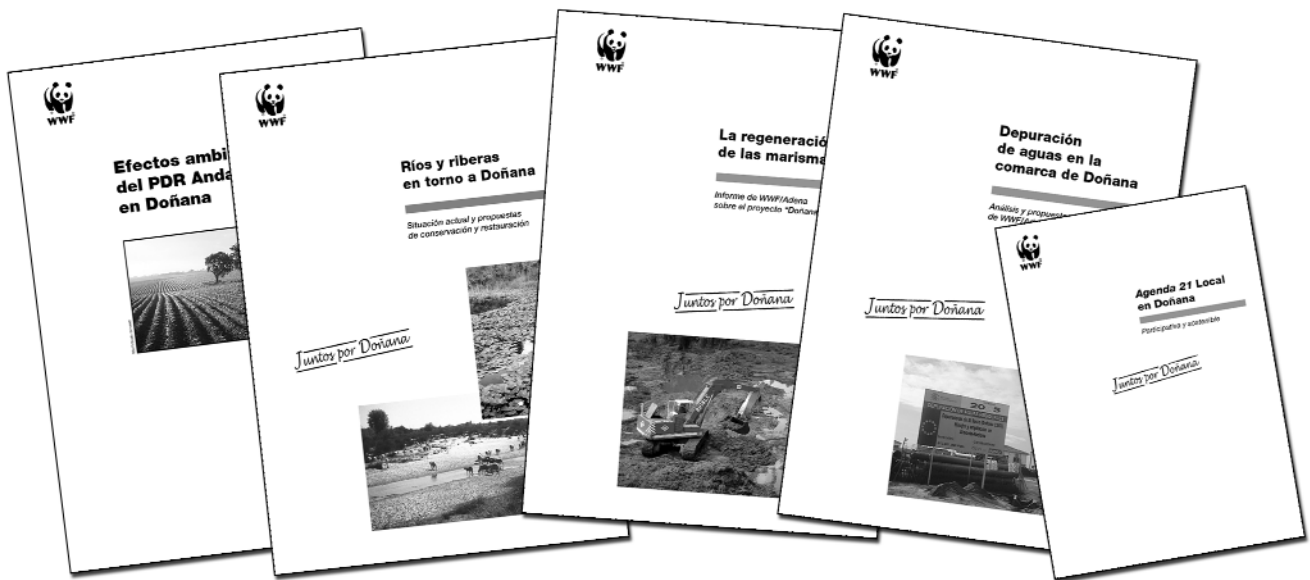
WWF followed with special attention the restart of the activities at the mining site. It presented allegations to the request of Boliden Apirsa for using the depleted Aznalcóllar pit as tailings disposal, to the corresponding Environmental Impact Assessment and to the project for the impermeabilisation of the Los Frailes pond.



WWF considered too rush the approval of the lagoon sealing without knowing the cause of the accident. In a "Statement for Doñana" of October 2000, WWF expressed its concern for the bankruptcy protection process started by Boliden Apirsa and the possible consequences of it: no proper conclusion of the mining site restoration due to lack of financial resources and evasion of environmental liability for the caused damages.



Source of information: Spanish Geomining Institute, Regional Governments of Murcia, País Vasco, Comunidad Valenciana and Principado de Asturias.



WWF commissioned studies for supporting the technical and scientific soundness of its proposals and actions. In July 1998, the consulting companies Buser & Finger (Switzerland) and Roth & Partner (Germany) examined for WWF the progress of the clean-up activities in the Guadiamar Catchment and formulated concrete proposals for improving the operations efficiency. Further on, the study suggested the removal of all the tailings remaining in the lagoon to a geologically more stable location. In 2001, the Mining Department of the Madrid University analysed the Restoration Plan for the Mine as an independent assessment for WWF.

Regarding the restoration efforts, WWF contacted the European Council, the European Commission, UNESCO and the Ramsar Convention, asking them to urge the Spanish authorities to fulfil the international commitments for the restoration of Doñana. Presently, WWF supports the Guadiamar “Green Corridor”, which it considers as the most relevant and environmental sensitive riverine restoration example in Spain, by actively participating in it as a member of the Green Corridor Assessment Board. As for the “Doñana 2005” restoration project, WWF has made several proposals to improve the Project (e.g. by reports on the ecological status of rivers and floodplains in Doñana and the water treatment efficiency) and works for creating the desirable collaboration between this restoration plan and the “Green Corridor” programme.

12 Conclusions

From WWF point of view the most highlighted aspects of the mining accident and its consequences have been as follows:

Legislation and social context

- There is no penal liability as consequence of the worst environmental disaster ever happened in Spain.
- Inappropriate legal frame. Proofs have not been looked for in order to determine guilty and responsibilities.
- Increment of the public opinion about environmental problems related to mining operations and opening of a debate about changing the mining-environmental legislation.

The accident, clean-up and restoration activities

- Political and social chaos after the accident, emphasizing mutual accusations and lack of information related to toxics and metals in the tailings.
- Lack of institutional co-operation in spite of having created an Official Co-ordination Commission
- Urge and precipitate implementation of different clean up techniques of tailings and polluted water.
- Start of important restoration projects of the marshlands and the affluent basins. The Green Corridor Project is supported by scientific knowledge and social participation. It is based on a convenient implementation of Ramsar's recommendations. The Doñana 2005 Project embraces huge area of the marshlands and it is also starting a process of restoration of basins and aquifers.
- Updating of exhaustive and rigorous information compiled by several institutions. This is produced due to there was lack of information about trends.

The mine

- The accident was foreseeable to a certain extent. The ecologist ONG *Ecologistas en Acción* warned about the leakages in 1996.
- The re-start of the mining activities in 1999 was authorised in 1999 without the necessary details, taking up office.
- The sole argument in favour of the restarting of the mine activities was getting jobs for the staff again. Behind this was the motivation of Boliden Apirsa, which wanted to take advantage of the situation getting the European subsidies for employment.
- The post management of the tailings was made in a too fast way. The deposit thought to be consumed in 9 years was made just in two, with a natural insufficient administrative supervision.
- The Restoration Programme is not sufficient at the moment in order to eliminate the risks of the lixiviation of metals, the leakages of the lagoon and the pollution of the aquifer, through the left pits.
- The environmental deficit provoked by the accident reach the figure of 298 M €. 42 M € must be added to this amount in order to make an appropriate restoration of the mine. Up to the moment, the public administrations have set aside the 55.29% of the costs.



Doñana Surroundings land flooded by tailings and acid water.

Learned lessons

The most important learned lessons from the accident are the following:

- Need to know the possible environmental threats from mining lagoons in further detail and the post implementation of prevent actions.
- Necessity to strengthen the mine legislation due to the inappropriate environmental management of the Aznalcóllar mine before and after the accident.
- The good practices in cleaning up activities techniques of the sludge have reduced the pollution levels of the affected area.
- Opportunity to create new restoration projects and to implement the Ramsar Convention Recommendations.

More information

www.boliden.se
www.cap.junta-andalucia.es
www.cedt.junta-andalucia.es
www.chguadalquivir.es
www.cma.junta-andalucia.es
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www.csic.es
www.mma.es
www.panda.org
www.wwf.es



Juntos por Doñana

There are thus many and diverse problems which affect Doñana and its environment; but as indicated by the title of our project —“*Juntos por Doñana*”— we cannot carry these tasks out by ourselves. We need collaboration, dialogue, and consensus from EVERYONE so that we can save Doñana.

If you want to collaborate, would like more information, or have a project which you think we could help you with, please don't hesitate to contact us.

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