Reducing Environment and Security Risks from Mining in South Eastern Europe

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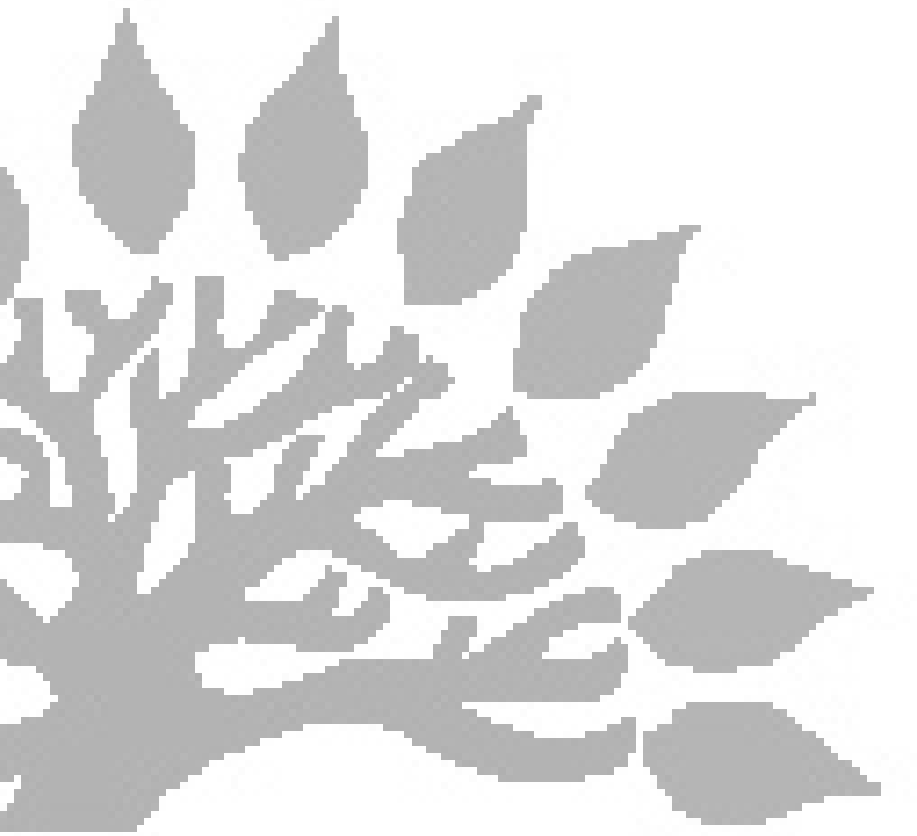
EXECUTIVE SUMMARY



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List of Abbreviations

BiH	Bosnia and Herzegovina	
EnvSec	Environment and Security	www.envsec.org
FYRoM	Former Yugoslav Republic of Macedonia	
NFP	National Focal Point	
Mtpa	Million tonnes per annum	
SEE	South-Eastern Europe	
SFRY	Socialist Federal Republic of Yugoslavia	
UN	United Nations	www.un.org
UNEP	United Nations Environment Programme	www.unep.org
UNMIK	United Nations Mission in Kosovo	www.unmikonline.org

Abstract

The United Nations Environment Programme's (UNEP) Environment and Security (EnvSec) Initiative intends to facilitate a framework for cooperation on environmental issues across borders and promote peace and stability through environmental cooperation and sustainable development. With these considerations in mind, a desk study process was conducted to identify, delineate and catalogue mineral resource related sites that pose substantial risk to the environment, public health and safety, and regional socio-political stability in the Western Balkans (South Eastern Europe (SEE)) region, and to provide information required to support work for risk and hazard reduction, particularly where such risks are of a trans-boundary nature. This study addressed mining activities in Albania, Bosnia and Herzegovina, Kosovo (Territory under UN interim administration), the Former Yugoslav Republic of Macedonia, and Serbia and Montenegro, and has identified and catalogued a large number of mineral resources related sites that can be of high hazard. Many appear to have significant risks associated with them that threaten the environment, public health and safety, and/or regional socio-political stability. The study has found, *inter alia*: a number of areas where significant data collection needs to take place to reduce uncertainty, where action for both capacity building and remediation works can be focused, and where legislative frameworks for mining can be improved.

Key words: environmental issues, security risk.

I. Introduction

The South Eastern Europe (SEE) region is rich in mineral resources, has a long history of mineral resource extraction activities, and already has a serious history of mining accidents. These are due in part to the widespread neglect of environmental safety and human security issues at existing sites, particularly in the post 1945 era. While the majority of risks are the culmination of a long period of sub-standard extraction and waste management activities, the marked changes in economic and political circumstances, conflict, and socio-economic hardship during the 1990s in the subject countries have exacerbated the problems associated with many sites.

Key among changes that contribute to deterioration in the risk situation is the cessation of industrial activities without planned closure measures. In many instances, this has occurred as a result of recent socio-economic turbulence or economic restructuring, but many sites in the region have also been abandoned[1] for many decades. Cessation of mining is also often associated with rapid deterioration in the condition of waste storage areas in the absence of maintenance activity and/or any form of monitoring. There are numerous abandoned or "temporarily abandoned" sites in the region that are gradually (or even rapidly) deteriorating. These sites pose risks to local communities, the environment, and international relations. The dramatic pollution of Tisza and Danube rivers with impacts on the whole region by a single modestly sized mine in Romania in 2000 clearly illustrates the potential impact of even relatively small operations that are not properly managed and/or maintained. Unfortunately, such an event is not the first such release that has occurred in the region, there have been more since, there are more to come.

Abandoned sites of mineral's related activity can always pose a risk to the environment and communities nearby, especially when human settlements are placed on, or near to toxic tailings areas; on potentially unstable slopes; in valleys downstream of impoundments; on areas of unstable underground workings; and so forth. Unfortunately, it is not uncommon that roads, railways, schools and homes are situated in such areas of risk. Where well-structured and regularly reviewed emergency response and local level preparedness routines are not established, the social and economic consequences of a failure or release can be catastrophic for such communities. Further, such events occurring in the absence of transboundary mechanisms for early warning can negatively impact relations between countries.

Further, it is usual that waterways and soils in adjacent areas have been, or are being, contaminated by toxic water leakages or by the fallout of airborne materials. Chronic (and acute) effects of such pollution have the potential to cause significant harm to human, animal and environmental well-being for extremely long periods of time if they are not dealt with effectively. Such chronic pollution also crosses national boundaries in many instances.

As such risks and problems exist now and are ongoing, action is urgently needed. This must both reduce the risks from mining activities and abandoned and orphaned mines in the region, and better prepare communities for minimising the impact of accidents that may occur in the period until high risk sites are made safe.

