Reducing Environment & Security Risks from Mining in South Eastern Europe

Desk-assessment study for the Environment and Security Initiative Project

Philip Peck, November 2004

for

UNEP Regional Office for Europe &
UNEP Division of Technology, Industry and Economics
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Preface

This project is a part of the Environment and Security (EnvSec) Initiative for Central Asia, Caucasus and South Eastern Europe that was launched in 2002 by the United Nations Environment Programme (UNEP), the Organization for Security and Cooperation in Europe (OSCE) and the United Nations Development Programme (UNDP). This Initiative intends to facilitate a framework for cooperation on environmental issues across borders and promote peace and stability through environmental cooperation and sustainable development.

The Environment and Security (EnvSec) consultations for South Eastern Europe, that took place in Belgrade in December 2002 assigned high priority to the issue of mining. The region is rich in mineral resources, has a long history of mineral resource extraction activities, and already has a serious history of mining accidents, 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.

Challenges are not just linked to the manner in which extraction activities and waste management has been conducted, the use of hazardous chemicals in mining and minerals processing, poses additional risks in communities when transport and storage accidents occur. In addition to causing widespread environmental pollution, including trans-boundary pollution and tensions, all these hazards often confront local communities with immediate dramatic risks and/or health damage from chemical contamination.

This Desk Study represents a first step within a targeted programme to reduce trans-boundary environmental and human safety risks posed by sub-standard mining and mineral processing operations – both active and abandoned – in the region.

It is considered that reduction in environment and security risks can be achieved through an action programme aimed at improved operational and regulatory systems – systems that provide greater levels of safety at the sites, as well as local-level and trans-boundary processes for emergency preparedness and response. Further, discussion with national authorities and international partners can identify practical options for risk reduction, both at the community level and through the application of national policy and cross-border cooperation.

With these considerations in mind, the aim of this desk study process is to identify, delineate and catalogue mineral resource related sites that pose substantial risk to the environment, public health and safety, and/or regional socio-political stability in the Western Balkans (South Eastern Europe) region, and to provide information required to support work for risk and hazard reduction – particularly where such risks are of a trans-boundary nature.

As such, the Desk Study has been undertaken with objectives to:

- catalogue sites of mineral resource extraction and/or beneficiation in the region and to make an inventory and description of active mines, inactive mines and/or abandoned mines;
- generate a number of maps clearly delineating the location and potential areas of impact posed by hazardous sites;

1 While the prime focus of this study has been upon mining related activities, oil and gas activities have been included for completeness in the initial inventory of mineral extraction and refining activities. Oil and gas, have not however been included in the analysis. Coal and lignite mining has been included, but downstream energy conversion activities (i.e. power plants) and their wastes, have not been included.
• provide detail of how and why sites of significant hazard pose risks of a site, local, sub-regional, regional and/or trans-boundary nature;

• identify/suggest a number of “hot-spot” sites for each subject country and provide qualitative descriptions of their associated risks.

This work formed the basis of a presentation of the most pressing issues of risks of a regional and/or trans-boundary nature at the “Environment and Security Consultations in South Eastern Europe”, held in Skopje, the Former Yugoslav Republic of Macedonia, on 23-24 September 2004.
Executive summary

This Desk Study has identified and catalogued a large number of mineral resource related sites that are of high hazard. Many have significant risks associated with them that threaten the environment, public health and safety, and/or regional socio-political stability in the South Eastern European countries addressed by this study. A number have significant risk parameters associated with all three of the aforementioned categories of threat and consequence and as such have been identified as candidate “hotspots”. Despite a large amount of information (qualitative data) found and included within the study, the level of delineation regarding the majority of these sites remains relatively low. While the risks associated with these sites appear unacceptable, insufficient quantitative data exists to determine if this premise is correct – and if so, to which degree. As such, quantification of potential risks has not been undertaken in this work.

This report is intended to provide information required to support on-going work for risk and hazard reduction in the region – particularly where such risks are of a trans-boundary nature.

This summary addresses the following items:

- general findings regarding significant risks associated with the sites/operations that threaten the environment, public health and safety, and/or regional socio-political stability in the region both in a trans-boundary and in a local context;
- a summarising section including general comments regarding the non-environmental stress factors considered to be of importance; a scoping of on-going activities focused at reduction of the risks, and an outline of potential gaps in available information and regional capacities required to address the issues.

Prior to reading this summary, the reader is reminded that the Desk Study project represents only a first step in a proposed programme aimed at the reduction of environment and security risks related to mining and minerals processing activities in South Eastern Europe. It is an overview of the extent of the problem in the designated countries, with a focus on threats to regional stability. Thus, impacts that may cause trans-boundary tensions and security risks have been given prime focus.

Much more than a study is required in order to provide greater levels of safety at the sites and in surrounding communities as well as improvements of local-level and trans-boundary processes for emergency preparedness and response. This report is intended as a foundation upon which to plan for tangible improvements via an action programme focusing upon improvement of operational and regulatory systems.

Due to the nature of the challenges faced, such an action programme must address both the needs of local communities so that they can respond appropriately to the security risk and pollution potential of any hazardous sites in their vicinity, and the needs of authorities who will be required to intervene for abandoned sites, or sites in states of minimal “care and maintenance” in order to improve site, sub-regional and regional security.

Prior to providing the findings of this study, and in order to provide context for the reading of this report, an observation that can be made is that almost the full range of warning signals for environmentally damaging incidents of large scale and consequence are present in the region. 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;

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2 Albania, Bosnia & Herzegovina, Kosovo (Territory under UN interim administration), Macedonia, Serbia and Montenegro.
Mining in South East Europe, Environment and Security

- large (historical) milling and concentration plants with significant tailings impoundments
- mountainous terrain;
- periods of heavy rain and/or snowmelt;
- numerous rivers and catchment areas shared by several countries;
- significant seismicity (earthquakes);
- abandoned and orphaned sites with little or no closure or control;
- lack of ongoing physical and/or biochemical monitoring of operational and/or abandoned sites;
- lack of ongoing maintenance, both proactive & reactive;
- absence of institutionalised accident/disaster response procedures;
- 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.

These points should provide a context of “considerable urgency” to the reader. The situation regarding mining and minerals related risks to environment and health that are of both national and transboundary nature is very serious.

**Significant transboundary 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. The pathways identified in this study include:

- airborne transport of pollutants such as dust, smelter emissions, gases, vapours;
- mass movement of “solid” wastes (generally tailings containing heavy metals and toxic compounds);
- mass movement of liquid, or semi-liquid wastes (again, generally tailings containing heavy metals and toxic compounds);
- waterborne transport of wastes as suspended solids and as dissolved materials.

Among the sites and operations examined in this study, it is clear that the dominant pathway of exposure – at all levels of interest – is via waterways (fluvial transport). A second exposure pathway, airborne toxic emissions from smelters transported in the atmosphere, has been a very significant issue in the past. However, as a number of smelter operations have ceased operations, or are closed until such time that acceptable levels of emission can be achieved through upgrading of plant, the regional and transboundary importance of airborne emissions appear to have generally reduced in importance. A third important pathway appears to be toxic particulate pollutant transport as dust – however, this is a largely local and sub-regional effect rather than a transboundary one.

The overriding importance of fluvial transport mechanisms for tailings wastes in transboundary pollution risks bears several implications with it. To name but a few – very large volumes of materials can be involved with catastrophic damage to downstream land, property and ecosystems associated with the physical impacts of such accidents; biochemical, and eco-toxicological effects of these pollutants can be catastrophic and can extend far beyond the zone physically affected by such materials;

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3 Although sites such as RTB Bor in Serbia and a range of others are still operational.
the physical and biochemical, and eco-toxicological effects can be very long term (in essence, it may be impossible to clean up some affected areas), and so forth.

Here, only the sites believed to have the potential for impacts of a transboundary nature are listed. Note however, that sites listed as being likely to pose only national risk still may have the potential to create serious negative consequence should there be an incident (as discussed above).

**Albanian transboundary 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/or transboundary risk hotspots) for Albania, the operations listed in Table ES-1 have been selected as most likely to be associated with significant transboundary risk emanating from Albanian territory.

<table>
<thead>
<tr>
<th>Site name &amp;/or activity</th>
<th>Hazards</th>
<th>Potential transboundary harm/consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elbasan Smelter complex - Ferrochromium, Fe (steel) &amp; Ni smelters</td>
<td>Toxic &amp; heavy metal emissions, uncontained and unprotected wastes, residues and chemicals.</td>
<td>Cross border air pollution, pollution of Lake Ohrid shared with FYR of Macedonia Pollution via Shukumbinit River to Adriatic Sea. Tensions with FYR of Macedonia.</td>
</tr>
</tbody>
</table>

Sites where risks were considered to be national rather than transboundary, include:

- Burrel Ferrochrome Smelter;
- Chromite mines such as those at Bater, Bulquize, Kalimash and others;
- Fushe-Arrez copper mine & mill;
- Kukes Copper Smelter;
- Lac Copper Smelter;
- Rubik Copper Smelter;
- Reps copper mine.

**Transboundary risk hotspots in Bosnia & Herzegovina**

Candidate hotspots in Bosnia & Herzegovina are principally associated with 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/or transboundary risk hotspots) in Bosnia & Herzegovina, those operations listed in Table ES-2 have been selected as most likely to be associated with significant transboundary risk emanating from BiH territory.
Table ES-2. Bosnia(n) & Herzegovina(n) candidate sites – transboundary hotspots

<table>
<thead>
<tr>
<th>Site name &amp;/or activity</th>
<th>Hazards</th>
<th>Potential transboundary harm/consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birac Zvornick – Alumina refinery &amp; Aluminium smelter</td>
<td>Toxic emissions, uncontained and unprotected wastes, residues and chemicals, particularly red mud wastes and spent pot linings etc. from smelting operations</td>
<td>Cross border pollution via Drina River (Serbian Border) and into Danube River. Tensions with Serbia and downstream Danube countries (Romania, Bulgaria).</td>
</tr>
<tr>
<td>Sebestenica Energoinvest Pb-Zn mine &amp; beneficiation mill.</td>
<td>Toxic/acidic effluents, uncontained waste rock, dust emissions &amp; unsecured workings, poorly contained and/unstable tailings wastes.</td>
<td>Cross border pollution via Drina River (Serbian Border) and into Danube River. Tensions with Serbia and downstream Danube countries (Hungary, Romania, Bulgaria).</td>
</tr>
</tbody>
</table>

Sites where risks were considered to be national rather than transboundary, include:

- Mostar – Aluminij d.d. Mostar Refinery & Smelter;
- Petrovo-Selo & Ilici Asbestos;
- Buzim FBC Manganese Energoinvest mine & concentrator;
- Jajce Elektrohemisjksa Plant Ferroalloy smelter;
- Zenica – RMK Zenica Steel.

Transboundary risk hotspots in Kosovo (Territory under UN interim administration)

Those operations listed in Table ES-3 have been selected as most likely to be associated with significant transboundary risk emanating from Kosovian territory. This list contains nearly all the sites indicated as hot spots. 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 have considerable risk associated with them but they appear to threaten Kosovian territory only.
### Table ES-3. Kosovian candidate sites – transboundary hotspots

<table>
<thead>
<tr>
<th>Site name &amp;/or activity</th>
<th>Hazards</th>
<th>Potential transboundary harm/consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Djakovic – DEVA Cr mine.</td>
<td>Toxic/acidic effluents, uncontained waste rock, dust emissions &amp; unsecured workings, poorly contained and/unstable tailings wastes.</td>
<td>Cross border pollution via Erenik River (tributary to Beli-Drin river) Flow to Lake Fierzës. Tensions with Albania</td>
</tr>
<tr>
<td><strong>Trepca Mills</strong> – Badovac, Leposavic, Maravce, Tuneli i pare &amp; Kishnica Mills, Pb-Zn mines &amp; beneficiation mills.</td>
<td>As above.</td>
<td>Multiple sites. Cross border pollution via Ibar River flowing to Serbia and into Danube River. Tensions with Serbia and downstream Danube countries (Romania, Bulgaria).</td>
</tr>
<tr>
<td><strong>Trepca Mills</strong> – Rudnik Pb-Zn mine &amp; beneficiation mill.</td>
<td>As above.</td>
<td>Cross border pollution via tributary to Beli (Drina) flowing into Albania. Tension with Albania.</td>
</tr>
<tr>
<td><strong>Sebrenica Energoinvest Pb-Zn mine &amp; beneficiation mill.</strong></td>
<td>As above.</td>
<td>Cross border pollution via Drina River (Serbian Border) and into Danube River. Tensions with Serbia and downstream Danube countries (Romania, Bulgaria).</td>
</tr>
<tr>
<td>Titova Metrovica electrolytic Pb &amp; Zn refinery.</td>
<td>Toxic solid waste, airborne toxics &amp; SO2. Toxic/acidic effluents, dust emissions, poorly contained smelter residues and chemicals</td>
<td>As above</td>
</tr>
</tbody>
</table>

**FYR of Macedonia transboundary risk hotspots**

Candidate hotspots in FYR of Macedonia are principally associated with associated with lead and 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 10 minerals related operations listed as potential hotspots (both national and/or transboundary risk hotspots) in the FYR of Macedonia, those operations listed in Table ES-4 have been selected as most likely to be associated with significant transboundary risk emanating from FYR of Macedonia territory.
Table ES-4. Macedonian candidate sites – transboundary hotspots

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

Sites where risks were considered to be national rather than transboundary, include: 4

- Radusa - Jugochrom (HEK) chromite beneficiation plant;
- Jegunovce – Jugochrom (HEK) smelter;
- Sase (Kamenica) Pb-Zn mine and mill;
- Rudnici Zletovo (Probostip) Pb-Zn mine and mill;
- Toranica Pb-Zn mine and mill (Kriva Palanka);
- Titov Veles (Zletovo) Pb smelter and Titov Veles Zn smelter;
- Mostar alumina refinery & aluminium smelter.

Serbian transboundary risks

Candidate hotspots in Serbia were principally associated with antimony mining, processing, and smelting; 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/or transboundary risk hotspots) in Serbia, the six operations listed in Table ES-5 have been selected as most likely to be associated with significant transboundary risk emanating from Serbian territory.

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4 A number of these sites have not been included as transboundary hotspots due to their being assigned the category “moderate” rather than “high” due to the considerable distance to the Greek Border. However, these gradings may require reassessment upon receipt of more detailed information.
## Table ES-5. Serbian candidate sites – transboundary hotspots

<table>
<thead>
<tr>
<th>Site name &amp;/or activity</th>
<th>Hazards</th>
<th>Potential transboundary harm/consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bor (RTB) Mine, mill, smelter &amp; 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.</td>
<td>Toxic/acidic effluents, uncontained waste rock, dust emissions &amp; unsecured workings, poorly contained and/unstable tailings wastes. Toxic solid waste, airborne toxics &amp; SO₂. Toxic/acidic effluents, dust emissions, poorly contained smelter residues and chemicals.</td>
<td>Cross border pollution to downstream Danube countries via Bor (Borska Reka), Timok Rivers, Krivljanka River and Danube Rivers. Tensions with downstream Danube countries (Romania &amp; Bulgaria). Cross border air pollution.</td>
</tr>
<tr>
<td>Majdanpek (RTB) Cu beneficiation mill and mine.</td>
<td>Toxic/acidic effluents, uncontained waste rock, dust emissions &amp; unsecured workings, poorly contained and/unstable tailings wastes.</td>
<td>Cross border pollution to downstream Danube countries via Pek River, then Danube. Tensions with downstream Danube countries (Romania &amp; Bulgaria).</td>
</tr>
<tr>
<td>Sabac electrolytic zinc smelter &amp; refinery</td>
<td>Toxic solid waste, airborne toxics &amp; SO₂. Toxic/acidic effluents, dust emissions, poorly contained smelter residues and chemicals.</td>
<td>Cross border pollution to downstream Danube countries via Sava River. Tensions with downstream Danube countries (Romania &amp; Bulgaria).</td>
</tr>
<tr>
<td>Veliki Krivelj (RTB) Cu beneficiation mill and mine.</td>
<td>Toxic/acidic effluents, uncontained waste rock, dust emissions &amp; unsecured workings, poorly contained and/unstable tailings wastes.</td>
<td>Cross border pollution to downstream Danube countries via Krivljanka River, Timok River then Danube River. Tensions with downstream Danube countries (Romania &amp; Bulgaria).</td>
</tr>
<tr>
<td>Zajaca Antimony (Sb) mine, beneficiation mill and smelter.</td>
<td>Toxic solid waste, airborne toxics &amp; SO₂. Toxic/acidic effluents, uncontained waste rock, dust emissions &amp; unsecured workings, poorly contained and/unstable tailings wastes. Poorly contained smelter residues and chemicals.</td>
<td>Cross border pollution to Bosnia &amp; Herzegovina via Drina River, then to Danube via Sava River. Tensions with BiH and other downstream Danube countries (Romania &amp; Bulgaria).</td>
</tr>
</tbody>
</table>

Sites where risks were considered to be national rather than transboundary, include the Rajiceva antimony mines and mills and lead-zinc mining and beneficiation operations at Lece. ⁵

### Montenegrin transboundary risks

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

Of the five minerals related operations listed as potential hotspots (both national and/or transboundary risk hotspots) in Montenegro, the four operations listed in Table ES-6 have been selected as most likely to be associated with significant transboundary risk emanating from Serbian territory.

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⁵ A number of these sites have not been included as transboundary hotspots due to their being assigned the category “moderate” rather than “high” due the considerable distance of flow through Serbia. However, these gradings may require reassessment upon receipt of more detailed information.
### Table ES-6. Montenegrin candidate sites – transboundary hotspots

<table>
<thead>
<tr>
<th>Site name &amp;/or activity</th>
<th>Hazards</th>
<th>Potential transboundary harm/consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mojkovac Pb-Zn beneficiation mill and mine.</td>
<td>Toxic/acidic effluents, uncontained waste rock, dust emissions &amp; unsecured workings, poorly contained and/unstable tailings wastes.</td>
<td>Cross border pollution to Bosnia &amp; Herzegovina via Tara River. Health and environmental damage in town of Mojkovac. Tensions with BiH.</td>
</tr>
<tr>
<td>Brskovo Pb-Zn beneficiation mill and mine.</td>
<td>As above.</td>
<td>Cross border pollution to Bosnia &amp; Herzegovina via Tara River. Tensions with BiH.</td>
</tr>
<tr>
<td>Suplja Pb-Zn beneficiation mill and mine.</td>
<td>As above.</td>
<td>Cross border pollution to Bosnia &amp; Herzegovina via Cehotina River, a tributary to the Drina River, which constitutes the BiH border &amp; flows to the Danube.</td>
</tr>
<tr>
<td>Titograd – Alumina &amp; Aluminium refining &amp; smelting</td>
<td>Toxic emissions, uncontained and unprotected wastes, residues and chemicals, particularly red mud wastes and spent pot linings etc. from smelting operations</td>
<td>Cross border pollution via Lake Scutari (Skadarsko Jezero) shared with Albania. Tensions with Albania.</td>
</tr>
</tbody>
</table>

Sites where risks were considered to be national rather than transboundary include the Niksic, Kutsko Brdo, Zagrad, Biločki Stan, and Durakov Dol bauxite mines.

### Conclusions and recommendations

A number of items are covered in this conclusions and recommendations summary. 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;
- discussion of non-environmental stress factors;
- potential work activities to deal with priority issues;
- A brief scoping of next steps forward – a road map at both local (national) scale and in a transboundary and regional perspective

### Priority issues and institutions to be involved

The Desk Study has highlighted a number of interlinked issues where action of varying urgency is required.

### 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. As detailed in this report – and summarised in the preceding discussions in this conclusion 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 waters and groundwater. Such effluents contribute to local, national and transboundary pollution of varying degrees of severity – often considerable severity. Directly related to this, and presented here as a sub-issue (as it is central to risk reduction strategies in general) is the remaining **degree of uncertainty** regarding such sites. As such, 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 of critical importance.\footnote{As an example based on hazardous water and waste impoundments – an inventory containing details such as: location, height, area, description and speciation of substance contained, age, material of construction, condition, ownership history, institutional jurisdiction and so forth – would provide information required to reduce uncertainty.}

**Issue 2 – risk reduction at operational sites**

The second priority issue or area of major concern 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 consequence are lower. 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 events leading to the dramatic pollution of the Tisza and Danube rivers in 2000/2001\footnote{Most infamously the events at the Aurul S.A. Baia Mare Company in northwest Romania during the year 2000.} – with effects on the whole region clearly have shown, modern operations can also fail catastrophically – with a range of physical/engineering and institutional factors contributing to failure. 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 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 transboundary risk management and/or disaster response, and so forth.

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. The nature of the issues identified in this work point
towards a focus upon institutional and industrial actors. However, as a range of Non Governmental Organisations (NGOs) are 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 such actors will need to be initiated and maintained.

**Relationships between hazard, risk and minerals sites in SEE**

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/or trans-boundary nature.

According to the definitions of key terms applied within this report, examples of the how and why sites of significant hazard pose risks of a site, local, sub-regional, regional and/or trans-boundary nature are briefly presented here. While these examples can be considered a synthesis of items found during the conduct of the Desk Study, they are not exhaustive.

**Harm**

Potential damage to people, property, or the biophysical, social, or cultural environment associated with the primary transboundary 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 forth. The types of damage listed here have the potential to occur at site, local, sub-regional, regional and/or 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. Further, the high number and common occurrence of “warning signals” as listed in the opening of this summary, indicate that many factors are present contributing to increased likelihood of incidents in this region.

**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, and so forth and so on.

**Consequence(s)**

The intermediate or final outcome(s) of events or situations 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; and so forth. 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 forth, 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.

**Non-environmental stress factors**
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”. A sample of parameters observed in this case study, or interpreted from observations to fall in this category include:

- 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;
- poorly established 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), and so forth;
- 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.

Dealing with risk – general work activities for priority issues

A range of work areas addressing the priority issues listed in the preceding discussion is provided below. Where feasible, general actor groups and their roles have also been listed. Parts of these activities would take place in parallel and this listing is thus not strictly chronological.

- **Hazard and risk uncertainty reduction** via focused information collection. Such work could be formulated and coordinated by national environmental agencies in association with international and national experts, and conducted by mines inspectorates and national experts.

- **Management of risks associated with the legacies of mining** and minerals processing activities. Such work could be coordinated by national environmental agencies and transboundary constellations of such agencies; formulated by bodies such as mines inspectorates, national and international experts, and academic institutions in association with key stakeholders, and; conducted by industrial actors within mining and related branches.

- **Capacity building within institutional actors** such as governmental regulatory agencies, mines inspectorates and so forth in order to support legacy management and as preparation for future mining and minerals processing activities. Such work could be formulated and coordinated by international bodies and experts in liaison with national environmental agencies, and in liaison other key stakeholders. It could be conducted by consortia of
international experts and academic institutions in association with national academic institutions.

- **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. Formulation and conduct as above.

- **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. At the current time, such work should likely be limited to a focus upon the specific tasks above. It could be formulated and coordinated by international bodies and experts in liaison with national environmental agencies and academic institutions and conducted by consortia of international experts and academic institutions in association with national academic institutions.

The work activities listed above are couched in general terms. However, it was also required that that guidance is provided regarding future activities to reduce transboundary risk and local risk within this study. The following text seeks to provide ideas in this direction suggested by this analysis.

### Scoping activities to reduce transboundary risk

The Desk Study has clearly indicated that activities to reduce transboundary 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 cooperation 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 transboundary) for such sites. The potential activities named or 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 transboundary 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 transboundary environmental and regional security issues;
- establishment of transboundary 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, and for the detection of pollution events;
- 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;
- capacity building for governmental and regulatory actors involved, or to be involved in activities such as those listed above.

### 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/or 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 transboundary 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, and for the detection of pollution events;

- National planning for hotspot site remediation and seeking international funding for execution of priority works;

Recommendations for steps forward

A number of tasks are required to take the work addressed by this study forward. As has been stressed, 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 the Desk Study is required from national actors. One important outcome of the Skopje EnvSec meeting 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 EnvSec activities.

An immediate step is the issue of this report to each NFP for distribution to national experts as identified by each relevant NFP. Each national expert, or expert group should then provide *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 transboundary risks of this type in respective countries.
Capacity building for management of mining related risks
This study has indicated that regional actors lack the necessary capacity to deal with the types of problems addressed by this study. Further, this study indicates that while substantial steps are being taken to strengthen legislative frameworks and capacity, that these also are presently inadequate. It also appears that both in 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 South Eastern Europe and theatre, action is required. Among other things, it is considered that a regional forum 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 workshop should be to identify regional priorities for action within two areas: preparing for future mining and minerals processing activities and managing risks associated with the legacies of mining and minerals processing activities. Among other things, such a forum 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 the workshop should seek to identify the most urgent capacity building needs. Two sub areas are considered within this: institutional (governmental and regulatory) capacity building and industrial capacity building. Similarly to the priorities for action discussed earlier, the workshop 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 study indicates that better understanding in many areas is required. Examples of such areas are:

- the challenges facing transboundary working groups (*inter alia*: cross border movement, geographical jurisdiction, sharing and compatibility of data, accountability, funding of activities, and so forth and so on);
- the manner in which gaps in legislative frameworks affect management of sites;
- how lack of institutional capacity limit progress with the management of transboundary 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;
- models for financing risk amelioration;

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 desk study has outlined a large of number of risks associated with mining and minerals processing activities in the countries addressed – however, it is the opportunity for improvement in the situation that perhaps should be focused upon. To close this overview report, 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 licence to operate for the minerals sector can flow on from responsible and planned proactivity.

In contrast, tardiness or a reactive approach to management of the types of risks outlined in this study are 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 maximised; tensions with affected communities will tend toward a maximum and centre on themes of mistrust and betrayal. Moreover, the consequences, (and not least 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.
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1. Introduction

1.1 Background to the project

This project is a part of the Environment and Security (EnvSec) Initiative for Central Asia, Caucasus and South Eastern Europe that was launched in 2002 by the United Nations Environment Programme (UNEP), the Organization for Security and Cooperation in Europe (OSCE) and the United Nations Development Programme (UNDP). This Initiative intends to facilitate a framework for cooperation on environmental issues across borders and promote peace and stability through environmental cooperation and sustainable development. These goals can only be fulfilled through a strong partnership between the governments, international organizations, academia, and the civil society.

During Phase I, the partner-agencies prepared a regional overview of the environment and security problems and hot spots in South Eastern Europe and Central Asia. The Environment and Security (EnvSec) consultations for South Eastern Europe, taking place in Belgrade in December 2002 assigned high priority to the issue of mining. This, not least because the region is rich in mineral resources, has a long history of mineral resource extraction activities, and already has a serious history of mining accidents, 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 without doubt exacerbated the problems associated with many sites.

After the initiative presented itself at the Kiev “Environment for Europe” Ministerial Conference in May 2003, the EnvSec partners have further developed priority fields of action and related projects in SEE. This Desk Study represents a first step within a targeted programme to reduce trans-boundary environmental and human safety risks posed by sub-standard mining and mineral processing operations – both active and abandoned – in the region.

Key among changes that contribute to deterioration in the risk situation, is that the cessation of industrial activities without planned closure measures (be it as a result of socio-economic turbulence, or for other reasons) is 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 with commensurate increase in risks to both local communities and international relations. The dramatic pollution of Tisza and Danube rivers with impacts on the whole region by a small mine in Romania in 2000 clearly illustrates the potential impact of even relatively small operations that are not properly managed and/or maintained (c.f. ICPDR/Zinke Environment Consulting, 2000). Unfortunately, this event is not the first such release that has occurred in the region, there have been more since, there are more to come.8

Abandoned mines and 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,

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8 At least one such event is detailed within this report – a tailings release at the Sase mine in the FYR of Macedonia during 2003.
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. Further, it is usual that waterways and soils in adjacent areas have been contaminated by toxic water leakages or by the fallout of airborne materials.

Further, the use of hazardous chemicals such as cyanide in mining and mineral processing activities poses additional risks to communities of transport and storage accidents – even the handling of more “mundane” hazardous substances such as hydrocarbon fuels are associated with significant risks to health and environment. In addition to possessing considerable potential for widespread environmental pollution, including trans-boundary pollution and tensions, all these hazards often confront communities with immediate dramatic risks and/or health damage from chronic exposure to serious chemical contamination of their neighbourhoods. Indeed, in a number of areas throughout the region, health effects such as respiratory disease, lung cancer, joint ailments and kidney disease (apparently) associated with sites of minerals processing activity have been observed (Jovic, Nikolic, Vukadinovic, & Grzetic, 2002; UNEP, 2000, 2004a, 2004b; UNEP/DEPI/Balkans Unit, 2001).

1.2 Project description

This Desk Study project represents the first steps in a proposed programme aimed at the reduction of environment and security risks related to mining and minerals processing activities in South Eastern Europe and addresses mineral resource extraction and beneficiation activities in Albania, Bosnia & Herzegovina, Kosovo (territory under UN interim administration), FYR of Macedonia and Serbia & Montenegro.

It is intended that tangible improvements be achieved through an action programme focusing upon improvement of operational and regulatory systems. This, in order to provide greater levels of safety at the sites and in surrounding communities as well as improvements of local-level and trans-boundary processes for emergency preparedness and response.

An immediate need is to help local communities to respond appropriately to the security risk and pollution potential of any hazardous sites in their vicinity. While, active sites can be helped to put more secure operational procedures in place, for abandoned sites, or sites in states of minimal “care and maintenance”, authorities may need to intervene directly to improve site security.

This Desk Study is to provide a first assessment of the extent of the problem in the designated countries. The location of sites presenting serious public and environmental risks, and a qualitative estimation of the likely impacts – both those currently occurring (e.g. chronic pollution emissions), and those with significant potential to arise (e.g. both diffuse chronic emissions and acute catastrophic events) are to be documented. In the interest of regional stability, impacts that may cause trans-boundary tensions and security risks have been given a particular focus.

Discussion and/or correspondence with national authorities and international partners, both in the preparation phase of this report, and subsequent to its issue, is intended to identify some practical options for risk reduction, both at the community level, and through the application of national policy and cross-border cooperation.

The second part of the project (anticipated to commence in late 2004, early 2005) will work towards implementation of the most promising options through demonstration at selected sites, and through an evaluation and testing of possible policy changes and trans-boundary cooperation mechanisms. Concomitantly, first actions to build local and national capacities in hazard identification and risk reduction will be proposed. It is also envisaged that better awareness of the risks and options will be built through national meetings and workshops, and that the key outcomes may be brought together at a regional conference.
This project may also identify follow-up options for capacity building activities within national authorities.

1.2.1 Aim
The aim of this Desk Study is to identify, delineate and catalogue mineral resource related sites that pose substantial risk to the environment, public health and safety, and/or regional socio-political stability in the Western Balkans (South Eastern Europe) region, and to provide information required to support work for risk and hazard reduction – particularly where such risks are of a trans-boundary nature.

1.2.2 Objectives
This study has the following objectives:

1. to catalogue sites of mineral resource extraction and/or beneficiation in the region and to make an inventory and description of active mines, inactive mines and/or abandoned mines;

2. to generate a number of maps clearly delineating the location and potential areas of impact posed by hazardous sites;

3. to provide detail of how and why sites of significant hazard pose risks of a site, local, sub-regional, regional and/or trans-boundary nature;

4. to identify/suggest (at least) three “hot-spot” sites for each subject country and provide qualitative descriptions of their associated risks;

5. to form the basis of a presentation of the most pressing issues of risks of a regional and/or trans-boundary nature at the “Environment and Security Consultations in South Eastern Europe”, held in Skopje, the Former Yugoslav Republic of Macedonia, on 23-24 September 2004.

1.2.3 Scope of works
The work encompassed by this Desk Study is intended to provide a first assessment of the extent of the problem in the designated countries, the location of sites presenting serious public and environmental risks, and an estimation of the likely impacts – in particular impacts that may cause trans-boundary tensions and/or constitute security risks.

The study focuses upon regional mineral resource extraction related activities and their potential impacts. It includes examination of information upon operational, idle, abandoned and orphaned sites, primarily as is documented within existing secondary information sources. Such material includes statistical records, previous assessments, maps, photographs, and geotechnical information. Information from primary sources (primarily correspondence with national/local institutions) is

10 Relevant Government officials from Albania, Bosnia and Herzegovina, Serbia and Montenegro, the FRY of Macedonia, the United Nations Interim Administration Mission in Kosovo (UNMIK), Bulgaria, Croatia and Romania attended this meeting.

11 Within this report, abandoned mines are deemed to be those where rehabilitation is incomplete but whose legal owners still exist. Orphaned sites, on the other hand, refer to abandoned mines for which the responsible party no longer exists or cannot be located while idle mining assets refer to abandoned mines that are currently under some form of care and maintenance.
included in this work but this constitutes only a minor portion of the material utilised. The restriction of works to a desk-based assessment is intended to provide a fast and cost-effective method of obtaining an overview of the likely risk potential for the environment and on the nearby communities in the region.

The information gathered, is collated and analysed to determine the potential risk of the identified sites and is intended to allow the formulation of appropriate evaluation and mitigation measures to be undertaken during future work.

The following works were specified and conducted for this desk-study:

1. examine information provided by UNEP representatives on mining activity in each of the concerned countries;

2. gather information from other sources (e.g. internet and via contact with regional actors);

3. make an inventory and description of active mines, inactive mines and abandoned mines (alt. operational, idle, abandoned and orphaned sites) based upon the information thus made available, with primary emphasis given to abandoned mines and mines that pose a trans-boundary risk(s);

4. provide support to UNEP’s Division of Early Warning and Assessment (DEWA) in their work to describe and map each item’s location;

5. provide details of the item’s current role and remaining risk aspects for the environment and for the nearby community;

6. prioritize (at least three) “hot-spots” in each country and estimate the likely impacts for each of them, in particular impacts that may cause trans-boundary tensions and security risks;

7. catalogue relevant mining institutions in each country as an information resource kit for further capacity building and policy advice issues, highlighting, where possible, relevant Government Authorities, UN bodies, private sector actors, NGOs and Academia in each relevant country along with their relationship to the mining sector;

8. catalogue the policy and legislative frameworks, if any, addressing abandoned mines in each country;

9. Prepare a summary of most relevant issues to be presented at the “Environment and Security Consultations in South Eastern Europe”, to be held in Skopje, the Former Yugoslav Republic of Macedonia, on 23-24 September 2004 with relevant Government Officials from countries in the region.

1.2.4 Methodology & chronology

The conduct of the Desk Study commenced in late June 2004 and had initial reporting of results at the Skopje workshop during late September 2004 as a major milestone. This draft report is scheduled for issue to EnvSec partners for review in November 2004.

The restriction of works for this study to a desk-based assessment, based primarily upon secondary sources, is intended to provide a fast and cost-effective method of obtaining an overview of risk potentials for the environment and for the nearby communities in the region. The steps taken in this investigation have reflected the tasks defined in the scope of works and work has been conducted in
several stages. A number of these have involved iterations between data collection, analysis and searches for additional data.

For clarity, the approaches utilised in this work are presented as they are related to work tasks (task numbers correspond to the items in the Scope of works).

**Task 1 – gather/catalogue relevant UNEP information**

A project start-up visit to UNEP ROE offices in Geneva in June 2004 was utilised to obtain a range of UNEP documentation, web-links and database details relevant for the Desk Study. A half-day was spent examining available databases on mining legacies, environmental security reports, and post conflict work conducted by UNEP upon each of the countries concerned.

**Task 2 - general data collection**

This project phase involved intensive data collection and collation. Material was sourced primarily from (downloadable) documents available via the Internet. Focus was maintained upon material provided by Government Authorities, UN bodies, private sector actors, NGOs and Academia in each relevant country. Sources utilised included statistical records, previous environmental and political assessments, maps, photographs, and diverse geotechnical and minerals-related information. Attempts to obtain information from primary sources (via email correspondence with national/local institutions) was undertaken within this work but was largely unsuccessful. Consequently, primary sources constitute only a minor portion of the material utilised. The majority of the data obtained for this project has been gathered within an online database system and is to be made available for UNEP world-wide-web resources in a later stage of the project.

As the study focuses upon the environmental impact potential of mineral resource extraction related activities in several categories (e.g. operational, idle, abandoned and orphaned sites) it has required examination of both historical and current data sources. However, the majority of data acquired is post 1991.

This data collection work was conducted during the European summer of 2004.

**Task 3 – documentation of site inventory**

An extensive spreadsheet inventory of mining and minerals related operations in the region was created utilising Microsoft excel®. The inventory details approximately 150 operations (although many operations have more than one location with significant environmental aspects). Where information was available descriptions of all aspects of operations were included. These included mineral types, production volumes, period of operation, operational status, environmental aspects and exposure pathways, nearby towns, adjacent waterways, and so forth. Extracts from this document are included within Section 3 of this report.

Where possible, triangulation of information regarding sites was undertaken. For a significant proportion of sites/operations, multiple sources of information have contributed to the site assessment. In general, more information was available for sites of concern.

This work was conducted during the European summer of 2004.

**Task 4 – support UNEP DEWA in site mapping**

Information generated for Task 3 was iteratively fed to UNEP DEWA and GRID Geneva in order to locate mining and minerals processing sites on maps of the region. This work was conducted primarily during August and September 2004. These outputs are provided at the following web address:
http://www.grid.unep.ch/envsec/mining/desk_study_maps.php

Tasks 5 and 6 - describe risk aspects for the environment, communities and neighbouring nations for sites of concern and prioritise key sites of trans-boundary tensions and security risks

Within the cataloguing process, as many of the site/operational parameters describing hazard aspects were documented. Further, a semi-quantitative ranking process was undertaken, where the relative hazard of differing operational facets/components, as well as the relatively likelihood of events were compared (within the limitations posed by the nature of information). This process helped to (crudely) determine the relative risk of the identified sites and is intended to help the formulation of appropriate evaluation and mitigation measures to be undertaken during future work. Cross-referencing between maps (task 4) and the information in the catalogue (tasks 2 and 3) was required in order to prioritise sites. Transboundary transport by water was given priority in this process. This work was conducted primarily during August and September 2004.

