ADVISORY ASSISTANCE PROGRAMME (AAP)

of

the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection

Project No. 154973

Project: “Improving the safety of tailings management facilities in Kyrgyzstan”

Improving the safety of tailings management facilities in Kyrgyzstan

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Report completed in January 2022

Tailing management facility of the Altynken mine in Kyrgyzstan
(Source: Riedl Oleksandra)

This project was financed by the German Federal Environment Ministry's Advisory Assistance Programme (AAP) for environmental protection in the countries of Central and Eastern Europe, the Caucasus and Central Asia and other countries neighbouring the EU. It was supervised by the German Environment Agency.

The responsibility for the content of this publication lies with the authors.

Umwelt Bundesamt

Federal Ministry
for the Environment, Nature Conservation
and Nuclear Safety

Abstract: Improving the safety of tailings management facilities in Kyrgyzstan

Mining activities are an extremely important branch of the economy in the Kyrgyz Republic, which contributes significantly to the gross national product of the entire country. Despite the Kyrgyz Republic has rich deposits of mineral resources, the retention of mine waste has very low safety levels, with a corresponding risk to people and the environment in the vicinity of these facilities. Improperly designed, handled, or managed tailings management facilities (TMFs) pose a threat which could trigger industrial accidents, including accidents with transboundary effects.

The objectives of the project were to narrow knowledge gaps and raise awareness related to TMF safety and TMF's hazards and risks in the Kyrgyz Republic according to the UNECE Convention on the Transboundary Effects of Industrial Accidents.

The project contributed to strengthen the technical and management capacity at the concerned facilities and responsible authorities by providing them with practical tools. Moreover, a previously developed Checklist methodology was updated and enhanced to evaluate TMF safety conditions and recommend measures to improve them. Competent authorities, TMF operators, concerned stakeholders and the public in the Kyrgyz Republic are encouraged to apply these tools.

Moreover, an inventory of Kyrgyz TMFs was complied, which includes both TMF mapping and risk assessment. Finally, the main steps to update the state cadastral system, alert system were defined and the TMFs with possible transboundary impacts were identified. In addition, an instructional video on the application of the TMF methodology was developed.

Finally, the project team together with the representatives of competent authorities has developed the policy recommendations for the Kyrgyz Republic to ensure sustainable use of project results and ensure the safety of TMFs in the future.

This report presents the outcomes of the project.

Kurzbeschreibung: Sicherheit von Rückhaltebecken (TMFs) in Kirgistan

Bergbauaktivitäten stellen einen besonders wichtigen Wirtschaftszweig in der Republik Kirgistan dar, welcher erheblich zum Bruttoinlandsprodukt des gesamten Landes beiträgt. Ungeachtet der Tatsache, dass die Republik Kirgistan über reiche Lagerstätten von Bodenschätzen verfügt, sind die Sicherheitsstandards für die Lagerung von Bergbauabfällen und Minen-Rückständen sehr niedrig, was mit einem dementsprechend erhöhtem Risiko für Bevölkerung und Umwelt im Bereich dieser Anlagen verbunden ist. Von unsachgemäß geplanten, bedienten und geführten Rückhaltebecken (TMFs), können gefährliche Industrieunfälle auslöst werden, inklusive solcher mit grenzüberschreitenden Auswirkungen. Diese Anlagen stellen also eine Gefahr und ein Risiko für Mensch und Umwelt dar.

Die Ziele des Projekts waren Wissenslücken zu schließen und das Bewusstsein in Bezug auf die Sicherheit von TMFs sowie deren Gefahren und Risken in der Republik Kirgistan, entsprechend der UNECE-Konvention über grenzüberschreitende Auswirkungen von Industrieunfällen, zu erhöhen.

Das Projekt hat zur Stärkung der technischen und Managementkapazitäten in den betroffenen Einrichtungen und zuständigen Behörden beigetragen, indem ihnen praktische Instrumente zur Verfügung gestellt wurden. Darüber hinaus wurde eine zuvor entwickelte Checklistenmethodik aktualisiert und verbessert, um die Sicherheitsbedingungen von TMFs zu bewerten und Maßnahmen zu deren Verbesserung empfehlen zu können. Die zuständigen Behörden, die Betreiber von Rückhaltebecken, andere betroffene Stakeholder sowie die Bevölkerung der Republik Kirgistan sind ermutigt, von diesen Instrumenten Gebrauch zu machen.

Darüber hinaus konnte eine Bestandsaufnahme von kirgisischen TMFs erstellt werden, welche sowohl die Kartierung von TMFs, also auch derenRisikoeinschätzung inkludiert. Schlussendlich wurden die wichtigsten Schritte zur Aktualisierung des staatlichen Katastersystem sowie des Warnsystems definiert und die Rückhaltebecken mit möglichen grenzüberschreitenden Auswirkungen identifiziert. Außerdem wurde ein Lehrfilm über die Anwendung der TMF-Methodik entwickelt.

Schlussendlich wurden vom Projektteam, gemeinsam mit Vertretern der zuständigen Behörden Strategieempfehlungen erarbeitet, auf deren Basis die nachhaltige Nutzung der Projektergebnisse sowie der Sicherheit von TMFs in der Zukunft sichergestellt werden sollen.

Dieser Bericht präsentiert die Ergebnisse des Projekts.