[1] Within this document, **abandoned** mines are deemed to be those where rehabilitation is incomplete but whose legal owners still exist. **Orphaned** sites refer to abandoned mines for which the responsible party no longer exists or cannot be located.

In recognition of these issues, a number of other recent studies have also addressed Environment & Security Risks related to mining activities, mineral processing activities and the environmental legacies left by the extractive industries in South Eastern Europe (and the Tisza River Basin). Notable among these are *the Rapid Environmental Assessment of the Tisza River Basin* (Burnod-Requia, 2004); the PECOMINES report: *Mining, Mining Waste and Related Environmental Issues: Problems and Solutions in Central and Eastern European Candidate Countries* produced by the Joint Research Centre of the European Commission (Jordan & M. D'Allessandro (Eds), 2004) and the *Regional Inventory of Potential Accidental Risk Spots in the Tisza catchment area of Romania, Hungary, Ukraine & Slovakia* prepared for the International Commission for the Protection of the Danube River (ICPDR/Zinke Environment Consulting, 2000).

II. Environment in the Adriatic Balkan Region

Europe's Adriatic Balkan region is part of the southern portion of the Mediterranean Alpine folded zone, which extends through Bosnia and Herzegovina, Croatia, the Former Yugoslav Republic of Macedonia, Serbia and Montenegro, and Slovenia, parts of Albania, and into Greece (Steblez, 2001). This study addresses Albania, Bosnia & Herzegovina, Kosovo (Territory under UN interim administration), Macedonia, Serbia and Montenegro only. This section in the report provides a general description of (some) environmental aspects of each country where they may relate to resource extraction in general or minerals processing in some way. While a number of details presented in this section are geographical rather than industrially focused, an overall view is deemed important. Description of the physical morphology of each subject country/territory, surface water regimes, and the general nature of environment and environmental concerns is valuable to any analysis of national or trans-boundary risks posed by mineral extraction related activities. In a transboundary pollution context, it is important to note that all countries in this region have downstream neighbours, many share waterbodies, watersheds and airsheds.

1. Albania

Albania is situated on the Adriatic and Ionian coast between Greece and the former Yugoslavia. It is richly biodiverse with a landscape of coastal plains and a largely forested mountainous interior. Albania faces serious anthropogenic threats to its environment. Erosion, illegal cutting and harvesting of forest and vegetation resources, urban waste, industrial pollution and rapid population growth have led to severe environmental degradation. This is particularly marked in the coastal areas as the coastal wetlands are reportedly the home to over 40% of the Albanian population. Further, recent population fluxes related to refugee movements have placed considerable pressures on the environment. The coastal plain continues to be used for extensive and unsustainable agricultural practices to support human populations. Current agricultural and grazing practices have led to severe erosion, environmental destruction, and pollution in Albania's watersheds. In a mining context, Albania has significant environmental challenges associated with chromite mining, ferrochromium processing/smelting, and the copper mining and processing industries.

Fortunately, despite the considerable concerns in Albania listed above, relatively large areas of the country still remain largely unaffected by industrial environmental pollution .

2. Bosnia and Herzegovina

Much of the territory of Bosnia and Herzegovina (aka. BiH) is mountainous with nearly 60% lying above 700m. Hilly or mountainous terrain covers nearly 84% of the country with some 80% of land within the country having slopes of 13% or more. Sewerage and water reticulation systems are generally in poor condition and waste and water borne pollutants, often arising from areas of waste disposal, are a serious concern for the environment and public health in the country. Municipal waste is being collected in half of the urban municipalities but rural municipalities are generally not included in waste collection. Large quantities of waste are reportedly being dumped illegally at roadsides, rivers, abandoned mines, etc., posing threats to public health and the environment. Approximately 300 000 hectares are reportedly being contaminated by anthropogenic activities while some 50 000 hectares are severely contaminated. Addressing mining issues, this sub-region has significant environmental challenges that are associated with aluminium and ferroalloy processing/smelting, manganese mining and processing, and iron/steel smelting. In addition, some 1.2 million hectares of land have been affected by mine fields during the conflict period (BiH, 1998).

3. Former Yugoslav Republic of Macedonia

The Republic of Macedonia (also referred to as the Former Yugoslavian Republic of Macedonia or FYRoM) is situated in the central southern part of the Balkan Peninsula. Although water shortages are experienced, when available, drinking water quality is generally of high quality as most of the drinking water sources are unpolluted mountain springs. Water pollution however, is evident in rivers and ground waters throughout the country. The most seriously polluted waterways are reportedly the central and lower sections of the Vardar, Pcinja, Bregalnica and Crna Rivers. Polluted groundwater is also an issue near Skopje, and especially in Veles. The most serious water pollution concerns are the discharge of untreated wastewater from mining and industry, as well as wastewater from urban centres and livestock breeding farms. Reportedly, less than 10% of wastewaters in the FYRoM are treated prior to their discharge in rivers. When viewing the mining situation, the FYRoM has significant environmental challenges related to lead-zinc mining, beneficiation, smelting and refining; ferrochromium smelting; chromite mining and beneficiation; copper mining and beneficiation; and ferronickel and antimony mining, beneficiation and smelting.

4. Serbia and Montenegro

Serbia and Montenegro is in the central north part of the Balkan peninsula and shares boundaries to the west with Bosnia and Herzegovina and Croatia, to the south with Former Yugoslav Republic of Macedonia and Albania, to the east with Romania and Bulgaria, and to the north with Hungary.

The quantity of the industrial and mining wastewater discharged directly into the waterways during the year 2000 has been (crudely) estimated to be in the order of 730 x 10^6 m^3/year. According to the Ministry for the Protection of the Natural Resources and Environment (Republic of Serbia, 2003), large amounts of industrial and mining wastewater are discharged into the Sava River and its tributaries. However, the basin of the Timok basin is also under great pressure due to highly

contaminated industrial and mining wastewater discharges. The Federal Ministry and Working Group for Environmental Protection (Jovic, Nikolic, Vukadinovic, & Grzetic, 2002) report that the current state of the environment in the vicinity of mines in the country is completely unsatisfactory and that the most serious conditions are found in the watershed in the vicinity of the mines of Bor, Krivelj, Majdanpek, Mojkovac and associated operations. This pollution is primarily generated by mineral resource beneficiation operations. Serious incidents of note in these areas have included breaches of tailings impoundments at Majdanpek, Veliki Majdan and Brskovo, where the rivers Pek, Drina and Tara were directly polluted. Such environmental pollution is principally associated with antimony, lead and zinc mining, processing, and smelting; and with very large operations for the mining, processing, and smelting of copper.