Tasks 7 and 8 - catalogue the policy and legislative frameworks and relevant mining institutions in each country

As a part of task 2 and in a similar fashion to the conduct of task 3, a catalogue of relevant legislative structures, national expert actors and interested parties was generated. This task will be ongoing throughout the project. Important input obtained from the Skopje workshop is included in this report. This work was conducted during the period June to September 2004.

1.2.5 Limitations

The primary limitation upon this Desk Study is the fact that it is a study based, almost in its entirety, upon secondary sources. While many of the key sources utilised in this study, address to some degree the risks associated with sites of mining and minerals processing activities (over 30 reports produced by relevant Government Authorities, UN bodies, private sector actors, NGOs and Academia have been examined), few have the same focus. That is, the identification of sites where there are significant risk aspects for the environment, nearby communities, and/or impacts that may cause trans-boundary tensions and security risks. No primary data collection activities such as site visits, interviews with local experts, etcetera, have been performed within this work.

As such, a range of significant limitations upon findings should be recognised.

- Many of the sites mentioned in the study, and findings presented regarding them, lack specificity (i.e. the identification of prime risks associated with one particular tailings impoundment at a large site of operations where there may be several such dams; the level of detail where a high hazard site can be judged to be in good condition or poor condition, and so forth). Only first hand examination by competent persons, preferably involving visual examination of sites and/or detail documentation of site layout etc., can provide the level of detail required for specific decision-making regarding such sites.

- 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 possible to ascertain the likelihood (probability and/frequency) that pollution incidents may occur in any quantitative form. Nor has this study been able to determine the likely harm (damage to people, property, or the biophysical, social, or cultural environment) or the consequences (intermediate or final outcome(s) of an event or situation) except in general terms.

- Details of the current role and remaining risk aspects for the environment, and for the nearby communities, for many of the sites/operations addressed by this study are, by necessity, based
upon “plausible scenarios” for emissions, effluents and wastes rather than specific data on volumes, concentrations, release rates and so forth. The determination of a “plausible scenario” has been almost purely qualitative – based upon the experience of the author – and is placed in the context of the region, where evidence suggests that “worst case scenarios” may be very valid.

- The prioritisation of “hot-spots” in each country and description of potential impacts associated with each of them, in particular impacts that may cause trans-boundary tensions and security risks, are based upon qualitative examination of the material referenced in this report and not upon accepted “quantitative” or “semi-quantitative” forms of risk assessment.

- The process of cataloguing the policy and legislative frameworks addressing mining in general, and abandoned mines in particular, have been performed utilising assessments performed by other parties (the prime source being a range of environmental performance review reports prepared by Economic and Social Council of the United Nations Economic Commission for Europe). Legislative material directly from the reference countries has not been sourced. The majority of the referenced sources are at least two years old. It is thus possible that significant progress may have occurred in some areas since that time.

A number of minor limitations are also highlighted here. It is anticipated that the review process for the draft version of this report will help address a number of these.

- The degree of triangulation of data regarding different sites varies widely. In some cases, several sources refer to a specific site or operation in some detail, and the confidence in the validity of information is high. In other cases, only fleeting or secondary reference to a site and/or its environmental hazards has been found and confidence is correspondingly low.

- In a number of instances difficulty has been experienced with the “double up” of place names in documentation, conflicting information regarding their location, and unclear information regarding the types of minerals extracted/processed, or the type of operations. As a result, a small number of sites may be incorrectly located. In some cases, the organisational name preceding a site has exacerbated this difficulty (i.e. a number of organisations have operations in differing parts of a country, but the place name within the organisational identifier is carried over to other sites)

- Details regarding the organisational/company names for certain operations may be out of date.

Finally, despite the clear links between the social and environmental aspects of mining and mineral processing activities and the potential for cross-border tensions, environmental and/or transboundary risks, health concerns and so forth, these lie beyond the direct scope of this desk study. While consideration of these factors is considered in the analysis within this study, examination of such aspects has not been taken up explicitly. Nor has data been explicitly sought in this arena.

### 1.2.6 Important risk related terminology

The meanings intended for a range of key terms and concepts referred to throughout this report are listed in the following points.

**Harm** Any damage to people, property, or the biophysical, social, or cultural environment.

**Likelihood** A qualitative term covering both probability and frequency. The use of this term can avoid problems caused by using frequency of defined events and probability of specific outcomes interchangeably. Exposure pathways – that is, the manner in which people, property, or the biophysical, social, or cultural environment are exposed to a source of potential harm or a situation with a potential for harm are important is important when considering the likelihood of harm.
Hazard  A source of potential harm or a situation with a potential for harm, thus a potential cause of harm.

Consequence(s)  The intermediate or final outcome(s) of an event or situation. Consequence is a term that contains elements of the social as well as biophysical world thus system response factors such as stakeholder reactions (e.g. outrage) to an event or situation are highly relevant here.

Risk  A description of the likelihood of the harm becoming actual. Importantly, risk is (at least) two dimensional and consideration of risks must encompass items such as the consequences of an event or set of circumstances and the likelihood of particular consequences being realised. Exposure pathways – that is, the manner in which people, property, or the biophysical, social, or cultural environment are exposed to a source of potential harm or a situation with a potential for harm are important when considering the likelihood of harm.
2. Environmental Context

2.1 Mining and environment in the Adriatic Balkan Region

Europe’s Adriatic Balkan region – generally referred to as the Western Balkans in this report, is part of the southern portion of the Mediterranean Alpine folded zone, which extends through the Dinarides of Bosnia and Herzegovina, Croatia, Macedonia, Serbia and Montenegro, and Slovenia, the Albanides of Albania, and the Hellenides of Greece (Steblez, 2001). This section provides a general description of (some) environmental aspects of each country in this region where they may relate to mining (and resource extraction in general) and minerals processing activities in some way. While a number of details presented in this section are geographical rather than geologically focused, an overall view is 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.

This report addresses the interaction of minerals industry activities and the environment in a geographical region spanning three major European water catchments that flow into three distinct seas; the Adriatic, the Aegean and the Black Sea (Danube Basin). In the context of mining and mineral processing, fluvial pollution transport in general, and the trans-boundary consequences of such transport in particular, are important. As a consequence, significant focus is devoted to rivers and streams where (and if) information has been readily available.

When considering only the countries addressed by this report, the Adriatic watershed is predominantly fed by flows from Croatia, Montenegro, Southern Bosnia/Herzegovina, Albania and parts of Kosovo; the Aegean watershed is predominantly fed by flows from Macedonia, parts of Kosovo; and the Danubian watershed, and thus the Black Sea, are fed by Serbia, parts of Montenegro and portions of Kosovo.

2.1.1 Historic aspects of minerals activity in the Western Balkans

The mineral extractive industries, with prime focus upon mining for base and precious metals and metallurgy, have had a long history in the Western Balkans and may be traced through historical records to at least the 5th century B.C. To take Serbia as one regional example, copper mining at Serbia’s Bor deposit is believed to have prehistoric beginnings, while archaeological studies also indicate ancient activities in Lepenski Vir, Vincin, Rudna Glava. It is also believed that the Crveni Breg lead and silver mine and the Šuplja Stena mercury mine on the Avala in the vicinity of Belgrade were in operation prior to recorded history. By the time of the Roman empire, there is evidence that many of the deposits mined today were being exploited and almost all known lead and zinc deposits were being exploited by the 13th and 14th centuries (Jovic et al., 2002).

By the early 1930s, mineral deposits in the region were well-defined and increasing levels of exploitation were undertaken. Commercial resources of major base metals mined have included aluminium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, and zinc. Precious metals such as gold, silver, palladium, and platinum are found mainly in association with such base metals as copper, lead, and zinc. Industrial minerals, represented by a broad range of carbonate and silicate rocks, gravels,
and sands as well as clays and volcanic materials have also been important. Mineral fuels extracted in the region include coal (lignite), natural gas, and petroleum (Steblez, 2001).

In the period up until the early 1990s, mining, minerals processing, and downstream exploitation of the base metals introduced above, established the region as a major European source of copper, lead, and zinc. The region, and in particular Albania, was also a major world producer of chromate (Steblez, 1994a, 2001). However, the transition of the region from central economic planning to market economy systems in the post 1991 period, with its rapid deconstruction of existing political and social structures, and ensuing political, social, and ethnic tensions and conflict, destroyed or degraded much of the region’s mining, mineral processing, and metallurgical industrial infrastructure (Steblez, 2001).

Such long association with mineral extractive industries indicates that both a long-established culture of mining activity, and a socio-economic dependency upon mining and metallurgical activities can be expected in many parts of the region. Unfortunately, it is also indicative of a higher likelihood of multiple abandoned mining sites that may constitute point sources of pollution. Further, a broad acceptance of such industries and their pollution – as a normal situation rather than an abnormality – is likely at many levels within the societies in the region.

While the traces of very old mining exploitation and metallurgy are still visible at many localities (Jovic et al., 2002), and are likely to contribute to the environmental risk portfolio of mining sites in some ways, it is the activities of the post 1945 era that have generated the most serious mining legacies for the region. These areas will pose a task for both this, and for coming generations. As with most of the former centrally planned economy countries, the countries of the Western Balkans accorded environmental protection issues a much lower status than were accorded in Western European market economy countries (at least during recent decades). Indeed, some sources go as far as to describe the era as one of “unregulated economic activity” (USDA, 2000). Significant soil, water, and atmospheric contamination have been caused by the country’s heavy industry, including branches of the mining and minerals industry (Steblez, 1994c).12

By the early 1990s, the use of low grades of coal and lignite in the region’s industrial and electric power generation facilities had raised the emission of sulphur dioxide in some areas to levels that were reportedly twice those recorded in Western Europe. Concentrations of SO$_2$ and NO$_x$ were consistently in excess of safety guidelines set by the World Health Organisation (WHO) and uncontained emissions from the nonferrous metals processing plants and smelters also contributed to regional acid rain (Steblez, 1994c). Moreover, such sites often contributed to serious local/sub-regional heavy metals contamination of the environment as a result of fallout (cf. UNEP, 2004b for examples).

During the 1990s, the extended period of regional conflict, international embargoes and civil disturbance further deteriorated the environmental risk picture for the minerals sector. Funds necessary for even routine maintenance of hazardous sites such as tailings ponds and hazardous waste dumps have not been available (Steblez, 1994c). As an inevitable result, the likelihood of environmental disasters has likely increased markedly in recent years.

For context, maps showing the South Eastern European region as referred to in this report, and the boundaries of the Former Yugoslavia are included overleaf as Figure 2-1 and Figure 2-2.

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12 In the context of ongoing environmental risk and or impact, it is important to note that different types of pollution are accumulative or transient in nature. The effects of emissions of sulphur containing gases and particulates, for example, may often be relatively short lived in nature. The cessation of activity or the addition of control devices can provide immediate relief and in many cases ecosystems can recover relatively rapidly. Other types of pollution however, can leave long-lasting legacies. Pollution due to effluents containing heavy metals, or due to inappropriate disposal of ore-tailings may affect recipient ecosystems for years, decades or even longer.
Figure 2.1. South Eastern Europe
2.1.2 Seismology

The area of South Eastern Europe addressed by this Desk Study is subject to regular seismic events at levels of intensity sufficient to cause concern for the stability of mining hazards. In particular, the stability of tailings impoundments throughout the region is an issue of import – in the event of event mild earthquakes such impoundments can fail.

A regional map showing seismology in region is provided in Figure 2-3. It indicates that earthquakes of moderate to high intensity can be anticipated for all countries in the region. Roughly 20% of the region experiences events of very high intensity.

\[13\] UNITED NATIONS, Department of Peacekeeping Operations, Cartographic Section: Map No. 3689 Rev. 10 Feb. 2003.
Figure 2-3. Areas of significant seismic activity in South Eastern Europe
2.2 Balkan Geography

2.2.1 Environmental parameters – 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. The country has a mild Mediterranean climate that supports some 277 species of birds, wild herbs, and up to 400 species of flowering plants. The forested interior provides habitat for large mammalian species, including brown bear and wild boar (USDA, 2000).

At the present juncture, 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 (USDA, 2000). Further, recent population fluxes related to refugee movements have placed considerable pressures on the environment (UNEP Balkans, 2000). 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 the period from 1945 to 1991 Albania’s industry and general economy developed under a system of central economic planning with a large portion of the economy based upon the mining and beneficiation of chromite, copper, nickeliferous iron ore and ferrochromium minerals. Albania was initially an active member of the Soviet based Council for Mutual Economic Assistance (CMEA), however withdrew in 1961 (Steblez, 1994a).

In part as a result of the country’s isolation, the USGS (Steblez, 1994a) reports that the industrial-environmental landscape of Albania is similar in kind, but not in degree, to that of other Eastern European members of the CMEA. While the technology applied in Albania was even more out of date than that at similar facilities in former CMEA countries, the pollution problems have been less serious. Despite the fact that Albania’s industrial facilities were both less efficient and more polluting than those in other Eastern European countries, operations were conducted at a significantly smaller scale and were less extensive than many in other former member countries of the CMEA. This said, there are serious point sources of pollution in the country. These are principally related to industrial sites, such as mining, smelting and refining complexes (chromite, etc.), the Elbasan iron and steel plant, refineries, lignite-fired thermal electric power stations and chemical plants (Steblez, 1994a).

Fortunately, despite the considerable concerns in Albania listed above, relatively large areas of the country remain largely unaffected by industrial environmental pollution (Government of Albania: committee of environment protection and preservation, 1994; USDA, 2000).
Figure 2-4. Map of Albania

14 UNITED NATIONS, Department of Peacekeeping Operations, Cartographic Section: Map No. 3769 Rev. 6 June 2004.
2.2.2 Environmental parameters – Bosnia & Herzegovina

Much of the territory of Bosnia and Herzegovina (aka. BiH) is mountainous with nearly 60% lying above the 700m level. Hilly or mountainous terrain covers nearly 84% of the country with some 80% of land within the country having slopes of 13% or more. The high mountainous barrier situated along the Mediterranean has resulted in the generation of a range of specific microclimates and ecosystems characterised by high biodiversity. (Federal Ministry of Physical Planning and Environment BiH, 1998).

Although the timber industry is not competitive on the world market, the country is rich in forests and forests cover roughly half of the land area. A substantial part of the forested area however, is land-mined or damaged by other conflict related activities. Illegal logging is also a significant problem (Civil Society Promotion Center of Sarajevo, 2002). The country has approximately 2.6 million hectares of agricultural land and some 2.5 million hectares of forest (Federal Ministry of Physical Planning and Environment BiH, 1998).

The population of the country is currently approximately 4 million15 after a rapid decline in the number of people during the war that reached its lowest point in 1996. The population is now recovering and is expected to reach a maximum by 2020. The urban population has been increasing steadily and this growth is expected to continue. While the rural population has also been increasing, it is expected that this trend will reverse by 2005 (Civil Society Promotion Center of Sarajevo, 2002). The largest cities include the capital Sarajevo, which is also an important cultural and commercial centre (1991 pop. 526,000), Banja Luka (1991 pop. 195,000), Mostar (1991 pop. 126,000) and Zenica (1991 pop. 146,000). Between 1991 and 2002 the population movement from the countryside to the towns increased the urban population from 40% to 60% (UNECE, 2004).

Water is relatively abundant in Bosnia and Herzegovina and the total length of rivers is estimated at around 2200 km. The main river is the Sava (331 km within Bosnia and Herzegovina), which runs along the northern border. The Sava and its tributaries, the Bosna (271 km) crossing through Sarajevo, the Una, the Drina and the Vrbas all flow to the north. A few rivers, notably the Neretva (218 km), flow towards the Adriatic Sea. Rivers also define the country’s two historical provinces; Bosnia lies in the Sava river valley and Herzegovina is situated in the Neretva river basin and the upper reaches of the Drina (UNECE, 2004). Rainfall exceeds evapo-transpiration by more than 2 to 1 in most of the country, and areas above 900m and the Mediterranean zone of the country experience generally moist climates with annual rainfalls of up to 2000 mm. The climate varies from mild Mediterranean (10 to 15°C yearly average) to cool-to-cold temperate (2°C to 8°C) in mountainous areas (Federal Ministry of Physical Planning and Environment BiH, 1998).

Much of the territory exhibits limestone karst geology and as a result groundwater migration – and the migration of any subsurface pollutants – is often rapid due to the existence of underground watercourses. Karst springs are common throughout the territory and surface watercourses are generally swiftly flowing.

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. Currently, municipal waste is being collected in half of the urban municipalities but rural municipalities are generally not included in waste collection. Large quantities of

15 In the latest census (1991), Bosnia and Herzegovina had 4,377,033 inhabitants and the population density was 85.5 inhabitants/km². Current population figures vary significantly depending on the source. According to Bosnia and Herzegovina’s Agency for Statistics, the permanent population in 2001 stood at 3,798,000, the estimate of the United Nations Economic Commission for Europe (UNECE) in 2002 was 4,302,000 (UNECE, 2004).
waste are reportedly being dumped illegally at roadsides, rivers, abandoned mines, and so forth, posing threats to public health and the environment (Civil Society Promotion Center of Sarajevo, 2002).

Among areas of significant pollution from land-based activities, hot spots are listed as the sewerage system and wastewater treatment plant in the town of Mostar, red mud disposal areas associated with the aluminium factory in Mostar, and the Neum-Klek area on the coast. Further, the Federal Ministry of Physical Planning and Environment report that approximately 300,000 hectares are currently being contaminated by anthropogenic activities, while some 50,000 hectares are severely contaminated. Some 1.2 million hectares of land were affected by mine fields during the conflict period (Federal Ministry of Physical Planning and Environment BiH, 1998).

Pollution concerns have also led to a program for investigation works on water quality protection in the region of Bosansko Grahovo town; solid municipal waste dumping site effects on water quality in Adriatic Sea basin; the Mali Ston Channel and Neum-Klek bay. The River Bosna, along which the majority of the territories industry facilities are placed, is reportedly severely polluted. Other important habitats and ecosystems include the Neretva river delta and the Neretva river canyon (Federal Ministry of Physical Planning and Environment BiH, 1998).

Bosnia and Herzegovina has a very short coastline approximately 25 km long. It is located approximately 60 km south of Mostar, and includes the Klek peninsula, Neum Klek Bay, Neum Klek marine environment and coastal marine environment of Mali Ston channel. The B&H coast divides the Croatian coast into east and the west coastal zones.

While not affecting environmental parameters per se, the political situation does affect the potential implications of environmental problems near borders. Politically, Bosnia and Herzegovina remained divided into two major administrative zones and the Brčko municipality under international supervision. BiH is divided into the administrative zone Federation of Bosnian Moslems and Croatians (FBC) or the Federation of Bosnia and Herzegovina, and the Republica Srpska (RS) with a predominantly Serbian population. The Brčko municipality is a small area in the North of the Country where the narrowest portion of Republika Srpska meets the Federation. Further, Bosnia and Herzegovina still has a number of unresolved border issues with Serbia and Croatia. While the government has reached an agreement with the Yugoslav government regarding half of the two countries’ boundaries, some sections of the border, especially along the Drina River, remain in dispute. As of 2001, the Bosnian government also disputed part of its border with Croatia along the Una River, the tip of the Klek Peninsula, and several islands near Neum, but talks between the two states were underway at that time (Indiana University, 2001).
Figure 2-5. Map of Bosnia and Herzegovina

United Nations, Department of Peacekeeping Operations, Cartographic Section: Map No. 3729 Rev. 5 June 2004.
2.2.3 Environmental parameters – Kosovo (Territory under UN interim Administration)\textsuperscript{17}

The territory of Kosovo (territory under UN interim administration) 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.

Kosovo is landlocked in the center of the Balkan Peninsula and has a surface area of nearly 11 000 km\textsuperscript{2}. It is bordered by the FYR of Macedonia (aka. FYROM), Albania, Serbia Proper and Montenegro and has a varied terrain with high plains at around 500 meters above sea level, rolling hills and mountains that reach an altitude of over 2000 meters. It has rivers flowing into 3 distinct seas; the Adriatic, the Aegean and the Black Sea via the Danube. Except for the source of the Ibar which is 30 km upstream from the boundary, there is virtually no water flowing into Kosovo.

The climate is mainly continental with warm summers and cold winters. There are also Mediterranean and alpine influences in parts of the territory, with temperature extremes ranging from +35ºC to -20ºC.

Kosovo is home to a rich ecosystem and biodiversity. 46 000 ha or approximately 4.3% of its territory is under protection. Protected areas include one National park, 11 wildlife sanctuaries, 37 natural monuments and two protected landscapes. Important among these is the “Sharr” national park on the southern FYROM border, which is linked through forested areas to the Curst Mountains, Durmitor and the Dinari\textsuperscript{k} forest. There are reportedly more than 2000 endemics species in the Sharr forest area constituting nearly 20\% of European flora. 26 species have been included on the Red List of threatened plants maintained by the World Conservation Union (IUCN). The Curst Mountain area is also an important part of European and Balkan biodiversity and this area is known to host around 750 types of endemic alpine flora. As of 2002, the Ministry of Environment and Spatial Planning had commenced procedures required to put the area under protection.

Kosovo is separated in 30 Municipalities with Pristina/Pristina as its administrative capital and largest urban centre. Other large cities/towns are Prizren, Peja/Pec, Mitrovica, Gjilan, Ferizaj/Urosevac and D\textsuperscript{ja}kova/D\textsuperscript{ja}kovica. Estimates of Kosovo’s population estimates range from 1.9 to 2.4 million, with the latest estimate conducted by the OSCE in 2001 placing the number at 2.4 Million. Population has grown steadily since the mid-20\textsuperscript{th} century and is expected to continue to increase well into this century. Population density at close to 200 persons/km\textsuperscript{2}, is one of the highest in Europe. The majority of the population is composed of ethnic Albanians while the largest minority is Serbian. Other minority ethnic groups include Bosnians, Turks and Roma.

The major towns in Kosovo are supplied mainly by reservoirs; the Gazivoda Reservoir for Mitrovica; the Batllava and Granckanka reservoirs for Pristina/Pristina, and the Radoniq reservoir for D\textsuperscript{ja}kova/D\textsuperscript{ja}kovica. Other towns rely on surface water and/or groundwater. Around 44\% of the total population, and only 8.4\% of the rural population, has access to piped municipal water. The rural population rely on village water-supply systems, their own wells or on springs and surface water. Rural wells are generally in poor condition and are subject to organic contamination.

There is no waste-water treatment in Kosovo with only 28\% 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) of

\textsuperscript{17} Unless otherwise indicated, the following summary is drawn from the Kosovo State of the Environment Report produced by the Ministry of Environment and Spatial Planning of the Provisional Institution of Self Government (PISG) of Kosovo (2002).
larger municipalities and industries are so heavily polluted that the water cannot be used for water supply, irrigation, or even industrial needs without prior treatment. Groundwater quality is significantly affected by pollution. Due largely to these factors, Kosova has a high incidence of water-borne diseases (PISG/Ministry of Environment and Spatial Planning, 2002).

Kosovo is located in a region of high seismic activity, namely the seismically active zone of the Alpine-Himalaya Orogenic Belt. Historical records show that the region has experienced some 82 earthquakes exceeding 5 degrees on the Mercalli-Cancani-Sieberg (MCS) scale or approximately 4.8 on the Richter scale. Of these, 25 have been of intensity 7 or greater (UNMIK, Elezaj, & Hasani, 2002).
Figure 2-6. Map of Kosovo (territory under UN interim administration)\(^{18}\)

\(^{18}\) UNITED NATIONS, Department of Peacekeeping Operations, Cartographic Section: Map No. 4069 Rev. 3, June 2004.
2.2.4 Environmental parameters – FYR 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. It borders the Federal Republic of Yugoslavia to the north, the Republic of Bulgaria to the east, the Republic of Greece to the south and the Republic of Albania to the west. The details of respective borders are shown in Table 2-1. The republic occupies an area of nearly 26 000 km² and has a population of nearly 2 million.

Table 2-1. Length of the Macedonian Border in kilometres

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Land</th>
<th>River</th>
<th>Lake</th>
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<td>Total</td>
<td>850</td>
<td>786</td>
<td>16</td>
<td>48</td>
</tr>
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<td>Albania</td>
<td>191</td>
<td>151</td>
<td>12</td>
<td>28</td>
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<td>0</td>
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<td>238</td>
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<td>20</td>
</tr>
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<td>Yugoslavia</td>
<td>232</td>
<td>232</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

Large and high mountain massifs characterize the country’s topography. The average elevation is 850 metres ASL and more than 30 per cent of the land area is above 1000 metres with 14 mountain peaks higher than 2000 metres. The highest peak, the 2753-metre-high Golem Korab is situated on the Albanian border. Amid the mountains are flat valleys and plains interconnected by passes or deep ravines. The Vardar River bisects the whole country with 301 km of its total length of 388 km inside the country. The Vardar passes through the capital Skopje before crossing to Greece and finally flowing to the Aegean Sea near Thessalonica. The rivers of the country belong to three basins: the Aegean Basin (covering 80 per cent of the country), the Adriatic Basin and the Black Sea Basin (UNECE, 2002c).

As a result of the country’s diverse natural conditions – with 8 distinct climate and vegetation soil areas – the country has rich and diverse flora and fauna. The country has 3 major natural tectonic lakes (Ohrid, Prespa and Doyran), over 30 glacial lakes, 15 mountain ecosystems, and 15 river basins with associated rivers.

The country is deemed semiarid (the region of Ovce Pole is the driest area within the Balkans), however, the western part of the country encompassing the watershed of Crni Drim river has substantially more water than central and eastern portions of the country. Surface water runs in about 250 waterways (watersheds larger than 20 km²), and the largest surface waterway is the Vardar River. Significant parts of watersheds and lakes lie within the territory of neighbouring countries.

In general, summers and autumns are warm and dry, and winters are relatively cold with heavy snowfall. The maximum summer temperature in most agricultural areas reaches 40°C, and the coldest winter temperature can fall to as low as −30°C, while the average annual temperatures are above +10°C almost everywhere. The average temperature in July is 22°C and in January −3°C. The warmest region of the country is Demir Kapija, where temperatures in July and August exceed 40°C (UNECE, 2002c).

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20 Submediterranean/modified mediterranean area, 50-500 m above sea level (ASL); Continental-submediterranean area, up to 600 metres ASL; Hot continental climate area, from 600-900 meters ASL; Cold continental climate area, from 900-1100 meters ASL; Sub-mount continental-mountaneous area,1100-1300 meters ASL; Mount continental-mountaneous area, from 1300-1650 meters ASL; Subalpine mountainous area, from 1650-2250 meters ASL; Alpine mountainous area, above 2250 meters ASL.
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 groundwaters throughout the country. The most seriously polluted waterways are reportedly the central and lower sections of the Vardar, Peinja, 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, only 6% of wastewaters in Macedonia are treated prior to their discharge in rivers (Republic of Macedonia, 2004).

The country is located in a region of high seismic activity. In 1963, Skopje suffered a devastating earthquake that damaged or destroyed about 80 per cent of its buildings and killed more than 1000 inhabitants. Between 1970 and 1990, the Skopje Seismological Observatory (Sts. Kiril and Metodij University, Skopje) registered about 30 earthquakes with a magnitude exceeding 5 degrees on the Mercalli-Cancani-Sieberg (MCS) scale or approximately 4.8 on the Richter scale (UNECE, 2002c).

Figure 2-7. Map of the FYR of Macedonia

21 UNITED NATIONS, Department of Peacekeeping Operations, Cartographic Section: Map No. 3789 Rev. 5, June 2004.
2.2.5 Environmental parameters – Serbia and Montenegro

Serbia is in the central north part of the Balkan peninsula and shares boundaries to the west with Bosnia & 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 country also has a sea boundary in the Adriatic with Italy. The total length of borders are approximately 2600 km. The Republic of Serbia occupies a little more than 88 000 km$^2$ (Ministry for the Protection of the Natural Resources and Environment - Republic of Serbia, 2003).

The country has a temperate continental climate with warm summers and snowy winters and hosts a population of somewhat more than 10 million inhabitants. The capital, Belgrade, with a population of around 2 million, lies at the crossing of the communication lines between Eastern and Western Europe on the Balkan Peninsula and is situated on the banks of the Sava and the Danube. The two rivers run along three sides of the city. The Republic is divided into 30 districts (if one includes the three Kosovian districts) and Belgrade (Ministry for the Protection of the Natural Resources and Environment - Republic of Serbia, 2003).

The largest river within the country is the Danube which flows for 588 km both within Serbia and as the border to Romania. Other notable waterways include: the Zapadna Morava (308 km), the Južna Morava, Ibar, Drina, Sava, Timok, Velika Morava, Tisa, Nišava, Tamiš and Begej rivers.

Water pollution is a major issue in the country. Small industrial operations are generally located in the urban zones and discharge their wastewater into the public sewerage network. Larger industrial operations however, are generally located outside the settlements and are usually near riverbanks or in their immediate vicinity. The wastewater from these facilities is often directly discharged into waterways without treatment. This situation is also reported to hold for mining facilities (Ministry for the Protection of the Natural Resources and Environment - Republic of Serbia, 2003).

The quantity of the industrial and mining wastewater discharged directly into the waterways in Serbia 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 (2003), the largest proportion of industrial and mining wastewater are discharged into the Sava and its tributaries. However, this source considers the basin of the Timok basin to be under the greatest pressure, due to the composition of the industrial and mining wastewaters discharging, their high level of contamination, and the assimilative capacity of recipient waters. On the other hand, the Federal Ministry and Working Group for Environmental Protection (Jovic et al., 2002) report 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. These authors report that the current state of the environment in the vicinity of mines in the country is completely unsatisfactory.

The Ministry for the Protection of the Natural Resources and Environment (2003) indicate that there are about 120 larger facilities for treatment of the industrial and mining wastewater in the Republic of Serbia, however these generally only address pre-treatment or have the minimal treatment capacity required to fulfil licence conditions for them to discharge into the city sewerage system. Only around 20 larger industrial operations located on the riverbanks have facilities for a complete treatment of wastewaters, however a number of these are only partially functional. As of 2003, there were about 10 facilities for treatment of the industrial wastewater under construction, and that there are 10 more for which project documentation was in the final phase.
Figure 2-8. Map of Serbia and Montenegro

22 UNITED NATIONS, Department of Peacekeeping Operations, Cartographic Section: Map No. 3815 Rev. 7, June 2004.
3. Resource extraction and hazard inventories

3.1 General background to the extraction of minerals in the Western Balkans

In this section, two informational components are provided for each subject country. First, a brief descriptive outline of the prime mineral resource extraction activities in each country is given. Second a catalogue table is provided indicating the site-by-site information that has been tabulated within the Desk Study work. A series of maps have also been developed to accompany this information.

3.1.1 South east europe mining risk maps

The full range of South Eastern Europe (SEE) draft mining risk mapping outputs are available at the UNEP, UNDP & OSCE web site hosted at the following web address:
http://www.grid.unep.ch/envsec/mining/desk_study_maps.php

The following maps from the SEE mining risk portfolio are included in Appendix G.

- SEE mining sites and water basins
- SEE mining sites and protected areas
- SEE metal beneficiation (milling, concentration) facilities
- SEE smelter and refinery facilities
- SEE metalliferous mine facilities
- SEE coal mine facilities
- SEE oil and gas related operations

3.1.2 Social and economic stability

As will be outlined throughout this section, minerals related activities have formed the backbone of the economies of a number of the countries in this region for many years – in some instances, even for centuries. While the social and environmental aspects of mining and mineral processing activities lie beyond the direct scope of this desk study, it must be recognised that the role of mining within both the economies, and the personal lives of the citizens, of the relevant countries cannot be separated from consideration of environmental and/or transboundary risks, health concerns and so forth.

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 a place in the future of the region. Moreover, meaningful employment and economic prosperity are both ingredients of the development of a stable and civil society. These aspects are thus considered within the analysis sections of this study.
3.2 Albania – resource extraction activities

3.2.1 Albania’s mineral sector

The chief mineral commodities traditionally produced in Albania have been chromite, copper, ferrochromium, nickeliferous iron ore, and petroleum refinery products. Under central economic 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 sources of foreign exchange. The principal mineral extraction areas in Albania are indicated in Figure 3-1 overleaf.

The principal commercial chromite deposits in Albania are located in ultramafic massifs in the Midrita region in the north-central and northern parts of the country and the mineral is mined from seven mining districts. Two of these, Bulquize and Batra, located approximately 30 km northeast of Tirana, represent about two-thirds of Albania’s total production capacity.

Albania’s output of copper ore was all mined underground and reached its maximum in the late 1980s at about 1 million metric tons per year (Mt/yr). Ores grade between 1.5% to 4% copper. With the exception of the Rehove Mine and beneficiation plant in southeastern Albania, copper ore was mined, processed, smelted, and refined largely in the northern part of the country. Fushe Arrez, the largest copper mining and beneficiation complex in the country, produced and concentrated more than 320 000 Mt/yr of copper ore during this period. Copper concentrates were smelted at the Gjegjan (Kukes), the Lac, and the Rubic pyrometallurgical primary smelters in the far north-eastern part of the country.

During the 1980s, production of nickeliferous iron ore in Albania output ranged from 1 to 1.2 Mt/yr, of which about one-half was consumed at the Elbasan iron and steel works to produce pig iron, a small amount of steel, and salts of nickel and cobalt. Deposits of commercial-grade nickeliferous iron ore were exploited in ultramafic massifs near Pogradec in eastcentral Albania. The principal mines were at Prrenjas, Guri i Kuq, and Bitinska. Until 1991, the largest mining operation was at Prrenjas, which produced about 600 000 t/yr of ore. The production of nickeliferous iron ore in Albania ceased in 1994 following the collapse of centrally planned economic systems in the countries of Central Europe and the Balkans.

Albania’s bauxite deposits are mainly in the central part of the country, just east of Tirana, as well as in the Northern Alpine region near the border with former Yugoslavia. Bauxite reserves are minor and are estimated to be about 12 Mt.

Albania also has reserves of lignite, natural gas, and crude oil. The country’s exploitable coal resources amount to about 158 Mt of low-calorie lignite. Lignite is mined for domestic consumption, mainly at thermal electric power stations.

At present industrial production consisting of the mining and enrichment of copper and chromium ores, coal (lignite) mining, oil exploration and oil processing, and extraction of construction materials generates a major proportion of the industrial waste for Albania. For the industrial facilities that are closed, the main environmental problems are associated with waste accumulated from previous operations. In 2000, the highest quantities of industrial hazardous waste were generated in the chromium and copper industry. Estimates of the quantities of accumulated waste from mining and ore enrichment at that time are given in Table 3-1.

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Table 3-1. Volume of solid industrial waste accumulated by 2000

<table>
<thead>
<tr>
<th>Mining</th>
<th>Estimated Waste Volumes</th>
</tr>
</thead>
<tbody>
<tr>
<td>coal mining</td>
<td>$3 \times 10^6$ m$^3$</td>
</tr>
<tr>
<td>iron nickel extraction</td>
<td>$4.2 \times 10^6$ m$^3$</td>
</tr>
<tr>
<td>copper extraction</td>
<td>$12 \times 10^6$ m$^3$</td>
</tr>
<tr>
<td>chromium extraction</td>
<td>$18.8 \times 10^6$ m$^3$</td>
</tr>
<tr>
<td>Enrichment</td>
<td></td>
</tr>
<tr>
<td>copper tails</td>
<td>$11.8 \times 10^6$ m$^3$</td>
</tr>
<tr>
<td>chromium tails</td>
<td>$2.5 \times 10^6$ m$^3$</td>
</tr>
</tbody>
</table>

After UNECE (2002a).
3.2.2 National inventory

An inventory of resource extraction activities in the subject country is provided overleaf.

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24 Source United States Geological Survey (USGS).
INSERT SHEET. A3 INVENTORY
3.3 Bosnia and Herzegovina—resource extraction activities

3.3.1 BiH’s mineral sector

Before the dissolution of the Federal Republic of Yugoslavia and the subsequent civil war, Bosnia and Herzegovina was a major centre for metallurgical industries in the former Yugoslavia. At that time the country’s total output of steel from the Rudarsko Metalurški Kombinat plant at Zenica (aka. Zeljezara Zenica) was more than 2 Mtpa. By the end of 1999, production was being maintained at approximately half this capacity.

The country was also a major producer of bauxite, alumina, and aluminium. Production was administered by Energoinvest with bauxite being mined in Vlasenica, Jajce, Bosanska Krupa, and a range of other sites – located in the north west part of the country. In the late 1990s, Bosnia and Herzegovina’s bauxite resources were estimated to be about 41 Mt of marketable grade ore containing circa 50% Al₂O₃ and about 5% SiO₂. Alumina refineries were located at Birac-Zvornik and Mostar. Mostar, was also the centre of aluminium fabrication and aircraft industries. In 1999, following a period of post-conflict reconstruction, an operational capacity of about 97 000 t/yr of primary aluminium was achieved at Mostar.

The production of other nonferrous metals included only relatively minor amounts of lead and zinc ore mined and milled at Srebrenica (Sase mine) in RS and at Olovo and Vares in the FBC. Reserves were estimated to be about 12 Mt of ore grading 1.8% to 4% lead and 2.5% to 6% zinc. In addition, Manganese has been mined at Buzim (Buchim).

The major mineral producing areas of BiH are shown in Figure 3-2 overleaf.

In the past, Bosnia and Herzegovina has also been a major producer of asbestos, barite, gypsum and salt and has also extracted construction aggregates, cement, clays, dimensioned stone, dolomite, kaolin, limestone, magnesite, and as sand and gravel and other industrial minerals. These latter minerals were produced mainly for local use. Asbestos and asbestos cement are reportedly mined, milled and produced in the Bos. Petrovo Selo area – this is adjacent to sensitive transport border crossing to Croatia.