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List of abbreviations

AAP	Advisory Assistance Programme
CIS	Co-operative Insurance Society
CA	Competent authorities
DDPSSES MH	Department of Disease Prevention and State Sanitary and Epidemiological Surveillance of the Ministry of Health
EIA	Environmental Impact Assessment
IAEA	The International Atomic Energy Agency
KG	Kyrgyz Republic
MES	Ministry of Emergency Situations of the Kyrgyz Republic
MH	Ministry of Health
MNRETS (former SAEPF)	Ministry of Natural Resources, Ecology and Technical Supervision (The State Agency for Environmental Protection and Forestry under the Government of the Kyrgyz Republic)
NGO	Non-governmental organization
SCIES	The State Committee for Industry, Energy and Subsoil Use (Mining)
SIETS	The State Inspectorate for Environmental and Technical Safety
SWG	Standards waste generation
TRI	Tailings Risk Index
TEI	Tailings Exposure Index
TEIEnv	Environment Exposure
TEIPop	Population Exposure
THI	Tailings Hazard Index
THICap	Tailings capacity
THIDam	Dam conditions
THIFlood	Flood hazard
THIMan	Management conditions
THINat	Total natural conditions
THISeism	Seismic hazard
THITox	Tailings toxicity
TMF	Tailings management facilities
TRI	Tailings Risk Index
UBA	German Environment Agency
UNECE	United Nations Economic Commission for Europe
USSR	Union of Soviet Socialist Republics
WHC	Water hazard classes

Summary

Over the past years, the problem of environmental protection and sustainable development continues to occupy one of the first places in the list of global priorities of the international community. At the same time, mineral production is expected to skyrocket in the coming decades, including a corresponding increase in the number of TMFs, as smart and advanced technologies will spike demand for certain metals and gold. Thus, society may face a growing risk of TMFs failures, with potential casualties and environmental damage, if TMFs safety is not adequately ensured, i.e., in line with strict requirements and respective measures that consider climate change. Unfortunately, we might have to face up to 1% of all TMFs having dramatic failures as analysis of past accidents demonstrate.

The mountains of Kyrgyzstan contain deposits of various minerals, the development of which makes a significant contribution to economic development. Many mines and other facilities in Kyrgyzstan are located within the settlements, in the basins of the transboundary rivers. In the past, when designing TMFs, long-term measures to protect the facilities from hazardous natural processes or measures to protect the population were not envisaged. As a result, there is a high probability that during the accident at a TMF not only the territory of the Kyrgyz Republic may be affected but also the territories of the Republic of Kazakhstan, the Tajik Republic, and the Republic of Uzbekistan with a total population of up to 5 million people.

Therefore, it is important to strengthen the safety, not only of existing but also of new tailings facilities in Kyrgyzstan, in order to prevent the accidental release of hazardous substances into the environment.

To ensure the safety management of tailing management facilities, the land-use planning aspects such as risk zones should be considered and the national standards and warning systems should be up to date. For these, the thresholds for the transboundary warning and alert system have been proposed and agreed upon.

A number of meetings and seminars were organised during the project implementation, which were attended by representatives of government agencies, NGOs and operators of several TMFs. Based on the discussion, the representatives of the responsible authorities and ministries discussed the optimal approach to applying the TMF methodology and the opportunities that exist for the sustainable transfer of this knowledge to the administrative structures of Kyrgyzstan. Besides, based on the recommendations which were made during the meetings, a list of services was compiled, that considers the specific needs of Kyrgyzstan.

Within the framework of previous projects of the German Environment Agency (UBA), a TMF Methodology had been developed to improve TMF safety. This methodology comprises an index-based evaluation of the hazard potential, the so-called “Tailings Hazard Index (THI)” and the so-called “Tailings Risk Index (TRI)” which asses the risk for the potentially affected population and the environment. These indexes were used for the prioritisation of 62 TMFs which are located in Kyrgyzstan. An updated on completed TMF inventory for the Kyrgyz Republic was compiled based on open access data and official national information. This inventory includes basic data as well as THI and TRI assessments for each identified TMF. The created database will be used as a tool for updating the cadastre system of TMFs in Kyrgyzstan together with the questionnaires for active and closed TMFs which were developed within the framework of the project. An internal agreement was reached between the responsible competent authorities on how the TMF Methodology will be applied in future.

The checklist for operating TMFs was revised and updated for better adaptation to the conditions of the Kyrgyz Republic. Competent authorities, TMF operators, concerned stakeholders

and the public in the Kyrgyz Republic are encouraged to apply the updated methodology, which is intended to contribute towards limiting the number of accidents at TMFs and to minimize the severity of their consequences for human health and the environment.

The outcomes of the Kyrgyzstan TMF project include easy to use online and offline maps that help to identify the most dangerous transboundary TMFs in order to improve the cross-border emergency measures in case of TMF failure, provide policy recommendations for the Kyrgyz Republic to ensure sustainable use of project results and ensure the safety of TMFs in the future and an instruction video for better understanding of the TMF methodology. In addition, the updated TMF Methodology and checklist were translated into Russian.

Zusammenfassung

Während der vergangenen Jahre war das Problem des Umweltschutzes und der nachhaltigen Entwicklung auf einem der ersten Plätze in der Liste der globalen Prioritäten der internationalen Gemeinschaft. Gleichzeitig ist zu erwarten, dass die Förderung von Bodenschätzen in den kommenden Jahrzehnten extrem ansteigen wird, damit verbunden wird auch die Zahl der Rückhaltebecken (TMFs) stark ansteigen, da smarte und fortgeschrittene Technologien die Nachfrage nach bestimmten Metallen und Gold zu einem neuen Höchststand bringen werden. Aus diesem Grund wird sich die Gesellschaft mit dem steigenden Risiko von Unfällen in TMFs konfrontiert sehen – mit möglichen Todesfällen und erheblicher Umweltverschmutzung – sofern die Sicherheit von TMFs nicht ausreichend und adäquat – auch in Übereinstimmung mit strikten Vorschriften und Maßnahmen, die die Klimaveränderung berücksichtigen – sichergestellt wird. Wie Analysen von vergangenen Unfällen zeigt, muss mit dramatischen Unfällen in bis zu 1% aller TMFs gerechnet werden.