Kosovo (Territory under United Nations interim administration)[2]

The territory of Kosovo is of particular interest in the trans-boundary context within the Balkans. It is both a centre of considerable minerals sector activity and a source of waters for each of the three distinct watersheds in the region. As such, all fluvial flows from Kosovo are trans-boundary. There is little or no waste-water treatment in Kosovo with less than a third of homes being connected to sewerage in 2002. In villages and other small settlements, waste water is disposed of in open channels contaminating surface and ground-waters. Industrial waste water is generally discharged directly into rivers without treatment. As a result, river water quality in the lowland rivers is very poor, while the upstream rivers are mostly of good quality. Some of main rivers downstream (e.g. Sitnica River) supply, irrigation, or even industrial needs without prior treatment. Groundwater quality is also significantly affected by pollution. Largely as a result of these factors, Kosovo has a high incidence of water-borne diseases. As a result of extensive mining and minerals processing activities, the territory has significant environmental challenges associated with sites of lead and zinc mining, beneficiation, smelting and refining; mining of chromites; ferronickel smelting and asbestos mining.

III. Resource Extraction Activities

The presence of high class deposits, and the economic dependence of a large number of communities upon minerals related activities, indicate that mining and minerals processing has an important socio-economic role to play in the future of the region. Moreover, meaningful employment and economic prosperity associated with the industry are both ingredients for the development of a stable and civil society. A brief précis of the extractive industries in the subject countries is provided here.

1. Albania

The chief mineral commodities traditionally produced in Albania have been chromite, copper, ferrochromium, nickeliferous iron ore, and petroleum refinery products. Under central economic

[2] Security Council Resolution 1244 (1999), on Kosovo, Serbia and Montenegro.

planning, and particularly from the late 1970s until 1990, Albania's chromite mining operations were among the most important components of the country's mineral industry. In this period, Albania was a leading world producer and exporter of the mineral. Indeed, returns derived from the export of chromite and ferrochromium constituted the country's chief source of foreign exchange.

2. Bosnia and Herzegovia

Before the dissolution of the Socialist Federal Republic of Yugoslavia (SFRY), Bosnia and Herzegovina was a major centre for metallurgical industries with steel production of more than 2 Mtpa[3]. The country was also a major producer of bauxite, alumina, and aluminium. Bosnia and Herzegovina also hosts asbestos, barite, gypsum and salt resources and extracts construction aggregates, cement, clays, dimensioned stone, dolomite, kaolin, limestone, magnesite, sand and gravel and other industrial minerals. These latter minerals are produced mainly for local use.

3. Former Yugoslav Republic of Macedonia

The Former Yugoslav Republic of Macedonia hosts deposits containing economic grades of copper, iron, lead, precious metals such as silver and gold, and zinc. In second half of the 20th century, an extensive processing and fabricating infrastructure was established that allowed the production of these metals and their alloys and ferroalloys such as ferrochromium, ferromanganese, and ferronickel, and aluminium. Further, industrial minerals such as bentonite, feldspar, gypsum, sand and gravel, and stone (carbonate and silicate) as well as cement and other construction materials that are based on quarried products were produced mainly for export.

4. Serbia and Montenegro

The mining industry in Serbia and Montenegro represents a vital component of the economy in general. Primary minerals extracted include: copper, coal, lead-zinc with associated gold, silver, copper, bismuth and cadmium, red bauxite and modest quantities of oil and gas. Prior to the conflicts of the 1990s, the country produced a significant proportion of European capacity for refined aluminium, copper lead, silver and zinc.

Kosovo (Territory under UN interim administration)

Prior to the 1990s, Kosovo hosted the region's largest lead and zinc mining, beneficiation, smelting, and refining complex Trepca. Much of the metal processed was also mined throughout the province. Trepca also produced such associated metals as antimony, bismuth, cadmium, gold, and silver (Steblez, 1994, 1999). The other major metallurgical production in Kosovo included the mining of nickel ore and smelting of ferronickel.

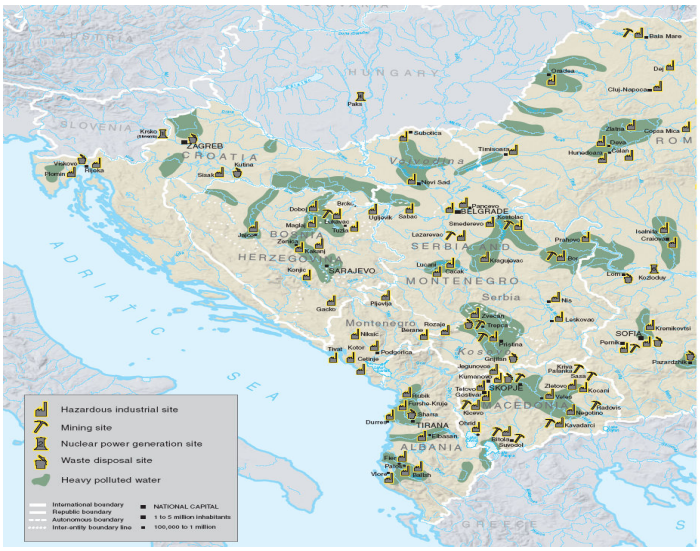
[3] Mtpa – Million tonnes per annum.

IV. Hazard Inventories and Significant Trans-boundary Risks

In general, it can be stated that the types of mining and minerals processing operations addressed in this study share a number of pathways in which the surrounding environment and communities can be exposed to the harmful effects of pollutants associated with mining and minerals processing activities.[4]

A total of more than 150 major sites or resource extraction and downstream processing are identified in the region.[5] For example in:

- Albania around 45 sites were found (more than 10 of concern),
- Bosnia and Herzegovina around 40 sites (7 of concern),
- Former Yugoslav Republic of Macedonia around 20 sites (10 of concern),
- Serbia and Montenegro circa 40 sites (more than 12 of concern), Kosovo circa 40 sites (more than 14 of concern).



[4] This study has only been able to provide qualitative descriptions of sites that "appear" to be of high hazard, and "may" have significant probabilities of an environmentally damaging event associated with them. It has not been sought to ascertain the likelihood (probability and/frequency) that pollution incidents may occur in any quantitative form; the likely harm (damage to people, property, or the biophysical, social, or cultural environment) or the consequences of an event or situation except in general terms.

[5] Important limitations for the study were that details of current ownership and activity status for identified sites and assessment of the legal status of abandoned/orphaned mines, both in general and for specific sites was not possible to undertake with the available information. This remains as an important area of work for all parties. Further, the sites identified from within the considerable information examined within the study generally only represent the larger "internationally visible" operations. Many smaller or older sites causing pollution or posing risk remain to be catalogued. Moreover, many of these "operational entities" contain multiple pollution sites.