Both brown coal and lignite are mined in the country. Coal mining in Bosnia and Herzegovina is organised into two separate operations. In the FBC, the Middle Bosnia and the Tuzla coal mines supply (supplied) the Kakanj and the Tuzla powerplants with more than 80% of their total coal production. In SR, the lignite surface mine at Gacko and the brown coal surface mine at Ugljevik were fully integrated with the Gacjo and Ugljevik powerplants respectively. Coal reserves for the entire country are estimated to be 3.8 billion metric tons, of which 40% is brown coal and 60% lignite. About 20% of Bosnia and Herzegovina’s resources of brown coal and 40% of the country’s lignite are in RS.

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26 Bauxite deposits in the FBC include Citluk, Mostar, Pousje, Stolac, Tomislavgrad, and Zitomislici in the southern part of the country and Bosanska Krupa and Jajce in the northwest. Those in RS are in Vlasenica and Zvornik in the eastern part of the region and Bosanska Kraijina in the Banja Luka area. The reconstruction and refitting of bauxite mines remains a concern for both the FBC and RS.
3.3.2 National inventory

An inventory of resource extraction activities in the subject country is provided overleaf.

27 Source United States Geological Survey (USGS).
INSERT SHEET.

A3 INVENTORY
3.4 Kosovo (Territory under UN interim Administration) – resource extraction activities

3.4.1 Kosovo’s mineral sector

Before the period of hostilities during the 1990s, Rudarsko-Metalursko-Hemijski Kombinat za Olovo i Cink Trepa (Trepa) in the (then Serbian) Kosovo Province was the country’s and the region’s largest lead and zinc mining, beneficiation, smelting, and refining complex. Trepa also produced such associated metals as antimony, bismuth, cadmium, gold, and silver (Steblez, 1994c, 1999).

The other major metallurgical facility in Kosovo was Ferro-Nickel D.D. Glogovac (Glogovac), which was the sole mine producer of nickel ore and smelter producer of ferronickel in the Serbia of that time. Glogovac has reportedly been closed since 1998 (Steblez, 1999). Mining for bauxite was also conducted in Kosovo by AB Kosovo Klina.

Trepa Mines28 Ltd. was established by Selection Trust in London in 1927 with regular production started at the Stan Terg mine in 1930. The nearby lead smelter at Zvecan was commissioned in 1940. After World War II, Trepa developed into a significant employer with widespread business units throughout Kosovo, Serbia and Montenegro. However, in the period since the early 1980s Trepa suffered from the lack of reinvestment, repair and maintenance. The period of social instability commencing in 1990, and continuing until recently, led to further deterioration of the Trepa business and its operations.

The arrival of the NATO led Kosovo Force (KFOR) in June 1999 led to a separation of the North with its predominantly Serb population, from the rest of Kosovo and the South, where Albanians are clearly in the majority. This event also separated Trepa. In the North, the mines in the Leposavic area and the lead smelter at Zvecan continued to operate. South of Pristina, at Kizhnica and Artana (Novo Brdo), Albanian workers repurchased the mines, but were unable to restart any production due to lack of supplies, consumables and other materials. In August 2000, KFOR forced the closure of operations at the lead smelter in Zvecan for environmental reasons and all production at Trepa came to an end. Since 2001, the United Nations Interim Mission in Kosovo (UNMIK) employs an international Trepa Manager and management team that is in charge of “Trepa under UNMIK Administration”. At this time (2004), moves are underway to recommence operations.

Kosovo has extensive deposits of pliocene brown coal (lignite) in the Prishtinë Basin. Coal is currently produced from Bardh and Mirash open cut mines and utilised for power generation. At least 6 billion tonnes of coal resources are estimated to exist in Kosovo (Steblez, 1999; UNMIK et al., 2002). Other coal resources previously controlled by the Trepa mining conglomerate are reportedly not in operation for technical as well as legal reasons linked to the ownership of Trepa (PSIG/Ministry of Environment and Spatial Planning, 2002). In general, the lignite mined in Kosovo was valued throughout the region for its low-sulphur content (Steblez, 1999).

In addition to the sites mentioned, and those to be documented in the following section, Elezaj and Hasani (UNMIK et al., 2002) report that there are over 200 quarries and processing plants operating in Kosovo dealing with the extraction of hardrock such as limestone and andesite, and sand and gravel

28 Operations at Trepa are so extensive, have been operational at large scale for such an extended period of time, and are so linked to pollution concerns and social stability, that additional attention, to this operation, is warranted. This material is primarily based upon and investment and redevelopment strategy report prepared by Trepa under UNMIK administration (Nelles, 2003).

29 Elezaj and Hasani (UNMIK et al., 2002) report significant pit stability problems and failures in the Bardh mine.

30 The latter source indicates 8.3 billion tonnes of proven reserves with an addition 10 billion “available”.

43
from river beds. Further, they report that many of these operations are not licensed and/or operate at a low technical and environmental standard with minimal safety precautions.

While a number of sources report that problems associated with hazardous material pollution of air, soil, and water are widespread in Kosovo, there is a marked lack of data on the extent of the problems (PSIG/Ministry of Environment and Spatial Planning, 2002; UNECE, 2002b).

Areas of minerals related activity in Kosovo are shown on the maps provided for the Federal Republic of Yugoslavia (Figure 3-4 and Figure 3-5) on pages 53 and 54.

3.4.2 National inventory

An inventory of resource extraction activities in the subject country is provided overleaf.
INSERT SHEET

A3 INVENTORY
3.5 FRY of Macedonia– resource extraction activities

3.5.1 Macedonia’s mineral sector

The Former Yugoslav Republic of Macedonia has 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 also established that allowed the production of not only these metals and their alloys, but also such ferroalloys 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.

Macedonia’s aluminum industry centered on Alumina A.D. in Skopje. The company has the capacity to produce around 20 000 metric tons per year (t/yr) of billets (primary shapes) and 12 000 t/yr of semi finished aluminium products.

Bucim Radovis DM in Radovis was the country’s only producer of copper ore with capacity to produce circa 4 000 000 t/yr of ore, 50 000 t/yr concentrates, 8 000 t/yr copper cathode, and 3 000 t/yr copper alloys. The company also produced gold and silver bars and granules as by-products.

MHK Zletovo-Veles operated the country’s smelter and refinery for the production of lead, zinc and associated metals. About 45% of the feedstock came from domestic lead and zinc mines (Sasa-Makedonska Kamenica, Zletovo-Probištip, and Toranica-Kriva Planca); the balance was imported concentrate. The zinc refinery had a production capacity of 14 000 t/yr and the lead refinery a capacity of 40 000 t/yr.

Macedonia operated two ferroalloy plants at Tetovo and Kavadarci. The Jugohrom HEK-Jegunovce ferroalloys plant at Tetovo was established in 1952 to produce mainly such chromite-related products as ferrochromium, ferro-silicochromium, and sodium dichromate. Power was supplied by hydroelectric plants nearby and utilised water from Lake Mavrovsko Ezero. Originally chromite was supplied by the nearby Radusa Mine. Capacity at the plant was about 70 000 t/yr of ferroalloys. The FENI-Kavadarci (FENI) ferronickel plant at Kavadarci commenced operation in 1982 with an installed capacity of about 12 000 t/yr utilising nickel or feedstock from the Rzanovo Mine. This plant is still operational and has been modernised with funds provided from Krupp, the German steel producer. Skopje also has a steel cold-rolling mill with 600 000-t/yr capacity and a 100 000-t/yr galvanizing line that has also been taken under foreign ownership.

In their 2004 State of Environment Report (Republic of Macedonia, 2004), the Ministry of Environment and Physical Planning indicate that waste is a serious issue in Macedonia. They indicate that at least 150 x 10^6 t of mine waste (principally tailings containing Pb, Cd, Zn, Cu, and organic flotation reagents) are held on mine sites; that at least 6 x 10^6 t of metallurgical slag and cinder has been produced by smelters, and that the two largest mining-power generation complexes so far have produced about 330 x 10^6 t of waste (mine spoil/tailings, cinder and ash). Generally, this source indicates that some data on pollution and waste (and its speciation) is available, but that the affected areas have not been adequately delineated.

3.5.2 National inventory

An inventory of resource extraction activities in the subject country is provided overleaf.

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INSERT SHEET. A3 INVENTORY
3.6 Serbia and Montenegro—resource extraction activities

3.6.1 Serbia and Montenegro’s mineral sector

The Mining industry in the Federal Republic of Yugoslavia (FRY) represents a vital component of the economy in general. Primary minerals extracted within the FRY include copper; coal; lead-zinc with associated gold, silver, copper, bismuth and cadmium; red bauxite and modest quantities of oil and gas (Jovic et al., 2002; PKS, 2004). Prior to the conflicts of the 1990s, the country represented a significant proportion of European capacity for refined aluminium, copper lead, silver and zinc (Steblez, 1994c).

Significant reserves of other mineral commodities, such as silica raw materials, quartz mineral sands; dolomite, zeolite, feldspars, clays, phosphorite, wolastoneite, barite, bentonite, sea salt, and construction materials have also been identified in many different locations in the FRY (Jovic et al., 2002). Projects are also planned for reserves of boron minerals, \(^{33}\) phosphates, zeolites, granite alluviums, ilmenite and zircon. There is also active production of ornamental stone such as marble and granite (PKS, 2004).

Copper ore deposits occur as porphyry copper and massive sulphide types, located predominantly in the East Serbian sector of the Carpatho-Balkanides (i.e. the Bor metallogenic zone). In addition to the significant concentrations of gold in the Bor metallogenic zone, other areas with gold potential have been found in Serbia, which include the volcanic complex of Lece, where gold is associated with hydrothermal vein type lead-zinc-copper deposits, and with several other prospective areas of volcanic hosted gold mineralization (Jovic et al., 2002).

Rudarsko Topionicki Bazen’s (RTB) Bor mining, beneficiation, and smelting complex in Serbia accounts for all of Serbia and Montenegro’s total mine output of copper from its Bor, Majdanpek, and Veliki Krivelj open pit mines. The Bor Mining and metallurgical complex produces copper ore in quantities that are significant at a regional level. Secondary precious metal refining at the complex is also substantial. Importantly in the context of this study, continued operations can be expected in the Bor zone – as recently as 1994, a major 700Mt copper ore (4Mt copper) deposit in the Bor region was discovered (Steblez, 1994c).

The most significant area for lead-zinc ore is the Kopaonik metallogenic district. Mineral deposits are of skarn, volcanic replacement, and vein type. Lead and zinc deposits and occurrences are mainly located in the regions of Ljubisnje and Bjelasica, with associated gold, silver, copper, bismuth and cadmium (Jovic et al., 2002).

Red bauxite, together with coal, represent the major strategic mineral raw materials in Montenegro (Jovic et al., 2002). Bauxite mining, alumina refining, and aluminium smelting are located chiefly in Montenegro. The country’s principal bauxite mines, which were operated by Rudnici Boksita Niksic, are located in Montenegro’s Niksic area. Primary aluminium was produced by DP Kombinat Aluminjuma, which had smelting facilities at Podgorica. This smelter had the capacity to produce more than 100 000 t/yr primary aluminium prior to the conflict period (Steblez, 1994c).

Serbia also hosts steel and magnesium metal production – the country’s major steel production site being the Sartid AD-Smederevo (Sartid) integrated steel mill. This facility was upgraded in 1999 (Steblez, 1999). Magnesium metal production takes place (has taken place) at the Bela Stena magnesium plant.

\(^{33}\) Jovic et al (2002) indicate that a hydrothermal-sedimentary boron deposit was recently discovered in the Neogene basins of Serbia in the area(s) of Valjevo, Vranje, Nis and Leskovac.
Small quantities of petroleum and natural gas are produced in Serbia’s northern Vjvodina Province. Oil and gas reserves in the FRY are modest compared to other regional producer countries. The most important oil field is Mokrin, in the Kikinda region, which accounts for 60% of all Serbian production. Although oil drilling in the coastal part of Montenegro has been performed during the last 50 years, no economic deposits have been discovered so far. Despite this lack of success, exploration activities for oil and gas continue in the zones considered to offer potential, such as Budva and Bar (Jovic et al., 2002).

With reserves exceeding 17 billion metric tons, Serbia and Montenegro are also major producers of coal in the region. Lignite composed more than 98% of the coal produced. This is primarily surface mined in the Kostolac, Kolubara, Metohija, and Pljevlja basins. Low-calorie coals (lignites) that are mined at the Kolubara and Kostolac sites, provide 65% of the electric power in Serbia. Significantly, available data shows that one Kolubara site alone - Field D, provides 32% of the fuel for electricity production in Serbia (PKS, 2004). Lignite deposits are also located at the Pljevlja region, while brown coal deposits are found in the Berane area. In addition, several peat deposits are located in the Skadarsko Lake (aka. Lake Scutari) basin (Jovic et al., 2002).

Serbia and Montenegro’s production of industrial minerals include such commodities as clays (bentonite, fire clay, and kaolin), feldspar, gypsum, magnesite, and pumice. In addition, silica raw materials, with mineral potential quartz sands are located in the Sava, Danube, Morava and other riverbeds. Further, gravel and sand deposits are abundant in the bed of the Moraca River, near Podgorica, in the Lim valley, and in the upper reaches of the Tara River (Jovic et al., 2002).

The main producers of building material are the cement factories in Beocin, Kosjeric and Novi Popovac, and brick factories in Kikinda, Novi Becej, Novi Pazar, Ruma, and Kanjiza. Quarrying of technical and building stone is also an important sector, with sites near Ub, in Topola, Jelen Do, and Aranjelovac (PKS, 2004). Sites for marble and granite production are common with major operations for extraction of these resources at Arandjelovac, Klikovace, Vinici, Suk, and Krute (Jovic et al., 2002). In addition, a (major) basalt quarry in the Mount Koaonik region was opened in the early 1990s (Steblez, 1994c).

With the wide range and extensive nature of Serbian mining operations, the existence of serious pollution sites is almost a given. According a group of Serbian experts (Jovic et al., 2002), there are close to 200,000 hectares of land that are seriously affected by metallic and non-metallic mineral resources exploitation. Further, a number of these deposits are situated in protected natural areas, and even in national parks. They go on to state that while there are are serious problems with unstable and eroding waste at the mines in Kolubara and Kostolac; the most seriously polluted areas are in the watershed in the vicinity of the Bor, Kriveli, Majdanpek and Mojkovac mining areas. Pollution risks are first and foremost related to sites of mineral beneficiation (milling and flotation plants). The most serious incidents listed are the breaches of tailings dams that have occurred at Majdanpek, Veliki Majdan and Brskovo, where the rivers Pek, Drina and Tara have been directly affected by serious heavy metals contamination.

34 Mr. Dusan Jovic, Environment Dept. of Federal Secretariat for Labour, Health and Social Care, Mr. Velizar Nikolic, Federal Ministry of Economy and Internal Trade, Ms. Isidora Vukadinovic, Geoazavod – Belgrade, Dr. Ivan Grzetic, Faculty of Mining and Geology - Belgrade
Figure 3-4. Sites of mineral resource extraction/processing in Serbia

Source UNECE (UNECE, 2002b, p108).

"The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations."

35 Source UNECE (UNECE, 2002b, p108).
3.6.2 National inventory
An inventory of resource extraction activities in the subject country is provided overleaf.
INSERT SHEET.  A3 INVENTORY
4. Environmental institutions and institutional frameworks

In this section, a listing of institutions and policy frameworks is provided. In the first instance, details of institutions dealing with aspects of environmental care (in general) are listed. Where they exist, institutions dealing with mines and mineral extraction have been highlighted. Similarly, details of general policy frameworks and laws dealing with environment, and environmental laws dealing with mines are provided where they have been found.

4.1 Albania – institutions

4.1.1 Institutions and their relation to the mining industry

Following years under a communist system of essentially unregulated industrial activity and, more recently, regional conflict, Albania faces considerable challenges to sustainable environmental management. In the period since the early 1990s, Albania has been in the processes of creating regulatory structures to mitigate the environmental stresses of an emerging liberalised market economy (USDA, 2000). Zuna (2003) reports that the Albanian legislation on environmental protection is clearly inspired by the standards of European Union and that the main principles of the EU environmental law are to be found also in Albanian legislation, albeit in an unclear and indirect form.

According to Samimi et al (1997) this process commenced with the structuring of the Committee of Environmental Protection (CEP) in 1991. With the establishment of Democratic Government in April 1992, the CEP was included in the Ministry of Health and Environmental Protection made responsible for environmental issues in the Albania. During 1993, the Government approved a new structure of the CEP, with three directorates and a legal office.

Faced with a situation of a complete lack of local environmental protection structures, the establishment of Regional Environmental Agencies (REA) at prefectural level was undertaken in 1994. During 1994, most of the REAs were fielded with professional personnel and began to function as responsible bodies for environmental control. In addition, a number of ministries also established “sectors” or directorates responsible for sectorial aspects of environmental protection and a number of other state organs; research and scientific institutions; and non governmental organizations also undertake roles in the administration of the country’s natural resources.

Among ministries, the highest authority is the Council of Ministers, which operates under the auspices of the National Council of the Territory Regulation, the National Water Council and so forth. A number of other Ministries also dealing with the protection and utilization of natural resources subject to this authority are listed below:

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1. Ministry of Public Affairs, Planning of the Territory and Tourism – in conjunction with the Institute of Planning of Territorial and Urban planning;

2. Ministry of Agriculture and Food – in conjunction with authorities such as the General Directorate of Forest and Pastures, Directorate of Fishing and so forth;

3. Ministry of Health and Environment Protection – through the Committee of Environment Preservation and Protection. The remit of this committee is to monitor the environment, but not to manage and administrate natural resources.

In 1994, a National Environmental Action Plan was issued that identified six priorities:

- monitoring industrial and urban pollution;
- establishing admissible pollution standards;
- halting illegal tree cutting and investing in soil erosion prevention;
- assessing the environmental protection needs of the Albanian coastline;
- regenerating severely polluted zones; and
- implementing European-level environmental mechanisms.

In 1998, the Albanian Parliament, through Law No. 8364, transformed the National Environmental Agency into an independent institution reporting directly to the Prime Minister. Albania established its first Ministry of Environment in September 2001. This continued the trend toward giving greater importance and authority to the environmental protection authorities (UNECE, 2002a).

With respect to ongoing pollution, industrial and municipal waste management has been allocated one of the top priorities of environmental management in Albania because, at that time:

- there was no legal framework for waste management;
- abandoned contaminated industrial sites have serious adverse effects on the population and the environment;
- there was no sound management of municipal waste in the major urban centres;
- there was a lack of research and development in the methods of waste treatment and utilization;
- the demolition of illegal buildings in the big cities was generating considerable construction debris;
- end of life vehicles are abandoned, and there was no controlled process for dealing with them.

The main administrative body which operates in Albania on matters of environment at the present time is the National Agency for Environmental Protection (“NAEP”). Under the Environmental Protection Law, the NAEP has wide powers in carrying out environmental impact assessment studies and monitoring of environmental compatibility on specific activities, on awarding and revoking licences, setting environmental standards and parameters, and so forth (Zuna, 2003).

Significant problems exist with the implementation and enforcement of legislation in Albania. According to the UNECE (2002a), the greatest problems with Albania’s legal framework, are not the development of the laws but their lack of implementation and enforcement. Poor implementation stems from a number of sources: lack of respect for the law, rooted in the years Albania suffered under a repressive dictatorship; absence of an ability to measure and monitor compliance; weak enforcement procedures; lack of institutional and administrative capacity, and a dysfunctional distribution of competencies among ministries. Poor implementation and weak enforcement are also related to the
absence of information and education campaigns that would increase public awareness and sense of responsibility.

Enforcement of the country’s environmental laws is also complicated by the fact that the environmental authority (i.e. now the Ministry of Environment) is not in charge of resource management (e.g. water, forest, fish and mineral resources). These competencies have been assigned to ministries or institutions, such as the National Water Council, the Ministry of Territorial Adjustment and Tourism, the Ministry of Agriculture and Food, and the Ministry of Industry and Energy, which are focused more on resource use than resource protection. Government awareness of the need for sustainable resource management is evolving slowly due to severe economic and social constraints (UNECE, 2002a).

In addition to the ministerial bodies listed by the UNECE above, Samimi et al (1997) provide more details of a number of Ministries and other bodies with established departments that are intended to deal with various (predominantly sectorial) aspects of the environmental protection. Ministerial bodies purported to be important among these are:

- Section for Protection of Cultivated Plants in Ministry of Agriculture and Food;
- Council for systemizing and regulating the territory under the Prime Minister;
- General Directorate of Forests, in Tirana and District Forest Directorates;
- Section for Environmental Protection in the Ministry of Energy and Mineral Resources;
- Section for Environment in the Ministry of Construction, Territorial Planning and Tourism;
- departments responsible for drinking water, air and urban greening at municipality and district levels;
- The Hydrogeological Service Analysis Laboratory;
- Section for Forest strategy and section for Fauna and Flora protection, Natural monuments and Pastures at the Institute of Forests;
- The Institute of Geology (minerals planning and reserves definitions) and the Department of GeoEnvironment (soil pollution assessments for mining, metallurgical, chemical and oil industries);
- the Institute of Soils Studies (pedology, erosion, soil protection, and pollution assessments);
- Directorates of Public Health (hygiene) in all districts;
- Public Health (hygiene) Services in all municipalities;
- The Institute of Public Health (Departments air pollution, water, protection of water and infectious diseases); and
- The Academy of Science through its scientific institutions.

Further, Institutes and Universities with environmental competencies that may be of importance in the context of the mining and minerals processing sector (and their respective competencies) are listed as:

- Institute of Hydrometeorology: meteorological, climatic and hydrological studies and laboratories for the analysis of air, surface and ground-waters;
- Institute of Nuclear Physics: radiation monitoring and measurement;
- Biological Studies Centre: biodiversity and flora;
- Faculty of Construction Engineering at the Polytechnic University: programme for environmental engineering;
- Faculty of Geology and Mines at the Polytechnic University: hosts the Department of Applied Geology and Environment;
- The University of Tirana, Shkodra, Elbasan and Gjirokastra: host departments of geography, biology and chemistry with environmental studies in both curricula and research - the chemical laboratory of Faculty of Natural Sciences of University of Tirana also has soil, water and air analysis competencies;
- Tirana and Korea Agricultural universities: research foci upon erosion, forest damage and soils contamination.

Despite demonstrable increases in capacity and resources in recent years, it was noted that there was a significant lack of coordination and information exchange among these Albanian actors in the latter half of the 1990s (Samimi et al., 1997). Evidence of the current status of multi-institutional coordination has not been found in this study, however, continued progress in Albania in the creation and capacity building of institutions, allied with extensive participation of donor agencies in both projects and institutional strengthening (Bockheim, 2001), would indicate that the situation is likely to have improved.

4.1.2 Policy and legislative frameworks
In this section a range of legislative items for environmental protection enacted in the period 1991-2002 documented by the UNECE (2002a) are presented. These are also discussed in Samimi et al (1997) and Bockheim (2001). Those that may have impact upon the resources sector are marked with an asterisk*.

- Law on Environmental Protection* (No. 7664, 1993; amended by Law No. 8364, 2 July 1998 and then No. 9834, 5 September 2002).
- Law on Fishing and Fish Farming (No. 7908, 5 April 1995).

Comparison between sources (between Samimi (1997), the Albanian SOE report from 1994 (Government of Albania: committee of environment protection and preservation, 1994), the UNECE (2002a) and Bockheim (2001) for example), indicate that the English translations of these legal acts are approximate only. Of these sources, the UNECE (2002a) material has been assumed the most reliable source. Sources for 2003 and 2004 have not been found at the time of writing.

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37 Comparison between sources (between Samimi (1997), the Albanian SOE report from 1994 (Government of Albania: committee of environment protection and preservation, 1994), the UNECE (2002a) and Bockheim (2001) for example), indicate that the English translations of these legal acts are approximate only. Of these sources, the UNECE (2002a) material has been assumed the most reliable source. Sources for 2003 and 2004 have not been found at the time of writing.
• Law on the Establishment and Operation of Soil Administration and Protection Structures (No. 8752, 26 March 2001).
• Law on Air Protection* (No. 8897, 16 May 2002).
• Law on Protected Areas* (No. 8906, 6 June 2002).
• Decision on Gaseous Emission Standards* (12 September, 2002).

Draft laws under review (as of 2002)
• Draft law on environmental impact assessment.*
• Draft law on biodiversity protection and conservation.
• Draft law on sea and coastal defence and protection.
• Draft law on natural resources preservation, protected areas and national parks.*
• Draft law on public access to environmental information.
• Draft law on the handling of chemicals.*
• Draft law on waste management.*
• Draft law on waste water treatment.*

Environmental legislation in draft form (as of 2002)
• Draft law on water protection.*
• Draft law on soil protection* (Preliminary text of draft Law on Soil Management, Protection and Rehabilitation. NEAP, 2001).

A final item worthy of mention is the decision of the Council of Ministers on “Hazardous Wastes and Residues” (Council of Ministers. Decision no. 26, 31 January 1994. On Hazardous Wastes and Residues) which controls the importation of hazardous wastes to Albania (Government of Albania: committee of environment protection and preservation, 1994).

4.1.3 Legislative frameworks addressing abandoned mines

No legislative frameworks specifically addressing abandoned, orphaned sites or idle mining assets have been identified although this does not preclude inclusion of this topic in one or more of the items listed in the previous section – in particular – the preliminary text of draft Law on Soil Management, Protection and Rehabilitation.

INPUT FROM SKOPJE PRESENTATION.

4.2 Bosnia and Herzegovina – institutions

Politically, Bosnia and Herzegovina remains divided into two major administrative zones: the administrative zone the Federation of Bosnia and Herzegovina (aka. Federation of Bosnian Moslems and Croatians [FBC]) and the Republica Srpska (RS) with a predominantly Serbian population. In
addition, a third small zone, the Brčko District is a single administrative unit of local self-government existing under the sovereignty of Bosnia and Herzegovina.38

4.2.1 Institutions - Federation of Bosnia and Herzegovina39

The following institutions and institutional structures with environmental accountabilities have been found described within the documents examined in this study.

Ministries (or ministry related bodies) with environmental responsibilities
- Ministry of Physical Planning and Environment
- Ministry of Agriculture, Water Management and Forestry
- Institute for Crop Protection in Agriculture
- Ministry of Health Administration Office for Protection from Radiation and for Radiation Safety
- Ministry of Education and Science
- Ministry of Culture and Sports Institute for the Protection of the Cultural, Historical and Natural Heritage
- Ministry of Energy, Mining and Industry Institute for Metrology
- Institute for Geology - (being formed)
- Ministry of Transport and Communications

Independent bodies with environmental responsibilities
- Institute of Statistics
- Meteorological Institute
- Administration Office for Geodesy and Property: Legal Proceedings
- Administration Office for Civil Protection

Their overall responsibilities of the parties outlined above are also defined in the Law on Federal Ministries and Other Administrative Bodies, but they are not further specified in by-laws or regulations. Reportedly, this leads to a lack of clarity and a potential overlap and duplication of functions.

The Federation is divided into ten cantons with 84 municipalities. The Federation and the cantons are jointly responsible for the “policy of environmental protection” and for the “use of natural

38 Brčko sits at the crossroads of Bosnia and Herzegovina where the narrowest portion of Republika Srpska meets the Federation. The Posavina Corridor in Republika Srpska, only five kilometres wide at Brčko, connects the eastern and western parts of Republika Srpska and provides the easiest north-south access for the Federation across the Sava river to the rest of Europe. Traditionally the trade, industry and transport hub of the region, Brčko borders Croatia on the Sava and is within three hours of Zagreb and ninety minutes from Belgrade via Croatia. As a result of the war, the municipality has been split between the Federation and the RS and the town itself, situated north of the Inter Entity Boundary Line (IEBL), is 97.5% Serb, approximately 75% of whom are displaced persons from the Federation and refugees from Croatia. At the Dayton Peace Talks in November 1995, the parties were unable to agree on control of Brčko. The dispute was put to international arbitration in Annex II of the Dayton Peace Accords. On 14 February 1997, the Presiding Arbitrator of the Brčko Tribunal, Mr. Roberts Owen (U.S.) issued a decision placing the RS portion of the Brčko municipality under international supervision. The Arbitral Tribunal further extended the supervision period, on 15 March 1998, for a year. The Final Award was issued on 5 March 1999.

risks and vulnerabilities from mining activities

resources”. These responsibilities may be exercised jointly or separately, or by the canton as coordinated by the Federation. Each canton has its own constitution and government. The cantons’ environmental authorities are their ministries of civil engineering, spatial planning and environmental protection and their ministries of agriculture, water management and forestry.

Other canton ministries with environmental responsibilities are usually the ones dealing with health, industry, energy and mining (or the economy in general), labour and public welfare. It is intended that the cantons’ constitutions provide for the establishment of a council of cantons to coordinate and harmonize policies and activities of common interest. According to the Law on Physical Planning, the municipalities are self-governing. As a result, they may issue permits for new developments without the approval of the cantonal ministry. However, the inspectorates (for noise, air and waste) are based with the cantonal ministries.

**Canton Ministries with environmental responsibilities**

- Una-Sana Ministry of Economy
- Una-Sana Ministry of Health
- Posavina Ministry of Industry, Energy and Physical Planning
- Posavina Ministry of Health
- Tuzla Ministry of Industry, Energy and Mining
- Tuzla Ministry of Health
- Zenica-Doboj Ministry of Economy
- Zenica-Doboj Ministry of Health
- Bosna-Podrinje Ministry of Labour, Health, Social Policy and Displaced Persons
- Central Bosnia Ministry of Economy
- Central Bosnia Ministry of Health
- Herzegovina-Neretva Ministry of Economy, Entrepreneurship and Agriculture
- Herzegovina-Neretva Ministry of Health, Labour and Public Welfare
- West Herzegovina Ministry of Economy
- West Herzegovina Ministry of Health
- Sarajevo Ministry of Economy (agriculture, water management and forestry)
- Sarajevo Ministry of Health
- Canton 10 Ministry of Economy
- Canton 10 Ministry of Labour, Health, Public Welfare and Refugees

**4.2.2 Institutions - Republika Srpska**

In Republika Srpska, the institutions most like to be relevant to this discussion are the Ministry of Spatial Planning, Civil Engineering and Ecology, and the Ministry of Agriculture, Forestry and Water Management. The Ecology Sector of the former is made up of seven people, including the Assistant Minister. Administration is more centralised in the RS, which has no cantons, although there is a local

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administration in each of the entity’s 65 municipalities. In Republika Srpska, some other ministries and independent administrative offices and institutions also have environmental responsibilities.

Ministries with environmental responsibilities
- Ministry of Economy, Energy and Development
- Ministry of Education and Culture
- Ministry of Health and Social Welfare
- Ministry of Transport and Communications
- Ministry of Trade and Tourism
- Ministry of Science and Technology

Independent bodies with environmental responsibilities
- Institute of Statistics
- Hydro-Meteorological Institute
- Institute for the Spatial Planning
- Institute for the Protection of the Cultural, Historical and Natural Heritage
- Institute for Standardization and Metrology
- Institute for Geological Survey
- Directorate for Water

The entity is responsible, with the municipalities, for ensuring environmental protection in accordance with the law. It is also supposed to meet the specific environmental protection needs of its citizens in accordance with article 102.5 of its Constitution. The larger municipalities have units for the control of construction, water and waste management and, more recently, environmental inspection.

4.2.3 Institutions Brčko district
According to the 2000 Statute of Brčko District, its Government consists of nine departments. The Department of Utilities has a logistics unit, with one environmental specialist, directly responsible for environmental protection. The other departments that are partially involved in environmental issues are:

- The Department of Public Works;
- The Department of Urbanism, Real Estate Affairs and Economic Development;
- The Department of Health, Public Safety and Community Services;
- The Department of Education; and
- The Department of Agriculture and Forestry.

According to the UNECE assessment, the environmental authorities in both entities are significantly understaffed. The situation does not appear to be any better at cantonal or municipal levels. The cantonal ministries have one to three environmental specialists, and the municipalities are only now developing environmental units, starting with one environmental inspector.
4.2.4 Policy and legislative frameworks

**State level** – There are no laws or other regulations on the environment at the State level. However, the Council of Ministers has charged the Ministry of Foreign Trade and Economic Relations with coordinating the drafting of an environmental protection bill. There is agreement with the Environment Ministries of both entities and the Government of Brčko district that they will take part in drafting the law, as will independent expert and nongovernmental organizations.

**Entity level** – Annex 2 to the new State Constitution stipulates that all laws that were in force in Bosnia and Herzegovina when the Constitution comes into effect and that are not inconsistent with it may remain in force. For the period 1996-2002, before new legislation was passed, this was important for the environment because it confirmed the standing in both entities of the Law on Physical Planning, passed in September 1987 (Official Gazette SR BIH 9/87). This Law was general and covered all major components of the environment. It dealt with the overall issues of urban planning, physical planning, the environment and building.

The Federation of Bosnia and Herzegovina’s new Laws on Physical Planning (Official Gazette F BiH 52/2002) and on Construction (Official Gazette F BiH 55/2002) go farther and include, for example, requirements for strategic environmental assessment “to protect the environment adequately spatial planning documentation is being prepared” (art. 8) and environmental assessment or environmental permits for new construction (art. 27, para. 4, and art. 41, para. 6).

Environmental protection in Republika Srpska has been regulated in a similar manner. Its new Law on Physical Planning was issued in 1996, but has since been amended several times (Official Gazette RS 19/1996, 25/1996, 10/1998 and 53/2002).

Separate laws on the environment and environmental media were drafted after 1998 for each of the entities, with financial support from the EU Community Assistance, Reconstruction, Development and Stabilisation Programme (CARDS). Considerable effort was made to harmonize them in order to avoid future difficulties with implementation. Both packages of laws have been discussed and approved by the Inter-Entity Steering Committee for the Environment. The contents of these laws are not identical, but are very similar and there are no differences as far as technical issues and goals are concerned. These laws are:

- The Law on Environmental Protection;
- The Law on Air Protection;
- The Law on Water Protection;
- The Law on Waste Management;
- The Law on Nature Protection; and
- The Law on the Environmental Fund.

The new laws reflect European practice. They are to a large extent harmonised with the goals and the principles of EU environmental legislation. According to the UNECE (2004, pp 20-21) the new laws for BiH are listed below.

- The Law on Environmental Protection lays down the principles of sustainable development, precaution and prevention, substitution, integration, cooperation and responsibility-sharing, public participation, access to information and the polluter pays. It includes tools for

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environmental management, such as environmental impact assessment, strategic environmental assessment, environmental permitting (integrated pollution prevention and control (IPPC) permits), major accident prevention, environmental quality standards, eco-labelling, voluntary environmental management systems, and civil liability for environmental damage.

- The Law on Air Protection requires monitoring, using general and particular emission limit values, setting air quality standards, measuring air quality in particularly polluted areas and informing the public. EU air quality standards and emission limit values will be adopted.

- The Law on Water Protection sets the provisions for water protection planning and establishes the river basins and sub-basins, and, to protect the water ecosystems, determines limit values for pollution as well as general and particular water protection measures.

- The Law on Waste Management determines the activities and responsibilities in waste management including those of the producers, sellers, and waste collection systems. It sets special provisions for household waste, waste treatment and waste transport, including the movement of transboundary waste, waste disposal, waste incineration, general rules for hazardous waste, and waste disposal sites registration.

- The Law on Nature Protection is also based on the principles of cooperation, precaution, prevention, and the polluters pays. It calls for capacity-building, the regulation of nature protection planning and the determination of the joint responsibilities of the entities. General and special measures are provided for the protection of landscapes, wild animals and plants, and the development of protected areas under Natura 2000. Under this Law an inter-entity or State body should be established to, inter alia, act as an advisory body, create a red list for the country, set guidelines for the introduction of species and for transboundary cooperation and develop a nature protection strategy.

- The Law on the Environmental Fund establishes a fund and determines its activities, the preparation of a financial plan, the management structure and management tools.

The six laws were adopted in Republika Srpska in 2002 (Official Gazette of RS 50, 51, 53/2002) and in the Federation of Bosnia and Herzegovina in 2003 (Official Gazette F BiH 33/2003). Republika Srpska has also adopted other specialised environmental laws, such as the Law on Hunting (Official Gazette RS 4/2002) and the Law on Forests (Official Gazette RS 66/2003). The Federation is preparing similar laws.

The Brčko district was to submit its environmental framework legislation for adoption by its Assembly in December 2003. All laws and regulations from both entities shall remain in force in the district if they do not contradict the provisions of the Statute and provided that the district has not adopted its own laws. It was expected that the cantons of the Federation would prepare their own environmental legislation following the framework laws adopted by the Federation. Some of them, like Tuzla, Zenica-Doboj, Posavina and West Herzegovina, have already adopted laws on environmental protection.

4.2.5 Legislative frameworks addressing abandoned mines

No legislative frameworks specifically addressing abandoned, orphaned sites or idle mining assets have been identified although this does not preclude inclusion of this topic in one or more of the items listed in the previous section – in particular – the environmental fund discussed earlier in this section.
While no specific legislative frameworks for abandoned or orphaned mining sites were found in this study, Bosnia and Herzegovina is the subject of a number of external initiatives that have connection with the mining sector and its effects upon the environment.42 43

4.3 Kosovo (Territory under UN interim Administration) - institutions

4.3.1 Institutions and their relation to the mining industry44

General Environmental Institutions
In May 2000, UNMIK issued a regulation on the establishment of the administrative department of environment protection as part of the Kosovo joint interim administrative structure. Functions and responsibilities for the department include water resources, air, soil and biodiversity. The environment department consisted of five international and nine local staff. In addition, there were five international regional coordinators.