In Kirgistan gibt es Lagerstätten verschiedener Metalle, deren Ausbeutung einen bedeutenden Beitrag zur wirtschaftlichen Entwicklung des Landes leisten. Viele Bergwerke und andere Einrichtungen liegen innerhalb von Siedlungsgebieten respektive in den Becken von grenzüberschreitenden Flüssen. In der Vergangenheit wurden bei der Planung von TMFs keine langfristigen Maßnahmen zum Schutz der Anlagen vor gefährlichen Naturereignissen oder Maßnahmen zum Schutz der Bevölkerung vorgesehen. Daher resultiert eine hohe Wahrscheinlichkeit, dass bei einem Unfall in einem TMF nicht nur das Gebiet der Republik Kirgistan betroffen sein würde, sondern auch die Gebiete der Republik Kasachstan, der Republik Tadschikistan sowie der Republik Usbekistan, mit einer Gesamtbevölkerung von insgesamt bis zu fünf Millionen Menschen, in Mitleidenschaft gezogen werden würden.

Deshalb ist es wichtig die Sicherheit, nicht nur von bestehenden, sondern auch von neuen TMFs in der Republik Kirgistan zu stärken, um die unbeabsichtigte Freisetzung von gefährlichen Substanzen in die Umwelt zu verhindern.

Um das sichere Management von Rückhaltebecken sicherzustellen, sollen Aspekte der Flächenwidmung, wie zum Beispiel Risikozonen, berücksichtigt werden und nationale Standards und Warnsysteme auf dem neuesten Stand sein. Diesbezüglich wurden Grenzwerte für das grenzüberschreitende Warn- und Alarmsystem vorgeschlagen und vereinbart.

Im Vorfeld der Projektumsetzung wurden mit Vertretern der zuständigen Behörden, NGOs und Betreibern die potentiellen Probleme bei der Sicherheit von TMFs diskutiert und analysiert. Darauf aufbauend haben Vertreter der zuständigen Behörden und Ministerien das optimale Vorgehen hinsichtlich der Anwendung der TMF Methodik sowie der Möglichkeiten in Bezug auf den nachhaltigen Wissenstransfer innerhalb der administrativen Strukturen der Republik Kirgistan diskutiert. Außerdem wurde, basierend auf den Empfehlungen, welche während der Sitzungen gegeben wurden, eine Liste von Services erstellt, welche auf die spezifischen Erfordernisse und Bedürfnisse der Republik Kirgistan eingeht.

Im Rahmen von bereits abgeschlossenen Projekten des Umweltbundesamtes (UBA), wurde die TMF-Methodik zur Verbesserung der Sicherheit von Rückhaltebecken (TMFs) ausgearbeitet. Diese Methodik besteht aus einer indexbasierten Evaluierung des Gefahrenpotentials, dem so genannten Tailings Hazardous Index (THI) und dem sogenannten Tailings Risk Index (TRI), welche die potenziellen Gefährdungen für die Bevölkerungen und Umwelt bewerten. Diese Indizes wurden für eine Priorisierung der 62 TMFs in der Republik Kirgistan verwendet. Ein aktualisiertes und vervollständigtes Inventar von TMFs in der Republik Kirgistan wurde auf Basis von open-access Daten und nationalen Informationen erstellt. Dieses Inventar beinhaltet grundle-

gende Daten sowie Bewertungen nach den THI und TRI Indizes für jedes identifizierte Rückhaltebecken (TMF). Die so erstellte Datenbank sowie ein im Rahmen des Projekts erstellter Fragebogen für aktive und stillgelegte Rückhaltebecken werden für die Aktualisierung des Katastersystems der Republik Kirgistan verwendet werden. Eine interne Vereinbarung konnte zwischen den verantwortlichen zuständigen Behörden erzielt werden, welche die zukünftige Anwendung der TMF-Methodik regelt.

Die Checkliste für aktive Rückhaltebecken (TMF) wurde überarbeitet und auf den neuesten Stand gebracht damit sie besser auf die Bedingungen in der Republik Kirgistan angewendet werden kann. Die zuständigen Behörden, die Betreiber von Rückhaltebecken, die betroffenen Stakeholder und die Bevölkerung der Republik Kirgistan werden ermutigt, die aktualisierte Methodik anzuwenden, welche dazu beitragen soll, die Zahl der Unfälle in Rückhaltebecken zu beschränken und die Schwere der Konsequenzen für die menschliche Gesundheit und die Umwelt zu minimieren.

Die Ergebnisse des Projekts zu Rückhaltebecken in der Republik Kirgistan beinhalten einfach zu benutzende On- und Offline-Landkarten, welche bei der Identifizierung der gefährlichsten grenzüberschreitenden Rückhaltebecken helfen, um die grenzüberschreitenden Notfallmaßnahmen im Falle eines Unfalls in einem Rückhaltebecken zu verbessern. Ebenfalls beinhalten sie Strategievorschläge für die Republik Kirgistan, welche die nachhaltige Nutzung der Projektergebnisse sowie die Sicherheit von Rückhaltebecken in der Zukunft sicherstellen sollen, sowie einen Lehrfilm zum besseren Verständnis der TMF-Methodik. Zusätzlich wurden die TMF-Methodik und die Checkliste auf Russisch übersetzt.

1 Introduction

Climate change or the climate crisis is likely to lead to the introduction of so-called “smart technologies”, which cause significantly less greenhouse gases and are significantly more energy efficient. However, these technologies also require appropriate energy storage devices, which in turn lead to an enormous increase in mining activities worldwide to ensure the raw material supply for these batteries. To the same extent, however, the increase in mining activities for the extraction of raw materials will also lead to an increase in Tailings management facilities (TMF) for the storage of mining waste. Due to the physical characteristics and the chemical nature of substances which can be found in the tailings, TMFs pose risks to the environment and population. Also, the pollution of waterbodies and the related risk or damage to environmental resources often have a negative transboundary effect. Moreover, accidents at TMFs may lead to long-term water and soil pollution and have negative chronic effects to human health. The mining industry is very important to the economies of many countries. And Kyrgyzstan is among them. The share of gold mining alone in the country's GDP is about 11%, 40% in industrial production and 48% in exports.