1. Albanian Trans-boundary Risk Hotspots

Candidate hotspots in Albania are principally associated with ferrochromium processing/smelting, chromite mining, and copper mining and processing industries. Of 11 minerals related operations listed as potential hotspots (national and trans-boundary risk hotspots) for Albania, the operations listed in Table 1 were selected as most likely to be associated with significant trans-boundary risk emanating from Albania.

Table 1. Albanian candidate sites – trans-boundary hotspots

Site name / activity	Hazards	Potential trans-boundary harm/consequences
Elbasan Smelter complex / Ferrochromium, Fe (steel) and Ni smelters.	Toxic and heavy metal emissions, uncontained and unprotected wastes, residues and chemicals.	Cross border air pollution, pollution of Lake Ohrid shared with FYRoM Pollution via Shukumbinit River to Adriatic Sea. Tensions with FYRoM.
Shkoder / Cu mines (incl. Palaj, Karma I and II)	Toxic/acidic effluents, uncontained waste rock, dust emissions and unsecured workings.	Pollution of Lake Scutari shared with Republic of Montenegro. Tensions with Republic of Montenegro, Serbia and Montenegro.

2. Bosnia and Herzegovina Trans-boundary Risk Hotspots

Candidate hotspots in Bosnia and Herzegovina are principally associated with aluminium, ferroalloy processing/smelting, manganese mining and processing, and iron/steel smelting.

Of seven minerals related operations listed as potential hotspots (national and trans-boundary risk hotspots) in Bosnia and Herzegovina, those operations listed in Table 2 have been selected as most likely to be associated with significant trans-boundary risk emanating from Bosnia and Herzegovina.

Table 2. Bosnia(n) and Herzegovina(n) candidate sites – trans-boundary hotspots

Site name / activity	Hazards	Potential trans-boundary harm/consequences
Birac Zvornick / Alumina refinery and Aluminium smelter.	Toxic emissions, uncontained and unprotected wastes, residues and chemicals, particularly red mud wastes and spent pot linings, etc. from smelting operations.	Cross border pollution via Drina River (border of Serbia and Montenegro) and into Danube River. Tensions with Serbia and Montenegro and downstream Danube countries (Romania and Bulgaria).
Srebrenica Energoinvest / Pb-Zn mine and beneficiation mill.	Toxic/acidic effluents, uncontained waste rock, dust emissions and unsecured workings, poorly contained and/unstable tailings wastes.	Cross border pollution via Drina River (border of Serbia and Montenegro) and into Danube River. Tensions with Serbia and Montenegro and downstream Danube countries (Hungary, Romania and Bulgaria).

3. Former Yugoslav Republic of Macedonia Trans-boundary Risk Hotspots

Candidate hotspots in FYR of Macedonia are principally associated with lead-zinc mining, beneficiation, smelting and refining; ferrochromium smelting; chromite mining and beneficiation; copper mining and beneficiation; and ferronickel and antimony mining, beneficiation and smelting.

Of the ten minerals related operations listed as potential hotspots (both national and trans-boundary risk hotspots) in the FYR of Macedonia, those operations listed in Table 4 have been selected as most likely to be associated with significant trans-boundary risk emanating from the FYR of Macedonia.

Table 4. Macedonian candidate sites – trans-boundary hotspots

Site name / activity	Hazards	Potential trans-boundary harm/consequences
Bucim / Cu mine and beneficiation mill.	Toxic/acidic effluents, uncontained waste rock, dust emissions and unsecured workings, poorly contained and/unstable tailings wastes.	Cross border pollution to Bulgaria then Greece via Nivicanska River, tributary of Strumica then Struma. Tensions with Bulgaria and Greece.
Lojane / Cr and Sb mine and beneficiation mill.	Toxic/acidic effluents, uncontained waste rock, dust emissions and unsecured workings, poorly contained and/unstable tailings wastes.	Cross border migration of pollutants by air and water at Tabanovce (detail pathways not known) – Serbia and Montengro Border. Tensions with Serbia and Montenegro and Kosovo .
Kavadarci / Fe-Ni and Sb mine(s) and ferronickel smelter (including Rzhanovo Ni mine)	Toxic solid waste, airborne toxics. Toxic/acidic effluents, uncontained waste rock, dust emissions, poorly contained tailings, smelter residues and chemicals.	Cross border pollution Greece via Vardar River. Tensions with Greece.

4. Serbia and Montenegro Trans-boundary Risk Hotspots

Republic of Serbia

Candidate hotspots in the Republic of Serbia were principally associated with antimony, lead and zinc mining, processing, and smelting; and with very large operations for the mining, processing, and smelting of copper.

Of the eight minerals related operations listed as potential hotspots (both national and trans-boundary risk hotspots) in the Republic of Serbia, the six operations listed in Table 5 have been selected as most likely to be associated with significant trans-boundary risk emanating from the Republic of Serbia.

Table 5. Serbian candidate sites – trans-boundary hotspots

Site name / activity	Hazards	Potential trans-boundary harm/consequences
Bor complex, mill, smelter and refinery / Cu mining; concentration, smelting and refining of copper, noble and rare metals, production of sulfuric acid, Cu billets and blocks, Cu alloys and alloy-based casts.	Toxic/acidic effluents, uncontained waste rock, dust emissions and unsecured workings, poorly contained and/unstable tailings wastes. Toxic solid waste, airborne toxics and SO_2. Toxic/acidic effluents, dust emissions, poorly contained smelter residues and chemicals.	Cross border pollution to downstream Danube countries via Bor (Borska River), Timok, Kriveljska and Danube Rivers. Tensions with downstream Danube countries (Romania and Bulgaria). Cross border air pollution.
Krupanj / Veliki Majdan Pb-Zn beneficiation mill and mine.	Toxic/acidic effluents, uncontained waste rock, dust emissions and unsecured workings, poorly contained and/unstable tailings wastes.	Cross border pollution to Bosnia and Herzegovina via Drina River (border of Bosnia and Herzegovina). Tensions with Bosnia and Herzegovina.
Majdanpek / Cu beneficiation mill and mine.	Toxic/acidic effluents, uncontained waste rock, dust emissions and unsecured workings, poorly contained and/unstable tailings wastes.	Cross border pollution to downstream Danube countries via Pek, then Danube Rivers. Tensions with downstream Danube countries (Romania and Bulgaria).
Sabac / electrolytic zinc smelter and refinery	Toxic solid waste, airborne toxics and SO_2. Toxic/acidic effluents, dust emissions, poorly contained smelter residues and chemicals	Cross border pollution to downstream Danube countries via Sava River. Tensions with downstream Danube countries (Romania and Bulgaria).
Veliki Krivelj / Cu beneficiation mill and mine.	Toxic/acidic effluents, uncontained waste rock, dust emissions and unsecured workings, poorly contained and/unstable tailings wastes.	Cross border pollution to downstream Danube countries via Kriveljska, Timok then Danube Rivers. Tensions with downstream Danube countries (Romania and Bulgaria).
Zajaca / Antimony (Sb) mine, beneficiation mill and smelter.	Toxic solid waste, airborne toxics and SO_2. Toxic/acidic effluents, uncontained waste rock, dust emissions and unsecured workings, poorly contained and/unstable tailings wastes. Poorly contained smelter residues and chemicals.	Cross border pollution to Bosnia and Herzegovina via Drina River, then to Danube via Sava River. Tensions with Bosnia and Herzegpvoma and other downstream Danube countries (Romania and Bulgaria).