In September 2001, the regulation on establishing the executive branch of the provisional institutions of self-government was issued. This regulation forms the basis for establishing a total of nine ministries, including the Ministry of Health, Environment and Spatial Planning. However, in March 2002 this Ministry was split into two: the Ministry of Health and the Ministry of Environment and Spatial Planning. The environmental responsibilities of the new Ministry of Environment and Spatial Planning include:

- setting norms and standards, and ensuring compliance;
- awareness raising;
- environmental education;
- transferring clean technologies;
- monitoring and assessment;
- coordinating environmental protection activities;
- developing policy and legislation; and
- establishing protected areas.

Planning was established in 2002 as an individual ministry, its structure. At that time there were three departments: one for the environment, one for spatial planning and one for housing and reconstruction. Within the environment department, there was to be four divisions: general environmental policy, environmental protection, nature protection and water management. A legal division will assist all departments within the Ministry.

42 BiH is part of the Environmental Regulation of Mine Waters in the European Union (ERMIT) project. This three-year research and development project aims at integrated policy guidelines for developing European legislation. The NGO Center for Environmentally Sustainable Development is responsible for this project in BiH.

43 USTDA funded two projects in BiH in 1999: 1. Metal Mines Rehabilitation Feasibility Study (9970048) - USTDA signed a $218,500 grant with the Federal Ministry of Energy, Mining and Industry for the rehabilitation of the Buzim Manganese Mine and Olovo Base Metals Mine. An American firm, MRDI was selected to perform this study. 2. Middle Bosnia/Tuzla Coal Mines (Desk study and Feasibility Study). Marston & Marston Inc. of St. Louis, MO was selected to perform the study, which was completed in July 2000. While more projects were not found in the material examined within this study, they may exist.

44 Unless otherwise cited, the material in this section is drawn in its entirety from UNECE (2002b).
The Spatial Planning Department commenced operation with four staff members in 2002. The Ministry of Environment and Spatial Planning has five regional coordinators based in Prishtinë/Pristina, Prizren/Prizren, Pejë/Pec, Mitrovicë/Mitrovica and Gjilan/Gnjilane. The regional coordinators liaise with the municipalities and monitor developments in their regions. They work within the General Policy Division of the Ministry.

At that time, the Institute for Environment and Nature Protection (INEP) and the Kosovo Hydrometeorological Institute (KHMI) were subordinated to the Ministry. They were originally established by Kosovo law for monitoring and research and were a part of Serbia’s network. According to the draft environmental protection law, the two institutes will be merged into the Kosovo environmental protection agency.

By June 2002, ten ministries had been established. The following are of direct relevance to the environment:

- The Ministry of Environment and Spatial Planning
- The Ministry of Trade
- The Ministry of Health
- The Ministry of Transport and Communication, and
- The Ministry of Agriculture, Forestry and Rural Development

Further, in the beginning of 2002, the Kosovo Trust Agency (KTA) was established under the reserved powers of the Special Representative. KTA has “ownership” of all publicly and socially owned enterprises, including the large enterprises for drinking-water supply, waste collection and electricity generation and distribution. KTA has a supervisory board of directors, consisting of representatives from the Kosovo Government and UNMIK.

**Mining specific institutions**

The Directorate of Mines and Minerals, in consultation with the Ministry of Environment and Spatial Planning, issues quarry and mining licences. The Mining Advisory Board approves all exploitation licensing. The Ministry of Environment and Spatial Planning is represented on the Board. The licensing procedure requires the company interested in exploration to prepare technical guidelines and a note on an EIA to the Ministry and the municipalities. At present, approximately 100 companies have received licences. Reportedly, there is still much illegal exploitation of sand and gravel, especially from riverbeds. A regulation establishing the Directorate of Mines and Minerals as an independent entity and the provision of this body and the Mining Advisory Board with real authority is in the final stages of approval. This should give the Directorate the powers necessary to close down illegal operations. The Directorate of Mines and Minerals of the Public Utilities Department of the Transitional Department of Trade and Industry issues licences for all mineral exploitation operations and mining facilities, but only a small percentage of these quarries have been licensed so far. This situation poses a problem for Kosovo at the present time as the region is rich in limestone and gravel, which are used as construction materials. Limestone quarries are common and operate mainly in the Gnjilane/Gjilan, Gllovoc/Glogovac, Lipjan/Lipljan, Ferizaj/Urosevac and Kaçanik/Kacanik areas. Further, as a result of the high demand for construction materials, there are about 200 small sand and gravel operations in riverbeds. Often these small operators abandon the extraction site without any rehabilitation, leaving the riverbed destroyed. If a licensing procedure is followed, the Ministry of Environment and Spatial Planning is consulted. In 2002, the only operational large-scale mineral exploitation in Kosovo is the opencast mining of lignite in the Obiliq/Obilic region. This lignite fuels Kosovo’s two thermal power plants.
There is a small Mines Inspectorate in the Directorate of Mines and Minerals. Municipal inspectors, together with inspectors of the Ministry of Environment and Spatial Planning, inspect the licensed quarries.

4.3.2 Policy and legislative frameworks

The general environmental policy framework
Kosovo has been developing a strategy for sustainable development and environmental protection at the central level, with expansion at the local level. A draft short- and medium-term action plan was developed in 2001. Although the document is descriptive in nature, implementation is detailed in the donor assistance programmes that have been secured for environmental protection.

While these programmes do not provide clear objectives and targets, the Environmental Policy Division intends to develop a strategic plan for international cooperation, information management and public awareness. Key staff have been recruited in these positions. These staff will also work to consolidate the regional offices, develop clear guidance for reporting issues, develop procedures for donor documents, develop the Kosovo consolidated budget, and compile a state-of-the-environment report for Kosovo.

In addition to the draft short- and medium-term action plan, a comprehensive development framework has been developed as part of the ministerial budget. This document outlines the current situation, key issues, objectives and policies, and identifies priority actions, performance measures and costs within the context of the Kosovo budget and the public investment programme. The list contains very general priority actions. At that juncture, it was planned to introduce taxes for environmental polluters in 2003.

The Legal Department of the Ministry of Environment and Spatial Planning is currently developing an environmental protection law to solve a number of the above-described problems. A first draft was finished in June 2002. In addition to giving legal standing to environment inspectors, the law will oblige the Ministry to develop an environmental protection and sustainable development strategy. It also makes the development of an environmental protection programme compulsory, but leaves open the opportunity for municipalities to develop their own local environmental protection plans. If a municipality decides to develop such a programme, it should be in line with the national one. As of 2002, the law was being debated in a parliamentary working group and was to be forwarded to the new Kosovo parliament for adoption.

Currently there is no integrated environmental permit requirement in Kosovo. The draft environmental protection law calls for environmental permits, issued by the Ministry of Environment and Spatial Planning, for activities that require an environmental impact assessment (EIA). In addition, for a second category of activities, environmental authorization by the Ministry of Environment and Spatial Planning would be required. The draft environmental protection law is a framework law and, therefore, does not provide details on the kind of activities that would require either an EIA or environmental authorization. These details will be spelled out in regulations after the approval of the law. In the draft law, authority for regulatory instruments is centralised within the Ministry and competences are delegated to the municipalities. An exception is the appointment of municipal environmental inspectors, who would have responsibility for environmental concerns that can be “controlled and prevented” by the municipalities themselves.

Mining specific legislation
There are two major laws on mining: the 1980 Mining Law (No. 26/80) and the 1983 Geological Law. Both, however, are outdated and do not reflect the current institutional situation in Kosovo. A new law

45 Unless otherwise cited, the material in this section is drawn in its entirety from UNECE (2002b).
on mining has been prepared but remains in draft form at this time – this document requires new mines to have closure and remediation plans, but does not address abandoned or orphaned sites.

At present there is no policy or strategy document for mining activities, but the Directorate of Mines and Minerals has identified certain policy objectives:

- Encourage larger-scale hard-rock quarrying and a few properly managed large sand and gravel operations rather than small alluvial sand and gravel operations;
- Further investigate magnesite, graphite, talc, kaolin and bentonite resources; and
- Attract foreign and local investors for the exploitation and exploration of lead-zinc, ferrous-nickel (Fe-Ni) and bauxite deposits.

While, regulation of mineral resource extraction activities remain developmental with respect to both form and function, the Ministry of Trade and Industry (Directorate of Mines and Minerals in the Department of Public Utilities) does issue quarry licences, which require an EIA. Until the draft environmental protection law discussed above is adopted and an EIA regulation is developed and approved, EIA is carried out on the basis of certain minimum requirements, including delineation of the project and its expected environmental impacts from construction to decommissioning, an evaluation of alternatives to the proposed project and compensation for environmental impacts. A Mining Advisory Board, in which the Environmental Protection Department is represented, has been set up and the quarry licence requires both approval by the Mining Advisory Board and consent from the affected municipality.

The quarry licence also requires the deposit of a modest environmental bond to guarantee rehabilitation of the site after decommissioning. The Directorate of Mines and Minerals collects the bond on behalf of the Ministry of Environment and Spatial Planning. For sand and gravel extraction, the bond is €500; for hard rock, it is €2500. In addition, royalties have to be paid for the extracted amounts of construction material. The municipalities, which receive half of the royalties, assess the excavated amounts. In certain municipalities, these royalties reportedly generate up to 85% of all income. The remaining portion of the royalties goes to the Kosovo budget. As more quarried material was entering from other parts of Serbia and from the former Yugoslav Republic of Macedonia during 2002, the Ministry of Trade and Industry was considering lowering the royalties. At that time, approximately 100 quarry licences have been issued. However, the Department of Mines and Minerals estimated that this was only 25-30% of the 300 to 400 quarry operations operational in the country.

While most focus appears to be upon municipal solid waste, the legal framework for waste management in Kosovo may also impinge on mining waste through its provisions for hazardous waste.

According to the UNECE (2002b, p228) the Ministry of Environment and Spatial Planning prepared a draft position paper on “solid waste management in Kosovo: status report, strategies and policies” in July 2002. It contains information on waste management, including the current situation, institutional responsibilities and requirements for the construction of environmentally sound or engineered landfills. The draft environment protection law of June 2002 also covers waste management. It defines all types of waste, including hazardous waste and prescribes the legal, managerial and technical aspects of waste management. This law will prohibit the storage and import of radioactive waste. Problems associated with the export and import of hazardous waste are also discussed.

In addition to the draft environmental law, a draft regulation on the solid waste sector in Kosovo has been developed by UNMIK. It covers the municipal waste service, the institutional aspects of waste management, including licensing, the privatization of waste services and the development and implementation of a future waste management strategy. It prohibits the dumping of all hazardous waste.

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46 At the time of writing, this document in draft form - *Draft of 15 September 2004, 13:00 Law No. 2004/xx ON MINES AND MINERALS*. 

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(hospital, radioactive and other toxic waste) as well as of certain other identified types and quantities of waste. The draft regulation is in compliance with European Union norms and standards.

Kosovo has also developed minimum standards for solid waste disposal to land. These cover rehabilitation standards for existing landfills, a description of minimum engineering works at the landfills, waste disposal operations, environmental monitoring, and conditions for temporary controlled storage of waste. However, these were seen as interim measures intended to provide a platform for (eventual) environmental protection equivalent to that in the EU.

### 4.3.3 Legislative frameworks addressing abandoned mines

The processing of lead and zinc ores in Kosovo is recognised to have generated different kinds of pollution: overburden from mining; tailings from concentration processes; sludge and filter residue; air pollution from sulphur dioxide and dust, including dust containing heavy metals; and water pollution from heavy metals. According to the Ministry of Environment and Spatial Planning and the Ministry of Trade and Industry (UNECE, 2002b, p235), the main environmental problems from the mining and metallurgical industry are the huge dumps of tailings and old mines. About 4600 ha are occupied by mines and tailing dumps. In addition, opencast lignite mines and ash dumps in Obiliq/Obilic take up about 4000 ha. The environmental effects are summarised as follows:

- deterioration of large areas of land, which can no longer be used for agriculture;
- disfigurement of the landscape from tailings dumps and old mines which are no longer in operation;
- toxic dust from tailings and ash dumps resulting in respiratory diseases and cancer among the local population;
- release of toxic gases from tailings, with consequent health risks to the local population and the environment;
- contamination of surface and groundwater by heavy metals in the vicinity of dumps (lead, zinc, nickel); and
- potential for major contamination of the territory in the event of a natural disaster (e.g. flood, earthquake).

The rehabilitation of these dumps and the introduction of a monitoring system for surface and groundwater as well as for air are listed as urgent tasks for the Ministry of Environment and Spatial Planning and the Ministry of Trade and Industry.

As an example of laws applicable for control, monitoring and/or rehabilitation of contaminated mineral extraction related sites, UNECE and the Kosovo Ministry of Environment and Spatial Planning (UNECE, 2002b) provided the example listed in Table 4-1.
Table 4-1. Kosovian Legislation that could be applicable to the minerals processing complex

<table>
<thead>
<tr>
<th>Media</th>
<th>Decree or legislation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water:</strong></td>
<td></td>
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<tr>
<td></td>
<td>Decree on the classification of waters, 1968 (Serbia)</td>
</tr>
<tr>
<td></td>
<td>Decree on the categorization of water streams, 1968 (Serbia)</td>
</tr>
<tr>
<td></td>
<td>Law on the protection of waters, 1976 (Kosovo)</td>
</tr>
<tr>
<td></td>
<td>Rulebook on dangerous materials in waters, 1982 (Serbia)</td>
</tr>
<tr>
<td><strong>Air:</strong></td>
<td></td>
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<tr>
<td></td>
<td>Rulebook on time periods and methods of measuring emitted hazardous materials into the air, 1974 (Serbia)</td>
</tr>
<tr>
<td></td>
<td>Rulebook on reports of measuring the quality of the air, 1974 (Serbia)</td>
</tr>
<tr>
<td></td>
<td>Decree of changes in the Law on the air, 1974 (Serbia)</td>
</tr>
<tr>
<td></td>
<td>Rulebook on the methods of measuring dangerous substances in the air, 1978 (Serbia)</td>
</tr>
<tr>
<td></td>
<td>Regulation for time limits and manner of providing report for performed measures in terms of air pollution</td>
</tr>
</tbody>
</table>

### 4.4 FRY of Macedonia - institutions

#### 4.4.1 Institutions and their relation to the mining industry

Since independence in the early 1990s, the former Yugoslav Republic of Macedonia has taken important steps towards strengthening its institutions for environmental protection. The 1996 Law on the Environment and Nature Protection and Promotion and its amendments designate the main environmental authority (the Ministry of Environment and Physical Planning). However, this law also makes a significant number of institutions are responsible for the environmental management of the industrial and energy sectors. These include: the Ministries of Economy; Agriculture, Forestry and Water Economy; Health; Transport and Communications; Labour and Social Policy; and the Institute of Occupational Health. The principal role in environmental matters and in the coordination between different organizations and departments belongs to the Ministry of Environment and Physical Planning. The Law on the Organization and Work of the State Administration, adopted in 2000, establishes the functions and responsibilities of all the State administration bodies, including the ministries (pp. 18-19).

The most important body with a direct role in the development of environmental policy is the Ministry of Environment and Physical Planning, established as a separate ministry in 1998. It was previously a department of the (former) Ministry of Construction, Urban Planning and Environment. The Physical Planning Department was incorporated into the Ministry of Environment in June 2000. The remaining

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47 As many of the above are based on Serbian requirements, it would appear reasonable that they be equally relevant to Serbian sites.

Risks and vulnerabilities from mining activities

The responsibilities of the former Ministry of Construction, Urban Planning and Environment were transferred to the Ministry of Transport and Communications (p.19).

The Law on the Organization and Work of the State Administration defines the responsibilities of the Ministry of Environment and Physical Planning as follows:

- monitoring the state of the environment;
- protecting waters, soil, air and the ozone layer;
- protecting against noise and radiation; and
- protecting biodiversity, mineral resources, national parks and protected areas;
- rehabilitating polluted areas;
- proposing measures for the treatment of hazardous waste;
- physical planning;
- operating the physical information system; and
- carrying out inspections and supervision within its scope of activity.

One discrepancy in the structure of the Ministry as laid down in the Law on the Environment and Nature Protection and Promotion and as stipulated in the Law on the Organization and Work of the State Administration that may be of relevance for mining and/or abandoned or orphaned mine sites is raised by the UNECE analysis. For example, the Law on the Environment and Nature Protection and Promotion provides for an “agency” for the environment within the Ministry, a fund for the environment and nature protection and promotion with the status of a legal entity, and an inspectorate for the environment and nature protection and promotion as a special body within the Ministry. However, the Law on the Organization and Work of the State Administration makes no mention of a fund and it does not refer to a State environment inspectorate as a “special body within the Ministry”. In 2002, the Ministry currently had approximately 80 full-time employees and 15 people working on a special contractual basis.

The Ministry is organised into five departments and four bodies, as follows:

- The Department for Regulation and Standardization;
- The Department for European Integration;
- The Department for Sustainable Development;
- The Department for Physical Planning;
- The Environmental Information Centre;
- The State Environment Inspectorate;
- The Environment Office;
- The Office for the Spatial Information System
- The Fund for the Environment and Nature Protection and Promotion.

The State Environment Inspectorate carries out inspections to check compliance with environmental standards and prescribe measures against pollution. While the Inspectorate itself is centralised, most of the national inspectors are located in sensitive areas (heavily industrialised areas or protected areas), such as Veles and Bitola.

The Environment Office (“Agency”) has four divisions: Monitoring and Environmental Impact Assessment; Laboratory Research; Natural Heritage Protection; and Biodiversity. In 2002, the office...
activities were restricted to environmental permitting for nature protection and capacity for environmental impact assessment was still undeveloped.

The Ministry of Environment and Physical Planning is the key institution for creating and implementing environmental policy. It collects data on atmospheric pollution from industrial and energy-related activities; its State Environment Inspectorate monitors emissions of carbon monoxide (CO), sulphur dioxide (SO₂), nitrogen oxides (NOₓ), suspended particulate matter and ozone. According to normal procedure all new industrial or energy projects should be reviewed from an environmental perspective by this Ministry, but until the law on environmental impact assessment comes into force this will remain a ‘grey’ area. The Ministry is also responsible for the rehabilitation of polluted areas. There is active ‘voluntary’ collaboration with the Ministry of Economy, largely through the Department for Sustainable Development, on industry and energy issues, particularly environmental pollution and energy efficiency.

Other relevant institutions

The State Public Health Institute is responsible for monitoring emissions, including SO₂, black smoke, carbon monoxide and lead, and is obliged to transmit all data collected to the Ministry of Environment and Physical Planning.

There are also a number of other national institutions with environmental responsibilities clearly overlapping with areas of mineral exploitation activity. The Ministry of Agriculture, Forestry and Water Economy has the most closely related activities and competence with the Ministry of Environment and Physical Planning. The most important issue treated by these two ministries is water management. The Ministry of Agriculture, Forestry and Water Economy is also responsible for matters concerning the use of agricultural land, forests and other natural resources, the protection of livestock and plants against diseases and pests, the monitoring and examination of the state of waters, the maintenance and improvement of the water regime, permitting for water use and waste-water discharge and so forth. The Hydrometeorological Institute (assumed to be within the Ministry of AF&WE) is also responsible for monitoring air emissions, including SO₂, black smoke and total oxidants, and industrial waste water, including chemical pollution. Again there is an obligation to transmit all data collected to the Ministry of Environment and Physical Planning.

The Ministry of Health, including the State Sanitary and Health Care Inspectorate, deals with a number of issues related to environment protection, such as: monitoring the pollution of air, water, soil and foodstuffs; monitoring and protecting the population against the harmful effects of gases, radiation, noise, and air, water and soil pollution; controlling the quality of food and monitoring public hygiene. The Ministry of Health is obliged to submit regularly the data that it collects on the environment to the Environmental Information Centre at the Ministry of Environment and Physical Planning (p. 21).

The Ministry of Economy is responsible for the exploitation of mineral raw materials and the application of common technical norms and standards in commercial and industrial activities. The Commission of Standardization is the Ministry of Economy’s environmental body, coordinating the standard-setting action of governmental bodies. The Ministry of Internal Affairs helps other bodies with inspections to check implementation of the environmental legislation by physical and legal entities. Further, this State organ is responsible for controlling the production, trade, storage and safety of inflammable liquids, gases, explosives and other hazardous substances and their transport. This is also the main ministry responsible for industrial and energy issues. It has a number of sectors focusing on industry, such as the Economic Policy, Technical, Technological and Structural Reforms Sector and the International Cooperation Sector. However, the Energy Supply and Resources Sector is solely responsible for energy-related issues. These include the preparation of the energy strategy, the preparation and implementation of the legislative framework and the coordination of international energy activities. Regional authorities, acting under the umbrella of the Ministry of Economy and the Ministry of Environment and Physical Planning, are also involved in industrial and energy activities.
The Ministry of Economy provides specific support for the introduction of cleaner production techniques in industry and energy.49

A Cleaner Production Centre started work in 2001/2 with assistance from the Czech Republic and the United Nations Industrial Development Organization (UNIDO) and has been undertaking demonstration projects. The Centre is based at the Chamber of Commerce and the intention is that it should operate as a non-governmental organization facilitating the introduction of cleaner technologies in industry.50

Although there is no regional level public administration in the former Yugoslav Republic of Macedonia, individual ministries and public services do sometimes operate in “regional” units responsible for several villages or local authorities. For example, the State Communal Inspectorate controls the application of the law in communal enterprises of national importance, while enterprises of local importance are subject to inspection by local inspectorates. The State Inspectorate for Construction and Urban Planning within the Ministry of Transport and Communications issues construction permits regionally through 34 Inspectorates. Inspectorates of the Ministry of Agriculture, Forestry and Water Economy and the Ministry of Health are also involved in environmental matters in their particular fields of competence.

The country has a “local self-government system” that includes the city of Skopje and 123 local authorities. Local authorities (usually through communal enterprises) may manage drinking-water supplies, green areas and solid waste disposal, and they also have some responsibilities in the areas of construction, land-use planning and zoning. Local authorities, however, are financially dependent on the national Government. There are no specialised units for environmental protection (pp. 22-24)

4.4.2 Policy and legislative frameworks51

The country is actively involved in the “Environment for Europe” ministerial process as part of developing its environmental policies and strategies. As part of this process, in December 1996, the Government developed and adopted the National Environmental Action Plan (NEAP). This is still the country’s main environmental strategy.

The National Environmental Action Plan (NEAP)

Three criteria guided the NEAP: the protection of human health; the improvement of the environment to enhance the quality of life and the conservation of natural resources for sustainable development. The preparation of the NEAP was an important step towards the integration of environmental policy into the country’s economic and social development programmes as it concerns not only the relevant environmental authority but also other institutions with responsibilities for environmental protection.

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49 Under the Law on Foreign Trade 0.1 per cent of total export/import profit is allocated to a special fund (in 2001 this amounted to around US$ 6-7 million) administered by the Ministry of Economy for: up to 70 per cent financing for companies seeking ISO accreditation; domestic and foreign consultancy for the modernization of industrial techniques and the introduction of new products; and cleaner production and energy-saving projects. If the former Yugoslav Republic of Macedonia were to accede to the World Trade Organization this funding would be restricted. However, the Ministry of Economy indicated that in view of the importance that it attaches to the introduction of cleaner production techniques and training in environmental management in industry it would find money from other sources to continue its activities. There is currently a blurring of responsibilities in relation to cleaner production within the country and as of 2002 there was reportedly no collaboration with the National Cleaner Production Centre.

50 As of 2002, there was reportedly no collaboration between the Chamber and the Ministry of Economy as the latter was working on a new legal basis for the Chamber’s operations. It was seeking to split the Chamber into three or four separate units each focusing on an area such as commerce, trade and industry (UNECE, 2002c, pp 134-136).

51 Unless otherwise cited, this section is summarised from the report: UNECE. (2002c). Environmental Performance Review of the former Yugoslav Republic of Macedonia (Online report for the Eighth session of the Committee on Environment Policy); United Nations Economic Commission for Europe: Economic and Social Council.
The NEAP was prepared for the five-year period from 1997 to 2001. However, in early 2002, it was still the operative plan. Its priorities are to:

- improve air quality;
- improve water quality;
- conserve biodiversity, especially in Lakes Ohrid, Prespa and Dojran;
- reforest and preserve existing forests;
- strengthen the management capacity of institutions responsible for environmental monitoring and enforcing environmental legislation.

The implementation of the NEAP has been ongoing since its inception – this process continues as certain system changes, such as decentralization and EU approximation, are under way. Work on updating the NEAP of 1996 has been funded by the European Commission and started at the beginning of 2002 (p. 11).

A number of protected areas have been declared in Macedonia. These are classified into 6 classes according to IUCN criteria and the Law on Protection of Natural Rarities (1973). The total area of protected zones in the Republic of Macedonia is approximately 237 000 hectares or a little more than 9% of its territory. Nearly half of these areas are National Parks (108 338 ha). In addition, two aquatic ecosystems have been included on the World Heritage Listing. These are the Ramsar Site Prespa lake, with an area of 18 920 ha (included 1995) and Ohrid natural, cultural and historical area (included 1981) with an area of 38 000 ha (Republic of Macedonia, 2004)

**Legislation directly applicable to mining activities.**

An overview of the main legislation relevant to environment and/or mining/environment is provided below.

- The Law on Energy (Official Gazette No. 47/97), as amended (Official Gazette Nos. 40/99 and 98/2000) prescribes conditions and measures for the protection of the environment in the energy sector. All forms of energy, including electricity, oil, natural gas, coal and geothermal, are covered by this Law, which also foresees the establishment of an energy efficiency strategy and an energy efficiency fund.

- The Law on Environment and the Protection and Promotion of Nature. Article 4 of this Law requires that, when carrying out their activities legal and natural entities should ensure: a rational use of natural resources, investment funds and production programmes for the protection and promotion of the environment, and the continuous monitoring of the environmental impact of their activities. Article 5 stipulates that the law regulates the specific conditions for the protection of the environment and public health. This Law also calls for the establishment of the Environment Fund.

- The Law on Mineral Raw Material (Official Gazette No. 18/99) contains a number of provisions for the protection of the environment and nature during the exploitation of mineral resources, including all forms of energy resources.

- The Law on Waters regulates the granting of concessions for the use of water as an energy resource. The Law on Communal Works, amongst other issues, addresses the treatment and delivery of processed water, the disposal and treatment of waste water, the treatment and disposal of industrial solid waste, and the disposal of industrial waste and harmful substances.

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52 Information regarding the current status of the NEAP were not found in material examined in this study.
Key legislation relevant to foreign natural or legal persons wishing to invest in the energy and industrial sectors includes: the Constitution, notably article 31; the Law on Trade Companies (Official Gazette No. 28/96); the Law on Public Enterprises (Official Gazette No. 38/96); the Law on Concessions (Official Gazette No. 42/93); and the Law on Expropriation (Official Gazette No. 13/95).

A number of laws that will impact on the environmental performance of the industrial and energy sectors were in draft form or being drafted in 2002. These include the law on environmental impact assessment and a law on air quality. Article 36 of the latter encourages the use of best available techniques. The Environment Fund is responsible for drafting the law on the polluter pays and user pays principles. A significant omission from planned legislation at that time (2002) were initiatives specifically encouraging the adoption of cleaner production techniques and environmental management systems and standards, such as the ISO 14000 or eco-management and audit schemes (EMAS).

4.4.3 Legislative frameworks addressing abandoned mines

The Ministry of Environment and Physical Planning is the key institution for creating and implementing environmental policy, is also responsible for the rehabilitation of polluted areas. While nothing explicit regarding the processes with which these activities would be supported were found in the principle sources addressed (cf. Republic of Macedonia, 2004; UNECE, 2002c), there are activities in the country where capital is set aside for environmental work via the Fund for the Environment and Nature Protection and Promotion – administered by the body within the Ministry.

The Environment Fund established in 1998, under the Law on Environment and the Protection and Promotion of Nature, is intended to mobilize financial resources in order to invest them in projects related to the protection and promotion of the environment and nature.

In the first years of the fund, the focus has clearly been on eco-efficiency/cleaner production type projects. Funds have been used to install new boilers and gas network connections in factories, including in the “Evropa” chocolate factory (Skopje) and OHIS AD, which have achieved significant energy savings and resulted in large reductions in emissions of particulates, SO₉, NOₓ, CO and benzopyrene. The Fund is also supporting an energy conservation project to install a closed steam condensation system with thermal compression in an export company. Other projects in the planning stage at that time (2002) included the reconstruction and conversion of boilers from crude oil or coal to natural gas in several factories and in a school and a clinic, the conversion of public buses from oil to natural gas, the installation of patent steam condensation systems, the replacement of crude oil with biomass in a stock-holding company and an energy efficiency project at OHIS AD.

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53 However, UNECE noted that there appeared to be no implementation or activity in this field at that time (2002).
4.5 Serbia and Montenegro – institutions

The Union of Serbia and Montenegro is made up of two member states, the State of Montenegro and the State of Serbia. The latter includes the Autonomous Province of Vojvodina and the Autonomous Province of Kosovo and Metohija which is currently under an international administration in accordance with United Nations Security Council resolution 1244.

4.5.1 Federal institutions and institutional framework

According to the Constitution and the present legislation, the environmental regulation of industry and industrial development is primarily the responsibility of the two constituent republics (states). However, since Yugoslavia is responsible for international conventions and trans-boundary issues, effective cooperation and coordination with the environment ministries of the two constituent republics is necessary. It is also stated in the Constitution of Yugoslavia (art. 77) that the Federal Republic shall formulate policies, enact and enforce federal legislation and ensure judicial protection in matters concerning the principles of environmental protection. Accordingly, it is an obligation of the Federal Government to take action if necessary to ensure a healthy environment; to provide timely information about the state of the environment, and to formulate policies and enforce legislation.

At the federal level, the responsible body for management of mineral resources is the Federal Ministry of Economy and Internal Trade (Department of Geology, Geodesy and Mining). Environmental Protection on federal level is under the responsibility of Environment Department of Federal Secretariat for Labour, Health and Social Care. Decisions regarding the management of mineral resources are mostly taken by the constituent republics and the municipalities. The main body in charge of the management of mineral resources on republic level are the Ministry of Mining and Energy of Serbia and the Division of Geology and Mining from the Ministry of Economy and Industry in Montenegro (Jovic et al., 2002).

According to the UNECE (, pp. 135-137), the Environment Department of the Federal Secretariat for Labour, Health and Social Care is accountable for the environmental management of industrial development. However, other federal authorities are also involved. These include:

- The Department for Health of the Federal Secretariat for Labour, Health and Social Care (production, trade and transport of medicine and poisonous substances; import and export of ozone-depleting substances);
- The Federal Ministry of the Economy and Internal Trade (energy sources, use of mineral resources and groundwater, production and use of radioactive materials, regime of rivers and territorial waters of international interests);
- The Federal Ministry of Interior Affairs (sales and transport of toxic, explosive, radioactive and other hazardous substances); and
- The Federal Ministry for Foreign Economic Cooperation (economic policies, development strategies, foreign trade).

Moreover, two federal institutes are involved in various kinds of monitoring and collection of data and information on the environment and industrial development. These are the Federal

54 Unless otherwise cited, the material is drawn from UNECE (2002b).
Hydrometeorological Institute (interpretation of data on ambient air quality, water pollution and radioactivity), and the Federal Institute for Public Health (collecting and reporting data on health protection, development of health protection standards).

The federal ministries and authorities mainly establish overall policies, strategies and the related administrative principles and general rules and standards to be reflected and detailed in the legislation and regulations of the two republics.

As of 2002, and as a direct result of the difficult economic situation, the application of many of the adopted standards and principles had been put on hold. In accordance with the constitutional legal framework the federal authorities do not have supervisory competencies over the environmental authorities of Serbia and Montenegro. Moreover, at that time, there was a remarkable lack of sufficiently reliable data to describe emissions and environmental impacts from industrial activities and the related industrial development trends.

4.5.2 Serbian institutional framework

The main body in charge of the management of mineral resources in Serbia is the Ministry of Mining and Energy. Its Division of Geology and Mining has, among other tasks, responsibility for attracting and facilitating both foreign and domestic investment in exploration and mining. The agency for mineral resources (still not established in 2002 due to lack of funds), will perform these promotional activities in the future. The Ministry's Division of Oil and Gas is responsible for the introduction and implementation of efficient policies in the oil and gas sectors.

The new Ministry for Protection of Natural Resources and Environment has been given responsibility for the protection and sustainable use of natural resources, including minerals. It will prepare research programmes in fundamental geological investigation and exploration. In addition, the Institute of Geology and the Geo-Zavod Institute undertake geological exploration as financed by the State budget, and the Department of Environment within the Municipality of Belgrade is in charge of environmental mining issues at the municipal level. The Republican Agency for Privatization and the Ministry of the Economy and privatization are the main institutions dealing with privatization issues in Serbia, including those related to the mining industry. (Jovic et al., 2002; UNECE, 2002b). The Ministry of the Economy and Privatization is in charge of industrial issues and SMEs. It has two agencies: the Privatization Agency and the Agency for SME Development.

While the Ministry for Protection of Natural Resources and Environment is the most important environmental authority in Serbia. Several other authorities and agencies are also involved and responsible for important issues related to industrial environmental management and the protection of the environment against negative impacts from industrial activities. The most important are:

- The Ministry of Construction and Urban Planning (urban planning and operating permits);
- The Ministry of Agriculture and Water Management (protection of soil, and water resources, control of impact from waste water);
- The Ministry of Energy and Mining (mining, permits for exploitation of mineral resources);
- The Institutes of Public Health (monitoring air, noise, water and groundwater quality). The Institute of Public Health of Belgrade is also the national focal point for the Basel Convention); and
- The Republic Hydrometeorological Institute (monitoring air and water quality)

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55 Drawn from (UNECE, 2002b) Part III: Economic and Sectoral Integration unless otherwise cited.
There are also other institutes involved in monitoring and in preparing EIA documentation, such as the Kirilo Savic Institute and the Institute for Work and Environmental Protection.

The resources allocated to environmental management issues and to the enforcement of environmental legislation are very small. The Ministry for Protection of Natural Resources and Environment is responsible for environmental impact assessment and for environmental control and supervision of industry. The Ministry has only 27 inspectors for industrial activities in Serbia. Compared to countries with effective environmental management and based on the number of industries in Serbia, this number is inadequate. For instance, in Denmark it has been agreed that there should be one inspector for every 10,000 inhabitants to enforce environmental legislation effectively. In Serbia, this would mean a minimum of 500 inspectors at republic and municipal levels (UNECE, 2002b).

Although the institutional set-up is still rather centralised, the municipalities also have some responsibilities of relevance for industrial environmental management, especially regarding urban planning, permits for smaller industrial facilities, inspection and control, waste collection and operation of landfills. However, as of 2002, many municipalities have not yet established an environmental secretariat.

4.5.3 Montenegrin institutional framework

According to Jovic et al. (2002), the Ministry of Environment and Spatial Planning is responsible for protection and sustainable use of minerals and natural resources in Montenegro. The Secretariat for Environment within the Belgrade government is in charge of environmental issues on mining in the city area. However, according to UNECE (2002b), the main institution in charge of the management of mineral resources in Montenegro is the Division of Geology and Mining of the Ministry of Economy and Industry. It is composed of two inspectors and two advisers covering the geology and mining areas, and one Deputy Minister. This body also issues exploration and exploitation permits and checks industry compliance with the law. The Geo-Zavod Institute acts as the national geological surveyor, performing geological exploration and monitoring natural geological processes and groundwater financed by the state budget. The Centre for Ecotoxicological Research monitors the environment in mining regions. However, monitoring is performed only sporadically, even in the most sensitive mining areas.

Industrial development is primarily regulated in Montenegro by the Ministry of the Economy (responsible for mining, energy and industry) and the Ministry of Environmental Protection and Physical Planning (responsible for the application of the Law on the Environment and related legislation). Other ministries are also involved in the regulation of industrial activities such as the Ministry of Agriculture, Forestry and Water Management (management of water resources, and agro–industry, production of food, drink and cigarettes) and the Ministry of Maritime Trade and Transport. The Centre for Ecotoxicological Research of Montenegro, the Republic Hydrometeorological Institute and the Institute of Public Health are involved in environmental monitoring.

According to the 1991 Law on Self-government, the municipalities also have some responsibilities regarding environmental issues, for example the protection of water and nature (UNECE, 2002b, pp 146-147). In general however, the municipalities are not effective owing to their lack of resources and experience. Moreover, according to the State-of-the-Environment Report 2000 (Ministry for the Protection of the Natural Resources and Environment - Republic of Serbia, 2003), the present legislation dealing with environmental management issues in Montenegro remains complicated and involves several authorities that operate without effective coordination.

4.5.4 Federal legislative frameworks

The main federal environmental legislation most relevant to industry comprises:
• the Law on the Basic Principles of Environmental Protection, No. 24/98 (addressing sustainable development, integrated pollution control, polluter pays principle, public participation, EIA in trans-boundary context and transport of hazardous waste);
• the Law on Protection against Ionizing Radiation, No. 46/96 (addressing import, export and transit of radioactive materials);
• the Law on the Transport of Hazardous Substances, No. 45/90 (addressing conditions for the transport of hazardous substances, transport safety measures, permits for the export, import and transit of hazardous substances); and
• the Law on the Production of and Trade in Poisonous Substances, No. 15/95 (conditions for the production of and trade in poisonous substances, categories of poisons, packing and use of poisonous substances).