Worldwide, at least 99 major tailings dam failures which caused significant pollution were reported in the period of 2008–2021 causing 790 deaths and significant environmental pollution. (https://www.umweltbundesamt.de/en/topics/sustainability-strategies-international/cooperation-eeca-centraleastern-european-states/project-database-advisory-assistance-programme/capacity-development-to-improve-safety-conditions).

The devastating impacts of such disasters, including in a transboundary context, have been demonstrated by major industrial accidents within and beyond the United Nations Economic Commission for Europe (UNECE) region over the past decades. The management of the safety of TMFs remains a huge problem worldwide, which regularly leads to major disasters (WISE, 2020). Unfortunately, this database almost does not contain information regarding the failures in former USSR countries such as Kyrgyzstan.

The most recent example of a TMF failure with human fatalities is an accident on the TMF in Minas Gerais State, Brazil, on January 26, 2019. The incident has become one of Latin America’s worst mining disasters ever. This disaster has killed 249 people and more than 21 people are reported missing. It is the second incident of its type occurring in less than four years as on 5 November 2015, another TMF accident occurred in the same area, killing 19 people, 60 million cubic meters of mud flowed down through several rivers towards the Atlantic Ocean (WISE, 2020). In China, the Ministry of Environmental Protection responded directly to 56 reported tailings-related pollution accidents in the period of 2006–2014 (Liu et al, 2015).

The severe environmental damage in the Danube River Basin caused by TMF dam breaching at the Baia Mare gold processing facility in Romania in 2000, is a well-known example of mining disasters. The polluted waters eventually reached the Tisza River and then the Danube River, killing large quantities of fish in Hungary and Serbia. On 4 October 2010 the dam of a TMF located near Ajka, a town in Hungary collapsed and a huge amount of red mud was released. The disaster killed 10 people and almost 150 others slightly or severely injured, including both, the local residents and the participants in the rescue operations (Mecsi, 2013).

Such accidents have in the past also occurred in the Kyrgyz Republic.

The 1958 Mailuu-Suu tailings dam failure in the industrial town of Mailuu-Suu, Jalal-Abad Region, southern Kyrgyzstan, caused the uncontrolled release of 600,000 cubic metres of radioactive waste. The event caused a number of direct casualties and widespread environmental damage. About 50% of the entire volume of the dam flowed into the swift Mailuu-Suu River, only 30

metres downhill from the breach. The waste then spread about 40 kilometres downstream across the national border into Uzbekistan then into the heavily populated Fergana Valley (Birsen et al, 2012).

In 1964, during the accident on TMF No. 2 in the area of Ak -Tuz village in Kyrgyztan 1.5 million cubic meters of radioactive tailings contaminated the transboundary Kichi-Kemin river and the lower part of the Kichi-Kemin valley with thorium, lead, copper, zinc, beryllium and other heavy metals (Stavinskiy et al, 2001).

There are six transboundary rivers originating in the country. No rivers flow into the Kyrgyz Republic. The Syr Darya River basin: called the Naryn River before it reaches the Fergana valley, the Syr Darya flows to Tajikistan and Uzbekistan. In Uzbekistan, the Syr Darya receives the Chatkal, a tributary which originates in the Kyrgyz Republic. The Chu, Talas and Assa rivers which are flowing to neighbouring Kazakhstan.

The south-eastern river basins: These consist of small catchment areas draining to China. The main rivers are the Aksay, Sary Jaz and Kek Suu, and are situated at high elevations.

Tailing sites, with an exception of the tailing site in Kaji-Sai, village, are located in the basins of the Naryn, Malusu, Chu rivers and are of a transboundary nature. The tailings site in Kaji-Sae are located near Issyk-Kul Lake.

In Sumsar village, in the area of 3 TMFs of the previously operating lead-zinc enterprise, according to the State Sanitary and Epidemiological Supervision authorities, an excess content of cadmium reached 320 MPC, manganese - 9 MPC.

Many areas where Kyrgyz TMFs are located are seismically active and hazardous to landslides.

In the Kyrgyz Republic all mining enterprises are classified as hazardous production facilities, of which TMFs are the most hazardous to the environment - storage facilities for toxic and radioactive industrial wastes. In the past when designing and establishing the TMFs, the long-term measures to protect the facilities from hazardous natural processes (landslides, floods and mudflows), anti-seepage solutions, measures to protect the population (sanitary protection zones, etc.) were not envisaged. Currently there is a high risk of hazardous environmental accidents, in the zone of possible impact of which, in addition to the territory of the Kyrgyz Republic, areas of the territory of the Republic of Kazakhstan, the Tajik Republic and the Republic of Uzbekistan can be affected.

Therefore, it is important to strengthen the safety of TMFs in Kyrgyzstan in order to prevent the accidental release of hazardous substances into the environment and to limit the risk to the population which may be affected.

The key environmental problems that pose a threat to the environment and the safety of the country's population associated with a large amount of inadequately contained waste are:

- pollution of the environment in the areas of TMFs with radionuclides and other toxic elements,
- the growing risk of destruction of waste storage due to climate change due to the threat of natural disasters and natural-man-made disasters typical for the mountainous, seismically active regions of the Tien Shan.

Thus, the allocation of TMFs and waste heaps to a separate list, as well as considering aspects of land-use planning, are key to ensure the safety of tailings and protect human life and the environment.

1.1 Scope of the report

The TMF-Methodology has been amended by UBA projects in Ukraine, Georgia and Armenia and in the north-eastern Danube River Basin countries whilst additional UBA projects (UBA, 2016; 2018; 2020a). In 2020 the first TMF project in Kyrgyzstan was provided to discuss optimization options and identify existing problems of the country. Based on the discussion, the responsible authorities and ministries discussed the optimal approach to applying the TMF methodology and what opportunities exist for the sustainable transfer of this knowledge to the administrative structures of Kyrgyzstan. As a result, the TMF project "Improving the safety of tailings management facilities in Kyrgyzstan" was implemented.

