Report on the situation of the Aznalcóllar Mine and the Guadiamar Green Corridor

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1. The Aznalcóllar Disaster.

On April 25, 1998, more than forty meters of the retaining wall of a tailings lagoon in the Aznalcóllar mine broke down. This wall was used to store pyrite tailings from this exploitation, owned by the Canadian-Swedish Company Boliden Limited.

The Agrio and Guadiamar rivers were immediately flooded with two billion liters of tailings with a high metal content from the pyrite flotation process, and another four billion liters of acid water filled with dissolved heavy metals.

The spill affected a branch of the Guadiamar river basin measuring 62 kilometers long with a width of between 500 and 1000 meters. It stretched from Aznalcóllar to the final branch of the Entremuros marsh, bordering the Doñana National Park. A series of retaining walls constructed by the administration, were able to keep nearly all the spill from entering the Doñana National Park.

The thickness of the tailings varied: in the areas adjacent to the lagoon, it was more than three meters deep, while at the entrance to the Entremuros marsh, the layer was only a few centimetres thick. Downstream of this point the marsh was only affected by the contaminated water.

In all, the affected area, according to official data, was 4.634 hectares.

The effects on the flora and fauna of the riverbed were immediate. Nearly all flora disappeared. In regard to fauna, the fish, crabs, amphibians and several bird species were severely harmed.

In economic terms, 3,000 hectares of agricultural lands were affected, and all mining activity was paralyzed. Later on, all fishing, hunting, and grazing in the affected area was, and is to this day, prohibited.

The Regional Government of Andalusia has invested some 165 million Euros in the cleaning, restoration, and investigation of the Green Corridor.

2. Plan of Emergency Measures to control and minimize the social, economic, and environmental impact generated by the spill.

The next step was to initiate a Plan of Emergency Measures, which involved the Spanish Authorities, the Regional Government of Andalusia, and the Boliden Apirsa.

On May 1, 1998, a Mixed Commission of Coordination was created among the different administrations. As its first measure, it decided on the urgent removal of the tailings that were deposited in the old section of the mine.

The removal of the tailings was carried out in two campaigns, one in 1998 and the other in 1999. As a result, 99% of the tailings have been collected, meaning a total of 7000 million liters of contaminated material (soil and tailings) have been removed, according to the Department of Environment of the Regional Government of Andalusia.

Another program was carried out which involved the treatment of soil through a chemical procedure to immobilize the heavy metals remaining in the soil.

The construction of the Entremuros dike resulted in the retention of two billion liters of acid water. A water treatment plant was constructed next to the dike that allowed the Guadalquivir River Basin Authority to purify the dammed waters and to discharge it later to the estuary of Guadalquivir.

Another emergency measure taken was the control of the environmental quality in the surface waters, the subterranean waters, the estuary, the air and the living beings, in addition to a sanitary control program of the population of the area affected by the spill.

This whole process was established in a series of laws, decrees and orders that were published from May 5, 1998 to 1999. In an accord of May fourth, the Council of Ministers of the Regional Government of Andalusia approved the actions necessary for the execution of a project of regeneration and adaptation for public use called the Guadiamar Green Corridor. The properties affected by the spill were declared of urgent occupation, to the effect of compulsory purchase.

3. The development of the Green Corridor (1999-2003).

The Guadiamar Green Corridor project has been established as a means of restoring the Guadiamar basin and its ecosystems, as represented in a plan of action (Guadiamar Green Corridor Strategy), supported in the conclusions of the International Seminary on Ecological Corridors which was held in Seville in March of 1999. It is also represented in the results of an investigation program specific to this area, known as PICOVER, developed between 1998 and 2002, whose conclusions have been published by the Regional Government of Andalusia. The presumed total of the PICOVER program is 5.8 million Euros. It was divided into two phases. During the first phase (1998-2001) the effects of the spill on the affected organisms and ecosystems were studied and the guidelines and criteria for restoration were established. The objective of the second phase, developed during the years 2002-2003, was the control of the elements most affected by the spill (water and soil) and attention to species considered to be the best bio indicators (plankton, macro invertebrates, plants, fish…).

The Guadiamar Green Corridor Strategy was begun in 1999 and is currently not entirely complete. The situation is fully evaluated in point number five.

4. Objectives of the Plan of Action of the Green Corridor

To be able to evaluate the state of the Green Corridor, it is necessary first to know the objectives that were emphasized in 1999 in the Green Corridor Strategy.