Republic of Montenegro

Candidate hotspots in Republic of Montenegro were principally associated with the waste products of the aluminium production process chain and with the mining, processing, and smelting of lead and zinc.

Of the five minerals related operations indicated as potential hotspots in Republic of Montenegro, the four operations listed in Table 6 have been selected as most likely to be associated with significant trans-boundary risk emanating from territory of Republic of Montenegro.

Table 6. Montenegrian candidate sites – trans-boundary hotspots

Site name / activity	Hazards	Potential trans-boundary harm/consequences
Mojkovac / Pb-Zn beneficiation mill and mine.	Toxic/acidic effluents, uncontained waste rock, dust emissions and unsecured workings, poorly contained and/unstable tailings wastes.	Cross border pollution to Bosnia and Herzegovina via Tara River. Health and environmental damage in town of Mojkovac. Tensions with Bosnia and Herzegovina.
Brskovo / Pb-Zn beneficiation mill and mine.	Toxic/acidic effluents, uncontained waste rock, dust emissions and unsecured workings, poorly contained and/unstable tailings wastes.	Cross border pollution to Bosnia and Herzegovina via Tara River. Tensions with Bosnia and Herzegovina.
Suplja / Pb-Zn beneficiation mill and mine.	Toxic/acidic effluents, uncontained waste rock, dust emissions and unsecured workings, poorly contained and/unstable tailings wastes.	Cross border pollution to Bosnia and Herzegovina via Cehotina River, a tributary to the Drina River, which constitutes the Bosnia and Herzegovina border and flows to the Danube River.
Podgorica / Alumina and Aluminium refining and smelting	Toxic emissions, uncontained and unprotected wastes, residues and chemicals, particularly red mud wastes and spent pot linings, etc. from smelting operations.	Cross border pollution via Lake Scutari (Skadarsko Lake) shared with Albania. Tensions with Albania.

Kosovo (Territory under UN interim administration)

Those operations listed in Table 3 have been selected as most likely to be associated with significant trans-boundary risk emanating from territory of Kosovo. Several operations have multiple contaminated sites. The sites are associated with lead and zinc mining, beneficiation, smelting and refining and chromite mining. Two other sites, the Drenas ferronickel smelter, and asbestos operations at Korlace may also have considerable risk associated with them.

Table 3. Kosovian candidate sites – trans-boundary hotspots

Site name / activity	Hazards	Potential trans-boundary harm/consequences
Djakovic – DEVA / Cr mine.	Toxic/acidic effluents, uncontained waste rock, dust emissions and unsecured workings, poorly contained and/unstable tailings wastes.	Cross border pollution via Erenik River (tributary to Beli-Drin River) Flow to Lake Fierzës. Tensions with Albania
Trepca Mills – Badovac, Leposavic, Maravce, Tuneli i pare and Kishnica Mills / Pb-Zn mines and beneficiation mills.	Toxic/acidic effluents, uncontained waste rock, dust emissions and unsecured workings, poorly contained and/unstable tailings wastes.	Multiple sites. Cross border pollution via Ibar River flowing to Serbia and Montenegro and into Danube River. Tensions with Serbia and Montenegro and downstream Danube countries (Romania and Bulgaria).
Trepca Mills / Kriva Feja Pb-Zn mine and beneficiation mill.	Toxic/acidic effluents, uncontained waste rock, dust emissions and unsecured workings, poorly contained and/unstable tailings wastes.	Cross border pollution via Binacka Mirava River flowing to Serbia and Montenegro, and eventually Danube River. Potential. Tensions with Serbia and Montenegro and downstream Danube countries (Romania and Bulgaria).
Trepca Mills / Rudnik Pb-Zn mine and beneficiation mill.	Toxic/acidic effluents, uncontained waste rock, dust emissions and unsecured workings, poorly contained and/unstable tailings wastes.	Cross border pollution via tributary to Beli (Drina) flowing into Albania. Tension with Albania.
Sebrenica Energoinvest / Pb-Zn mine and beneficiation mill.	Toxic/acidic effluents, uncontained waste rock, dust emissions and unsecured workings, poorly contained and/unstable tailings wastes.	Cross border pollution via Drina River (border of Serbia and Montenegro) and into Danube River. Tensions with Serbia and Montenegro and downstream Danube countries (Romania and Bulgaria).
Zvecan / Pb-Zn mines, beneficiation mill and smelter.	Toxic solid waste, airborne toxics and SO_2. Toxic/acidic effluents, uncontained waste rock, dust emissions and unsecured workings, poorly contained and/unstable tailings wastes.	Cross border pollution via Ibar River flowing to Serbia and Montenegro and into Danube River. Cross border air pollution. Tensions with Serbia and Montenegro and downstream Danube countries (Romania and Bulgaria).
Kosovska Mitrovica / electrolytic Pb and Zn refinery.	Toxic solid waste, airborne toxics and SO_2. Toxic/acidic effluents, dust emissions, poorly contained smelter residues and chemicals	Cross border pollution via Ibar River flowing to Serbia and Montenegro and into Danube River. Cross border air pollution. Tensions with Serbia and Montenegro and downstream Danube countries (Romania and Bulgaria).

V. Conclusions and recommendations

In this final section, a number of items are covered and/or reiterated. These include discussion of:

- priority issues and institutions to be involved in work in this area,
- levels of risk and quantification of risk,
- non-environmental stress factors affecting the consequences of pollution incidents,
- potential work activities to deal with priority issues,
- a brief scoping of next steps forward at both local and national scales and in a trans-boundary perspective.

1. Priority Issues and Institutions to be involved

The Desk Study highlighted a number of interlinked issues where action of varying urgency is required. It is important to note that the tasks at hand differ somewhat between sites that are **abandoned** (mines where rehabilitation is incomplete but whose legal owners still exist); **orphaned** sites (abandoned mines for which the responsible party no longer exists or cannot be located) and sites that are **idle** (mining assets where activity has ceased but where some form of care and maintenance is undertaken).