The main tasks of the TMF project were:

- Deepening the knowledge of operators, inspectors and experts on TMF management by a training event;
- Amending an existing hazard and risk assessment method and integrating land-use planning aspects into it (risk zones);
- Further enhancing and completing the previously developed detailed checklist method;
- Updating and completing the TMF inventory for the Kyrgyz Republic;
- Providing recommendations for the Kyrgyz Republic on managing TMFs.

Long-term objectives of the project are:

- The main goal of the project is a further developed tailings safety methodology and consolidate it for sustainable use throughout the UNECE region and beyond.
- Narrowed knowledge gaps and raised awareness on the TMF issue;
- Strengthened technical and management capacity at the concerned facilities and responsible authorities;
- Established regional framework for national training programs on TMF safety management (training of trainers);
- a common set of minimum standards and safety requirements;
- Ensured adaptation and further sustainable use of the TMF checklist, THI (Tailings Hazard Index) and TRI (Tailings Risk Index) methods, which were developed in the context of earlier UBA projects;
- Exchanged experience and lessons from transboundary cooperation for accident prevention, preparation and response to industrial accidents;
- Updated database of TMFs and starting discussions on their inclusion in the cadastral system;
- a map for integration into the cadastral system of Kyrgyzstan.

This report presents the outcomes of the project. It starts with a short overview of the Kyrgyz competent authorities that are in charge of the issues related to management of the TMFs and their responsibilities. Moreover, a TMF inventory complied for Kyrgyzstan is discussed which includes TMF mapping and risk assessment. TMF hazard and risk in Kyrgyzstan are assessed using THI and TRI indexes. Using the THI and TRI methods, a large number of TMFs can be evaluated with limited efforts and data demand. In the framework of the project, the TMF Checklist for safety evaluation of individual TMFs has been acknowledged by all participants, tested, proofed and recommended as a sound practical tool to raise the safety of TMFs. With this method Kyrgyzstan has now tools and experience and would be now able to re-establish a high safety level towards TMF in their national regulatory system and a sustainable education in especially of TMF inspectors.

The project report presents also the main information about the inventory of TMFs, land-use planning aspects alert and cadastral systems.

Based on these results of the project new policy recommendations were proposed and discussed with the representatives of competent authorities and international experts. The policy recommendations were divided by topics:

- Education and integrating of the Checklist Methodology,
- Inventory of TMFs,
- Land-use planning aspects,
- Public participation,
- Cadastre system.

As a result, agreements with representatives of the ministries were reached and all recommendations were approved and taken into account. Moreover, the education video was created in Russian and English, which can help in using the checklist and TMF methodology, and also explains the main features of this approach to assessing the safety of TMFs.

Finally, during the project the Checklist and TMF Methodology have been updated and aligned to the Kyrgyz Republic conditions. The evaluation method has also been revised and simplified.

2 State regulation of tailings management facilities

In Kyrgyzstan, the authorities that are in charge of the issues related to management of the tailings, are:

- Ministry of Natural Resources, Ecology and Technical Supervision including the Department of Geology and Subsoil Use and the Service of environmental and technical Supervision under the Ministry,
- Ministry of Emergency Situations of the Kyrgyz Republic,
- Ministry of Health of the Kyrgyz Republic,
- State Customs Service,
- local government bodies and economic operators, which have been operating the TMFs on their balance sheets.

2.1 Responsibilities of the competent authorities

Ministry of Natural Resources, Ecology and Technical Supervision of the Kyrgyz Republic (former State Committee on Environment and Climate, *before The State Agency for Environmental Protection and Forestry under the Government of the Kyrgyz Republic*)

The Regulation and Management Scheme of the Ministry of Natural Resources, Ecology and Technical Supervision of the Kyrgyz Republic were approved on 1 December 2021. This decision was taken as part of implementation of the Decree of the KR President "On the Structure and Composition of the KR Cabinet of Ministers and Structure of the KR President's Administration" dated 12 October 2021, No. 425. The Regulation and Management scheme, as well as functions, are not published yet. This Ministry was formed on the basis of the State Committee on Ecology and Climate of the Kyrgyz Republic. The Ministry has the following tasks:

- pursuing a unified state policy in the field environmental protection, environmental safety,
- implementation of state administration and regulation in the field of environmental protection, environmental safety,
- state supervision and control in the field of environmental protection, environmental safety,
- state supervision and control over compliance with the requirements of regulatory legal acts, technical regulations in the field of environmental safety,
- State regulation on environmental protection and rational use of natural resources,
- State environmental impact assessment of projects and EIA materials for tailings management facilities,
- Issuing permits for waste disposal,
- Environmental monitoring of sources of air emissions, wastewater discharges and waste disposal,
- Accounting and rationing of emissions, discharges of pollutants, production and consumption waste and other harmful effects on the environment and their sources, including radioactive ones.

- Participation in commissions for selection of location of environmental impact facilities and their acceptance for operation,
- Participation in investigations of accidents and incidents causing environmental damage,
- Technical cooperation with the International Atomic Energy Agency (IAEA).

In addition, the Ministry of Natural Resources, Ecology and Technical Supervision of the Kyrgyz Republic absorbed the State Inspectorate for Environmental and Technical Safety under the KR Government (Gosekotehinspetsiya), which was the authorized state executive body exercising state supervision and control over environmental and technical safety issues. Currently it is a structural body of the Ministry.

Service of Environmental and Technical Supervision of the Ministry of Natural Resources, Ecology and Technical Supervision of the Kyrgyz Republic (before the Inspectorate for Energy, Mining Supervision and Industrial Safety under MEI is responsible for:

- State control over compliance with mechanical, seismic, fire, environmental, industrial, energy, biological, chemical and radiation safety of facilities;
- Supervision and control over compliance with requirements for location, construction, operation, conservation and liquidation of hazardous production facilities;
- Proper organization of production control and compliance of employees of these services with qualification requirements.