- Decontamination of the soil, water and organisms of the fluvial riverbed and of the flooded plains and the marsh damaged by the tailings and acid water.
- Restoring the functionality of the aquatic and terrestrial ecosystems damaged or destroyed by the spill.

- Promoting a model for the management of the multiple uses of the territory in order to promote considerable ecological heterogeneity, reinstating the flood of species and natural processes between the mountain range and the coast.

- Improving the quality of life of the inhabitants of the area through strategies of development compatible with the conservation of the functions of their natural systems.
- Contributing to the transformation of the Network of Protected Natural Areas of Andalusia, as a network of areas connected through ecological corridors, among which the fluvial ones stand out.
- To serve as a model of integrated planning of a Mediterranean basin that can be extrapolated to other areas and regions.

5. Current Situation

Objective no. 1.
To decontaminate the soil, water and organisms of the fluvial riverbed and of the flooded plains and marsh damaged by the tailings and acid water.

Soil.
According to the existing data, the decontamination of the soil has been effectively carried out and the levels of metals are less than that established by the Regional Department for the Environment according to the legislation. For the most part, the residual heavy metals are not biodegradable.

Since 2002, there has been a continuing follow up of the soil, centered fundamentally in the northern branch (between the bridge of Doblas [Sanlúcar the Greater] and the Aznalcóllar mine). This area was the most affected zone due to its proximity to the disastrous lagoon, causing high levels of residual contamination of zinc, lead, and arsenic. During the past two years most of the remaining affected areas have been cleaned, including those where the cleaning carried out by Boliden Apirsa was insufficient. This process has eliminated important focal points of contamination, but there is still residual contamination in some small stains of the land.

The Surface Waters.
The Technical Office of the Green Corridor controls the surface waters through the monthly follow up of 17 stations.

Of them, only the station of El Guijo (Sanlúcar the Greater) has had above normal values. The detected metals are cadmium, zinc, and in small amounts, copper. A study of the Guadalquivir River Basin Authority that has completed monthly samples from the station between January and July of 2003, has concluded that “the station situated in the Guadiamar river continues presenting a high level of non-compliance metals, as it exceeds the legal limits of cadmium, zinc and copper”. The Guijo station is the one closest to the Aznalcóllar mine (2.5 water km below), and is the first point where monthly samples are taken. At the second point for sampling, near the bridge of Doblas, five water kilometers down from the mine, the levels are within the legal limits as established by the European level as waters fit for human consumption. Each of the 15 remaining sample points meets the conditions as well.

The Guadalquivir River Basin Authority has indicated, with caution, that such permanent contamination raises the possibility that the lagoon of the Analcóllar mine has some type of crack.

There are still some municipalities that empty directly into the Guadiamar without having the city water go through any type of purification station (Aznalcóllar, Garrobo,

Catillo de las Guardas, Castilleja del Campo…). Additionally, there are problems with the olive preparation industries, which periodically dump residual alkaline with a high organic load. These spills occur in the middle branch of the Guadiamar, between the Doblas bridge, due to the industries situated in Huevar, and Aznalcázar, where there are installation projects for new olive industries. There has not been knowledge, however, of olive oil production by-product spills.

In the mining area there have been recent episodes of contaminated water. In February, due to the filtration of the dumps by acid mining waters, the waters of the Agrio river, tributary of the Guadiamar, were contaminated, killing all the fish of the affected area. The episode of contamination has been given in the counter-reservoir of Agrio, since the municipality of Aznalcóllar uses that water for human consumption, although it did not affect the Green Corridor.

Subterranean water.
There was no noticeable contamination in the aquifers of the area.

Guadalquivir estuary
After the spill an increase in contamination levels was confirmed. However, the situation only lasted a few months before returning to the previous level.

Fauna.
Without entering into exhaustive details, the main concerns addressed are the amphibians, fish, birds and mammals.
In regard to the amphibians and fish, these populations were seriously affected, especially the latter, which were practically exterminated in the riverbed. Since then, the bed has been recolonized with amphibians and fish. The first ones have been raised in the Guadiamar without problems. In the case of the fish, this year the first egg laying of six species have been detected. In regard to contamination by heavy metals, there has been a decrease in the concentration of Pb, Fe, As and Sb, although there have been slight rises in Cd, Cu, Zn, and Mn.
Among the birds, some species' colonies of young were affected the first year. But the risk of contamination has descended drastically since 1999 and the current progress is favorable.

Flora.
The contamination by metals (Cd, Cu, Zn, As, Pb) in the plants has diminished with time, although there continue to be cases in which they are found at levels above the toxic threshold.