In addition, several of the 64 international conventions that Yugoslavia has ratified are relevant to industrial development and activities, for example:

• The Convention on Long-range Trans-boundary Air Pollution, by succession, 12 April 2001
• The Vienna Convention for the Protection of the Ozone Layer, by succession, 27 April 1992
• The Montreal Protocol, by succession, 27 April 1992
• The Basel Convention, 18 April 2000

The federal environmental legislation is detailed and supplemented by the environmental legislation and regulations of the constituent republics. Jovic et al (2002) have catalogued the main environmental legislation at federal level as follows:

• Law on the Basis of Environmental Protection;
• Law on Water Regime;
• Law on Hydro-meteorological Affairs of Interest to the Country;
• Law on Protection Against Ionizing Radiation;
• Law on Prohibiting Construction of Nuclear Power Plants;
• Law on Transportation of Hazardous Substances;
• Law on Production and Trade of Poisonous Substances;

4.5.5 Serbian legislative framework

The most important law for managing environmental impacts from industrial activities in Serbia is the Law on Environmental Protection. This Law and the Regulations on Environmental Impact Assessment of Facilities and Works establish the EIA procedure, which is obligatory for new industrial activities. Other relevant laws and regulations are the Law on Waters, the Law on the Handling of Waste Substances and the Regulations on the Handling of Hazardous Waste.

A new environmental framework law has been prepared but not yet adopted by the Government. This draft law on the environmental protection system has been designed to modernize the legal framework and to ensure compatibility and compliance with EU requirements. It should promote harmonization with the EU Directive on Integrated Pollution Prevention and Control (IPPC), thus institutionalizing a modern permit and audit system for industry. However, being a framework law, it must be

56 Drawn from UNECE (2002b).
supplemented by more specific legislation and regulations. At present, the aim is to fully harmonize legislation with EU requirements and have industry comply with it by 2010.57

The adoption of the new environmental law and the recent establishment of the Ministry for Protection of Natural Resources and Environment are expected to be the starting point for a necessary comprehensive restructuring, modernization and clarification of the legal framework for ensuring effective environmental management and performance in industry.

The most important regulatory tool at present to ensure adequate environmental performance is the EIA requirement for new industries and for industries being privatised. Public hearings and public participation are not yet practised or integrated into the EIA procedure.

Ecological audits of existing industries are not common practice, as they are not compulsory. Due to the limited resources of the Ministry for Protection of Natural Resources and Environment, control and inspections are mainly initiated on the basis of specific complaints (UNECE, 2002b, pp. 141-142). Most companies operating in the mineral sector have a monitoring network, but monitoring has been reduced due to budgetary restrictions

Jovic et al (2002) record the following main environmental legislation in Serbia:

- Law on Environmental Protection;
- Law on Handling of Waste;
- Law on Planning and Disposition of Space and Settlements;
- Law on Construction of Facilities;
- Law on Agricultural Land;
- Law on the Protection on Forests;
- Regulation on Environmental Impact Assessment of Facilities and Works;
- Regulation on Handling of Waste Products of Hazardous Nature;

They also list other laws and regulations and regulations of relevance as:58

- Law on Spatial Plan of Republic of Serbia;*
- Law on Hunting;
- Law on Fishing;
- Law on Mining;*
- Law on Geological Investigations;*
- Law on Public Health Protection;
- Law on Sanitary Monitoring;
- Law on Tourism;

57 However, according to the UNECE (2002b), the legal framework for the environmental management and operation of industrial premises is characterised by a high number of laws and regulations with many redundancies as well as many gaps. The authorities involved believe that an unclear division of responsibilities and the insufficient cooperation and coordination among them represent a serious problem. In addition, the very limited resources allocated to the administration and enforcement of environmental legislation and regulations are far from sufficient to ensure effectiveness.

58 Items of likely or potential relevance to mining are marked with an asterisk*.
• Law on Communal Activity;
• Decree on Protection of Natural Rarities of Republic of Serbia;
• Decree on Controlling Exploitation and Trade of Wild Plant and Animal Species;
• Regulations on Limit Values, Emission measuring Methods, Selection of Sample Spots, Criteria and Data Collecting;*
• Regulations on Emission Limit Values, Methods and Timeframe for Measuring and Data Noting;*
• Regulations on Criteria for Determining Location and Disposition of Waste Materials Deposit Sites;*
• Regulations on Permitted amounts of Hazardous and Harmful Substances in Soil and Water for Irrigation and Methods of Their Testing;*
• Regulations on Hazardous Substances in Waters.*

The legislative framework & waste management.

The Law on Environmental Protection No. 66/91 (amended in 1991, 1992, 1993, 1994 and 1995) contains general principles for waste management. A new draft law on environmental protection was sent to the National Assembly in April 2002. When adopted, the new law will provide the Framework for waste management and be followed by a new waste law and other regulatory instruments to address all aspects of waste management from the classification of waste, to its collection, transport, storage, recycling, recovery and disposal, including information on waste generation and management.

It is foreseen that a number of the general environmental policy measures currently being developed will address certain aspects of waste management. These include:

• the development of a national environmental action plan, local environmental action plans and strategies for sustainable use of natural resources and protected areas;
• the strategy for environmental hot-spot remediation; and
• the development of an integral environmental information system (public awareness, civil society building, environmental education) (UNECE, 2002b, pp. 94-99).

At present, the main industrial waste generators are mining, the chemical and metallurgical industries, and the energy sector (thermal power plants). The registration of industrial waste is based on reports from industries. Although waste generators are required to report on the types and quantities of industrial waste to the Ministry for Protection of Natural Resources and Environment according to the Law on Waste Handling, only a few do so. The number of registered waste generators in Serbia in 2000 was 361. Of those only 35 reported regularly on their waste generation. As a result, only a fraction of the real amount is registered (UNECE, 2002b, p94).

4.5.6 Montenegrin legislative frameworks

In 1991, the Montenegrin Parliament adopted the “Declaration on the Ecological State of Montenegro”. Environmental concerns in mining, especially in coal mining, are addressed by the 1996 Law on the Environment. However, the 1994 Law on Mining, does not incorporate some of the important principles for the sustainable use of mineral resources.

According to Jovic et al (2002), the main environmental legislation in Montenegro comprises:

• Law on the Environment;
• Law on Air Protection;
Risks and vulnerabilities from mining activities

- Law on Waters;
- Regulation on the Quality of Wastewaters and Means of Their Conducting into Public Sewer and Natural Recipient and Regulation on the Classification and Categorization of Waters; and
- Regulation on Environmental Impact Assessment.

They list secondary laws and regulations as:

- Law on Mining;
- Law on Geological Explorations;
- Law on Planning and Spatial Organization;
- Law on Waters;
- Regulation on Contents of Technical Documentation Necessary for Issuing Water Resources Compliance and Water Resources Permit;
- Law on Construction of Facilities;
- Regulation on Permitted Concentrations of Harmful Substances in the Air;
- Regulation on Analysis Methodology, Timeframe and Forms for Informing on Results of Monitoring and Detecting Harmful Substances in the Air on the Sources of pollution;
- Decree on Determining Sampling Locations for Measuring Expert Analyses and Determining Air Pollution in Montenegro;
- Law on Cleaning, Collecting and Utilization of Waste Production
- Regulation on Criteria for Selection of Localities, Methods and Procedures for Depositing Waste Materials; and
- Regulations on Permitted amounts of Hazardous and Harmful Substances in Soil and Water for Irrigation and Methods of their Testing.

According to the UNECE (2002b, p.147), the legislation and regulations of most importance for industrial development and the environment under the authority of the Ministry of Environmental Protection and Physical Planning includes:

- the Law on Air Protection;
- the Regulations on Admissible Concentrations of Harmful Substances in the Air, and
- the Law on Nature Protection.

Under the authority of the Ministry of Agriculture, Forestry and Water Management are:

- the Law on Waters;
- the Regulations on the Quality of Waste Waters; and
- the Regulations on the Classification and Categorization of Waters

### 4.5.7 Legislative frameworks addressing abandoned mines

No legislative frameworks specifically addressing abandoned, orphaned sites or idle mining assets have been identified although this does not preclude inclusion of this topic in one or more of the items listed in the previous section.

One item of particular note found in the study was direct reference to site remediation in the identification of the National Environmental Priorities for the Republic of Serbia (Ministry for the
Protection of the Natural Resources and Environment - Republic of Serbia, 2003) where three main immediate challenges were been identified as follows:

- Building and reinforcing of institutions and services relevant to the system of environmental protection. This includes inter-section cooperation between Environmental and other sectors.
- Adoption of Framework Law on System of Environmental Protection and designing and implementation of the new Environmental Strategies, e.g. Waste Management Strategy, National Environmental Action Plan (NEAP), Local Environmental Action Plans (LEAP) and Strategies for Sustainable Use of Natural Resources and protected areas.
- Environmental Hot Spots remediation and the commencement of problem realization in waste and wastewater treatment.

Further, identification and adoption of the national environmental priorities at the same time defined development challenges within the environmental sector. Here, both site remediation and emergency preparedness are addressed. Both with direct relevance to this study. Items II and III of a total of six key challenges are listed as:

- II Monitoring and accidental response environmental system management & technical assistance, including environmental mobile units.
- III Environmental hot spots remediation and technology development as the condition of agriculture, economic & in general sustainable development in Danube basin-, Carpathian-, Balkan-, SEE-, CEE - region, including selected case studies, ecological zoning of Serbia and management system.
5. Initial prioritisation of hot-spots and areas of concern

As a basis for discussion and analysis within this Desk Study report, and in recognition of the limitations placed by a reliance on secondary sources, this section of the report presents those sites that are considered to be likely to be of most concern. Thus, with the exception of a few high profile problem sites where considerable risks of accidents with serious trans-boundary consequences are known to exist, these are candidate sites only.

It is stressed, that in the absence of detail descriptions of environmental problems associated with sites, the choice has been based upon assessment of parameters consistent with high hazard (e.g. large volumes of heavy metal tailings in the immediate vicinity of a town or waterway). As has been highlighted throughout this report, such information has been predominantly drawn from secondary sources such as mining reports, the Internet, United Nations assessment reports, and so forth. No primary data collection activities such as site visits or interviews with local experts, etc. have been performed within this work.

While in some instances, reports have been available from reputable sources that outline serious environmental problems; this has generally not been the case. Thus, it has not been possible to ascertain the likelihood (probability) that pollution incidents may occur in either qualitative or quantitative forms.

It remains unavoidable that a number of the sites here will not be of high risk despite the indications found that they could be, and their consequent classification within this report. Similarly, it remains unavoidable that sites of both high hazard and high risk have not been captured here. Further assessment of the status of each candidate site listed in this report section must be updated with more information from local actors in order to ensure validity. A particular aspect in this regard that must be checked is the proximity of many of these sites to rivers and streams. Throughout this section, the comment “Proximity to waterways not known” has been assigned to the majority of sites (within the tabulated category “Level of trans-boundary risk”). This comment indicates, that while maps or literature sources indicate that the site is “near” a waterway, it is not known if the site is directly proximal (i.e. “beside”, or within) a watercourse, or a significant distance (several hundred metres, or even several kilometres) from such. Due to the dominant importance of fluvial waste transportation, this parameter in particular is of critical importance when assessing the risk associated with high hazard sites.

5.1 Sites of particular concern in Albania

5.1.1 Sites with high hazard indications in Albania

The cataloguing and analysis of the information available for this analysis (as documented in Section 3) indicates that a number of sites in Albania were of relatively higher hazard. Table 5-1 and Table 5-2 provided overleaf summarise those sites deemed to be of particular concern.

The indicated tables list sites associated with 11 minerals related operations as potential hotspots (note however, some facilities may have more than one site of concern). The sites are associated with ferrochromium processing/smelting, chromite mining, and copper mining and processing industries. It
should be noted that the largest chromite mining sites in the country have been included in this table in order to highlight the environmental risk potential of such mines. However, insufficient information was found in this study to differentiate the relative hazard/event risk between the many chromite mines in the country based on any other parameter than production size. These mineral related sites have been chosen from the list of nearly 50 sites for this country listed in Section 3.

5.1.2 Significant trans-boundary issues and security risks

While all minerals related operations listed for Albania may be associated with high hazard, and indeed may be causing serious environmental impacts within Albania, first indications are that high risks of significant trans-boundary pollution issues are only likely to be associated with two of them. Sites denoted as being of moderate-high, or high trans-boundary risk are the Elbasan Smelter (due to its proximity to Lake Ohrid shared with the Former Yugoslav Republic of Macedonia), and copper mining operations in the Shkoder area that may affect Lake Scutari (shared with Montenegro).
<table>
<thead>
<tr>
<th>Site name</th>
<th>Activity</th>
<th>Key hazard vectors</th>
<th>Key release or exposure vectors</th>
<th>Level of trans-boundary risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elbasan Smelter complex</td>
<td>Ferrochromium smelting</td>
<td>Ni, Cr, Fe, Cu and Zn and total ferrochromium dust to atmosphere. Depositional soil contamination, waste/slag dumps and process chemical pollution.</td>
<td>to air to water/gwater Possibly Shukumbinit River then Adriatic Stored ferronickel slags and ferrochromium wastes. (principal mines were at Bitinska, Guri i Kuq, and Prrenjas. Prrenjas, produced about 600,000 t/yr of ore).</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Steel smelting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nickel smelting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burrel Ferrochrome Smelter</td>
<td>Ferrochromium smelting</td>
<td>as above</td>
<td>to air to water/gwater</td>
<td>Low</td>
</tr>
<tr>
<td>Chromite Bater mining</td>
<td>Chromite mining</td>
<td>Unstable tailings impoundments, mine workings, toxic materials in tail containing arsenic, antimony, base metal sulfides and arsenides. May include Mg and Ni, etc.</td>
<td>to air (dust) to water (large) size 450kpa</td>
<td>Low</td>
</tr>
<tr>
<td>Chromite Bulquise</td>
<td>Chromite mining</td>
<td>as above</td>
<td>to air (dust) to water (large) size 450kpa</td>
<td>Low</td>
</tr>
<tr>
<td>Chromite Kalimash</td>
<td>Chromite mining</td>
<td>as above</td>
<td>to air (dust) to water (large) size 250kpa</td>
<td>Low</td>
</tr>
</tbody>
</table>

59 The metallurgical complex in Elbasan produced steel, coke, pig iron, and nickel. The plant was closed in 1990, although there is still a scrap smelter working with obsolete equipment and technologies. Tailings (about 1.5-2.0 millions tons) from the metallurgical operation contaminate soil and groundwater with heavy metals (chromium, nickel and manganese). Water in the Shkumbini River is also contaminated by heavy metals and phenol. As it has no gas purification system, the smelter causes air pollution, emitting some 20 000 tons of particles, and over 900 tons of CO and SO₂ into the air each year. There are no data on the quality of river water and groundwater due to a lack of monitoring (UNECE, 2002a).

60 It is estimated that some 18.8 million m³ of solid waste from the mining of chromium ores and about 2.5 million m³ from their enrichment have been stored in Albania. This waste contains hexavalent chromium, which is highly toxic and a threat to people and the environment (UNECE, 2002a).
### Table 5-2. Albanian sites of concern – candidate sites II

<table>
<thead>
<tr>
<th>Site name</th>
<th>Activity</th>
<th>Key hazard vectors</th>
<th>Key release or exposure vectors</th>
<th>Level of trans-boundary risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fushe-Arrez copper mine &amp; mill</td>
<td>Underground copper mining</td>
<td>Waste rock. Effluents: Mines where ores have high sulfur content: potential for ARD/AMD from mine workings and waste heaps - can have a pH of 3 or lower; sulfate levels of 800-1,800 milligrams per liter (mg/l); copper levels up to 50 mg/l; iron levels up to 1,000 mg/l; lead levels up to 12 mg/l; zinc levels up to 1,700 mg/l; and cadmium levels of several milligrams per liter, depending on the contents of the ore. Particulates: significant levels of dust, above 3 kilograms per ton (kg/t) of ore mined, and ranging from 0.003 to 27 kg/t, may be generated by extraction activities, crushing, ore beneficiation, transport and traffic, and wind-borne losses. Postclosure issues such as the long-term geotechnical stability of the impoundment, the chemical stability of the tailings, long-term surface and groundwater management (including provisions for long-term spillway capacity requirements).</td>
<td>to air (dust) to water/gwater</td>
<td>Low to medium. Regional air transport. Large lake downstream in Albania. Proximity to waterways not known.</td>
</tr>
<tr>
<td>Kukes Copper Smelter</td>
<td>Copper Smelting &amp; electrowinning</td>
<td>Solid waste slag. Wastewater (primary copper production): dissolved and suspended solids Cu, Cd, Pb, Zn, As, Hg, residues from mould release agents (lime or aluminum oxides), fluoride may also be present, often low pH. Wastewater sources: spent electrolytic baths, slimes recovery, spent acid from hydrometallurgy processes, cooling water, air scrubbers, washdowns, stormwater, and sludges from wastewater treatment processes; particulate emissions range 0.1 kg/t of copper to as high as 20 kg/t Cu - Cu, Fe compound; sulfides, sulfates, oxides, chlorides; fluorides of arsenic, antimony, cadmium, lead, mercury, and zinc.</td>
<td>to air (dust &amp; smelter emissions) to water/gwater</td>
<td>Low to medium. Regional air transport. Near Lake Fierzës &amp; border with Serbia/Kosovo but flow direction to Albania. Proximity to waterways not known.</td>
</tr>
<tr>
<td>Shkoder Copper mines (incl. Palaj, Karma I and II)</td>
<td>Copper mining</td>
<td>Waste rock. Effluents: Mines where ores have high sulfur content: potential for ARD/AMD from mine workings and waste heaps - can have a pH of 3 or lower; sulfate levels of 800-1,800 milligrams per liter (mg/l); copper levels up to 50 mg/l; iron levels up to 1,000 mg/l; lead levels up to 12 mg/l; zinc levels up to 1,700 mg/l; and cadmium levels of several milligrams per liter, depending on the contents of the ore. Particulates: significant levels of dust, above 3 kilograms per ton (kg/t) of ore mined.</td>
<td>to air (dust &amp; smelter emissions) to water/gwater</td>
<td>Potentially moderate to high. Shkoder is directly adjacent to and upstream of Lake Scutari shared with Montenegro. Proximity to waterways not known.</td>
</tr>
<tr>
<td>Lac Copper Smelter</td>
<td>Copper Smelting &amp; electrowinning</td>
<td>As above for Fushe-Arrez and Kukes.</td>
<td>to air (dust &amp; smelter emissions) to water/gwater</td>
<td>Low to medium. Regional air transport. River flow only to Adriatic. Proximity to waterways not known.</td>
</tr>
<tr>
<td>Rubik61 Copper Smelter</td>
<td>Copper Smelting &amp; electrowinning</td>
<td>As above for Fushe-Arrez and Kukes.</td>
<td>to air (dust &amp; smelter emissions) to water</td>
<td>Low to medium. Regional air transport. River flow only to Adriatic. Proximity to waterways not known.</td>
</tr>
<tr>
<td>Reps copper mine</td>
<td>Copper mining</td>
<td>As above for Shkoder.</td>
<td>to air (dust &amp; smelter emissions) to water/gwater size 250ktpa</td>
<td>Low to medium. Regional air transport. River flow only to Adriatic. Proximity to waterways not known.</td>
</tr>
</tbody>
</table>

61 The copper plant in Rubik was closed in 1998. It produced refined copper for wiring. For 60 years the plant generated about 30 000 tons of mineral residues a year. Groundwater, which is used for drinking, is contaminated by copper (UNECE, 2002a).
5.2 Sites of particular concern in Bosnia and Herzegovina

5.2.1 Sites with high hazard indications in Bosnia and Herzegovina
The cataloguing and analysis of the information available for this analysis (as documented in Section 3) indicates that a number of sites in Bosnia and Herzegovina were of relatively higher hazard. Table 5-4 overleaf summarises those sites considered to be of particular concern.

The indicated tables list sites associated with seven (7) minerals related operations as potential hotspots (note however, that some facilities may have more than one site of concern). The sites are associated with aluminium, ferroalloy processing/smelting, manganese mining and processing, and iron/steel smelting. These sites have been chosen from the list of some 40 minerals related operations listed in Section 3.

5.2.2 Significant trans-boundary issues and security risks
While all minerals related operations listed for Bosnia and Herzegovina may be associated with high hazard, and indeed may be causing serious environmental impacts within the territory(s), first indications are that moderate-high or high risks of significant trans-boundary pollution issues will only be associated with two of them. Sites denoted as being of moderate-high, or high trans-boundary risk are the lead and zinc mining/processing sites in Srebrenica and Alumina refining and aluminium smelting operations at Birac Zvornick. Both sites are located near (or on) the Drina River, the shared border with Serbia and a tributary of the Danube.

5.2.3 Hotspots and potential impacts identified by earlier studies
Fifteen (15) contaminated industrial “hot spots” were highlighted by UNECE in their 2004 review of environmental performance in Bosnia and Herzegovina (2004). These include thermal power plants, and chemical, paper and metallurgical industries. Depending on the industry, the sites are contaminated by heavy metals, different toxic chemicals or asbestos. These sites are listed in Table 5-3.
Table 5-3. Industrial facilities with hazardous waste storage (UNECE, 2004)\textsuperscript{62}

<table>
<thead>
<tr>
<th>Category of waste</th>
<th>Description</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>highly toxic</td>
<td>Waste from zinc and lead production</td>
<td>Srebrenica (Lead and Zinc Mines)</td>
</tr>
<tr>
<td>highly toxic</td>
<td>Red mud (aluminium industry)</td>
<td>Zvornik (TG Birac; Al oxide plant)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mostar (Aluminij-Mostar)</td>
</tr>
<tr>
<td>highly toxic</td>
<td>Vares (Iron/steelworks – Vares)</td>
<td>Vares</td>
</tr>
<tr>
<td>highly toxic</td>
<td>Asbestos mud</td>
<td>Bos. Petrovo Selo and Ilicii (Separation)</td>
</tr>
<tr>
<td>toxic</td>
<td>Thermal power plants (ash and slag)</td>
<td>Kakaraj, Tuzla, Ugljevik, Gacho</td>
</tr>
<tr>
<td>toxic</td>
<td>Waste from paper production plants</td>
<td>Maglaj (Natron), Bania Luca (Incel)</td>
</tr>
<tr>
<td>toxic</td>
<td>Ferrosilicate electrolysis waste</td>
<td>Jaje (Electrobosna)</td>
</tr>
<tr>
<td>toxic</td>
<td>Soda ash waste</td>
<td>Lucavach (Soda Ash Plant)</td>
</tr>
<tr>
<td>toxic</td>
<td>Leather tanning waste</td>
<td>Visoko (KTK, Leather factory)</td>
</tr>
<tr>
<td>low toxicity</td>
<td>Steel industry slag</td>
<td>Zenica (Steel plant, steel slag)</td>
</tr>
</tbody>
</table>

According to the UNECE report (2004), there is no information on the degree of soil, groundwater and air contamination at industrial sites or in their vicinity, including residential areas of nearby towns. Similarly, there are no environmental impact assessments (EIA) of these sites or environmental audits of industrial facilities, including industrial storage facilities.

\textsuperscript{62} Quoting the following reference: Project on Environmental Protection Assessment of Industrial, Medical and Other Hazardous Waste in Bosnia and Herzegovina, Bosna-S Oil Services Company, book 3, 2002.
<table>
<thead>
<tr>
<th>Site name</th>
<th>Activity</th>
<th>Key hazard vectors</th>
<th>Key release or exposure vectors</th>
<th>Level of trans-boundary risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mostar – Aluminij d.d. Mostar Refinery &amp; Smelter</td>
<td>Alumina Refining</td>
<td>Geotechnical stability of red mud storage. Significant risk of groundwater and surface water pollution from SPL wastes. Air emissions: alumina dust; coke dust; gaseous and particulate fluorides; sulfur and carbon dioxides; SOx; VOCs; PAHs, carbon oxides, CF4 and C2F6. Emissions up to 80 kg/t for particulates, 12 kg/t for hydrogen fluoride, and 10 kg/t for fluoride particulates. Solid waste: 40–60 kg mixed solid wastes per ton Al SLP - 50% refractory material, 50% carbon, impregnated with aluminum and silicon oxides and cyanide compounds (about 400 ppm). Skim, dross, fluxing slags, and road sweepings. Possible emissions of chloride, hexachloroethane, chlorinated benzenes, and dioxins and furans.</td>
<td>to air (dust &amp; smelter emissions) to water/gwater</td>
<td>Moderate</td>
</tr>
<tr>
<td>Croatia is 30-40km d/s on Neretva River. Proximity to waterways not known.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birac Zvornick – Aluminij d.d. Mostar Refinery &amp; Smelter</td>
<td>Alumina Refining</td>
<td>Geotechnical stability of red mud storage. Significant risk of groundwater and surface water pollution from SPL wastes. Air emissions: alumina dust and red mud dust.</td>
<td>to air (dust) to water/gwater</td>
<td>Moderate-High. Located on Drina River (Serbian Border). Danube is d/s. Proximity to waterways not known.</td>
</tr>
<tr>
<td>Petrovo-Selo &amp; Ilici Asbestos</td>
<td>Asbestos mining &amp; beneficiation</td>
<td>Fibres are released during processing, installation and disposal of asbestos-containing products and from uncovered waste dumps. Manipulation of friable products may be an important source of chrysotile emission. Fibrogenic and carcinogenic effects - chrysotile-induced pulmonary fibrosis, lung cancer and mesothelioma.</td>
<td>to air (dust)</td>
<td>Moderate. Border crossing area to Croatia. Proximity to waterways not known.</td>
</tr>
<tr>
<td>Sebenica Energoinvest lead zinc mine &amp; concentrator</td>
<td>Lead-Zinc mining and beneficiation</td>
<td>Mining: overburden waste, ARD/AMD pH 3, sulphates, Pb, Zn, Cu, Fe, Zn, Cd. Particulates - 3 kg/t of ore mined (ranging 27 kg/t), long-term geotechnical stability Beneficiation: as above plus geotechnical instability of tailings waste</td>
<td>to air (dust) to water/gwater mass solids releases</td>
<td>High. Located adjacent to Drina River (Serbian Border). Danube is d/s. Proximity to waterways not known.</td>
</tr>
<tr>
<td>Buzim FBC Manganese Energoinvest mine &amp; concentrator</td>
<td>Manganese mining and beneficiation</td>
<td>Mining: overburden waste, ARD/AMD pH 3, Fe, Zn, Cd. Particulates - ranging to 30kg/t ore mined, long-term geotechnical stability Beneficiation: as above plus geotechnical instability of tailings waste</td>
<td>to air (dust) to water/gwater mass solids releases</td>
<td>Moderate. Circa 30km from Croatian border apparently on tributary to Kupa, then Sava (to Serbia) in Danube catchment. Proximity to waterways not known.</td>
</tr>
<tr>
<td>Jajce Elektrohemisjska Plant Ferroalloy smelter</td>
<td>FerroAlloy (Ferrochromium) smelting</td>
<td>Ni, Cr, Fe, Cu and Zn and total ferrochrome dust to atmosphere. Depositional soil contamination, waste/slag dumps and process chemical pollution.</td>
<td>to air (dust &amp; stack emissions) to water/gwater mass solids releases</td>
<td>Low. On Vrbas River, tributary to Sava (to Serbia) in Danube Catchment - significant distance (circa 100km) to Croatian border. Proximity to waterways not known.</td>
</tr>
<tr>
<td>Zenica – RMK Zenica Steel</td>
<td>Pig Iron production</td>
<td>Furnace particulate emissions, slag, volatile materials released during coking incl. by-products ammonia, benzol, xylene, toluene, tar, pitch and tar acids</td>
<td>to air (dust &amp; stack emissions) to water/gwater mass solids releases</td>
<td>Moderate. On Bosna River, tributary to Sava (to Serbia) in Danube Catchment - significant distance (circa 100km) to Croatian border. Proximity to waterways not known.</td>
</tr>
</tbody>
</table>

5.3 Sites of particular concern in Kosovo (Territory under UN Administration)

5.3.1 Sites with high hazard indications in Kosovo

The cataloguing and analysis of the information available for this analysis (as documented in Section 3) indicates that a number of sites in Kosovo (territory under UN interim administration) were of relatively higher hazard. Table 5-6 and Table 5-7 provided on the following pages summarise those sites considered to be of particular concern.

The indicated tables list sites associated with twelve (12) minerals related operations (note however, that some facilities may have more than one site of concern). The sites are associated with lead and zinc mining, beneficiation, smelting and refining; ferronickel mining, beneficiation, smelting and refining; chromite mining, and (possibly) asbestos mining. These sites have been chosen from the more than 40 listed in Section 3.

5.3.2 Significant trans-boundary issues and security risks

First indications are that moderate-high or high risks of significant trans-boundary pollution issues are associated with most sites within Kosovo (Territory under UN interim Administration). Sites denoted as being of moderate-high, or high trans-boundary risks are associated with lead and zinc mining/processing sites with the exception of one chromite mining and processing facility at Djakovic.

All fluvial flows from Albania are cross-boundary, thus it can be assumed that any event leading to the release of wastes into waterways within the Territory has the potential to constitute a trans-boundary issue. Among the sites highlighted by this analysis, the majority (9 sites) lie within the catchment of the Ibar River which flows into Serbia; one in the catchment of the Binacka Mirava River also flowing to Serbia, and two within the catchment of the Beli (Drin) River, which flows across the border to Albania and Lake Fierzës.

Note that this preliminary judgement does not rule out that all minerals related operations listed for Kosovo in the attached tables may be associated with high hazard, and indeed may be causing serious environmental impacts within the territory.

5.3.3 Sites of concern identified by earlier studies

An extensive review of environmental performance was conducted by the United Nations Economic Commission for Europe: Economic and Social Council (UNECE) in 2002 - Environmental Performance Review of Serbia and Montenegro - Report for the Eighth session of the Committee on Environment Policy. The following excerpts from that report are of relevance here and are quoted essentially verbatim.

**Industrial waste** (UNECE, 2002b): Most industrial waste was generated from mining activities and concentration processes of nonferrous metals, super-phosphate production, battery factories and the combustion of lignite for electricity production. At present industrial waste dumps and opencast mines cover more than 10,000 hectares. The biggest mines and tailing sites are listed below.

Huge areas affected by mining require rehabilitation. There are little or no monitoring systems to measure the environmental impact of mining activities, nor equipment for rehabilitation. Further development of the mining sector is hampered by a lack of investment, the mining industry’s lack of experience in environmental management, and old and obsolete equipment.
Table 5-5. Mines and tailing sites.

<table>
<thead>
<tr>
<th>Site</th>
<th>Area (hectares)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mines and tailing dumps in Mitrovicë/Mitrovica</td>
<td>2700</td>
</tr>
<tr>
<td>Waste dumps, battery factory</td>
<td>215</td>
</tr>
<tr>
<td>Mines and tailing dumps in Kishnica and Ajvali/Ajvalija</td>
<td>1200</td>
</tr>
<tr>
<td>Waste site super phosphate factory</td>
<td>320</td>
</tr>
<tr>
<td>Mines and waste dumps, Ferro-nickel plant in Glogoc/Glogovac</td>
<td>1700</td>
</tr>
<tr>
<td>Opencast lignite mines and ash dumps in Obiliq/Obilic</td>
<td>4000</td>
</tr>
</tbody>
</table>

To date, no activities have been undertaken to rehabilitate or reduce the risk from industrial waste sites. For example, the tailing dumpsite of the Trepca Metallurgical Complex near Mitrovicë/Mitrovica is covered by municipal waste. There is a river just at the bottom of the site. Drainage water from the tailings is polluted with soluble hazardous substances and eventually ends up in the Sitnica and Ibar rivers. Both rivers are suspected of being polluted by heavy metals. Natural disasters, or even heavy rain, could result in the collapse and sliding of the tailings and municipal waste causing acute and severe pollution of the river. Another problem associated with the dumpsite is the spreading of dust, including heavy metals, into the city of Mitrovicë/Mitrovica and its surroundings.

The ash dumpsites of the thermal power plants in Obiliq/Obilic also cause environmental problems. Ash is transported to the dumps by a hydraulic system with recycled water from coal drying and coal gasification. This water is contaminated with phenols. Since there is no drainage or treatment system, the polluted water can easily enter the groundwater. This site, which covers productive land, also generates dust and has adverse health effects on the local population.

**Hazardous waste and chemicals:** Hazardous materials and waste are currently stored in poor conditions at many sites in Kosovo, mainly in the industrial complexes where they were used or generated. There are no proper storage facilities for hazardous waste, although there is a plan to build temporary storage facilities. At some industrial sites where there is an immediate danger to life or the environment, the risks have been reduced.

For example, there are significant quantities of hazardous waste at the industrial site of IBG Batteries, in Gjilan/Gnjilane, left over from previous industrial processing. About 2000m³ of hazardous liquid waste, containing nickel, cobalt, cadmium and other hazardous components, are stored at this facility. The exact composition of the mixed hazardous waste is not known and the facility does not meet sanitary requirements for hazardous waste storage. There are no waterproof floors, no spillage basins or other emergency measures. In addition, some drums are open, rusted and damaged.

There are plans to concentrate all hazardous waste in a single location in Kosovo to better contain the risks. The Environment Department of the Ministry of Environment and Spatial Planning and KTA are responsible for planning and implementing this project. Speeding up implementation of this project is an urgent task in order to prevent further contamination of both the IBG site and residential areas in its vicinity. There are many similar sites that need urgent intervention and risk reduction.

**Health and Environment concerns (UNECE, 2002b, pp. 239-241):** Most heavy industries in Kosovo are concentrated in a number of industrial complexes. They are mainly based on mineral resources, are energy intensive, have been badly maintained and have a poor environmental performance record. The main industrial hot spots are the two power plants in Obiliq/Obilic near
Prishtinë/Pristina, the Trepca Mining and Metallurgical Complex near Mitrovicë/Mitrovica, the Mitrovica Industrial Complex and the ferronickel mines and metallurgical industries near Glogovc/Glogovac. There are also some smaller industries, including a cement plant in Hani i Elezit/Djeneral Jankovic and a paint factory in Vushtrri/Vucitrn.

The Trepca Mining and Metallurgical Complex consists of nine lead, zinc and silver mines, three concentrators (crushing and flotation), a lead smelter, a zinc roaster and refinery, and two battery production plants. It is one of the biggest of its kind in Europe with proportionate environmental consequences. In particular, the ‘Zvecan’ lead smelter, situated just north of Mitrovicë/Mitrovica, has been associated with high levels of lead in the blood of employees and local residents, including in Mitrovicë/Mitrovica. During operation, the lead smelter reportedly emitted 15 to 30 kg of dust per ton of lead produced. The maximum capacity of its three furnaces was 840 tons of lead per day, but their mean daily production in 1986 was less than 300 ton/day.

Studies conducted already in the 1980s found significantly higher levels of lead in the blood of children and pregnant women in Mitrovicë/Mitrovica than in a control group in Prishtinë/Pristina. Lead is known to have adverse health effects, especially on the psychomotor development and Respiratory organs of children. In addition to exposure to airborne lead dust, high concentrations of zinc, cadmium and copper have also been measured.

Given the high environmental and human risks, UNMIK closed down the operations of the lead smelter in August 2000. However, blood lead levels taken during and after the operations indicated that the expected sharp decrease in blood lead levels did not materialize, suggesting secondary sources of lead pollution. The situation has since stabilised, and environmental pollution from the complex now comes mainly from circulating lead dust and water pollution from the various waste sites and tailings.

There are seven flotation tailing dumps containing 30 million tons of semi-liquid waste. In addition, it is estimated that 95 000 tons of industrial waste (of which half has a lead content of between 5 and 30%) is stored on site. The Zvecan lead slag heap amounts to 2.5 million tons, and there are about 1 million tons of waste at the Mitrovica Industrial Complex dumpsite. The environmental problems associated with the tailings are considerable. Air monitoring studies conducted by the Kosovo Force (KFOR) suggest that most of Mitrovicë/Mitrovica is exposed to an airborne lead concentration at or near the EU limit value of 0.5 µg/m³. Samples taken at the smelter and the Mitrovicë/Mitrovica industrial park have shown concentrations as high as 57.5 µg/m³.

Lead deposition in the centre and south of Mitrovicë/Mitrovica exceeded 1000 mg/m²/day, which is four times the WHO guideline. The United Nations-led administration of Trepca is currently trying to secure funds for environmental remediation and for the development of business opportunities at the sites. Significant funds have been spent on environmental assessments to identify the environmental risks and protection measures for the Zvecan lead smelter, the mines and the subsidiary industries. These studies have been used to secure funding from Denmark, the Netherlands, Sweden and EAR for specific environmental remediation projects. These include the re-establishment of a waste-water treatment plant, hazardous waste management, investigation and remediation of two tailings dams and environmental monitoring at selected sites. During 2003, the World Health Organization was also facilitating a health risk assessment and public health awareness campaign in Mitrovicë/Mitrovicë, in which the Ministry of Environment and Spatial Planning and the Ministry of Health were integral implementing partners.

There has also been an environment and health assessment of the population near the Grancinca acid mine tailings dam,64 as well as investigations into the structural stability of the sites and plans for environmental remediation. A recent survey identified very poor public knowledge of exposure and

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64 No other information has been found regarding this site.
health effects. Further funding would be required to ensure a further reduction in environmental risk and a sustainable reduction in the affected population’s exposure to lead.\textsuperscript{65}

The Mitrovica industrial complex is part of the Trepça Mining and Metallurgical Complex and is situated at the southern end of Mitrovicë/Mitrovica. It consists of a zinc smelter, a sulphuric acid plant, a battery plant and a fertilizer plant. The sulphuric acid, as by-product of the zinc smelter, was used in the fertilizer and battery plants. No production is currently taking place. However, many chemicals remained stored on site, including 7 300 tons of sulphuric acid, which is being sold and removed from the site. Owing to the absence of maintenance, most storage tanks are in bad condition and may cause soil and groundwater pollution. There are also stockpiles with concentrates of heavy metals (lead, zinc, copper and cadmium) on the site and the adjacent evaporation pond has been polluted with residual heavy metals.