The Industrial Safety Regulatory Department of the Ministry of Natural Resources, Environment and Technical Supervision of the Kyrgyz Republic (before under the Ministry of Energy and Industry of the Kyrgyz Republic) carries out activities to improve the efficiency of the public policy in the field of the industry, fuel and energy complex, in the field of subsoil use and industrial safety, as well as ensuring energy security, and also coordinates work on the UNECE Convention on the Transboundary Effects of Industrial Accidents (UNECE, 2019b).

The Industrial Safety Regulatory Office and Mining and the Service of Environmental and Technical Supervision under the Ministry of Natural Resources, Environment and Technical Supervision of the Kyrgyz Republic also develop and submit drafts of regulatory legal acts and decisions of the Government on the issues related to the competence of the Committee, as well as develops and implements programs for the future development of the industry, the fuel and energy complex and subsoil use.

Main responsibilities are:

- State regulation of industrial safety of hazardous production facilities, including tailings management facilities,
- Issuance, renewal, suspension, revocation of licenses for the right to use subsurface resources, including facilities with tailings management facilities, conclusion of license agreements,
- Monitoring of compliance with the terms of license agreements,
- Expert review of design documentation for industrial safety at hazardous production facilities, including tailings management facilities,
- Participation in commissions to select locations for hazardous production facilities and their commissioning,

- Participation in technical investigations of causes and circumstances of accidents, incidents at hazardous production facilities,
- Accounting for financial resources for special purpose accounts for reclamation works at the deposits.

Ministry of Emergency Situations of the Kyrgyz Republic (hereinafter MES). The purpose of the Ministry is to develop and implement a unified state policy in the field of civil protection, fire, radiation safety, safety of people at water facilities and hydrometeorology (MES, 2012).

Responsibility of the Ministry of Emergency Situations together with the Tailings Management Agency under the Ministry of Emergency Situations:

- Monitoring of tailings and waste dumps under the jurisdiction of the Ministry of Emergency Situations,
- Maintaining records, safety assessments and passports for tailings and waste dumps under the jurisdiction of the Ministry of Emergency Situations,
- Development and implementation of state programmes on prevention of accidents at radioactive and toxic tailings and waste dumps to ensure protection of population and territories,
- Implementation of a set of measures for the safe maintenance of mothballed tailing pits, mining dumps and radioactive waste under the jurisdiction of the Ministry,
- Prevention, implementation of preventive protective measures against emergencies,
- Planning of activities in the field of civil protection, fire and radiation safety,
- Monitoring and forecasting of dangerous natural, anthropogenic processes and phenomena,
- Organization and conduct of search and rescue, rescue and other urgent activities, liquidation of consequences of emergencies, assessment of their scale,

The Ministry of Health of the Kyrgyz Republic develops and implements national, state and targeted programs in the field of health protection and promotion, programs of state guarantees, it monitors and evaluates their implementation, and also develops draft regulatory legal acts in the field of health and submits them for consideration to the Government (MH,2012).

The Department of State Sanitary and Epidemiological Surveillance of the Ministry of Health of the Kyrgyz Republic is a state institution of the health care system that organizes state sanitary and epidemiological surveillance, regulatory regulation, special licensing, supervisory and control measures in the field of ensuring the sanitary and epidemiological well-being of the population of the Kyrgyz Republic.

The Department of State Sanitary and Epidemiological Surveillance of the Ministry of Health of the Kyrgyz Republic (hereinafter - State Sanitary and Epidemiological Supervision Department) are responsible for:

- State regulation of public health issues,

- Control and supervision of facilities, regardless of ownership and departmental affiliation, to meet the requirements of regulatory legal acts in the field of public health, identification, prediction of the possible effects of biological, chemical, radiation and other physical factors on the health of the population and workers,
- Conducting research on the impact of non-ionizing radiation sources and other physical factors in the environment and human habitat,
- Participation in investigation and elimination of mass poisonings, epidemics, occupational diseases, accidents, natural disasters, ecological disasters and other emergency situations dangerous for life and health of population.

The Ministry of Economic Development and Commerce of the Kyrgyz Republic operates in terms of issuing licenses for export, import and re-export of nuclear materials, technologies, equipment and facilities, special non-nuclear materials and products, equipment, dual-use technologies related to nuclear activities, as well as radioactive sources of ionizing radiation, including radioactive waste and isotope products (radioactive and artificially produced stable isotopes). The Ministry is responsible for the implementation of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

2.2 Regulatory legal acts, instructional and methodological documents regarding design, operation, assessment of condition and safety of tailings sites

In the Kyrgyz Republic, subsoil use issues are regulated by the Law on Subsoil No. 49 of May 19, 2018, and the licensing of subsoil use is carried out under the Regulation on Subsoil Use Licensing Procedure (SRCR, 2018). Technical designs for relevant works are subject to expert review for compliance with the requirements of industrial, environmental safety, and protection of subsoil. The decision-making process also considers the issues of subsequent reclamation of subsoil facilities. However, the mechanisms for accumulating funds for reclamation are not elaborated.

The Ministry of Natural Resources, Ecology, and Technical Supervision of the Kyrgyz Republic performs state environmental expertise of project documentation on the feasibility of planned activities, issues permits for emissions and approves waste passports. The initiator of the proposed activity shall prepare a draft Environmental Impact Assessment (EIA) under the Regulations on the Procedure of Environmental Impact Assessment in the Kyrgyz Republic (hereinafter the Regulations) (EIA, 2015) in addition to approval of the land allocation at the design stage. The EIA is conducted for activities subject to mandatory environmental expertise under the Law of the Kyrgyz Republic "General Technical Regulations on Environmental Safety in the Kyrgyz Republic". (Law, 2009), the list of which is given in Annex 1 and based on the requirements given in Annexes 5-11 to this Regulation and in a mandatory manner to obtain a positive conclusion of the state environmental expertise. Also, according to Article 3 of the Law of KR "On Environmental Expertise". (Law, 1999), activities on waste disposal and utilization are also the objects of environmental expertise. Availability of EIA as part of all types and stages of development of project documentation is mandatory and it serves as the basis for decision-making by the state environmental expertise body.