Issue 1 – risk reduction at abandoned or orphaned sites

First and foremost, it is considered that the most pressing issue for action is the reduction of the very significant risks associated with non-operational, abandoned and/or orphaned sites where large quantities of physically and chemically unstable, and/or poorly contained mine wastes are stored. There are a considerable number of sites of this kind and the most significant hazard is related to the mass release of tailings wastes to waterways. Less serious, but still of major concern is the ongoing generation of acidic, metals bearing effluents from such sites affecting both surface and ground waters. Such effluents contribute to local, national and trans-boundary pollution of varying degrees of severity – often considerable severity. Directly related to this, and presented here as a sub-issue is the remaining degree of uncertainty regarding such sites. The lack of high resolution quantitative data describing the morphology of sites; their general degree of risk; actors who are accountable, or can be made accountable for such sites; and the form and sequence of activities to manage the risks associated with such sites is a matter of concern and of critical importance.

Issue 2 – risk reduction at operational sites

The second priority issue is related to essentially the same hazards, but at sites of mining or minerals processing that are still operational. While the degree of hazard related to such sites can the same or even greater, it appears reasonable to consider that the actual likelihood of an event of consequent are lower, than in the case of abandoned and orphaned sites. Conduct of ongoing maintenance at sites of hazard associated with ongoing operations can contribute to risk reduction. Further, where such sites are being monitored in some way, if only visually, there is the potential for some degree of

risk reduction. A positive factor regarding such sites is that economic actors and industrial activities exist and it may be possible to base risk mitigation and remediation strategies upon them. While uncertainty (as discussed above) may be somewhat lower at such sites, it remains high.

Issue 3 – development of new resources and re-mining aligned with sustainable development

The third priority issue area highlighted within this study is related to the development of new sites of mining or mineral processing in a fashion that is aligned with sustainable development (similarly where old sites are to be redeveloped or reprocessed in some way). Despite the opportunities that best practice approaches imported from countries with traditions of stricter environmental control can offer for environmentally benign minerals extraction activities (and increasingly the expectations of stakeholders that best practice will be applied), it appears that this is an opportunity that can be missed.

As shown by the events leading to the dramatic pollution of the Tisza and Danube Rivers in 2000 and 2001 with effects on the whole region, modern operations can also fail catastrophically. It appears fair to say that a range of physical/engineering and institutional factors contributed to failures. Development of institutional capacity, a culture of risk control, and markedly improved operational procedures is clearly required throughout the region to help prevent similar scenarios unfolding.

Issue 4 – fostering of institutional frameworks for mining legacy management and sustainable mining and minerals processing

The fourth priority issue identified is a lack of clarity in the institutional structures enfolding mining and minerals processing – and significant gaps in such structures. In reading these comments, it should be noted that there is a high degree of flux in this area and national development of many of the items discussed here are underway in some form. Challenges noted in the study include: a lack of specific legislative frameworks addressing mining and minerals processing legacies, unclear accountability for the environmental aspects of mining and minerals processing activities (including overlapping and confused jurisdiction), a lack of clarity in institutions supporting trans-boundary risk management and/or disaster response, and so forth.

Issue 5 – fostering of institutional frameworks and capacity building for better accident prevention, early warning systems, improved emergency preparedness and response measures.

The fifth priority area identified that there were significant areas of weakness in emergency preparedness. While the actions listed for other priority issues clearly address the reduction of risk, unacceptable levels of risk exist today. Such threat levels will continue until considerable achievements in the above priority areas are achieved. Accidents can, and likely will, occur in the considerable intervening period before mining related risks are made safe. Far more advanced preparedness regimes are needed at local, regional and transboundary levels. Further, and beyond a direct mining context, these are also closely related to other risk management areas such as flood protection, flood mitigation, and flood control; seismic events and so forth.

Institutions to be involved

The specific actor groups to be involved in work addressing the issues outlined above have not been clearly identified within this Desk Study. However, it is clear that future work needs to involve institutions (potentially including a range of national agencies and mines inspectorates, municipal and regional organs, governmental and quasi-governmental bodies), industrial actors and more general social actors. In particular, it appears that work is required to build regional institutional and industrial capacity to a level that can initiate, manage and support mining and minerals activities that are compatible with regional sustainable development. Moreover, clear accountability and jurisdiction needs to be established that answers queries such as the following – *Is a mining release to be dealt with by an environmental inspectorate, a national disaster response administration, a natural resources bureau, or a combination?* The nature of the issues identified in this work point towards a focus upon institutional and industrial actors. Nevertheless, a range of Non Governmental Organisations (NGOs) are also active in the region. Any activities taking place will need to consider their role in the processes discussed above, and their views upon such work. As such, it is likely that a dialogue process with those actors will need to be initiated and maintained.

2. Levels of Risk and Quantification of Risk

This discussion is intended to help underpin discussions of how and why sites of significant hazard pose risks of a site, local, sub-regional, regional and trans-boundary nature. These examples can be considered a synthesis of items found during the conduct of the Desk Study but they are not exhaustive.

Harm

Potential damage to people, property, or the biophysical, social, or cultural environment associated with the primary trans-boundary risks found in this study include: poisoning of surface water and groundwater with dissolved and suspended substances; smothering of aquatic environments with toxic sludge; destruction of property through mass releases of solids and semi-solids; chronic health effects associated with heavy metals poisoning in humans and animals; acute poisoning of ecosystems, humans and animals; and so on. The types of damage listed here have the potential to occur at site, local, sub-regional, regional and trans-boundary levels.

Likelihood

The probability and frequency of the types of defined events that can cause harm and probability of specific outcomes were not assessed in this study. However, as many pollution incidents have occurred, and many are ongoing, the likelihood of damage of the types discussed above (harm) are very high or certain in many instances. Furthermore, the high number of “warning signals” present in the region,[6] indicate an increased likelihood of incidents in this region.

[6] These include *inter alia*: ore types and rock with significant acid rock drainage (ARD) generating potential; absence of mine planning for ARD control, and or closure; large (historical) milling and concentration plants with significant tailings impoundments; mountainous terrain and extreme weather conditions; numerous shared river and lake systems; catchment areas shared by several countries; significant earthquake risk; abundance of abandoned and orphaned mine sites; lack of ongoing physical and/or biochemical monitoring or maintenance of operational and/or abandoned sites; absence of

Hazards

Many sources of potential harm and situations with a potential for harm were found in the study. Examples include: waterways and groundwater resources bearing acidic water and dissolved heavy metals; large unstable tailings impoundments near waterways in seismic areas; metals smelter stacks emitting near population centres; waste dumps for toxic materials located over groundwater resources; large uncovered toxic dust generating surfaces near agricultural land and population centres; etc.