\textsuperscript{65} Depending on important questions of ownership, debt relief and the feasibility of re-opening (parts of) the complex, investments are not expected to be sufficient. According one of the feasibility studies, a number of the mines and concentrators are viable as business units and could provide an interesting return on investment, while financial analysis indicates that the lead and zinc plants would have only a marginal return on investment. The Trepça Complex is aware that any new operations would have to have an accompanying EIA.
### Table 5-6. Kosovo (Territory under UN Administration) sites of concern – candidate hotspot sites I

<table>
<thead>
<tr>
<th>Site name</th>
<th>Activity</th>
<th>Key hazard vectors</th>
<th>Key exposure vectors</th>
<th>(Potential) trans-boundary risk level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Korlace</strong></td>
<td>Asbestos mining &amp; beneficiation</td>
<td>Fibres are released during processing, installation and disposal of asbestos-containing products, Manipulation of friable products may be an important source of chrysotile emission. Fibrogenic and carcinogenic effects - chrysotile-induced pulmonary fibrosis, lung cancer and mesothelioma.</td>
<td>to air (dust)</td>
<td>Not known. Proximity to waterways not known.</td>
</tr>
<tr>
<td><strong>Djakovic</strong></td>
<td>DEVA Chromite mine &amp; beneficiation</td>
<td>Unstable tailings impoundments, mine workings, toxic materials in tails containing arsenic, antimony, base metal sulfides and arsenides. May include Mg and Ni, etc.</td>
<td>to air (dust)</td>
<td>Moderate to high. Immediately SW of Djakovic near Albanian border. Erenik River (tributary to Beli-Drin river) cross-border flow to Lake Fierzës. Proximity to waterways not known.</td>
</tr>
<tr>
<td><strong>Trepca Mills</strong></td>
<td>Badovac Mill – Lead-Zinc mining and beneficiation</td>
<td>Mining: overburden waste, ARD/AMD pH 3, sulphates, Pb, Zn, Cu, Fe, Zn, Cd. Particulates - 3 kg/t of ore mined (ranging to 27 kg/t), long-term geotechnical stability. Beneficiation: as above plus geotechnical instability of tailings waste</td>
<td>to air (dust)</td>
<td>Moderate to high.* On a tributary of Simica and Ibar Rivers flowing to Serbia. Proximity to waterways not known.</td>
</tr>
<tr>
<td>– Kriva Feja</td>
<td>as above</td>
<td>as above</td>
<td>as above</td>
<td>On Binacka Mirava River flowing to Serbia - Proximity to waterways not known.</td>
</tr>
<tr>
<td>– Leposavic</td>
<td>as above</td>
<td>as above</td>
<td>as above</td>
<td>In Ibar Valley - Proximity to waterways not known.</td>
</tr>
<tr>
<td>– Maravce</td>
<td>as above</td>
<td>as above</td>
<td>as above</td>
<td>In Ibar Valley - Proximity to waterways not known.</td>
</tr>
<tr>
<td>– Tuneli i pare</td>
<td>as above</td>
<td>as above</td>
<td>as above</td>
<td>On Tributary to Beli (Drina) flowing into Albania</td>
</tr>
<tr>
<td>– Rudnik</td>
<td>as above</td>
<td>as above</td>
<td>as above</td>
<td>On Tributary of Simica and Ibar Rivers. Proximity to waterways not known.</td>
</tr>
<tr>
<td>– Kishnica</td>
<td>as above</td>
<td>Large tails dump adjacent to population centres and agricultural land. Geotechnically unstable tailings wastes, ARD/AMD pH 3, sulphates, Pb, Zn, Cu, Fe, Zn, Cd. Particulates pollution, heavy metals in solution, long-term geotechnical stability</td>
<td>to water/gewater mass waste release</td>
<td>as above</td>
</tr>
</tbody>
</table>

*some may be “high to very high”.
### Table 5-7 Kosovo (Territory under UN Administration) sites of concern – candidate hotspot sites II

<table>
<thead>
<tr>
<th>Site name</th>
<th>Activity</th>
<th>Key hazard vectors</th>
<th>Key exposure vectors</th>
<th>(Potential) trans-boundary risk level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drenas – Ferronickel smelter</td>
<td>Ferro-nickel mining &amp; beneficiation</td>
<td>Ni, Fe, Cu and Zn dust to atmosphere. Depositional soil contamination, waste/slag dumps and process chemical pollution. (Cobalt often found in lateritic nickel deposits) Refining of nickel matte: fluid bed roasting and chlorine-hydrogen reduction produce high-grade nickel oxides (more than 95% nickel). Vapor processes such as the carbonyl process can be used to produce high-purity nickel pellets.</td>
<td>to air (dust &amp; smelter emissions) to water/gwater</td>
<td>Low to Moderate. Located near Sitnica River, Tributary to Ibar. Proximity to waterways not known.</td>
</tr>
<tr>
<td>Zvecan – Mill, Smelter &amp; Smelter &amp; Refinery</td>
<td>Lead-Zinc mining, beneficiation &amp; smelting Gornje Polje tails dump. 50 ha, 1.3% Pb, geotechnically unstable tailings wastes, ARD/AMD pH 3, sulphates, Pb, Zn, Cu, Fe, Zn, Cd. Particulates pollution, heavy metals in solution, long-term geotechnical stability. Toxic solid waste, airborne particulate matter &amp; SO₂. Particulate matter: lead/zinc and iron oxides including of oxides As, Sb, Cd, Cu, Hg + metallic sulfates. Air emissions for processes with few controls may be of the order of 30 kg Pb or Zn/t lead or zinc produced. Emissions of arsine, chlorine, and hydrogen chloride vapors and acid mists are associated with electrorefining. Water effluents: Pb, Zn, As, etc. including dissolved and suspended solids, metals, and oil and grease. Discard slag up to 0.7%/lead/zinc. Up to 3 tons of solid waste per ton of lead/zinc produced.</td>
<td>to air (dust &amp; smelter emissions) to water/gwater</td>
<td>High. Smelter located adjacent to Ibar River. Cross border flow to Serbia. Proximity to waterways not known.</td>
<td></td>
</tr>
<tr>
<td>Titova – Metrovica Electrolytic refinery</td>
<td>Lead and Zinc refining</td>
<td>Toxic solid waste, airborne particulate matter &amp; SO₂. Particulate matter: lead/zinc and iron oxides including oxides of As, Sb, Cd, Cu, Hg + metallic sulfates. Air emissions for processes with few controls may be of the order of 30 kg Pb or Zn/t lead or zinc produced. Emissions of arsine, chlorine, and hydrogen chloride vapors and acid mists are associated with electro-refining. Water effluents: Pb, Zn, As, etc. including dissolved and suspended solids, metals, and oil and grease. Discard slag up to 0.7%/lead/zinc. Up to 3 tons of solid waste per ton of lead/zinc produced.</td>
<td>to air (dust &amp; refinery emissions) to water/gwater</td>
<td>High. Smelter located adjacent to Ibar River. Cross border flow to Serbia. Proximity to waterways not known.</td>
</tr>
</tbody>
</table>
5.4 Sites of particular concern in FRY of Macedonia

5.4.1 Sites with high hazard indications in FYR of Macedonia

The cataloguing and analysis of the information available for this analysis (as documented in Section 3) indicates that a number of sites in the FYR of Macedonia were of relatively higher hazard. Table 5-8 and Table 5-9 provided on the following pages summarise those sites considered to be of particular concern.

The indicated tables list sites associated with ten (10) minerals related operations as potential hotspots (note however, that some facilities may have more than one site of concern). The sites are associated with lead and zinc mining, beneficiation, smelting and refining; ferrochromium smelting; chromite mining and beneficiation; copper mining and beneficiation; and ferronickel and antimony mining, beneficiation and smelting. These sites have been chosen from the list of some 20 minerals related operations listed in Section 3.

5.4.2 Significant trans-boundary issues and security risks

First indications are that most trans-boundary pollution issues associated with sites within Macedonia are of a moderate nature and that the relevant operations lie in the catchment of the Vardar River. Greece is the receiving nation of any cross-boundary pollution for this river. However, the category “moderate” rather than “high” for a number of sites has largely been based upon the considerable distance to the Greek Border. The gradings may require reassessment. More clear cut high risk candidates are the Bucim copper mine and milling facilities, which may affect the Nivicanska River that in turn flows into the Strumica and Struma in Bulgaria, and the Kavadarci ferronickel and antimony mine(s) and ferronickel plant (Fenimak) located near a tributary to the lower Vardar, which flows into Greece. An additional potential candidate for transboundary concern is the Lojane chromium and antimony mining waste dump that is located directly adjacent to a border crossing to Croatia. While cross-border fluvial pathways, if any, are not known, the transboundary risks associated with this site may be high.

Note that this preliminary judgement does not rule out that all minerals related operations listed for Macedonia in the attached tables may be associated with high hazard, and indeed may be causing serious environmental impacts within the territory. In the case of the Sasa mine and milling facilities for example, a recent spill of tailings into the river system had extremely serious consequences, but the presence of a dam downstream has contained pollution within Macedonia.

5.4.3 Sites of concern identified in other studies

Sasa mine tailings dump: Field trips by the University of London, Department of Geology over recent years have documented pollution associated with various mining activities in the former Yugoslav republic of Macedonia (Alderton, 2003). In 2003, representatives of this institution documented a dramatic illustration of the problems suffered by the residents in these mining areas. On the 30th of August the drainage culvert underneath the waste (“tailings”) dump at the Sasa lead-zinc mine collapsed. The culvert, intended to keep the unpolluted river water from interacting with the metal-rich waste dump had collapsed. The collapse left a crater-like hole 170m across and nearly 50m deep. Approximately 4 million tonnes of waste were carried downstream in the steep-sided valleys, eventually settling up to 12km away in a reservoir. Preliminary work has shown that the waste deposited all the way down the valley contains 0.5% lead and 0.5% zinc.
Lojane Chromium and Antimony Mine and Beneficiation Plant: UNDP in Macedonia has proposed a Feasibility Study for Lojane Mine see Kodzoman (2004) as a follow up of the Post-Conflict Environmental Assessment conducted by UNEP in year 2000. Among the other things, the UNEP Report and mission identified Lojane Mine as one of the sites that could be categorised as an environmental “hot spot”. The Mine is located north of Kumanovo, near the border with Serbia & Montenegro and Kosovo (Territory under UN Administration). Due its position near the border, the Mine was in the one of the crisis areas that were most affected by 2001 conflict in Macedonia. Lojane was active in the period 1923 till 1979 when an antimony and chromium were extracted. After the closure of the mine, the complete infrastructure i.e. the flotation facilities, the open dump site for flotation waste and the production facilities were abandoned without undertaking any conservation measures. As such, they are source of contamination (heavy metals and toxic compounds) to surface and underground waters, soil and air. Additional problems related to the Mine are associated with considerable volumes of toxic mining tailings which are inappropriately deposited near the railway and the important border crossing at Tabanovce. The dump site reportedly holds over one million tons of tailings containing arsenic, antimony and other hazardous substances. A soil sample taken at the edge of the dump during the UNEP mission found 8,093 mg/kg of arsenic.66 A comprehensive environmental

66 Which is more than 50 times western European standards for arsenic in industrial soil.
investigation has been proposed in order to scope short-term risk reduction and long-term remediation and environmental protection measures for the Lojane Mine in order to prevent further contamination of the area and the impact on the neighbouring country. Such work is also considered to have potential for a positive impact on the relations between the national/local governments and the local citizens from the affected area which is still declared as a crisis region.

It is proposed that the project will focus on the assessment and determination of the quality of the water, soil and air, as well as the chemical composition of the deposited mining tailings. Within this activity, a comprehensive investigation and sampling program will be developed. This will include: hydro-geological and hydro-chemical analyses of the surface and underground waters; geochemical analyses of the soil; analyses of the impact of the mining dust to the air quality; analyses of the physical and chemical composition of the deposited mine tailings and the mining dust. Comparative analyses of the identified remediation solutions/measures will also be carried out, accompanied by the cost analyses related to each of the proposed solution/measures. Based on the national consultation with the relevant institutions and experts, the most appropriate measures will be selected. A closure plan for the Mine will also be developed.
### Table 5-8. Macedonia sites of concern – candidate hotspot sites 1

<table>
<thead>
<tr>
<th>Site name</th>
<th>Activity</th>
<th>Key hazard vectors</th>
<th>Key release or exposure vectors</th>
<th>(Potential) trans-boundary risk level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bucim Copper mine and mill (Bucim, Rabotna Organizacija za Rudarstvo i Metalurgija za Baker mine &amp; mill)</td>
<td>Copper mining, milling and flotation (beneficiation)</td>
<td>Waste rock. Effluents: Mines where ores have high sulfur content: potential for ARD/AMD from mine workings and waste heaps - can have a pH of 3 or lower; sulfate levels of 800-1,800 milligrams per liter (mg/l); copper levels up to 50 mg/l; iron levels up to 1,000 mg/l; lead levels up to 12 mg/l; zinc levels up to 1,700 mg/l; and cadmium levels of several milligrams per liter, depending on the contents of the ore. Particulates: significant levels of dust, above 3 kilograms per ton (kg/t) of ore mined, and ranging from 0.003 to 27 kg/t, may be generated. Postclosure issues such as the long-term geotechnical stability of the impoundment, the chemical stability of the tailings, long-term surface and groundwater management (including provisions for long-term spillway capacity requirements).</td>
<td>to air (dust) to water/gwater mass solids releases</td>
<td>Moderate* Apparently located adjacent to Nivicanska River, tributary of Strumica then Struma (flows into Bulgaria then Greece). Proximity to waterways not known.</td>
</tr>
<tr>
<td>Radusa - Jugochrom, Hemijsko-Elektrometakurjski Kombinat (HEK) Concentrator</td>
<td>Mining &amp; beneficiation of chromium ores</td>
<td>Unstable tailings impoundments &amp; workings, tails containing As, Sb, base metal sulfides and arsenides, even Mg, Ni etc</td>
<td>to air (dust) to water/gwater mass solids releases</td>
<td>Low-Moderate On border to Kosovo Territory, on Vardar river, but flows are into Macedonia. Proximity to waterways not known.</td>
</tr>
<tr>
<td>Jegunovce - Jugochrom, 67 Hemijsko-Elektrometakurjski Kombinat (HEK) Smelter</td>
<td>Smelting of ferrochromium</td>
<td>Cr, Fe, Cu and Zn and total ferrochrome dust to atmosphere. Depositional soil contamination, waste/slag dumps and process chemical pollution.</td>
<td>to air (dust &amp; smelter emissions) to water/gwater</td>
<td>Low-Moderate On border to Kosovo Territory, on Vardar river, but flows into Macedonia. Proximity to waterways not known.</td>
</tr>
<tr>
<td>Lojane Chromium &amp; Antimony mine</td>
<td>(Former) Mining &amp; beneficiation of chromium &amp; antimony</td>
<td>Generally: unstable tailings impoundments, mine workings, toxic materials in tails containing arsenic, antimony, base metal sulfides and arsenides. May include Mg and Ni, etc. Specifically for Lojane: Circa 1 million tonnes toxic mining tailings deposited near the railway and the very frequent border crossing at Tabanovce. Tailings containing arsenic, antimony and other hazardous substances.</td>
<td>to air (dust) to water/gwater mass solids releases</td>
<td>Moderate to high* Located near border crossing at Tabanovce Cross border pathways not known.</td>
</tr>
<tr>
<td>Kavadarci - Feni-Rudnici i Industrija za Nikel, Celik i Ferronikel Antimony Mine(s) and ferronickel plant (Fenimak) (including Rahanovo Nickel mine)</td>
<td>Ferronickel &amp; Antimoniy mining and ferronickel smelting</td>
<td>Overburden waste, ARD/AMD pH 3, sulphates, Ni, Pb, Zn, Cu, Fe, Zn, Cd. Particulates - 3 kg/t of ore mined (ranging 27 kg/t), long-term geotechnical stability SO2 as high as 4 t/t-nickel produced, Particulate emissions 2.0-5.0 (kg/t) multiple hearth roaster; 0.5-2.0 kg/t fluid bed roaster; 0.2-1.0 kg/t electric furnace; 1.0-2.0 kg/t P-S converter; 0.4 kg/t dryer upstream of the flash furnace. NH3, H2S from ammonia leach process; H2S from acid leaching. Process emissions Sb, As, Hg. Hazardous carbonyl processes.</td>
<td>to air (dust) to water/gwater mass solids releases</td>
<td>Moderate to high* Located near a tributary to lower Vardar. Flow is into Greece. Proximity to waterways not known.</td>
</tr>
</tbody>
</table>

67 The uncontrolled disposal of waste material from the HEK Jugochrom ferro-Alloy plant and the improper handling of material containing chromium salts have led to severe chromium contamination of groundwater and soil, including in the vicinity of the River Vardar. In 1982 the plant began monitoring soil and groundwater and the data confirmed contamination of the water by chromium. To address this problem the plant designed, installed and financed a groundwater abstraction system, which resulted in the concentrations of Cr6+ decreasing by 200-800 mg/l to total contamination levels of 5-15 mg/l. The plant’s target is 1 mg/l (for comparison the target and intervention levels in the Netherlands are 0.001 mg/l and 0.03 mg/l) – if this is to be achieved remediation measures will need to be stepped up. Chromium production ceased in 1993 and the building where chromium was produced and used has neither been cleared of chromium nor secured. Significant air pollution from the stacks, notably an estimated 9 000 to 17 000 tons of dust and fly-ash/yr., is due to the plant’s electric furnaces operating without any form of gas cleaning (UNECE, 2002c, p126).
### Table 5-9. Macedonia sites of concern – candidate hotspot sites II

<table>
<thead>
<tr>
<th>Site name</th>
<th>Activity</th>
<th>Key hazard vectors</th>
<th>Key release or exposure vectors</th>
<th>(Potential) trans-boundary risk level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sase (Kamenica) lead-zinc mine and mill</td>
<td>Lead-Zinc mining and beneficiation</td>
<td>Mining: overburden waste, ARD/AMD pH 3, sulphates, Pb, Zn, Cu, Fe, Zn, Cd. Particulates - 3 kg/t of ore mined (ranging 27 kg/t), long-term geotechnical stability. Beneficiation: as above plus geotechnical instability of tailings waste</td>
<td>to air (dust) to water/gwater mass solids releases</td>
<td>Low. Near Bregalnica River, upper tributary of Vardar River. A dam d/s of site reportedly contains flow. Proximity to waterways not known.</td>
</tr>
<tr>
<td>Rudnici Zletovo (Prohostip) lead-zinc mine and mill</td>
<td>Lead-Zinc mining and beneficiation</td>
<td>as above</td>
<td>to air (dust) to water/gwater mass solids releases</td>
<td>Moderate* Near an upper tributary of Kriva (then Vardar) River. Flow is eventually to Greece. Proximity to waterways not known.</td>
</tr>
<tr>
<td>Toranica lead-zinc mine and mill (Kriva Palanka)</td>
<td>Lead-Zinc mining and beneficiation</td>
<td>as above</td>
<td>to air (dust) to water/gwater mass solids releases</td>
<td>Moderate* Near Kriva River, upper tributary of Vardar river. Flow is eventually to Greece. Proximity to waterways not known.</td>
</tr>
<tr>
<td>Titov Veles – (Zletovo) Lead Smelter</td>
<td>Lead smelting &amp; refining</td>
<td>Toxic solid waste, airborne particulate matter &amp; SO₂. Particulate matter: lead/zinc and iron oxides, but oxides As, Sb, Cd, Cu, Hg + metallic sulfates. Air emissions for processes with few controls may be of the order of 30 kg Pb or Zn/t lead or zinc produced. Emissions of arsine, chlorine, and hydrogen chloride vapors and acid mists are associated with electrorefining. Water effluents: Pb, Zn, As, etc. including dissolved and suspended solids, metals, and oil and grease. Discard slag up to 0.7% lead/zinc: up to 3 tons of solid waste per ton of lead/zinc produced.</td>
<td>to air (dust &amp; smelter emissions) to water/gwater</td>
<td>Moderate* Located near the Vardar River in Central Macedonia. Flow is eventually to Greece. Proximity to waterways not known.</td>
</tr>
<tr>
<td>Titov Veles – (Zletovo) Zinc Smelter</td>
<td>Zinc smelting &amp; refining</td>
<td></td>
<td>to air (dust) to water/gwater mass solids releases</td>
<td></td>
</tr>
</tbody>
</table>

* While the hazard related to these sites may be high, they have a considerable distance to the Greek border. The potential for them to be of a higher level of transboundary concern does exist.
Figure 5-3. Key industrial polluters and hotspots in the FYR of Macedonia

The former Yugoslav Republic of Macedonia
Key Industrial Environmental Polluters and Hot Spots

- Mining Operations
  1. Rudnici Zetovo Lead & Zinc Mine
  2. Soka Lead & Zinc Mine
  3. Toranja Lead & Zinc Mine
  4. Radojiv Sicilin Copper Mine
  5. Suvodol Lignite Mine
  6. Oslomej Lignite Mine
  7. Rostavnik Nickel Mine
  8. Mojncan Chromium & Antimony Mine

- Metallurgical Factories
  9. HEK Jugalrom (copper plating)
  10. MNK Zetovo Lead & Zinc Smelter
  11. Fumarak (nickel & ferroalloys)

- Thermal Power Plants
  12. REK Ribla (lignite-fired)
  13. Osijek (coal-fired)
  14. Negotin (oil-fired)

- Other Industrial Plants or Sites
  15. Haftra AD Paper Processing Plant
  16. MNK Zetovo Fertiliser Plant
  17. Zetoljkica ASP Car Components Plant
  18. Tisaks Textile Plant
  19. Silike Alumina KAD Fireproof Materials Plant
  20. Crni Lavlje
  21. Tane Colussi Metal Resourceting Factory

Legend:
- National boundary
- District boundary
- Rivers
- Country capitals
- District capitals

Source: Ministry of Environment and Physical Planning and UNEP.

68 Source: UNECE (2002c)
5.5 Sites of particular concern in Serbia and Montenegro

5.5.1 Sites with high hazard indications in Serbia and Montenegro

The cataloguing and analysis of the information available for this analysis (as documented in Section 3) indicates that a number of sites in both Serbia and Montenegro were of relatively higher hazard. Details of Serbian sites of particular concern are provided in Table 5-10 and Table 5-11. Details of sites of concern within Montenegro are provided in Table 5-12.

The indicated tables list sites associated with seven (7) minerals related operations as potential hotspots in Serbia, and six (6) minerals related operations as potential hotspots in Montenegro (note however, some facilities may have more than one site of concern). The Serbian sites are associated with antimony mining, processing, and smelting; lead and zinc mining, processing, and smelting; and with very large operations for the mining, processing, and smelting of copper. The Montenegrin sites are associated with the full aluminium process chain and with the mining, processing, and smelting of lead and zinc. These sites have been chosen from 13 sites in Montenegro and circa 32 sites for Serbia that were listed in Section 3.

5.5.2 Significant trans-boundary issues and security risks from Montenegro

While all minerals related operations listed for Montenegro may be associated with high hazard, and indeed may be causing serious environmental impacts within Montenegrin territory, first indications are that moderate-to-high or high risks of significant trans-boundary pollution issues may be associated with four of the six sites. Sites denoted as being of high trans-boundary risk include the Mojkovac and Brskovo lead-zinc mining and and beneficiation operations that are both located on, or adjacent to, the Tara River, which flows to Bosnia and Herzegovina; and Suplja (aka. Suplja Stijena) lead-zinc operations, which are located directly upstream of the BiH border. Sites denoted as being of moderate-to-high trans-boundary risk include the aluminium process facilities at Titograd, all of which lie directly upstream of Lake Scutari (shared with Albania).

5.5.3 Significant trans-boundary issues and security risks from Serbia

While all minerals related operations listed for Serbia may be associated with high hazard, and indeed may be causing serious environmental impacts within Serbian territory, first indications are that high risks of significant trans-boundary pollution issues may be associated with four of the seven sites. These include the infamous Bor site where mining, milling, smelting and refining of copper takes place; Veliki Krivlje a site of mining and milling copper ore; the Majdanpek mine and mill, also a copper site; and the Veliki Majdan lead-zinc mine and mill. The first two operations are located on tributaries of the Timok River, which in turn is a tributary to the Danube; Majdanpek is located on the Pek river, also a tributary of the Danube; while the Veliki Majdan site is located near the Drina River and the BiH border.

Two facilities have been categorised as being of moderate-high trans-boundary risk within this analysis. These include the Zajaca sites for mining, milling and smelting antimony, which is located in the catchment of the Drina River (the border with BiH); and the Sabac zinc smelting and refining sites, located on the Sava River just upstream of the Danube junction.

5.5.4 Sites of concern identified in other studies

An extensive review of environmental performance was conducted by the United Nations Economic Commission for Europe: Economic and Social Council (UNECE) in 2002 - Environmental Performance Review of Serbia and Montenegro - Report for the Eighth session of the Committee on Environment Policy. An excerpt from that report is provided below.
Tailing management: the Mojkovac case: The Mojkovac lead and zinc mine is located in northern Montenegro, in the vicinity of Mojkovac, a small town on the bank of the Tara River, which is on the UNESCO World Heritage List. The mine started operations in 1976 and went bankrupt in 1990, when its activities ceased. The mine complex was composed of underground mining and processing facilities, using a wet process to obtain lead and zinc. Waste water from the flotation plant containing toxic substances was transported by pipeline to a final disposal pond, located along the right bank of the Tara River.

About 3.5 million tons of toxic mining and processing waste has been accumulated in a tailing pond near Mojkovac during 14 years of Pb-Zn mining operations. The tailing deposit is (also) estimated to contain about 140,000 tons of lead and zinc ores. The tailing pond occupies 20 ha, with an average depth of 12 m and is located at an altitude of 807.5 m. The pond also receives overflow from the municipal sewerage system. Previous reclamation works in the site included the reinforcement of the dam walls with gravel and concrete slabs, and the placing of a bottom liner to protect the Tara River from contamination. The deposit surface was covered with gravel, followed by a layer of humus, and then vegetation was planted.

However, these measures have proven to be insufficient to tackle the chronic negative environmental impact on the air, soil, surface water and groundwater. Moreover, the dam walls failed twice, which had the potential to result in a regional ecological catastrophe had they not been repaired on time. For example, during the autumn of 1992, the northern region of Montenegro was struck by intensive rainfalls, which led to a significant increase in the Tara River flow. The flooding waves caused a severe erosion of the lateral walls of the dam and a partial failure at the dam crest. Fortunately, the tailing deposit remained stable, and some repairs have been carried out. However, this episode illustrates the danger of an accidental discharge of enormous amounts of toxic materials into the Tara River, which would result in serious environmental consequences for the entire region.

Environmental monitoring of the tailing pond is not regularly carried out and consequently chemical data from the site are scarce. Recently, the Centre for Ecotoxicological Research of Montenegro carried out some analyses of the air, bottom sediments, mud and waste water at the Mojkovac tailing pond. The results reveal relatively high concentrations of heavy metals, such as Pb, Zn, Fe, Cu, Cd, Hg, As, Mo, Au and Ag, as well as phenols and cyanides. In the southern part of the deposit, 6,092 mg of Pb/kg and 9,250 mg of Zn/kg were measured, and, in the central part, 2,354 mg of Pb/kg and 78 mg of Cd/kg were found.

The mobility of heavy metals could result in severe consequences for human health, flora and fauna.

Fortunately, the predominantly alkaline pH of the waste waters (up to 8.35) helps to prevent this, although in some upper parts of the pond (10-20 cm deep) the pH is strongly acid, with values between 2 and 3. In addition, the waste waters have a high sulphate content, are highly radioactive and even contain pesticides (DDT, heptachlor). The state of groundwater cannot be assessed due to the lack of monitoring. However, water infiltrating into the underground is now controlled by piezometers located in the rim and foundations of the dam. Air analyses at the site indicate high concentrations of SO$_2$, NO$_x$ and heavy metals, with Cd, Pb and Hg breaching maximum permitted concentrations. The current situation at Mojkovac needs urgent remediation to ensure the safety of the dam in the event of flooding, erosion or an earthquake. The improvement of environmental conditions is crucial to prevent direct negative impacts on the local population, which is continuously exposed to pollution.

To address this problem, the Ministry of Environmental Protection and Physical Planning prepared a project under the umbrella of REREp. However, project implementation has been hampered by a lack of funding. (UNECE, 2002b, pp. 111-112)
<table>
<thead>
<tr>
<th>Site name</th>
<th>Activity</th>
<th>Key hazard vectors</th>
<th>Key release or exposure vectors</th>
<th>(Potential) trans-boundary</th>
<th>risk level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zajaca – Rudarsko Tapionicarski Bazen - Zajaca smelter - Zajaca mill - Zajaca mine</td>
<td>Antimony metal mining, beneficiation and smelting</td>
<td>Unstable workings and overburden storages: tailings wastes containing As, Sb, base metal sulfides and arsenides, even Mg, Ni etc. Wastes containing As, Sb, base metal sulfides and arsenides, even Mg, Ni etc. Heavy metal fallout from smelter emissions.</td>
<td>to air (dust &amp; smelter emissions) to water/gwater mass release of solids</td>
<td>Moderate-high*</td>
<td>Apparently close to Drina River (Border to BiH). Leads to Sava River. Proximity to waterways not known</td>
</tr>
<tr>
<td>Rajiceva Gora – Rudarsko Tapionicarski Bazen - Rajiceva mines and mills</td>
<td>Antimony metal mining and beneficiation</td>
<td>Unstable workings and overburden storages: tailings wastes containing As, Sb, base metal sulfides and arsenides, even Mg, Ni etc.</td>
<td>to air (dust) to water/gwater mass solids releases</td>
<td>Moderate.</td>
<td>Apparently on tributary to Morava River Leads to Danube River. Proximity to waterways not known</td>
</tr>
<tr>
<td>Sabac – Hemija Industrija Zorka - Electrolytic Zinc plant</td>
<td>Zinc smelting &amp; refining</td>
<td>Toxic solid waste, airborne particulate matter &amp; SO₂. Particulate matter: lead/zinc and iron oxides, but oxides As, Sb, Cd, Cu, Hg + metallic sulfates. Air emissions for processes with few controls may be of the order of 30 kg Pb or Zn/t lead or zinc produced. Emissions of arsine, chlorine, and hydrogen chloride vapors and acid mists are associated with electrorefining. Water effluents: Pb, Zn, As, etc. including dissolved and suspended solids, metals, and oil and grease. Discard slag up to 0.7% lead/zinc, up to 3 tons of solid waste per ton of lead/zinc produced. Environmental management responsibilities for the complex’s shared facilities are not clearly delineated. Storage of gypsum slurry next to the Sava River, as well as storage of hazardous waste (jarosite) in an unlined and unprotected landfill, may be polluting the Sava River. Additional hazardous and non-hazardous wastes stored in an unlined and unsecured location. Ammonia and other air emissions. Improperly closed facilities (eg. pesticides plant) posing environmental risks.</td>
<td>to air (dust &amp; smelter emissions) to water/gwater mass solids releases</td>
<td>Moderate-high.</td>
<td>Located on Sava River, u/s of Belgrade leads to Danube.</td>
</tr>
<tr>
<td>Krupanj - Veliki Majdan Mine and mill</td>
<td>Pb-Zn mining &amp; beneficiation</td>
<td>Overburden waste, tailings, ARD/AMD pH 3, sulphates, Pb, Zn, Cu, Fe, Zn, Cd. Particulates - 3 kg/t of ore mined (ranging 27 kg/t), long-term geotechnical stability, geotechnical instability of tailings impoundments.</td>
<td>to air (dust) to water/gwater mass solids releases</td>
<td>High.</td>
<td>near Drina River and Bosnian Border. While proximity to waterways not known, previous serious release events have been documented.</td>
</tr>
<tr>
<td>Lece</td>
<td>Pb-Zn mining &amp; beneficiation</td>
<td>as above</td>
<td>As above</td>
<td>Moderate.</td>
<td>Apparently located adjacent to a tributary to the Morava that flows through Serbia to the Danube.</td>
</tr>
</tbody>
</table>
Table 5-11. Serbia sites of concern – candidate sites II

<table>
<thead>
<tr>
<th>Site name</th>
<th>Activity</th>
<th>Key hazard vectors</th>
<th>Key release or exposure vectors</th>
<th>(Potential) trans-boundary risk level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bor - Rudarsko Topionicki Bazen (RTB) Mine, mill, smelter &amp; refinery</strong></td>
<td>Copper mining, beneficiation, smelting &amp; refining copper ore exploitation; production of copper concentrate, pyrites, magnetite and molybdenum; smelting and refining of copper, noble and rare metals; production of sulfuric acid, copper billets and blocks, copper alloys and alloy-based casts.</td>
<td>Specifically for this site: Severe air pollution from mining and smelting operations. Toxic dust emissions from tailings impoundments. Extensive land and soil degradation, including loss of agricultural land and destruction of local buildings from failed pit slopes. Potential collapse of the concrete culvert/collector running beneath flotation tailings. Heavily contaminated industrial wastewater discharged into local receiving waters. PCB-containing capacitors buried on the surface of an uncontrolled industrial landfill. Solid waste slag, dissolved and suspended solids Cu, Cd, Pb, Zn, As, Hg, residues (lime or Al(OH)x), fluorides, spent electrolytic baths, slimes recovery, spent acid, wastewater treatment sulde, particulate emissions 0.1 kg/t of copper to 20 kg/t Cu - Cu, Fe compounds; sulfides, sulfates, oxides, chlorides; fluorides of As, Sb, Cd, Pb, Hg, Zn.</td>
<td>to air (dust &amp; smelter emissions) to water/gwater mass release of solids</td>
<td>High. Bor (Borska Reka) &amp; Timok Rivers, Kriveljska River, Danube River (final recipient)</td>
</tr>
<tr>
<td><strong>Majdanpek</strong>&lt;sup&gt;69&lt;/sup&gt; - (RTB) Mine and mill</td>
<td>Copper mining &amp; beneficiation</td>
<td>Mining &amp; beneficiation: Waste rock. Effluents: Mines where ores have high sulfur content: potential for ARD/AMD from mine workings and waste heaps - can have a pH of 3 or lower; sulfate levels of 800–1,800 milligrams per liter (mg/l); copper levels up to 50 mg/l; iron levels up to 1,000 mg/l; lead levels up to 12 mg/l; zinc levels up to 1,700 mg/l; and cadmium levels of several milligrams per liter, depending on the contents of the ore. Particulates: significant levels of dust, above 3 kilograms per ton (kg/t) of ore mined, and ranging from 0.003 to 27 kg/t, may be generated by extraction activities, crushing, ore beneficiation, transport and traffic, and windborne losses. Postclosure issues such as the long-term geotechnical stability of the impoundment, the chemical stability of the tailings, long-term surface and groundwater management (including provisions for long-term spillway capacity requirements).</td>
<td>to air (dust) to water/gwater mass solids releases</td>
<td>High. Pek River, then Danube Previous events of extremely serious nature.</td>
</tr>
<tr>
<td><strong>Veliki Krivelj – (RTB) Mine and mill</strong></td>
<td>Copper mining &amp; beneficiation</td>
<td>as above</td>
<td>to air (dust) to water/gwater mass solids releases</td>
<td>High. Kriveljska River, Timok River then Danube River (final recipient)</td>
</tr>
</tbody>
</table>

<sup>69</sup> 1974 entire River Pek wiped out. 7Mm³ solids + 4.5Megalitres of cyanide waters.
Table 5-12. Montenegro sites of concern – candidate sites

<table>
<thead>
<tr>
<th>Site name</th>
<th>Activity</th>
<th>Key hazard vectors</th>
<th>Exposure vectors</th>
<th>(Potential) trans-boundary risk level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mojkovac Mine and Mill&lt;sup&gt;70&lt;/sup&gt;</td>
<td>(former) Pb-Zn mining &amp; beneficiation</td>
<td>Tailing management: the Mojkovac case Circa 3.5 Mt toxic mining and processing waste Tailings pond occupies 20 ha, with an average depth of 12 m, (807.5 mASL), and also receives overflow from the municipal sewerage system.</td>
<td>to air (dust), to water/gwater mass solids releases</td>
<td>High. Tara River &amp; Town of Mojkovac. Tara River crosses border to BiH. Previous serious release events.</td>
</tr>
<tr>
<td>Brskovo - Brskovo Mine</td>
<td>Pb-Zn mining &amp; beneficiation</td>
<td>Overburden waste, tailings, ARD/AMD pH 3, sulphates, Pb, Zn, Ca, Fe, Zn, Cd. Particulates - 3 kg/t of ore mined (ranging 27 kg/t), long-term geotechnical stability, geotechnical instability of tailings impoundments.</td>
<td>to air (dust), to water/gwater mass solids releases</td>
<td>High. Directly on Tara River, crosses border to BiH. Previous serious release events.</td>
</tr>
<tr>
<td>Suplja&lt;sup&gt;71&lt;/sup&gt;</td>
<td>Pb-Zn mining &amp; beneficiation</td>
<td>as above</td>
<td>to air (dust), to water/gwater mass solids releases</td>
<td>High. Located directly adjacent to River Cehotina, a tributary to the Drina River, which constitutes the BiH border &amp; flows to Danube.</td>
</tr>
<tr>
<td>Titograd&lt;sup&gt;72&lt;/sup&gt; – Alumina Kombinat Aluminijuma Plant and Smelter</td>
<td>Alumina refining and Aluminium reduction (smelting)</td>
<td>Geotechnical stability of red mud storage. Significant risk of groundwater and surface water pollution from SPL wastes. Air emissions: alumina dust; coke dust; gaseous and particulate fluorides; sulphur and carbon dioxides; SOx; VOCs; PAHs, carbon oxides,CF&lt;sub&gt;4&lt;/sub&gt; and C&lt;sub&gt;2&lt;/sub&gt;F&lt;sub&gt;6&lt;/sub&gt;. Emissions up to 80 kg/t for particulates, 12 kg/t for hydrogen fluoride, and 10 kg/t for fluoride particulates. Solid waste: 40–60 kg mixed solid wastes per ton Al, SPL - 50% refractory material, 50% carbon, impregnated with aluminium and silicon oxides and cyanide compounds (about 400 ppm). Skim, dross, fluxing slags, and road sweepings. Possible emissions of chlorine, hexachloroethane, chlorinated benzenes, and dioxins and furans.</td>
<td>to air (dust &amp; smelter emissions), to water/gwater</td>
<td>Moderate-high. Lake Scutari (shared with Albania) directly d/s.</td>
</tr>
<tr>
<td>Rudnici Boksita, Niksic Mine, Kursko Brdo mine, Zagradska planina, Biocki Stan mine, Durakov Dol mine</td>
<td>Geotechnical stability of mine workings and overburden dumps. Dust.</td>
<td>to air (dust), to water/gwater mass solids releases</td>
<td>Not known but likely to be low.</td>
<td></td>
</tr>
</tbody>
</table>

<sup>70</sup> In Mojkovac, there is a large amount of accumulated mining tailings and industrial waste from a plant that produced zinc, lead and pyrites. The plant was closed 10 years ago. It is situated on the bank of the Tara River. The estimated quantity of sludge is 3.5 million tons. The disposal sites occupy an area of 20 ha. The tailing pond is 12m deep. The River Tara is part of the Durmitor national park . The Tara River is protected by an earth-gravel dam, reinforced by concrete slabs. Water from the sites has a pH of up to 12 and is contaminated by sulphides and sulphates, radioactive substances, heavy and other toxic metals and pesticides. This site poses a serious threat to the population and the environment, especially in the event of an accident or heavy rainfall.