The restoration of the affected area has involved the planting of some 2.5 million plants, especially in the branch between the mine and the beginning of the Entremuros marsh. The riverside vegetation is recovering perfectly, and this year has withstood the serious floods of December and March. The Entremuros area was replanted in

small plots, allowing the ecosystem to recover naturally. The results have been very positive, due to the restoration works already carried out and those which we will discuss later.

Objective no. 2.
Restoring the functionality of the aquatic and terrestrial ecosystems damaged or destroyed by the spill.

The floodplains of Guadiamar.
All the affected area between the mine and the entrance to the Entremuros swamp has been restored, with the goal of creating a fluvial ecological corridor.
The Guadiamar riverbed has suffered intense transformations, above all by the agricultural occupation or the gravel extractions, which limited its meandering character, and eliminated the flooded zones. At the time of restoration it was considered more important to recuperate the processes of fluvial dynamics that had been modified than to reconstruct the original morphology of the river.
Towards this end, the need for the restoration of flows, as much in a longitudinal sense as a lateral, has been identified, requiring the elimination of the barriers that impeded it.
During the large growths of this year, it has been confirmed that part of the natural dynamic of the river has been recuperated, especially the flood plains in several branches.
Regarding the restoration of vegetation, in addition to what has already been discussed, the elimination of non-indigenous vegetation, especially eucalyptus, has been initiated.

Gravel extraction sites.
There used to be several gravel exploitations in the riverbed along the upper and middle branches of the Guadiamar. These have now been rehabilitated with a double objective. One is environmental recuperation, by adapting them as artificial wetlands, and the other is for public use.
This year, thanks to the abundant rains, the new lagoons are totally full of water and have begun to be used by various species of birds as a nesting and feeding ground.

Entremuros marshes.
The fundamental objective of the activities has been the recuperation of the riverbed, through the elimination of the impacts that impeded natural functioning, and the reconstruction of the riverbed with a more natural outline of tubes, veins, and lateral banks.
The results have been significantly good and flora and fauna have rapidly colonized the zone. Just as in the earlier cases, it is necessary to continue following up on the progress of the completed activities.

Objective no. 3.
Promoting a model for the management of the multiple uses of the territory in order to promote considerable ecological heterogeneity to reinstate the flood of species and natural processes between the mountain range and the coast.

Some information has been collected on the movement of the land animals through the Corridor, with positive results in the middle course of the Guadiamar. This is

primarily due to its contact with the pine groves of Villamanrique and Aznalcázar-Puebla, although it is necessary to improve the connectivity between these areas, part

of which are integrated within the Doñana Nature Park. On the other hand, it is interesting that communities like the rabbit, prey of species like the lynx or the imperial eagle, are beginning to become established in the Corridor. This would facilitate the purpose of the ecological corridor of the Guadiamar.
The existing data on the area close to the mine are negative, since this area holds many obstacles for wildlife, such as the non-restored mining area. The Corridor must be connected through the northern part, restoring the mining area and the river basin of the Guadiamar in its upper course.
It is necessary to follow up the restoration now, and in the long term, to keep a tight

rein on the progress of the river and its future tendencies as well as its function as a fluvial ecological corridor.

Objective no. 4.
Improving the quality of life of the inhabitants of the area through strategies of development compatible with the conservation of the functions of their natural system.

Public Use.
The Green Corridor has been established as a tourist destination, with trails for walking, biking and horseback riding. As the Green Corridor towards the north has not been developed, it is not currently possible to create paths between the Sierra Morena and Doñana.
Additionally, various infrastructures have been constructed: observatories in the gravel extraction sites, Dehesa de Abajo and Benecazón; recreational areas in Buitrago and Doblas; a botanical garden in Buitrago; and a visitor's center in the Dehesa de Abajo. A visitor center in Aznalcázar is currently under construction.
Signposts have been installed of the area as well as the roads, and of the main ethnographic, natural and historical elements that exist in the Green Corridor.
Guides have been created on the programs and infrastructures for public use in the Green Corridor.
In spite of these initiatives, there are currently no tourism companies that offer a visit to the Green Corridor as a differentiated element of their activities. Nor have any new active tourism companies appeared in the municipalities in the Corridor, although they could benefit from the existing paths for walking, biking and horseback riding, routes as well as the opportunity for bird watching, etc.

Other uses.
Fishing, raising livestock, and hunting is still prohibited in the whole Green Corridor.
Agrarian use is prohibited within the grounds of the Green Corridor as well. In the old mine grounds, construction has begun on an environmental services site, but progress has been slower than expected.
The Green Corridor's potential as a brand of quality for other services and products has not yet been developed.
A strategic plan would be necessary for the development of sustainable activities connected to the Green Corridor and the strengthening of the Green Corridor brand of quality.