Consequence(s)

The intermediate or final outcome(s) of events affecting elements of the biophysical spheres observed in the study include: increased human mortality; developmental problems in children; livestock losses; decreased crop yields; reduced aquatic food resource yields; damage and destruction of housing and infrastructure, among others. Outcomes affecting elements of the social sphere include: rising opposition to mining and minerals processing from citizens; increased scrutiny and coordinated opposition from NGOs; tensions between Nation-states; retarded social and economic development, and so on.

Risk

The likelihood of damage to people, property, or the biophysical, social, or cultural environment of the types listed above appears to be high. While only qualitative comments can be passed based upon this analysis, the fact that chronic damage is ongoing in many areas and that many major incidents resulting in acute effects have occurred, should underline the seriousness of the risks observed in this study.

Relationships between hazard, risk, likelihood, harm, consequence and minerals sites in SEE

The five points addressed above underline that high **hazard** situations exist throughout the region addressed and that serious and **harmful consequences** have been experienced and will be suffered in continuation unless there is action on several fronts.

First, it is clearly stated that the **probability** of negative events is unclear, though likely to be high. This **indicates high risk** but also demands that action include more work to gather information to quantify such risk. Information facilitates the conduct of prioritised action. As priorities are established, ongoing works to reduce risks and reduce the **consequence** of accidents can proceed. Particularly, such works need to also address accident prevention, early warning systems, emergency preparedness and response measures related to mining sites and activities. This, in recognition that accidents can, and likely will, occur in the considerable intervening period before risks are made safe. Such preparedness regimes are needed at local, regional and transboundary levels.

institutionalised accident/disaster response procedures and community accident preparedness; apparent focus upon site jurisdictions rather than natural boundaries such as watersheds; institutional flux, low capacity, and a lack of clarity in accountability;national economic difficulties, and so on.

3. Non-environmental Stress Factors Affecting the Consequences of Pollution Incidents

There are a large number of non-environmental factors associated with potential risks from industrial activities and legacies related to mining. Where they serve to serve to exacerbate the degree of consequence associated with an event of the types covered by this study, they can said to be "stress factors". As has been discussed above, the consequence of an event that occurs, or may occur is a function of many such factors. A sample of parameters observed in this case study, or interpreted from observations to fall in this category includes:

- economic hardship at multiple societal levels (e.g. from individual and family level, through municipal up to regional level);
- employment related factors such as rampant unemployment, limited employment opportunities or development prospects in work roles, and similar;
- developmental factors such as a high dependence upon "homegrown" produce from home gardens and small farms in areas affected by mining related pollution;
- a widespread ignorance but potentially growing awareness, of dangers related to exposure to environmental pollution;
- under-developed structures for civil society;
- a sense of powerless and mistrust related to the manner of political and institutional process, the ability of the individual to influence the outcome of decisions important to their daily life (the decision to open or close a mining operation could be seen as an example);
- areas where borders are disputed, at a state or even at an individual property rights level;
- displacement of civilian populations;
- ethnic unrest and tensions;
- institutional flux – both in terms of organisational institutions and in terms of the rules and frameworks by which the social and industrial society is managed/regulated (i.e. civil society).

While it is difficult to evaluate the contribution of such factors to the potential consequence of impacts related to mining and minerals processing activities, such factors were found to be relevant in varying degrees to all subject countries addressed by the Desk Study.

4. Potential Work Activities to Dealt with Priority Issues

A range of work areas addressing the priority issues listed in the preceding discussion is provided below. Parts of these activities would take place in parallel and this listing is thus not chronological. It is anticipated that such work could be formulated and coordinated in liaison with inter-governmental agencies and conducted by groups drawn from national environmental agencies, mineral resources administrations, mines inspectorates, disaster response administrations and other national experts. Such work could also involve other international bodies and experts in liaison with inter-governmental agencies, international experts and academic institutions.

- Hazard and risk **uncertainty reduction** via focused information collection.

- **Management of risks** associated with the legacies of mining and minerals processing activities.
- **Capacity building** within **institutional** actors such as governmental regulatory agencies, mines inspectorates and so forth in order to develop consistent policies for future mining and minerals processing activities that reflect current best practice.
- **Capacity building** within **institutional** actors such as governmental regulatory agencies, mines inspectorates and so forth in order to support legacy management and the conduct of future mining and minerals processing activities.
- **Capacity building** within **industrial** actors such as miners, mineral processors and their associated industry bodies to support legacy management and as preparation for future mining and minerals processing activities.
- **Dialogue** with key stakeholders such as national and international NGOs, affected citizens, and so forth, in order to support the conduct of the works described above.

Within this Desk Study, it is also required that guidance is provided regarding future activities to reduce trans-boundary risk and local risk. The following text seeks to provide ideas in this direction suggested by this analysis.

5. A Brief Scoping of Next Steps Forward – A Road Map at Both Local (National) Scale and in a Trans-boundary and Regional Perspective

Scoping activities to reduce trans-boundary risk

The Desk Study has clearly indicated that activities to reduce trans-boundary risk will be important for regional security. Activities will need to fall into two main categories, that is control measures aimed at the prevention of major accidents and control measures aimed at the limitation of consequences of major accidents. It is also clear that bilateral or multilateral collaboration between countries and territories will be required to achieve this.

The first step indicated for future action is the collection of data on hotspot sites and the assessment of risk levels (including local, national and trans-boundary) for such sites. The potential activities listed here will be addressed in general terms only – this, in recognition of the fact that such activities are underway in some countries. As such, it is considered that the following activities are relevant:

- establishment of officially sanctioned bodies or working groups for the assessment and management of trans-boundary risk management – such bodies will need to include representatives from generating territories and receiving territories, and as required include international experts and international bodies involved in trans-boundary environmental and regional security issues;
- establishment of trans-boundary notification and disaster response systems linked to the parties mentioned above;
- establishment of monitoring programmes, and/or early warning systems for the assessment of ongoing chronic pollution;

- establishment of monitoring programmes, and/or early warning systems for the detection of acute pollution events;
- improved emergency preparedness and response measures including accident prevention an emergency preparedness at a local level;
- multi-lateral participation in the establishment of officially sanctioned bodies or working groups with the responsibility of scoping programmes for hotspot site remediation and seeking international funding for execution of priority works and pilot projects;
- capacity building for governmental and ministerial actors working with minerals and mining policies;
- capacity building for governmental and regulatory actors working with licensing and enforcement of best mining practices.

Scoping activities to reduce risk at a local level

The Desk Study has also clearly shown that activities to reduce risk at a local level will be important for the achievement, and/or maintenance of human quality of life, functional environmental systems, and protection of property. In a number of cases, the study has shown that work is required to ameliorate apparently very significant risks of events involving loss of life, environmental harm, and significant property damage. Again, as it is considered that the first step required involves the collection of data on hotspot sites and the assessment of risk levels (particularly local and national) for such sites, the potential activities here will be discussed/listed in general terms only. Further, while the activities mentioned here are couched in terms of events that are limited to national effects, it should be recognised that events of a trans-boundary nature as discussed above, will commonly involve harm at a local level as well. As such, it is considered that a range of activities should be considered.