<sup>71</sup> Suplja (aka. Suplja Stijena) is a further site of concern where flotation tailings from zinc and lead production are dumped. The plant operated from 1959 to 1987, when it was closed, and then it restarted in 1996. At present, the mines and flotation facilities are closed. About 1.2 million tons of toxic tailings are deposited at the landfill, which is located on the bank of the River Cehotina. This landfill is neither monitored nor maintained. Heavy metals are washed out by rain and migrate into groundwater and into the river. So far no remediation action has been planned to solve the problem.

<sup>72</sup> The aluminium plant constructed between 1969 and 1971 is located 10 km from Podgorica in the Zeta Valley near Skadarsko Jezero. The initial capacity of the plant was 200 000 tons of alumina per year based on Montenegro’s high-quality bauxite. At present, the plant operates at more than full capacity, producing 210 000 tons of alumina per year. Approximately 350 000 to 420 000 tons of red mud (cathode production residue) is generated by the aluminium plant each year. About 7 million tons of red mud are accumulated at two disposal sites. There are also about 70 tons of PCBs, as well as phenols, mercury-containing waste, fluorides, polyaromatic hydrocarbons (PAHs), fluorine gases, and dust from coke. About 3.5 million tons of red mud are stored at the first disposal site (basin), which occupies a surface area of 170 000 m2. The basin has an insulation layer to protect against the seepage of heavy metals into groundwater. The second basin does not have any protection layer. At present about 4 million tons of red mud have already been dumped over 220 000 m2. The second basin poses a serious threat of groundwater contamination, including to drinking water, because the plant is located near the city. In addition, contaminated groundwater could easily enter Skadarsko Jezero.
6. Summary and Conclusions

6.1 Introduction – Desk Study results

This Desk Study has identified and catalogued a large number of mineral resource related sites that are of high hazard. Many have significant risks associated with them that threaten the environment, public health and safety, and/or regional socio-political stability in the South Eastern European countries addressed by this study. A number have significant risk parameters associated with all three of the aforementioned categories of threat and consequence and as such have been identified as candidate “hotspots”. Despite a large amount of information (qualitative data) found and included in this report, the level of delineation regarding the majority of these sites remains relatively low. While the risks associated with these sites appear unacceptable, insufficient quantitative data exists to determine if this premise is correct – and if so, to which degree. As such, quantification of potential risks has not been undertaken in this work.

This report is intended to provide information required to support on-going work for risk and hazard reduction in the region – particularly where such risks are of a trans-boundary nature.

This final section of the report addresses the following items:

- a brief overview of the status of the major Desk Study outputs;
- general findings regarding significant risks associated with the sites/operations that threaten the environment, public health and safety, and/or regional socio-political stability in the region both in a trans-boundary and in a local context;
- a summarising section including general comments regarding the non-environmental stress factors considered to be of importance; a scoping of on-going activities focused at reduction of the risks, and an outline of potential gaps in available information and regional capacities required to address the issues.

Prior to reading this chapter, the reader is reminded that the Desk Study project represents only a first step in a proposed programme aimed at the reduction of environment and security risks related to mining and minerals processing activities in South Eastern Europe. It is an overview of the extent of the problem in the designated countries, with a focus on threats to regional stability. Thus, impacts that may cause trans-boundary tensions and security risks have been given prime focus.

Much more than a study is required in order to provide greater levels of safety at the sites and in surrounding communities as well as improvements of local-level and trans-boundary processes for emergency preparedness and response. This report is intended as a foundation upon which to plan for tangible improvements via an action programme focusing upon improvement of operational and regulatory systems.

Due to the nature of the challenges faced, such an action programme must address both the needs of local communities so that they can respond appropriately to the security risk and pollution potential of

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73 Albania, Bosnia & Herzegovina, Kosovo (Territory under UN interim administration), Macedonia, Serbia and Montenegro.
any hazardous sites in their vicinity, and the needs of authorities who will be required to intervene for abandoned sites, or sites in states of minimal "care and maintenance" in order to improve site, sub-regional and regional security.

In closing this introduction, an observation that can be made is that almost the full range of warning signals for environmentally damaging incidents of large scale and consequence are present in the region. These include, but are not limited to:

- 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;
- periods of heavy rain and/or snowmelt;
- numerous rivers and catchment areas shared by several countries;
- significant seismicity (earthquakes);
- abandoned and orphaned sites with little or no closure or control;
- lack of ongoing physical and/or biochemical monitoring of operational and/or abandoned sites;
- lack of ongoing maintenance, both proactive & reactive;
- absence of institutionalised accident/disaster response procedures;
- 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.

These points should provide a context of “considerable urgency” to the reader. The situation regarding mining and minerals related risks to environment and heath that are of both national and transboundary nature is very serious.

### 6.2 Major desk study outputs

This section provides a brief summary discussion addressing the major items covered in the report and/or the major outputs of the work. Where considered relevant, this discussion will compare the outputs achieved in the work against the objectives at the commencement of the work, and/or suggest areas where additional work is required in order to support the next project phases anticipated.

#### 6.2.1 Catalogue of sites

The catalogue exercise documented in Section 3 has been successful in capturing information regarding a large number of sites and operations. These address the majority of the regional production volumes. The catalogue of sites of mineral resource extraction and/or beneficiation in the region, was formed from multiple sites of information but the primary source has been data and reports supplied by the US Geological Survey. As such, the focus of source data was primarily upon large important sites of important commodity minerals mining and processing that supplied the international market or upon strategically important (and generally high volume) minerals serving local markets local markets. Further, the available information generally addressed sites that have been recognised on international markets in the 1990s and forward in time. However, operations that had their “production lifetime”
earlier than this, are generally absent from the data set. Data on small mine sites, quarries, gravel pits and so forth, are also absent.

While, the lack of availability of information regarding smaller sites bears with it some potential that some such operations posing significant risk have been missed, this potential is likely to be small. The same cannot be said however, of sites where the data set has missed their operational lifetime. Some of these could be large metalliferous concerns with considerable hazard parameters (the Lojane mine, in the FYR of Macedonia is one such example that has been found). There remains a significant potential that major risk sites that are abandoned or orphaned have not been captured. As such, there remains weakness with regards orphaned mine sites. Input is required from local experts in order to identify such sites.

Regarding the operations and sites that have been documented, it has not been possible to identify subcomponents of the operations, or how close they are to important environmental parameters at threat (e.g. a waterway). For example, one source (UNECE, 2002b, pp. 239-241), indicates that there are seven tailings impoundments at Zvecan lead smelter site in Kosovo. While it is quite probable that the sites are near waterways due to the need for process water in considerable volumes, the actual proximity of the tailings impoundments to such waterways is unknown. Again, in order to deliver the level of resolution required for rational formulation and prioritisation of action at such sites, input from local experts or from “on-the-ground” is required.

6.2.2 Maps

A range of mapping outputs delineating the location and potential areas of impact posed by hazardous sites have been created in cooperation with UNEP's DEWA/GRID department in Geneva. These have served an important function in the conduct of the work, particularly in the identification of the pathways in which pollutants from sites can be transported. Indeed, an understanding of the manner in which identified sites actually pose risks to in a local, regional and/or trans-boundary sense cannot be fully appreciated without examination of the site in relation to its geographical context – particularly waterways.

A range of mining and environment related maps are available at the GRID web site [http://www.grid.unep.ch/envsec/mining/desk_study_maps.php](http://www.grid.unep.ch/envsec/mining/desk_study_maps.php). Both high definition and low definition maps having been provided. These include:

- South Eastern European (SEE) mining sites;
- SEE mining sites and water basins;
- SEE mining sites and protected areas;
- SEE Seismic Risks and Mining;
- SEE metal beneficiation (milling, concentration) facilities;
- SEE smelter and refinery facilities;
- SEE metalliferous mine facilities;
- SEE coal mine facilities;
- SEE oil and gas related operations;
- Other mining operations.

A number of these have been made available in Appendix G. At present, there remain some areas where the work is complete, and a number of inconsistencies, particularly with regards to the accepted common usage names of sites (a challenge common to all facets of the work associated with this Desk Study).
When hotspot status has been confirmed for sites identified by this report, (and potentially some as yet unidentified sites) these maps should be updated with both the location and the expected extent of the trans-boundary risk area (usually a fluvial system). Similarly, cross-checking of the data within this report by local experts will allow, if necessary, the correction of inconsistencies.

6.2.3 Catalogue of mining and minerals related institutions and policy/legislative frameworks

The listing of mining and minerals related institutions included in this report (relevant Government Authorities, UN bodies, private sector actors, NGOs and Academia in each country) along with their relationship to the mining sector is incomplete. While a significant number of institutions were identified, the sources where names and contact details were found were somewhat dated in a number of instances (See Appendices C to F). Further, there has been a very high degree of institutional flux in the countries of the region – this being a major topic of discussion at the Skopje workshop in September 2004. Calls for information regarding institutional details sent to national actors during the summer of 2004 were largely unanswered.

Appendix B, documented in conjunction with the Skopje workshop represents the most up-to-date information in this regard. National Focus Partners (NFPs) for each country were in the process of being identified as of October 2004. Future work via the NFPs should serve to strengthen listings of important national actors.

The listing of mining and minerals related policy and legislative frameworks included in this report (appear to) contain no legislative items directly addressing conduct and accountability for abandoned or orphaned mining or minerals related sites. This said, extensive listings of rules, laws, decrees and so forth dealing with the protection of the natural environment, toxic materials, waste disposal and so forth - areas that impinge upon, and are relevant to the minerals sector – were found. In the area of law – as with institutions – there has been a very high degree of flux in the countries of the region. New legal frameworks are in the process of construction, generally along the lines of European Union frames. These challenges were also highlighted in discussions at the Skopje workshop in September 2004. Again, future work via the NFPs should serve to strengthen listings of national legislative frameworks.

6.3 Significant transboundary 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. The pathways identified in this study include:

- airborne transport of pollutants such as dust, smelter emissions, gases, vapours;
- mass movement of “solid” wastes (generally tailings containing heavy metals and toxic compounds);
- mass movement of liquid, or semi-liquid wastes (again, generally tailings containing heavy metals and toxic compounds);
- waterborne transport of wastes as suspended solids and as dissolved materials.

Among the sites and operations examined in this study, it is clear that the dominant pathway of exposure – at all levels of interest – is via waterways (fluvial transport). A second exposure pathway, airborne toxic emissions from smelters transported in the atmosphere, has been a very significant issue in the past. However, as a number of smelters have ceased operations, or are closed until such time that acceptable levels of emission can be achieved through upgrading of plant, the regional...
and transboundary importance of airborne emissions appear to have generally reduced in importance.\textsuperscript{74} A third important pathway appears to be toxic particulate pollutant transport as dust – however, this is a largely local and sub-regional effect rather than a transboundary one.

The overriding importance of fluvial transport mechanisms for tailings wastes in transboundary pollution risks bears several implications with it. To name but a few – very large volumes of materials can be involved with catastrophic damage to downstream land, property and ecosystems associated with the physical impacts of such accidents; biochemical, and eco-toxicological effects of these pollutants can be catastrophic and can extend far beyond the zone physically affected by such materials; the physical and biochemical, and eco-toxicological effects can be very long term (in essence, it may be impossible to clean up some affected areas), and so forth.

The tables provided in Section 5 provide details of sites considered to be of particular concern in each of the countries. The more detailed tabulation of sites for each country was provided in Section 3. Here, only the sites believed to have the potential for impacts of a transboundary nature are listed. Note however, that sites listed as being likely to pose only national risk still may have the potential to create serious negative consequence should there be an incident (as discussed above).

### 6.3.1 Albanian transboundary risk hotspots

The 11 minerals related operations listed as potential hotspots (national and/or transboundary risk hotspots) in Section 5 were associated with ferrochromium processing/smelting, chromite mining, and copper mining and processing industries.

Those operations listed in Table 6-1 have been selected as most likely to be associated with significant transboundary risk (thus, transboundary risk hotspots) emanating from Albanian territory.

<table>
<thead>
<tr>
<th>Site name &amp;/or activity</th>
<th>Hazards</th>
<th>Potential transboundary harm/consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elbasan Smelter complex - Ferrochromium, Fe (steel) &amp; Ni smelters</td>
<td>Toxic &amp; heavy metal emissions, uncontained and unprotected wastes, residues and chemicals.</td>
<td>Cross border air pollution, pollution of Lake Ohrid shared with FYR of Macedonia, Pollution via Shukumbinit River to Adriatic Sea. Tensions with FYR of Macedonia.</td>
</tr>
</tbody>
</table>

Sites where risks were considered to be national rather than transboundary, include:

- Burrel Ferrochrome Smelter;
- Chromite mines such as those at Bater, Bulquizze, Kalimash and others;
- Fushe-Arrez copper mine & mill;
- Kukes Copper Smelter;
- Lac Copper Smelter;
- Rubik Copper Smelter;
- Reps copper mine.

\textsuperscript{74} Although sites such as RTB Bor in Serbia and a range of others are still operational.
6.3.2 BiH transboundary risk hotspots

The seven minerals related operations listed as potential hotspots (national and/or transboundary risk hotspots) in Section 5 were associated with aluminium, ferroalloy processing/smelting, manganese mining and processing, and iron/steel smelting.

Those operations listed in Table 6-2 have been selected as most likely to be associated with significant transboundary risk emanating from BiH territory.

Table 6-2. Candidate transboundary hotspots in Bosnia & Herzegovina

<table>
<thead>
<tr>
<th>Site name &amp;/or activity</th>
<th>Hazards</th>
<th>Potential transboundary harm/consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birac Zvornick – Alumina refinery &amp; Aluminium smelter</td>
<td>Toxic emissions, uncontained and unprotected wastes, residues and chemicals, particularly red mud wastes and spent pot linings etc. from smelting operations</td>
<td>Cross border pollution via Drina River (Serbian Border) and into Danube River. Tensions with Serbia and downstream Danube countries (Romania, Bulgaria).</td>
</tr>
<tr>
<td>Sebestenica Energoinvest Pb-Zn mine &amp; beneficiation mill.</td>
<td>Toxic/acidic effluents, uncontained waste rock, dust emissions &amp; unsecured workings, poorly contained and/unstable tailings wastes.</td>
<td>Cross border pollution via Drina River (Serbian Border) and into Danube River. Tensions with Serbia and downstream Danube countries (Hungary, Romania, Bulgaria).</td>
</tr>
</tbody>
</table>

Sites where risks were considered to be national rather than transboundary, include:

- Mostar – Aluminij
- Petrovo-Selo & Ilici Asbestos;
- Buzim FBC Manganese Energoinvest mine & concentrator;
- Jajce Elektrohemijksa Plant Ferroalloy smelter;
- Zenica – RMK Zenica Steel.

6.3.3 Kosovian (Territory under UN interim administration) transboundary risk hotspots

Those operations listed in Table 6-3 have been selected as most likely to be associated with significant transboundary risk emanating from Kosovian territory. This list contains nearly all the sites indicated in Section 5. 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 have considerable risk associated with them but they appear to threaten Kosovian territory only.
### Table 6-3. Kosovian candidate sites – transboundary hotspots

<table>
<thead>
<tr>
<th>Site name &amp;/or activity</th>
<th>Hazards</th>
<th>Potential transboundary harm/consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Djakovic – DEVA Cr mine.</strong></td>
<td>Toxic/acidic effluents, uncontained waste rock, dust emissions &amp; unsecured workings, poorly contained and/unstable tailings wastes.</td>
<td>Cross border pollution via Erenik River (tributary to Beli-Drin river) Flow to Lake Fierzës. Tensions with Albania</td>
</tr>
<tr>
<td><strong>Trepca Mills – Badovac, Leposavic, Marave, Tuneli i pare &amp; Kishnica Mills. Pb-Zn mines &amp; beneficiation mills.</strong> As above.</td>
<td>Multiple sites. Cross border pollution via Ibar River flowing to Serbia and into Danube River. Tensions with Serbia and downstream Danube countries (Romania, Bulgaria).</td>
<td></td>
</tr>
<tr>
<td><strong>Trepca Mills – Kriva Feja Pb-Zn mine &amp; beneficiation mill.</strong> As above.</td>
<td>Cross border pollution via Binacka Mirava River flowing to Serbia, and eventually Danube. Potential tensions as above.</td>
<td></td>
</tr>
<tr>
<td><strong>Trepca Mills – Rudnik Pb-Zn mine &amp; beneficiation mill.</strong> As above.</td>
<td>Cross border pollution via tributary to Beli (Drina) flowing into Albania. Tension with Albania.</td>
<td></td>
</tr>
<tr>
<td><strong>Sebrenica Energoinvest Pb-Zn mine &amp; beneficiation mill.</strong> As above.</td>
<td>Cross border pollution via Drina River (Serbian Border) and into Danube River. Tensions with Serbia and downstream Danube countries (Romania, Bulgaria).</td>
<td></td>
</tr>
<tr>
<td><strong>Zvecan Pb-Zn mines, beneficiation mill &amp; smelter.</strong> Toxic solid waste, airborne toxics &amp; SO₂. Toxic/acidic effluents, uncontained waste rock, dust emissions &amp; unsecured workings, poorly contained and/unstable tailings wastes.</td>
<td>Cross border pollution via Ibar River flowing to Serbia and into Danube River. Cross border air pollution. Tensions as above.</td>
<td></td>
</tr>
<tr>
<td><strong>Titova Metrovica electrolytic Pb &amp; Zn refinery.</strong> Toxic solid waste, airborne toxics &amp; SO₂. Toxic/acidic effluents, dust emissions, poorly contained smelter residues and chemicals.</td>
<td>As above</td>
<td></td>
</tr>
</tbody>
</table>

### 6.3.4 FYR of Macedonia transboundary risk hotspots

The 10 minerals related operations listed as potential hotspots (both national and/or transboundary risk hotspots) in Section 5 were associated with lead and zinc mining, beneficiation, smelting and refining; ferrochromium smelting; chromite mining and beneficiation; copper mining and beneficiation; and ferronickel and antimony mining, beneficiation and smelting.

Those operations listed in Table 6-4 have been selected as most likely to be associated with significant transboundary risk emanating from FYR of Macedonia territory.
### Table 6-4. Macedonian candidate sites – transboundary hotspots

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

Sites where risks were considered to be national rather than transboundary, include:75

- Radusa - Jugochrom (HEK) chromite beneficiation plant;
- Jegunovce – Jugochrom (HEK) smelter;
- Sase (Kamenica) Pb-Zn mine and mill;
- Rudnici Zletovo (Probostip) Pb-Zn mine and mill;
- Toranica Pb-Zn mine and mill (Krina Palanka);
- Titov Veles (Zletovo) Pb smelter and Titov Veles Zn smelter;
- Mostar alumina refinery & aluminium smelter.

### 6.3.5 Serbian transboundary risks

The eight minerals related operations listed as potential hotspots (both national and/or transboundary risk hotspots) in Section 5 were associated with antimony mining, processing, and smelting; lead and zinc mining, processing, and smelting; and with very large operations for the mining, processing, and smelting of copper.

The six operations listed in Table 6-5 have been selected as most likely to be associated with significant transboundary risk emanating from Serbian territory.

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75 A number of these sites have not been included as transboundary hotspots due to their being assigned the category “moderate” rather than “high” due the considerable distance to the Greek Border. However, these gradings may require reassessment upon receipt of more detailed information.
### Table 6-5. Serbian candidate sites – transboundary hotspots

<table>
<thead>
<tr>
<th>Site name &amp;/or activity</th>
<th>Hazards</th>
<th>Potential transboundary harm/consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bor (RTB) Mine, mill, smelter &amp; 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.</td>
<td>Toxic/acidic effluents, uncontained waste rock, dust emissions &amp; unsecured workings, poorly contained and unstable tailings wastes. Toxic solid waste, airborne toxics &amp; SO₂. Toxic/acidic effluents, dust emissions, poorly contained smelter residues and chemicals.</td>
<td>Cross border pollution to downstream Danube countries via Bor (Borska Reka), Timok Rivers, Krivelska River and Danube Rivers. Tensions with downstream Danube countries (Romania &amp; Bulgaria). Cross border air pollution.</td>
</tr>
<tr>
<td>Majdanpek (RTB) Cu beneficiation mill and mine.</td>
<td>Toxic/acidic effluents, uncontained waste rock, dust emissions &amp; unsecured workings, poorly contained and unstable tailings wastes.</td>
<td>Cross border pollution to downstream Danube countries via Pek River, then Danube. Tensions with downstream Danube countries (Romania &amp; Bulgaria).</td>
</tr>
<tr>
<td>Sabac electrolytic zinc smelter &amp; refinery</td>
<td>Toxic solid waste, airborne toxics &amp; SO₂. Toxic/acidic effluents, dust emissions, poorly contained smelter residues and chemicals.</td>
<td>Cross border pollution to downstream Danube countries via Sava River. Tensions with downstream Danube countries (Romania &amp; Bulgaria).</td>
</tr>
<tr>
<td>Veliki Krivelj (RTB) Cu beneficiation mill and mine.</td>
<td>Toxic/acidic effluents, uncontained waste rock, dust emissions &amp; unsecured workings, poorly contained and unstable tailings wastes.</td>
<td>Cross border pollution to downstream Danube countries via Krivelska River, Timok River then Danube River. Tensions with downstream Danube countries (Romania &amp; Bulgaria).</td>
</tr>
<tr>
<td>Zajica Antimony (Sb) mine, beneficiation mill and smelter.</td>
<td>Toxic solid waste, airborne toxics &amp; SO₂. Toxic/acidic effluents, uncontained waste rock, dust emissions &amp; unsecured workings, poorly contained and unstable tailings wastes. Poorly contained smelter residues and chemicals.</td>
<td>Cross border pollution to Bosnia &amp; Herzegovina via Drina River, then to Danube via Sava River. Tensions with BiH and other downstream Danube countries (Romania &amp; Bulgaria).</td>
</tr>
</tbody>
</table>

Sites where risks were considered to be national rather than transboundary, include the Rajiceva antimony mines and mills and lead-zinc mining and beneficiation operations at Lece. 76

### 6.3.6 Montenegrin transboundary risks

The five minerals related operations listed as potential hotspots (both national and/or transboundary risk hotspots) in Section 5 were associated with the full aluminium process chain and with the mining, processing, and smelting of lead and zinc.

The four operations listed in Table 6-6 have been selected as most likely to be associated with significant transboundary risk emanating from Serbian territory.

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76 A number of these sites have not been included as transboundary hotspots due to their being assigned the category “moderate” rather than “high” due the considerable distance of flow through Serbia. However, these gradings may require reassessment upon receipt of more detailed information.
### Table 6-6. Montenegrin candidate sites – transboundary hotspots

<table>
<thead>
<tr>
<th>Site name &amp;/or activity</th>
<th>Hazards</th>
<th>Potential transboundary harm/consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mojkovac Pb-Zn beneficiation mill and mine.</td>
<td>Toxic/acidic effluents, uncontained waste rock, dust emissions &amp; unsecured workings, poorly contained and/unstable tailings wastes.</td>
<td>Cross border pollution to Bosnia &amp; Herzegovina via Tara River. Health and environmental damage in town of Mojkovac. Tensions with BiH.</td>
</tr>
<tr>
<td>Brskovo Pb-Zn beneficiation mill and mine.</td>
<td>As above.</td>
<td>Cross border pollution to Bosnia &amp; Herzegovina via Tara River. Tensions with BiH.</td>
</tr>
<tr>
<td>Suplja Pb-Zn beneficiation mill and mine.</td>
<td>As above.</td>
<td>Cross border pollution to Bosnia &amp; Herzegovina via Cehotina River, a tributary to the Drina River, which constitutes the BiH border &amp; flows to the Danube.</td>
</tr>
<tr>
<td>Titograd – Alumina &amp; Aluminium refining &amp; smelting</td>
<td>Toxic emissions, uncontained and unprotected wastes, residues and chemicals, particularly red mud wastes and spent pot linings etc. from smelting operations</td>
<td>Cross border pollution via Lake Scutari (Skadarsko Jezero) shared with Albania. Tensions with Albania.</td>
</tr>
</tbody>
</table>

Sites where risks were considered to be national rather than transboundary include the Niksic, Kutsko Brdo, Zagrad, Biocki Stan, and Durakov Dol bauxite mines.

### 6.4 Conclusions and recommendations

In this final short section of the report, 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;
- discussion of non-environmental stress factors
- potential work activities to deal with priority issues
- A brief scoping of next steps forward – a road map at both local (national) scale and in a transboundary and regional perspective

#### 6.4.1 Priority issues and institutions to be involved

The Desk Study has highlighted a number of interlinked issues where action of varying urgency is required.

**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. As detailed in this report – and summarised in the preceding discussions in this conclusion 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 waters and groundwater. Such effluents contribute to local, national and transboundary pollution of varying degrees of severity – often considerable severity. Directly related to this, and presented here as a sub-issue (as it is central to risk...
Risks and vulnerabilities from mining activities

reduction strategies in general) is the remaining **degree of uncertainty** regarding such sites. As such, 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 of critical importance.77

**Issue 2 – risk reduction at operational sites**

The second priority issue or area of major concern 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. 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 events leading to the dramatic pollution of the Tisza and Danube rivers in 2000/200178 – with effects on the whole region clearly have shown, modern operations can also fail catastrophically – with a range of physical/engineering and institutional factors contributing to failure. 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 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 transboundary risk management and/or disaster response, and so forth.

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

77 As an example based on hazardous water and waste impoundments – an inventory containing details such as: location, height, area, description and speciation of substance contained, age, material of construction, condition, ownership history, institutional jurisdiction and so forth – would provide information required to reduce uncertainty.

78 Most infamously the events at the Aurul S.A. Baia Mare Company in north west Romania during the year 2000.
capacity to a level that can initiate, manage and support mining and minerals activities that are compatible with regional sustainable development. The nature of the issues identified in this work point towards a focus upon institutional and industrial actors. However, as a range of Non Governmental Organisations (NGOs) are 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 such actors will need to be initiated and maintained.

6.4.2 Levels of risk – quantification of risk

Relationships between hazard, risk and minerals sites in SEE

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/or trans-boundary nature.

According to the definitions of key terms supplied in Section 1.2.6 of the report, examples of the how and why sites of significant hazard pose risks of a site, local, sub-regional, regional and/or trans-boundary nature are supplied in this section. These examples can be considered a synthesis of items found during the conduct of the Desk Study, however they are not exhaustive.

Harm

Potential damage to people, property, or the biophysical, social, or cultural environment associated with the primary transboundary 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 forth. The types of damage listed here have the potential to occur at site, local, sub-regional, regional and/or 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. Further, the high number and common occurrence of “warning signals” as listed in Section 6.1, indicate that many factors are present contributing to increased likelihood of incidents in this region.

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, and so forth.

Consequence(s)

The intermediate or final outcome(s) of events or situations 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; and so forth. 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 forth, 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.
Non-environmental stress factors

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 include:

- 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;
- poorly established 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), and so forth;
- 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.

Dealing with risk – general work activities for priority issues

A range of work areas addressing the priority issues listed in the preceding discussion is provided below. Where feasible, general actor groups and their roles have also been listed. Parts of these activities would take place in parallel and this listing is thus not strictly chronological.

- **Hazard and risk uncertainty reduction** via focused information collection. Such work could be formulated and coordinated by national environmental agencies in association with international and national experts, and conducted by mines inspectorates and national experts.

- **Management of risks associated with the legacies of mining** and minerals processing activities. Such work could be coordinated by national environmental agencies and transboundary constellations of such agencies; formulated by bodies such as mines inspectorates, national and international experts, and academic institutions in association with key stakeholders, and; conducted by industrial actors within mining and related branches.

- **Capacity building within institutional actors** such as governmental regulatory agencies, mines inspectorates and so forth in order to support legacy management and as preparation for future mining and minerals processing activities. Such work could be formulated and coordinated by international bodies and experts in liaison with national environmental
agencies, and in liaison other key stakeholders. It could be conducted by consortia of international experts and academic institutions in association with national academic institutions.

- **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. Formulation and conduct as above.

- **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. At the current time, such work should likely be limited to a focus upon the specific tasks above. It could be formulated and coordinated by international bodies and experts in liaison with national environmental agencies and academic institutions and conducted by consortia of international experts and academic institutions in association with national academic institutions.

The work activities listed above are couched in general terms. Within this Desk Study, it is also required that guidance is provided regarding future activities to reduce transboundary risk and local risk. The following text seeks to provide ideas in this direction suggested by this analysis.

**Scoping activities to reduce transboundary risk**

The Desk Study has clearly indicated that activities to reduce transboundary 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 cooperation 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 transboundary) for such sites. The potential activities named or 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 transboundary 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 transboundary environmental and regional security issues;

- establishment of transboundary 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, and for the detection of pollution events;

- 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;

- capacity building for governmental and regulatory actors involved, or to be involved in activities such as those listed above.

**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
Risks and vulnerabilities from mining activities

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/or 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 transboundary 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, and for the detection of pollution events;

- National planning for hotspot site remediation and seeking international funding for execution of priority works;

- and so forth, and so on.

6.4.3 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 the Desk Study is required from national actors. One important outcome of the Skopje EnvSec meeting 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 EnvSec activities.

An immediate step is the issue of this report to each NFP for distribution to national experts as identified by each relevant NFP. Each national expert, or expert group should then provide 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 transboundary risks of this type in respective countries.

Capacity building for management of mining related risks

This study has indicated that regional actors lack the necessary capacity to deal with the types of problems addressed by this study. Further, this study indicates that while substantial steps are being taken to strengthen legislative frameworks and capacity, that these also are presently inadequate. It also appears that both in 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 South Eastern Europe and theatre, a number of issues need to be addressed. Among other things, it is considered that a regional forum 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 workshop should be to identify regional priorities for action within two areas: preparing for future mining and minerals processing activities, and; managing risks associated with the legacies of mining and minerals processing activities. Among other things, such a forum 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 the workshop should seek to identify the most urgent capacity building needs. Two sub areas are considered within this: institutional (governmental and regulatory) capacity building and industrial capacity building. Similarly to the priorities for action discussed earlier, the workshop 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 study indicates that better understanding in many areas is required. Examples of such areas are:

• the challenges facing transboundary working groups (inter alia: cross border movement, geographical jurisdiction, sharing and compatibility of data, accountability, funding of activities, and so forth and so on);

• the manner in which gaps in legislative frameworks affect management of sites;

• how lack of institutional capacity limit progress with the management of transboundary 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;
• and so forth and so on.

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.

6.4.4 Closing comments
This desk study has outlined a large of number of risks associated with mining and minerals processing activities in the countries addressed – however, it is the opportunity for improvement in the situation that perhaps should be focused upon. To close this overview report, 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 licence to operate for the minerals sector can flow on from responsible and planned proactivity.

In contrast, tardiness or a reactive approach to management of the types of risks outlined in this study are 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 maximised; tensions with affected communities will tend toward a maximum and centre on themes of mistrust and betrayal. Moreover, the consequences, (and not least 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.
Glossary of Mining/Environment Terminology

For the context of this study, the following definitions are provided for general mining and minerals sector related terminology:

**Acid Deposition** The falling of acids and acid-forming compounds from the atmosphere to the Earth’s surface. Acid deposition is commonly known as acid rain, a term that refers only to wet deposition of droplets of acids and acid-forming compounds. Acid deposition includes the fallout of dry acid-forming compounds.

**Acid Drainage** Also referred to as Acid Mine Drainage (AMD) or Acid Rock Drainage (ARD). Acid drainage arises from the rapid oxidation of sulphide minerals and often occurs when such minerals are exposed to the atmosphere by excavation from the earth’s crust. Incident rainfall or surface water is acidified when acid-forming compounds dissolve. Effects include acid drainage from waste rock stockpiles and tailings, development of acid conditions in exposed surface materials, increased solubility and or release of metals, and increased salinity or solute loads in waters.

**Acidic Water** Water with a pH below 7 but generally referring to pH values of 4 and below. Any water solution where the concentration of hydrogen ions (H⁺) is greater than the concentration of hydroxide ions (OH⁻).

**Aquifer** Porous, water-saturated layers of sand, gravel, or bed rock that can yield an economically significant amount of water.

**Backfill** Material used to fill areas in underground mines made void by the extraction of ore. This material generally comprises coarse sand, rock and cement.

**Beneficiation** Separation of an ore mineral from the waste mineral material.

**Bioavailability** A measure of the availability (number of available pathways for exposure) for toxic substances (such as certain metallic compounds) to contact and affect humans, fauna or flora.

**Biodiversity** Variety of different species (species diversity), genetic variability among individuals within each species (genetic diversity), and variety of ecosystems (ecological diversity).

**BOD Biological Oxygen Demand** Amount of dissolved oxygen needed by aerobic decomposers to break down the organic material in a given volume of water at a certain temperature over a specified time period.

**Carbon Dioxide (CO₂)** A colourless, odourless, tasteless gas, approximately 1.5 times the density of air. The basis for plant respiration. Liberated when vegetable matter rots, burns and when oil and gas are burnt. Bound when plants grow.

**Chlorofluorocarbons (CFCs)** Abbreviation for various chemical compounds containing chlorine, fluorine and carbon. CFCs are produced in industrial processes, contribute to ozone layer depletion and are green house gases in the lower levels of the atmosphere.

**COD, Chemical Oxygen Demand** An indicator of the potential environmental impact of effluents to water. The COD is a laboratory measure of the quantity of oxygen required to oxidise the
constituents of a liquid effluent. The lower the COD, the lower the potential for reduction in the concentration of dissolved oxygen in the receiving water.

**Concentrate** - Concentrate is the product of ore treatment and contains metal at a higher concentration than the source ore. In metallurgical processes for the production of nickel and copper, concentrate is smelted to produce a metallic compound suitable for further refining.

**Cuttings** - Earth and rock removed during a drilling operation to make an exploration hole. Cuttings are invariably contaminated with oil from drilling fluids (oil based and other muds).

**Discharge** - This is used as a general term for all releases of contaminants into the environment, be they gas, liquid, or solid, or a combination thereof. The term “emission” is used exclusively for releases in the atmosphere, “effluent” is restricted to releases into surface waters and “waste” is used for remaining releases, such as disposal to landfill or treatment by incineration. A contaminant is a compound which is present in the environment in concentrations higher than the background level, but not necessarily causing a negative impact.

**Environmental Audit** - A program to evaluate compliance with regulations, systems, programs and policies.

**Environmental Compliance** - When an organisation is in strict compliance with an environmental law(s), regulation, or other regulatory condition imposed on an operation via a licence, approval, consent, environmental impact assessment or other regulatory process.

**Fauna** - Animal life characteristic of a particular region or environment.

**Flora** - Plant life characteristic of a specific geographic region or environment.

**Greenhouse Effect** - Warming of the lower level of the atmosphere (troposphere) as a result of heat radiating from the ground being absorbed by global warming gases.

**Greenhouse Gases** - Or climate change gases, contributing to the global warming effect (carbon dioxide, methane, CFCs, ozone, dinitrogen oxide).

**Groundwater** - All water present below the ground surface. Groundwater fills the voids between soil or rock particles. Groundwater is replenished by surface water infiltration.

**Hazardous Material** - A material which, as a result of its physical, chemical or other properties, poses a hazard to human health or the environment when it is improperly handled, used treated, stored, disposed of, or otherwise managed.

**Hazardous Waste** - Any solid, liquid, or containerised gas that can catch fire easily, is corrosive to skin tissue of metals, is unstable and can explode or release toxic fumes, or has harmful concentrations of one or more toxic material that can leach out.

**Incident** - An unplanned event of chain of events which has, or could have caused injury or illness and/or damage to the environment, third parties or company assets.

**Matte** - Such as nickel matte, a metallic nickel sulphide, containing approximately 75% metal. The material produced by smelting a metal concentrate.