In accordance with Article 8 of the Law of the Kyrgyz Republic "On Licensing and Permitting System in the Kyrgyz Republic", for each type of activity falling under this law, it is necessary to develop licensing requirements approved by the Government of the Kyrgyz Republic.

According to paragraph 4 of Article 16 of the Law of the Kyrgyz Republic "On Licensing and Permitting System in the Kyrgyz Republic", the disposal, storage, burial, destruction of wastes of toxic materials and substances, including radioactive ones, is subject to licensing. Also, article 17 of this law provides for obtaining permits for the disposal of wastes in the environment.

According to the Law, licensing should include:

- urban planning, design and survey work of residential, public and industrial buildings and constructions (facilities of the I, II and III categories);
- construction and installation works, except for the construction of individual residential buildings (facilities of the I, II and III categories);
- transportation (including transboundary one) of wastes from the production of toxic substances, including waste from the production of radioactive substances;
- disposal (utilization), storage, burial, destruction of wastes of toxic materials and substances, including radioactive ones.

Article 17 of this law provides for permits for mining, placement of emissions into the environment, import and export outside the Kyrgyz Republic of ore and rock samples, concentrates, production wastes and laboratory samples for analytical research, permits for disposal, storage, burial, destruction of wastes of toxic materials and substances, including the radioactive ones.

The Ministry of Natural Resources, Ecology, and Technical Supervision of the Kyrgyz Republic (Department of the Regulation in the Field of Environmental Protection and Environmental Safety) carries out state regulation in the field of environmental protection and environmental safety, including chemical, biological as well as radiation and nuclear safety, carries out technical cooperation with the International Atomic Energy Agency (IAEA) in the established field of activity, makes proposals on establishment of the accounting procedures in the field of waste management, the procedures for maintaining the state register of waste disposal facilities, as well as maintaining the state cadaster of wastes, and carries out state registration of facilities and sources, which have negative environmental impact.

At the same time, the issues of radiation exposure to health are within the competence of the Ministry of Health of KR, radioactive TMFs and waste heaps are on the balance sheet of the Ministry of Emergency Situations of KR or the operators, radiation control at checkpoints on the state border of the Kyrgyz Republic (Law, 2009) is carried out by the border and the customs services, neutralization and disposal of radioactive waste is carried out by the Republican Special Combine for the Disposal of Radioactive Waste.

According to Section 5 of the Law of the Kyrgyz Republic "On Environmental Protection"(Law, 1999b), the system of state environmental monitoring also falls under control in the field of environmental protection. State monitoring related to TMFs, in accordance with their profile obligations, is carried out by the: Department of Ecological Monitoring of thehe Ministry of Natural Resources, Ecology, and Technical Supervision of the Kyrgyz Republic, Department of Disease Prevention and State Sanitary and Epidemiological Surveillance of the Ministry of Health and the Agency for Tailings Management under the Ministry of Emergencies of KR. These departments have their own laboratory facilities, and they monitor the environment. However, these bodies not always have access to industrial facilities for monitoring, and when conducting inspections of business authorities, cannot independently and fully assess the degree of environmental pollution from economic activities. Existing laboratories of these state bodies have low human and technical capacity for analysis of emissions.

Department of Ecological Monitoring of thehe Ministry of Natural Resources, Ecology, and Technical Supervision of the Kyrgyz Republic is a structural unit financed from the state budget and other sources stipulated by the legislation of the Kyrgyz Republic. The main goals and objectives of the Department are:

- conducting policy in the field of ecological monitoring of the environment;
- identification of sources of anthropogenic impact, assessment of their condition;
- provision of information to state management bodies, economic entities about actual changes in the condition of the environment, the causes of these changes to prevent and reduce damage.

Department of Disease Prevention and State Sanitary and Epidemiological Surveillance of the Ministry of Health analyses the state of environmental facilities according to the health safety indicators, organizes, monitors and supervises compliance with the requirements of the legislation in the field of public health, identifies, predicts the possible impact of biological, chemical, radiation and other physical factors on the health of the population and workers, participates in the investigation and elimination of mass poisonings, epidemics, occupational diseases, accidents, natural disasters, environmental disasters and other emergencies dangerous to the life and health of the population, carries out sampling for laboratory examination within the framework of state sanitary and epidemiological supervision (Regulation, 2013).

In accordance with Article 19-1 of the Law of the Kyrgyz Republic "On Public Health" dated July 24, 2009 No. 248 (Law, 2009c): sanitary and epidemiological examinations, investigations, examinations, studies, tests are carried out by the officials exercising state sanitary and epidemiological supervision (control), in order to:

- establishing and preventing the harmful effects of environmental factors on human beings;
- establishing the causes and conditions for occurrence and spread of infectious diseases and mass non-infectious diseases (poisoning) and assessing the consequences of the occurrence and spread of such diseases (poisoning).

In connection with the above, it is not possible to carry out full assessment of the environmental pollution, which affects the efficiency of control, the ability to quickly respond to accidents and emergencies, the person / hours during research increase, all this leads to additional costs of the state budget and negatively affects the implementation of rights to an environment favourable to life and health.

It should be noted that "supervision over the exact and uniform implementation of the laws by executive authorities, as well as other state bodies, the list of which is determined by the constitutional law, local government bodies and officials of these bodies" is carried out by the prosecutor's office (Law, 2009d).