Volunteering.
A first call for subsidies of environmental volunteering in the Green Corridor was made in 2000.
Currently there is no specific call, rather within the call for subsidies of environmental volunteering of the Department of Environment; certain preference is given to those that have indicated the Green Corridor as the desired destination.

Relations with the population.
Various environmental education activities have been developed for the municipalities around the Green Corridor, mainly for school children.
The general population is unaware of the activities underway in the Green Corridor, and its main beliefs. In order to enlighten them, it would be necessary to touch on the sensitivities of the local population concerning social, economical, natural, historical, botanical, landscape, cultural, ethnographic, and wildlife values of the Green Corridor.
WWF/Adena has participated in the diffusion of these ideas for three years with a cycle of environmental education workshops in Aznalcázar.

Objective no. 5.
Contributing to the transformation of the Network of Protected Natural Areas of Andalusia, as a network of areas connected through ecological corridors, among which the fluvial ones stand out.

To comply with this objective, the first thing that has been done is the declaration of the Green Corridor as a "Protected Landscape", a means of protection, used for the first time in Andalusia, and its consequent inclusion in the Network of Protected Natural Areas of Andalusia (RENPA).
However, the Green Corridor is not yet connected as an ecological corridor in the mountain range with the coast, since as we have previously mentioned, the Green Corridor has not been extended up to the north of Aznalcóllar, nor has the mining area been restored, a major obstacle for the wildlife.

Objective no. 6.
To serve as a model of integrated planning of a Mediterranean basin that can be extrapolated to other areas and regions.

The Green Corridor is a model of basin restoration, as the WWF has recognized. The program of international exchange "Across the Waters", of the Office for the Mediterranean, has selected a model of restoration and management of Mediterranean wetlands as one of its projects. During 2001 and 2002 it has been making this known to experts of various Mediterranean countries (Turkey, Italy, Morocco, Tunisia…).
WWF also has transferred the "learned lessons" of Guadiamar to the mine accident of Baia Mare (Romania).

6. Assessment and next steps.

WWF/Adena greatly values the initiative of the Regional Government of Andalusia in confronting the mining catastrophe of Aznalcóllar. It took the appropriate actions of urgent cleaning, and followed through on its proposal and actions for restoring the mining zone and the Green Corridor without delay.

WWF/Adena considers that on the global level, the Green Corridor of the Guadiamar constitutes one of the most important and positive restoration experiences of a mining accident.

Nevertheless, there are a series of aspects that could be improved and resolved in the next few years so that the present gains are not lost. Furthermore, they would assure the fulfillment of the objectives of the project. Therefore, we must point out the following:

1. **Design and approval of a Mine Restoration Plan** of Aznalcóllar on the part of the Regional Government of Andalusia. There still does not exist a complete restoration plan adopted by the Regional Government of Andalusia – as occurred with the Green Corridor – only some sketches and projects. Nor have the measures for resolving the problem of the Aznalcóllar pits been analyzed.

2. **Restoration of the mine** on the part of the Department of Employment and Technological Development, with the enlargement of the impermeable retaining wall of the lagoon, restoration of dumps and decontamination of soil.

3. Guaranteed quality of water: **Elimination of the industrial and urban spills** without purification, especially those coming from the olive companies. Elimination of agricultural spills.

4. **Establishment of an efficient corridor**:

- Enlargement of the Green Corridor towards the north, for which it is necessary to obtain a clear, positive pronouncement of the local governments, which would facilitate the enlargement on the part of the Department of Environment.

- Arrangement of the territory of the Basin: control of urban pressure surrounding the Green Corridor. Especially worrying are the Huévar and Aznalcázar projects because of their proximity to the corridor. In the case of Húevar, we are talking about the construction of an industrial site and residential areas at less than 700 meters from the Green Corridor.

5. Finishing the infrastructures of public use and using the potential for tourism in the corridor as a tool of economic development.

6. **Carrying out a plan of economic and social development** with the participation of the local governments and social agents. The plan will be based on the principles of sustainability for the area influenced by the Green Corridor. It should include environmental education programs to sensitize the population with regard to the values of the Green Corridor.

7. Continuing the **follow up of environmental indicators** to be aware of the progress of the processes once begun.

8. **Maintaining a specific technical office** to follow up on the progress of the projects.

9. **Creating a follow up commission** of the plan with administrations, scientists and NGOs. This commission should continue to work over a fairly long period of time.