- establishment of officially sanctioned bodies or working groups for the assessment and management of risk management associated with specific sites, specific operations, or within specific communities. Such bodies will likely need to include representatives from affected, or potentially affected communities; organisations responsible for the industrial operation in question (where identifiable); and national professionals competent in the relevant area of hazard. In some cases, the involvement of international experts and international bodies involved in environmental and/or health issues may be required,
- establishment of monitoring programmes, and/or early warning systems for the assessment of ongoing chronic pollution, accident prevention, and for the detection of pollution events,
- establishment of programmes improve community level emergency preparedness and response measures.
- national planning for hotspot site remediation and seeking international funding for execution of priority works, among others.

Recommendations for steps forward

A number of tasks are required to take the work addressed by this study forward. The first steps recommended are related to improved understanding of the situation outlined by the Desk Study (thus additional data collection and assessment work), and capacity building for national actors. While site remediation and concrete risk reduction works are without doubt required, such works are somewhat further in the future. They will not be addressed in specific terms here.

Better understanding/identification of hotspot sites

Additional detail beyond that provided by this desk-assessment study is required. Much of this must be provided by national actors. One important outcome of the Environment and Security Consultations, held in Skopje, in September 2004 was that National Focal Points (NFPs) for each country/territory would be proposed. These NFPs are to act as the point of contact regarding environment and security activities.

An immediate step in furthering work to reduce environment and security risks posed by mining is the ongoing feedback on this assessment from national experts (via NFP's). During 1994, each NFP was requested to consult such experts and to gather *inter alia*:

- critical comment on the validity of findings in their National context,
- more detail (where available) on identified sites of concern,
- details of additional of sites that they deem to be of concern that are not listed,
- completion of details of current ownership and activity status for identified sites,
- assessment of the legal status of abandoned/orphaned mines, both in general and for specific sites,
- addition of details with regards national experts, centres of expertise and so forth who should be involved in works related to the management of risks related to mining and minerals processing activities,
- suggestions for additional works required to reduce local, national and trans-boundary risks of this type in respective countries.

Capacity building for management of mining related risks

This study has indicated that regional actors often lack the necessary capacity to deal with the types of problems addressed. Further, this work indicates that while substantial steps are being taken to strengthen legislative frameworks and capacity, these are presently inadequate. It also appears that both the resources and professional capacity to apply legislation is also wanting.

To prepare for the development of regional institutional and industrial capacity building to a level that can support mining and minerals processing activities compatible with regional sustainable development in the broader SEE and theatre, a number of issues need to be addressed. Among other

things, it is considered that work (a regional forum is suggested) to map capacity building needs is warranted. It should involve representatives of each country addressed by this study, and/or affected by pollution of this type in the region.

Firstly, it is suggested that the specific objectives of the such work should include the identification of regional priorities for action within three areas: preparing for future mining and minerals processing activities; managing risks associated with the legacies of mining and minerals processing activities; and improving the accident prevention and accident preparedness of communities, regions and nations. Among other things, such work should seek national input upon where such items are most relevant, what actions are considered (by national actors) to be required, and who should be involved.

Secondly, it is suggested that such work should seek to identify the most urgent capacity building needs. Three sub areas are considered within this: institutional (governmental and regulatory) capacity building; industrial capacity building and capacity building at a community level. Similar to the priorities for action discussed earlier, activities should focus upon which capacity building needs are most acute and relevant, which actors groups require strengthening, and in which countries such activities should take place. Identification of candidate "capacity builders" and of pathways for capacity exchange between nations should also be considered.

Better understanding of the process of risk reduction in the South Eastern European context

Pursuant to activities of the type listed above, it is considered that pilot projects in risk reduction that target specific sites in a number of countries have the potential to provide significant tangible benefit.

While work towards the amelioration of risks at individual sites is likely to yield environmental, social, developmental and regional security benefit, the prime benefit of any pilot activity should sought in the area of learning for future work. For example, the desk-assessment study indicates that better understanding in many areas including:

- the challenges facing trans-boundary working groups (*inter alia:* cross border movement, geographical jurisdiction, sharing and compatibility of data, accountability, funding of activities);
- the manner in which gaps in legislative frameworks affect management of sites;
- how lack of institutional capacity limit progress with the management of trans-boundary risks;
- how general resource deficiencies (finance, equipment, technical capacity and so forth) place restraints on execution of works;
- pathways for stakeholder consultation that function best;
- models for industry/community cooperation that function best;
- technical knowledge gaps that prove most critical for success;
- pathways for financing risk amelioration, etc.

The scoping of any pilot projects within the region should take place pursuant to activities focused upon data collection and capacity building needs. Proposals to undertake such projects and the

determination of the specific objectives of any such projects can only take place if the desire to undertake such is expressed by representatives of the affected countries.

Closing comments

This assessment outlined a large of number of risks associated with mining activities but it is perhaps the opportunity for improvement in the situation that should be focused upon. To close this overview, it is considered that comment regarding the two divergent paths of action open to actors in the area is pertinent. To look on the positive side of this situation, there is considerable room for **proactivity**.

Proactive approaches can certainly prevent many negative events that are simply "waiting to happen" from ever occurring. Moreover, awareness and preparedness for events among stakeholders can serve to reduce the scale of potential events (hazard reduction), reduce the likelihood of event, engage and build trust with downstream communities – including downstream nations, and shift the focus of tensions with affected communities to the nature of risks rather than upon experienced harm. It is also vital to stress that prevention costs are invariably very much less than cleanup and that benefits such as increased or continued license to operate for the minerals sector can flow on from responsible and planned reactivity.

In contrast, tardiness or a **reactive** approach to management of the types of risks outlined in this study is associated with a number of negative facets. Among these, one can list that:

- the scale of potential events will tend towards a maximum, the likelihood of many potential events will continue to grow;
- the impacts upon downstream communities – including downstream nations, that are unaware of danger and unprepared for consequences will often be maximized;
- tensions with affected communities can tend toward a maximum and centre on themes of mistrust and betrayal.

Moreover, the consequences, (and thus the costs related to clean-up/remediation) will tend towards the higher end of any potential scale. Such scenarios also point towards the likelihood of real reductions in the willingness of communities and nations to accommodate the activities of the minerals sector. Such an eventuality may not be the best course for countries possessing valuable mineral resources that are desperately in need of investment and wealth generating activities to underpin their future development and life quality.

Acknowledgements: full report and full report references available at
http://www.grid.unep.ch/envsec/mining/draft_report.php

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