**Methane (CH₄)** - A global warming gas produced by anaerobic decay of organic material. The main component in natural gas. Is often held within coal seams. Conventionally not included in the category of gases called volatile organic compounds.
Mineral (Mineral resource)  Concentration of naturally occurring solid, liquid, or gaseous material, in or on Earth’s crust, in such form and amount that its extraction and conversion into useful materials or items is currently or potentially profitable. Mineral resources are classified as metallic, or non-metallic.

Nitrous Oxides (NO\textsubscript{x}) - A general term for nitrogen oxide gases. These are generally produced by combustion processes and can contribute to the formation of smog and acidification effects.

Non-compliance Environmental non-compliance means to be out of strict compliance with an environmental law, regulation, or other regulatory condition imposed on an operation via a licence, approval, consent, environmental impact assessment or other regulatory process.

Ore Part of a metal yielding material that can be economically and legally extracted. An ore typically contains two parts: the ore mineral, which contains the desired metal, and the waste mineral material (gangue).

Overburden Soil and weathered rock which is excavated and removed to reach underlying ore.

Ozone A reactive form of oxygen. Ozone plays an important role both at ground level and in the upper atmosphere. In the upper atmosphere it acts as a filter for ultraviolet radiation but is destroyed by halogenated hydrocarbons (halons and CFCs). At ground level it is produced by reactions with VOCs and NO\textsubscript{x} and is a constituent of photochemical smog, it is an irritant, can cause breathing difficulties, and can retard the growth of plants.

Ozone Layer Ozone formed in the upper atmosphere (stratosphere) under the effects of solar radiation. This layer absorbs much of the harmful ultraviolet radiation and prevents it from reaching the earth’s surface.

Particulates Fine solid particles which remain individually dispersed in air.

Perfluorinated Carbon Compounds (PFCs) Also known as perfluorocarbons. Global warming gases contributed (principally) by aluminium smelting. The principal PFCs are CF\textsubscript{4} and C\textsubscript{2}F\textsubscript{6}, their global warming potential is 6300 and 12500 CO\textsubscript{2} equivalents respectively. While relatively small volumes are produced, a very significant environmental effect ensues. PFCs are produced during anode effects (AEs), perturbations of current flow at the anode in reduction cells.

Petrochemicals Chemicals obtained by refining crude oil. Used as raw materials in the manufacture of most industrial chemicals, fertilisers, pesticides, plastics, synthetic fibres, paints medicine and many other products.

Recycling Extraction and recovery of valuable materials from scrap or used products.

Rehabilitation Treatment of disturbed areas ultimately leading to stable, vegetated land forms consistent with the previous landforms or an acceptable alternative use.

Sulphuric Acid (H\textsubscript{2}SO\textsubscript{4}) Acid commonly used in industry for the refining of metals, solvent extraction of uranium and in the manufacture of chemicals and fertiliser.

Sulphur Dioxide (SO\textsubscript{2}) A gas that contributes to climate effects, acidification and other air quality problems.

Salinisation Accumulation of salts in soil that can eventually make the soil unable to support plant growth.
Salinity  Amount of various salts dissolved in a given volume of water.

Surplus Rock or Waste Rock  Rock that must be extracted to reach economic ore but does not contain significant commercial mineralisation.

Tailings  Residue from metallurgical processing, mainly comprising finely ground rock. Tailings may contain process chemical residues.

Tailings Retention System  Holding areas for process wastes (tailings), also referred to as Tailings Storage Facilities, Tailings Dams, and Process Waste Storage Facilities.

Topsoil  The upper layer of soil which supports plant growth. Generally the layer containing nutrients, organic matter and seeds.

Toxic Chemical  Chemical compound that is fatal to humans in low doses, or fatal to over 50% of test animals at stated concentrations.

Toxicity  Measure of how harmful a substance is.

Units  k = kilo (thousands - 10^3) as in kilogram (kg), G = giga (billions - 10^9) as in gigajoule (GJ), M = mega (millions - 10^6) as in megajoule (MJ), T = tera (one million million or 10^12) as in terajoule (TJ), ppm = parts per million, ppb = parts per billion.

VOCs  Volatile Organic Compounds. Organic compounds (i.e. compounds of carbon) which evaporate at normal ambient temperatures. In addition to hydrocarbons (i.e. compounds of carbon and hydrogen) VOCs include oxygenated compounds and compounds containing sulphur and halogens. Methane (CH₄) is treated separately by convention. VOCs contribute to the formation of ground level ozone through reaction with NOₓ and sunlight. VOCs can include toxics such as benzene and 1,3-butadiene.

Waste Rock  see Surplus Rock

Water Table  Upper surface of the zone of saturation, in which all available pores in the soil and rock in the sub-surface are filled with water. Also called the phreatic surface.
References


Appendix A  Mining related environmental impacts

The majority of this material is drawn from the 1999 World bank publication *Pollution prevention and abatement handbook 1998: toward cleaner production* (handbook, report #19128). Washington D.C. The handbook was developed by The World Bank Group in collaboration with the United Nations Environment Programme and the United Nations Industrial Development Organization.

Only short excerpts from industry sectors covered in this study have been included here. Significantly more detailed descriptions for the industries can be found in the handbook. For each industrial activity listed here, a short summary of environmental aspects and/or emissions and/or effluents with the potential to damage the environment is provided.

**ALUMINIUM PRODUCTION**

*Air emissions:* alumina dust from handling facilities; coke dust from coke handling; gaseous and particulate fluorides; sulfur and carbon dioxides and various dusts from reduction cells; gaseous and particulate fluorides; sulfur dioxide; tar vapour and carbon particulates from the baking furnace; coke dust, tars, and polynuclear aromatic hydrocarbons (PAHs) from the green carbon and anode-forming plant; carbon dust from the rodding room; and fluxing emissions and carbon oxides from smelting, anode production, casting, and finishing. Electrolytic reduction cells (pot line) are the major source of the air emissions, with the gaseous and particulate fluorides being of prime concern. The anode effect associated with electrolysis also results in emissions of carbon tetrafluoride (CF₄) and carbon hexafluoride (C₂F₆). Emissions numbers that have been reported for uncontrolled gases from smelters are 20–80 kilograms per ton of product (kg/t) for particulates, 6–12 kg/t for hydrogen fluoride, and 6–10 kg/t for fluoride particulates. Corresponding concentrations are 200–800 milligrams per cubic meter (mg/m³); 60–120 mg/m³; and 60–100 mg/m³ (prebaked-technology plant built in 1983).

*Solid waste:* 40–60 kg mixed solid wastes per ton Al, with spent cathodes (spent pot and cell linings) being the major fraction - 50% refractory material and 50% carbon, impregnated with aluminum and silicon oxides (averaging 16% of the carbon lining), fluorides (34% of the lining), and cyanide compounds (about 400 parts per million). Other by-products: skim, dross, fluxing slags, and road sweepings.

*Atmospheric emissions* from secondary aluminum melting: hydrogen chloride and fluorine compounds. Demagging may lead to emissions of chlorine, hexachloroethane, chlorinated benzenes, and dioxins and furans. Chlorinated compounds may also result from the melting of aluminum scrap that is coated with plastic. Salt slag processing emits hydrogen and methane. Solid wastes from the production of secondary aluminum include particulates, pot lining refractory material, and salt slag. Particulate emissions, possibly containing heavy metals, are also associated with secondary aluminium production.

**ALLUVIAL GRAVEL EXTRACTION**

Sediment transport, turbidity, riverbed erosion and flooding

**BAUXITE-ALUMINA PROCESSING**

Geotechnical stability of red mud storage is a concern. Red Mud: a) Wet disposal: washed red mud slurry containing 10–30% solids; b) Dry disposal: red mud 30–50% moisture (thickened tailing disposal). There is also a significant risk of groundwater and surface water pollution. Air emissions: alumina dust and red mud dust.
CEMENT PRODUCTION
Dust generation from: Lime Stone Crusher; Raw Mill; Kiln; Clinker Cooler, Coal Mill; Cement Mill; Packing Plant. Unstable pit/mine workings.

CHROMITE MINING
Unstable tailings impoundments, mine workings, toxic materials in tails containing arsenic, antimony, base metal sulfides and arsenides. May include Mg and Ni, etc.

FERROCHROME PRODUCTION
Particulates: Cr, Fe, Cu and Zn and total ferrochrome dust to atmosphere. Soil contamination by the dust deposited around the smelter. Cr and Fe occurred in the fine particulates of sizes less than 70 µm, Cu and Zn in the coarse particulates of size range 70–100 µm. Other issues include waste/slag dumps and process chemical pollution.

COPPER MINING
Solid waste: overburden (waste-to-ore) ratio for surface mining of metal ores generally ranges from 2:1 to 8:1. Effluents: Mines where ores have high sulphur content: potential for ARD/AMD from mine workings and waste heaps - can have a pH of 3 or lower; sulfate levels of 800–1,800 milligrams per liter (mg/l); copper levels up to 50 mg/l; iron levels up to 1 000 mg/l; lead levels up to 12 mg/l; zinc levels up to 1,700 mg/l; and cadmium levels of several milligrams per litre, depending on the contents of the ore. Particulates: significant levels of dust, above 3 kilograms per ton (kg/t) of ore mined, and ranging from 0.003 to 27 kg/t, may be generated by extraction activities, crushing, ore beneficiation, transport and traffic, and wind-borne losses. Postclosure issues such as the long-term geotechnical stability of the impoundment, the chemical stability of the tailings, long-term surface and groundwater management (including provisions for long-term spillway capacity requirements).

COPPER SMELTING
Solid waste: slag. Wastewater (primary copper production) dissolved and suspended solids Cu, Cd, Pb, Zn, As, Hg, residues from mold release agents (lime or aluminum oxides), fluoride may also be present, often low pH. Wastewater sources: spent electrolytic baths, slimes recovery, spent acid from hydrometallurgy processes, cooling water, air scrubbers, washdowns, stormwater, and sludges from wastewater treatment processes. Particulate emissions range 0.1 kg/t of copper to as high as 20 kg/t - Cu, Fe compounds; sulfides, sulfates, oxides, chlorides; fluorides of arsenic, antimony, cadmium, lead, mercury, and zinc.

IRON ORE MINING
Solid waste: overburden (waste-to-ore) ratio for surface mining of metal ores generally ranges from 2:1 to 8:1. Wastewater: Mines where ores have high sulphur content: potential for ARD/AMD from mine workings and wasteheaps - can have a pH of 3 or lower; sulfate levels of 800–1,800 milligrams per liter (mg/l); copper levels up to 50 mg/l; iron levels up to 1 000 mg/l; lead levels up to 12 mg/l; zinc levels up to 1,700 mg/l; and cadmium levels of several milligrams per liter, depending on the contents of the ore. Particulates: Significant levels of dust, above 3 kilograms per ton (kg/t) of ore mined, and ranging from 0.003 to 27 kg/t, may be generated by extraction activities, crushing, ore beneficiation, transport and traffic, and wind-borne losses. Postclosure issues such as the long-term geotechnical stability of the impoundment, the chemical stability of the tailings, long-term surface and groundwater management (including provisions for long-term spillway capacity requirements).

STEEL PRODUCTION
Blast furnace - particulate emissions, slag. Coke ovens - volatile materials released during coking incl. by-products ammonia, benzol, xylene, toluene, tar, pitch and tar acids. The operations are associated
with fugitive and stack emissions. PAH compounds released as fugitive emissions are carcinogenic in nature. Sintering plant - particulate emissions.

**MAGNESITE MINING**

Unfavourable influence on soil, water, air and biota. Predominantly alkalization of soil horizons, water and biosphere, unstable mine workings, airborne particulates, noise pollution and vibration.

**NICKEL SMELTING**

**Sulphidic ores:** Blast furnace operations, reverberatory furnace (old technologies), flash furnace. Copper present. Sulfur dioxide (SO\textsubscript{2}) is a major air pollutant emitted in the roasting, smelting, and converting of sulfide ores. (Nickel sulfide concentrates: 6–20% nickel and up to 30% sulfur.) SO\textsubscript{2} releases as high as 4 t/t-nickel produced, before controls. Reverberatory furnaces and electric furnaces produce SO\textsubscript{2} concentrations of 0.5–2.0%, while flash furnaces produce SO\textsubscript{2} concentrations of over 10%. Particulate emission loads: 2.0–5.0 kilograms per metric ton (kg/t) multiple hearth roaster; 0.5–2.0 kg/t fluid bed roaster; 0.2–1.0 kg/t electric furnace; 1.0–2.0 kg/t Pierce-Smith converter; and 0.4 kg/t dryer upstream of the flash furnace. Ammonia and hydrogen sulfide are pollutants associated with the ammonia leach process; hydrogen sulfide emissions are associated with acid leaching processes. Process bleed streams may contain antimony, arsenic, or mercury. **Refining of nickel matte:** fluid bed roasting and chlorine-hydrogen reduction produce high-grade nickel oxides (more than 95% nickel). Vapor processes such as the carbonyl process can be used to produce high-purity nickel pellets. Lateritic ores (hydrated nickel oxides) are smelted in electric furnaces. While many of the above impacts are relevant, the essential absence of sulphur removes many acidification issues.

**LEAD/ZINC SMELTING**

Particulate matter & SO\textsubscript{2}: Fugitive emissions at furnace openings, launders, casting molds, and ladles. Additional fugitive particulates: materials handling and transport. Particulate matter: lead/zinc and iron oxides, but oxides As, Sb, Cd, Cu, Hg + metallic sulfates. Dust from raw materials handling contains metals, mainly in sulfidic form. Air emissions for processes with few controls may be of the order of 30 kg Pb or Zn/t lead or zinc produced. Emissions of arsine, chlorine, and hydrogen chloride vapors and acid mists are associated with electrorefining. **Scrubber effluents:** Pb, Zn, As, etc. Wastewater from spent electrolytic baths, slimes recovery, spent acid from hydrometallurgy processes, cooling water, air scrubbers, washdowns, and stormwater. Pollutants include dissolved and suspended solids, metals, and oil and grease. Discard slag up to 0.7% lead/zinc. up to 3 tons of solid waste per ton of lead/zinc produced.

**LIGNITE MINING**

Impacts include massive disturbances of large areas of land and possible disruption of surface and groundwater patterns. Acid mine drainage (AMD) can be a major problem. Fugitive dust and disposal of overburden and waste rock are common problems. Methane generation and release possible under certain geological conditions. Potential for serious pollution from highly saline or highly acidic water exists. Beneficiation plants produce large volumes of tailings and solid wastes. Storage and handling of coal generates dust up to 3 kg/t of coal mined, with the ambient dust concentration ranging from 10 to 300 micrograms per cubic meter (µg/m\textsuperscript{3}) above the background level at the mine site.

**GAS PRODUCTION**

Drilling-waste muds may be freshwater gel, salt water (potassium chloride or sodium chloride), or oil invert–based systems. Oil invert mud systems may contain up to 50%, by volume, of diesel oil. Drilling wastes may contain drilling muds (bentonite), borehole cuttings, additives (polymers, oxygen scavengers, biocides, and surfactants), lubricants, diesel oil, emulsifying agents, and various other wastes that are specifically related to the drilling activities. Drilling-waste solids, may contain drill cuttings,
flocculated bentonite, and weighting materials and other additives. Additional wastes from the drilling process include used oils, cementing chemicals, and toxic organic compounds.

Field processing of crude oil and gas generates several waste streams, including contaminated wastewater, tank bottoms that may contain lead, emulsions, and heavy hydrocarbon residues, which may contain polynuclear aromatic hydrocarbons (PAHs). Cooling tower blowdown, boiler water, scrubber liquids, and steam production wastes are also generated, as well as contaminated soil, used oil, and spent solvents. Toxic metals include antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, vanadium, and zinc.

Air emissions include fired equipment, vents, flares (including those from compressor stations), and fugitive emissions. The emissions may contain volatile organic compounds (VOCs), sulfur oxides (SOx), hydrogen sulfide, and nitrogen oxides (NOx).

**OIL PRODUCTION**

Drilling-waste muds may be freshwater gel, salt water (potassium chloride or sodium chloride), or oil invert–based systems. Oil invert mud systems may contain up to 50%, by volume, of diesel oil. Drilling wastes may contain drilling muds (bentonite), borehole cuttings, additives (polymers, oxygen scavengers, biocides, and surfactants), lubricants, diesel oil, emulsifying agents, and various other wastes that are specifically related to the drilling activities.

Drilling-waste solids, may contain drill cuttings, flocculated bentonite, and weighting materials and other additives. Additional wastes from the drilling process include used oils, cementing chemicals, and toxic organic compounds.

Field processing of crude oil generates several waste streams, including contaminated wastewater, tank bottoms that may contain lead, emulsions, and heavy hydrocarbon residues, which may contain polynuclear aromatic hydrocarbons (PAHs). Cooling tower blowdown, boiler water, scrubber liquids, and steam production wastes are also generated, as well as contaminated soil, used oil, and spent solvents. Toxic metals include antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, vanadium, and zinc.

Air emissions include fired equipment, vents, flares (including those from compressor stations), and fugitive emissions. The emissions may contain volatile organic compounds (VOCs), sulfur oxides (SOx), hydrogen sulfide, and nitrogen oxides (NOx).

**OIL & GAS REFINING.**

Per ton of crude processed, approximately as follows:

**Particulate matter:** 0.8 kilograms (kg), ranging from less than 0.1 to 3 kg.

**Sulfur oxides:** 1.3 kg, ranging 0.2–06 kg; 0.1 kg with the Claus sulfur recovery process.

**Nitrogen oxides:** 0.3 kg, ranging 0.06–0.5 kg. Petroleum Refining

**Benzene, toluene, and xylene (BTX):** 2.5 grams (g), ranging 0.75 to 6 g; 1 g with the Claus sulfur recovery process. Of this, about 0.14 g benzene, 0.55 g toluene, and 1.8 g xylene may be released per ton of crude processed. VOC emissions depend on the production techniques, emissions control techniques, equipment maintenance, and climate conditions. Circa 1 kg per ton of crude processed (ranging from 0.5 to 6 kg/t of crude).

Petroleum refineries use relatively large volumes of water, especially for cooling systems. Surface water runoff and sanitary wastewaters are also generated. As a general guide, approximately 3.5–5 cubic meters (m3) of wastewater per ton of crude are generated when cooling water is recycled. Refineries generate polluted wastewaters, containing biochemical oxygen demand (BOD) and chemical oxygen
demand (COD) levels of approximately 150–250 milligrams per liter (mg/l) and 300–600 mg/l, respectively; phenol levels of 20–200 mg/l; oil levels of 100–300 mg/l in desalter water and up to 5,000 mg/l in tank bottoms; benzene levels of 1–100 mg/l; benzo(a)pyrene levels of less than 1 to 100 mg/l; heavy metals levels of 0.1–100 mg/l for chrome and 0.2–10 mg/l for lead; and other pollutants. Solid wastes and sludges (ranging from 3 to 5 kg per ton of crude processed), 80% of which may be considered hazardous because of the presence of toxic organics and heavy metals. Toxic metals include antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, vanadium, and zinc.
Appendix B  Institutional Attendees, Skopje Workshop

Attendees at the “Environment and Security Consultations in South Eastern Europe”, held in Skopje, the Former Yugoslav Republic of Macedonia, on 23-24 September 2004 are tabulated overleaf.

This list of regional and international actors constitutes a central contact resource for matters revolving around risks associated with mining and minerals processing related sites, and around transboundary pollution risks in general for the region addressed by this study.
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Appendix C  Albanian Institutions

In addition to the institutions named in Chapter 4 and included in Appendix B, the following actors were identified during the study.

Institutions working with environment in Albania

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<tr>
<td>4. Institute of Public Health</td>
<td>Tel: ++355 42 62731</td>
</tr>
<tr>
<td>Rruga “A. Motti”, Tirana-Albania</td>
<td></td>
</tr>
<tr>
<td>5. Ministry of Construction and Tourism</td>
<td>Tel: ++355 42 27879</td>
</tr>
<tr>
<td>Sheshi “Skenderbej”, Tirana-Albania</td>
<td></td>
</tr>
<tr>
<td>6. Ministry of Agriculture and Food</td>
<td>Tel: ++355 42 27924</td>
</tr>
<tr>
<td>Tirana-Albania</td>
<td></td>
</tr>
<tr>
<td>7. Ministry of Industry and Transport</td>
<td>Tel: ++355 42 27713</td>
</tr>
<tr>
<td>Rruga “S. Toptani”, Tirana-Albania</td>
<td></td>
</tr>
<tr>
<td>8. Institute of Forestry</td>
<td>Tel: ++355 42 33343</td>
</tr>
<tr>
<td>Rruga “Dibër”, Tirana-Albania</td>
<td></td>
</tr>
<tr>
<td>9. Ministry of Health and Environment Protection</td>
<td>Tel: ++355 42 32937</td>
</tr>
<tr>
<td>Bulevardi “Zhan D’Arc”, Tirana-Albania</td>
<td></td>
</tr>
<tr>
<td>10. Institute of Geology and Mines</td>
<td>Tel: ++355 42 26597</td>
</tr>
<tr>
<td>Rruga “Deshmoret e Lirise”</td>
<td></td>
</tr>
<tr>
<td>Tirana-Albania</td>
<td></td>
</tr>
<tr>
<td>11. Seismological Centre</td>
<td>Tel: ++355 42 28274</td>
</tr>
<tr>
<td>Rruga “Mine Peza”, 140</td>
<td></td>
</tr>
<tr>
<td>Tirana-Albania</td>
<td>Fax: ++355 42 28274</td>
</tr>
<tr>
<td>12. Center for Hydraulic Research</td>
<td>Tel: ++355 42 26541</td>
</tr>
<tr>
<td>Rruga “Sam Frashëri” no.5, Tirana-Albania</td>
<td>Fax: ++355 42 26541</td>
</tr>
<tr>
<td>13. Institute of Statistics</td>
<td>Tel: ++355 42 22411</td>
</tr>
<tr>
<td>Rruga “Lek Dukagjini”, no.5, Tirana-Albania</td>
<td>Fax: ++355 42 28300</td>
</tr>
<tr>
<td>14. Institute of Military Photography (aerial photography), Tirana-Albania</td>
<td>Tel: ++355 42 28470</td>
</tr>
<tr>
<td></td>
<td>Fax: ++355 42 28470</td>
</tr>
<tr>
<td>15. Public Health and Environment Sector Directorate, Sheshi “Skenderbej”,</td>
<td>Tel: ++355 42 25120</td>
</tr>
<tr>
<td>Bashkia “Tirane”, Tirana-Albania</td>
<td>Fax: ++355 42 25120</td>
</tr>
</tbody>
</table>

Source: Samimi et al (1997)
### Institutions working with environment in Albania

<table>
<thead>
<tr>
<th>Institution</th>
<th>Contact details</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 Department of Environmental Geology</td>
<td>Tel: ++355 42 22592 Fax: ++355 42 22592</td>
</tr>
<tr>
<td>Faculty of Engineering, Polytechnic University</td>
<td></td>
</tr>
<tr>
<td>Tirana-Albania</td>
<td></td>
</tr>
<tr>
<td>17 Department of Environment Engineering</td>
<td>Tel: ++355 42 23793 Fax: ++355 42 23707</td>
</tr>
<tr>
<td>Faculty of Engineering, Polytechnic University</td>
<td></td>
</tr>
<tr>
<td>Tirana-Albania</td>
<td></td>
</tr>
<tr>
<td>18 Regional Agency for Environment</td>
<td>Tel: ++355 42 26828 Fax: ++355 42 26828</td>
</tr>
<tr>
<td>Rruga “Q. Stafa”, Tirana-Albania</td>
<td></td>
</tr>
<tr>
<td>19 Department of Geography</td>
<td>Tel: ++355 224 43747 Fax: ++355 224 43747</td>
</tr>
<tr>
<td>University “Luigi Gurakuqi”, Shkoder-Albania</td>
<td></td>
</tr>
<tr>
<td>20 Department of Geography</td>
<td>Tel: ++355 726 3858 Fax: ++355 726 3858</td>
</tr>
<tr>
<td>University “E. Cabez”, Gjirokastra-Albania</td>
<td></td>
</tr>
<tr>
<td>21 Department of Geography</td>
<td>Tel: ++355 824 2580 Fax: ++355 834 2230</td>
</tr>
<tr>
<td>University “F. Noli”, Korca-Albania</td>
<td></td>
</tr>
<tr>
<td>22 Department of Geography</td>
<td>Tel: ++355 5459? Fax: ++355 5459?</td>
</tr>
<tr>
<td>University “A. Xhuvani”, Elbasan-Albania</td>
<td></td>
</tr>
<tr>
<td>23 Department of Geography</td>
<td>Tel: ++355 42 24109 Fax: ++355 42 24109</td>
</tr>
<tr>
<td>University, Faculty of History &amp; Philosophy, Rruga “Elbasanit” Tirana-Albania</td>
<td></td>
</tr>
<tr>
<td>24 Regional Agency of the Environment</td>
<td>Tel: ++355 ????? Fax: ++355 ?????</td>
</tr>
<tr>
<td>Council of the District, Berat-Albania</td>
<td></td>
</tr>
<tr>
<td>25 Regional Agency of the Environment</td>
<td>Tel: ++355 ????? Fax: ++355 ?????</td>
</tr>
<tr>
<td>Council of the District, Shkodra-Albania</td>
<td></td>
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<tr>
<td>26 Regional Agency of the Environment</td>
<td>Tel: ++355 ????? Fax: ++355 ?????</td>
</tr>
<tr>
<td>Council of the District, Lac-Albania</td>
<td></td>
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<tr>
<td>27 Regional Agency of the Environment</td>
<td>Tel: ++355 574 2866 Fax: ++355 574 2866</td>
</tr>
<tr>
<td>Council of the District, Kavaja-Albania</td>
<td></td>
</tr>
<tr>
<td>28 Regional Agency of the Environment</td>
<td>Tel: ++355 ??? Fax: ++355 ???</td>
</tr>
<tr>
<td>Fushe-Arrez, Puke-Albania</td>
<td></td>
</tr>
<tr>
<td>29 General Directory of the Water Utilization Sheshi “Skenderbej”, Tirana-Albania</td>
<td>Tel: ++355 42 27148 Fax: ++355 42 27148</td>
</tr>
</tbody>
</table>

Source: Samimi et al (1997)
### NGOs in Albania

<table>
<thead>
<tr>
<th>Non Governmental Organisation (NGO)</th>
<th>Contact details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 National Geographical Committee (IGU), Qendra e Studimeve Gjeografike Rruga “ Murat toptani” Nr.11 Tirana - Albania</td>
<td>Tel: ++355 42 27985 Fax: ++355 42 27985</td>
</tr>
<tr>
<td>2 National Cartographic Committee (Join ICA) Qendra e Studimeve Gjeografike Rruga ” Murat toptani “ Nr.11 Tirana - Albania</td>
<td>Tel: ++355 42 27985 Fax: ++355 42 27985</td>
</tr>
<tr>
<td>3 Albanian Association of Engineers, Geologists and Geoscientists, Institute of Geology, Bll “Vasil Shanto “ Tirana – Albania</td>
<td>Tel: ++355 42 26597 Fax: ++355 42 ??</td>
</tr>
<tr>
<td>4 Mass Media association and the Environment Rruga “G. Domi” Pall 2 shk. 2/21 Tirana - Albania</td>
<td>Tel office: ++355 42 30314 Tel Priv. ++355 42 64100</td>
</tr>
<tr>
<td>5 Environment Center of Administration and Technology - ECAT Rruga “A. Frasheri “ P16, Shk. 6/53, Tirana - Albania</td>
<td>Tel: ++355 42 23930 Fax: ++355 42 23930</td>
</tr>
<tr>
<td>6 Albanian Civil Society Foundation Rruga “ Asim Vokshi “ vila 137 , Tirana - Albania</td>
<td>Tel: ++355 42 23564 Fax: ++355 42 23564 mobile 038 2020 482 e-mail: <a href="mailto:postmaster@acsf.Tirana.Al">postmaster@acsf.Tirana.Al</a></td>
</tr>
<tr>
<td>7 Albanian Open Foundation - SOROS Rruga “Mihal Duri “ Nr.15 Tirana – Albania</td>
<td>Tel: ++355 42 34621 Fax: ++355 42 34621</td>
</tr>
<tr>
<td>8 Organization for Education Resources and Technical Training ( ORT - USA ) Rruga “Vaso Pasha” No.4, Tirana – Albania</td>
<td>Tel &amp; Fax: ++355 42 23564 email: <a href="mailto:ortdemonet@aol.com">ortdemonet@aol.com</a> &amp; <a href="mailto:guest@demnet.Tirana.Al">guest@demnet.Tirana.Al</a></td>
</tr>
<tr>
<td>9 American Agency for the development ( USAID )</td>
<td>Tel: ++355 42 3075 Fax: ++355 42 3075</td>
</tr>
</tbody>
</table>

Source: Samimi et al (1997)
NGOs in Albania

10 International Culture Center, Kati i II, Tirana – Albania
Tel: ++355 42 28777
Fax: ++ 355 42 28777

11 Youth Club of Environment - PERLA, Faculty of the Natural Sciences, Tirana - Albania
Tel Office: ++355 42 25454
Tel. Priv: ++ 355 42 25018

12 Environmental Youth Club, Gjimnazi “ Santi Frasheri”, Tirana - Albania
Tel: ++355 42 25873
Fax: ++ 355 42 23116

13 The association “Young ecologists”
Gjimnazi “ Santi Frasheri”, Rruga e Barrikadave, Tirana – Albania
Tel office: ++355 42 25873
Tel. Priv: ++ 355 42 24020

14 Scientific Association of Forestry Students, University of Bujqesor, Tirana - Albania
Tel: ++355 42 25360

15 Environment and Development Society, Institute of Hydrometeorology, Rruga e Durresit, 219, Tirana – Albania
Tel: ++355 42 23518
Fax: ++ 355 42 23518

16 Albanian Speleolog Society
Rruga “Konstandin Kristoforidhi” Nr. 16, Tirana – Albania
Tel priv. ++355 42 33244
Fax: ++ 355 42 32800

17 Association of Water Maintenance and Protection, Institute of Hydrometeorology, Rruga e Durresit, 219, Tirana – Albania
Tel & Fax ++355 42 23518
Tel Priv. ++ 355 42 27990

18 National Society of Flora and Fauna
Rruga “Kostandini Kristoforidhi” Nr.16, Tirana – Albania
Tel priv. ++355 42 33244
Fax: ++ 355 42 32800

19 Protection and Maintenance of the Natural Environment of Albania, Rruga “Asim Vokshi” Pall 13, Shk 4/7, Tirana - Albania
Tel: ++355 42 27342
Fax: ++ 355 42 27342

20 Albanian Ecology Club
Rruga “ Todi Shkurti” Pall 13, Shk 4/32, Tirana - Albania
Tel: ++355 42 27342
Fax: ++ 355 42 27342

Source: Samimi et al (1997)
Appendix D  Institutions in Bosnia & Herzegovina

In addition to the institutions named in Chapter 4 and included in Appendix B, the following actors were identified during the study.

Federal Ministry of Energy, Mining & Industry of Bosnia-Herzegovina

Alipasina 41
BA-71000 Sarajevo
BOSNIA-HERZOGOVINA
Tel: +38733200142 Fax: +38733220619


Geology Institute in Bosnia and Herzegovina.

Geološki zavod Bosne i Hercegovine
Ustanicka 11, 71210 Ilidža (Sarajevo)
Tel/Fax +387-33-621.567

NGO Center for Environmentally Sustainable Development

http://www.coor.ba/en/

Mr. Branko Vucijak
Tel.: +387 33 207 949
Tel: +387 33 212 466
branko.vucijak@heis.com.ba
Appendix E  Institutions in the FYR of Macedonia

In addition to the institutions named in Chapter 4 and included in Appendix B, the following actors were identified during the study.

Data missing.
Appendix F    Institutions in Serbia & Montenegro

In addition to the institutions named in Chapter 4 and included in Appendix B, a range of actors, and sources of information about them were identified during the study.

Internet Addresses for Ministries and government institutions – Federal Republic of Yugoslavia

Archives of Yugoslavia: http://www.gov.yu/arhiv/


Federal Customs Service: http://www.fcs.yu/

Federal Hydrometeorological Institute: http://www.meteo.yu/


Standardisation: http://www.jus.org.yu

Internet Addresses for Ministries and government institutions – Serbia


City of Nis: http://www.nis.org.yu/indexe.html


Ministry for Liaisons with Serbs outside Serbia: http://www.srbisvet.org.yu/

Ministry for Youth and Sport: http://www.minsport.org.yu/

Ministry of Information: http://www.srbija-info.yu/

The Serbian government: http://www.serbia.sr.gov.yu/facts/

**Internet Addresses for Ministries and government institutions – Montenegro**

Assembly of the Republic of Montenegro: http://www.skupstina.cg.yu/

Development Fund of the Republic of Montenegro: http://www.fzrreg.cg.yu/


Hydrometeorological Office of Montenegro: http://www.meteo.cg.yu/

President of the Republic of Montenegro: http://www.predsjednik.cg.yu/

Privatization Council of the Republic of Montenegro: http://www.savjet.org/

Republic of Montenegro: http://www.montenegro.yu/

Republican Seismological Office of Montenegro: http://www.seismo.cg.yu/


Institute of Marine Biology in Kotor: http://www.biokotor.org/indexe.htm

Russian and East European Network Information Center: http://reenic.utexas.edu/reenic/countries/yugoslavia.html


UNEP Balkans: http://balkans.unep.ch/

USAID: http://www.usaid.gov/

Other contacts of interest found during the conduct of this desk study include:

**Ministry for the Protection of the Natural Resources and Environment Republic of Serbia**

*Mailing address:* Nemanjina 22-26, 11000 Belgrade, Serbia and Montenegro  
*Phone:* +381 11 361 63 68  
*Fax:* +381 11 158 793  
*E-mail:* ekabin@ekoserb.sr.gov.yu

**Hydro-Meteorological Institute of Republic of Serbia**

*Mailing address:* Kneza Višeslava 66, 11000 Belgrade, Serbia and Montenegro  
*Phone:* +381 11 545 093

**City Institute for Public Health Belgrade**

*Mailing Address:* 29 novembra 54a, 11000 Belgrade, Serbia and Montenegro  
*Phone:* +381 11 323 39 76  
*Fax:* +381 11 322 78 28  
*E-mail:* gzdir@eunet.yu

**Institute for Public Health of Serbia**
Address: Doktora Subotica 5, 11000 Belgrade, Serbia and Montenegro
Phone: +381 11 684 566
Website: www.batut.org.yu

Institute for Nature Conservation of Serbia
Address: III Bulevar 106, 11070 New Belgrade, Serbia and Montenegro
Phone: +381 11 138 062
Fax: +381 11 142 281
Website: www.natureprotection.org.yu

Institute of Soil Science
Address: Teodora Drajzera 7, 11000 Belgrade, Serbia and Montenegro
Phone: +381 11 667 199
Fax: +381 11 667 175
Website: www.soilinst.co.yu
E-mail: soilscis@eunet.yu

VINCA Institute of Nuclear Sciences
Address: Mihajla Petrovica Alasa 12-14, 11000 Belgrade, Serbia and Montenegro
Phone: +381 11 458 222
Fax: +381 11 444 08 71
Website: www.vin.bg.ac.yu

Clinical center of Serbia – Institute for Labour Medicine and Radiological Protection
Address: Deligradska 29, 11000 Belgrade, Serbia and Montenegro
Phone: +381 11 361 50 79
Website: www.kcs.ac.yu

Recycling Agency
Address: Masarikova 5/XIV, 11000 Belgrade, Serbia and Montenegro
Phone: +381 11 683 253
Fax: +381 11 683 253
Website: www.reciklaza.sr.go.yu
E-mail: reciklaza@www.yu

Institute for Forestry
Address: Kneza Višeslava 3, 11000 Belgrade, Serbia and Montenegro
Phone: +381 11 553 454
Fax: +381 11 545 969
E-mail: inszasum@eunet.yu

Geoinstitute
Address: Rovinjska 12, 11000 Belgrade, Serbia and Montenegro
Phone: +381 11 488 99 66
Fax: +381 11 488 52 96
E-mail: geoins@eunet.yu, geoins@tehnicom.net
Provincial Secretariat for the Environment and Development
*Address:* Bulevar Mihajla Pupina 16, 21000 Novi Sad, Vojvodina
*Phone:* +381 21 456 238, +381 21 424 305
*Fax:* +381 21 456 238, +381 21 424 305
*Website:* www.eco.vojvodina.sr.gov.yu
*E-mail:* ekolog@nspoint.net, pivconki@eunet.yu

PE “Geozavod”
*Address:* Karadordeva 48, 11000 Belgrade, Serbia and Montenegro
*Phone:* +381 11 3283 272, +381 11 180 931, +381 11 3283 383
*Fax:* +381 11 638 241
*E-mail:* hgp@beotel.yu

PE “Geozavod-Gemini”
*Address:* Karadordeva 48, 11000 Belgrade, Serbia and Montenegro
*Phone:* +381 11 328 32 85, +381 11 625 063
*Fax:* +381 11 631 052
*E-mail:* pzdevon@eunet.yu

PE “Geozavod-Nemetan”
*Address:* Karadordeva 48, 11000 Belgrade, Serbia and Montenegro
*Phone:* +381 11 3283 160
*Fax:* +381 11 3283 161
*E-mail:* gzvnemet@eunet.yu

PE “Geozavod-IMS”
*Address:* Karadordeva 48, 11000 Belgrade, Serbia and Montenegro
*Phone:* +381 11 628 409, +381 11 626 968
*Fax:* +381 11 630 118
*E-mail:* geozons@ptt.yu
Appendix G  Desk Study Mapping Outputs

- SEE mining sites and water basins
- SEE mining sites and protected areas
- SEE metal beneficiation (milling, concentration) facilities
- SEE smelter and refinery facilities
- SEE metalliferous mine facilities
- SEE coal mine facilities
- SEE oil and gas related operations