3 Inventory Development

At present, in accordance with the Order of the Ministry of Emergency Situations of the Kyrgyz Republic No.496 dated May 7, 2019, within the framework of implementation of decisions of the Security Council of the Kyrgyz Republic, held in January 2019, an inventory of tailings and waste dumps located in the Kyrgyz Republic has to be conducted by the interagency commission with visits to each facility. The idea of this inventory is to bring the tailings and dumps in line with the requirements of environmental and technical safety, as well as proper readiness to respond to emergencies of a man-made and natural character. Due to the coronavirus pandemic, this inventory has not yet been completed and it is planned to update the existing up-to-date data on almost all TMFs in the country by the end of the 1st quarter of 2022. At the same time, the inventory data which was carried out during the project will be integrated to the state inventory.

The last inventory and the State Cadastre of Mining Wastes of the Kyrgyz Republic, which contains 92 passports for TMFs and mining dumps, has not been updated since the 1990s. It was compiled for the purpose of possible use of tailings and waste dumps as promising technogenic deposits for secondary extraction of useful components from them. Much of the information contained in these records is already outdated and does not meet modern standards.

According to the data, the TMFs and mining dumps contains the volume of the tailings of more than 307.12 million m^3. There are 33 TMFs and 25 waste heaps with a total waste volume of 11.9 million cubic meters. Of these, 6.2 million cubic meters are radioactive, 5.7 million cubic meters are toxic including 28 radioactive TMFs with a volume of 4.3 million cubic meters, 5 - toxic ones with a total volume of 5.7 million cubic meters, 25 - radioactive waste heaps with a total volume of 1.9 million cubic meters. The rest of the facilities are on the balance sheet of economic authorities.

The mountainous regions of the country are characterized by a high number of landslides, which can intensify and thereby damage the waste heaps and the TMFs and may lead to a sudden, uncontrolled release of hazardous and radioactive materials. The danger of landslides increases during the periods of seismic activity.

Many mines and other facilities are located within the settlements, in the basins of the transboundary rivers. Thus, 23 TMFs and 13 waste heaps are located near to the city of Mailuu-Suu and contain 3.1 million cubic meters of radioactive waste. Three TMFs are located in the city of Sumsar with 4.1 cubic meters of toxic waste. Eight waste heaps in the Shekaftar village contain 0.7 million cubic meters of wastes. In the village of Sovetskoye of the Batken region there are two TMFs with a total volume of 1.6 million cubic meters. In the village of Kadji-Sai of the Issyk-Kul region there is one tailing dump with a volume of 0.4 million cubic meters; four TMFs and four ore and waste heaps are located in the village of Min-Kush of the Naryn region. There 2 million cubic meters of radioactive waste were buried. The uranium burial ground in Kara-Balta is one of the five largest in the country. In addition, there are two large radioactive TMFs that are considered operational - one in the city of Kara-Balta and one in the village of Ak-Tyuz. The Ak-Tyuz TMFs are located in the Kemin district of the Chui region. Since 1942 ore containing lead, zinc and rare earth elements has been mined and processed here. The processed ore in this area contains radioactive elements from minerals containing thorium (turnerite, thorite, zirconium and others). In the vicinity of the Ak-Tyuz town there are four TMFs with a total volume of about 2.3 million cubic meters and three waste heaps with waste rock.

Many TMFs are located in the basins of the transboundary rivers Naryn, Mailusu and Chu. The tailing dump in Kajisay is located near the Issyk-Kul lake.

Currently in the territory of the Kyrgyz Republic the TMFs are operated by industrial enterprises such as OJSC "Kadamjai Antimony Plant", Khaidarkan mercury SJSC, OJSC "Kyrgyz chemical and metallurgical plant", OJSC " Kyrgyz mining plant ", LLC " Tien Shan tin ", LLC" Makmal Gold Company ", Branch of the " Kyrgyzaltyn " agency OJSC " Tereksay mine ", " Eti Bakyr Tereksay " LLC, " Kazakhmys Gold Kyrgyzstan LLC, " Geo-Reserve " LLC, " Kumtor Gold Company " CJSC, " Altynken " LLC, " Full Gold Company " LLC ", LLC "Kaidi".

3.1 Data collection

Data have been collected in two steps. In the first step, the data regarding TMFs were collected during the previous advisory assistance project of German Environment Agency (UBA) in 2020 (UBA 2020a). The compiled data sets and the related assessments were considered as preliminary database and information. In the second step, the data regarding the TMFs had to be revised and approved by the competent authority in Kyrgyzstan (the Ministry of Natural Resources, Environment and Technical Supervision of the Kyrgyz Republic) and has been checked and updated according to the national information. As a result, the information about 62 TMFs was provided for further analyses. The information received has been compiled into a list of TMFs and can be found in Appendix A. The provided data contained only the information about the enterprise (name of TMF), the amount of tailings materials, dam height and status of TMF. The data on major contaminants, and location have been used from the open sources or from the data collected during the last project.

3.2 Preliminary hazard assessment of TMFs in Kyrgyzstan (THI approach)

The TMF Methodology was designed to implement the Safety Guidelines into a living document and offers an index-based assessment of the hazard potential of a number of TMFs, the so-called THI method (UBA, 2016). With this method it's easy to sort and prioritise a large number of TMFs on a national and international level according to the calculated hazard potential. The approach was updated during the advisory assistance project of German Environment Agency (UBA) in Danube River Countries (UBA 2020b).

The THI method takes the following parameters into account that have been identified as being most crucial:

- total capacity of TMFs,
- toxicity of substances of the stored tailings,
- TMF management status,
- natural conditions specific to the TMF site,
- and dam safety parameters.

During the ongoing project, slight modifications of TMF management status index were made. Due to the fact that 37 of 62 TMFs in the Kyrgyz Republic have a suspended status, THI_{Man} should also take into account the management status for transient suspended TMFs which can pose a greater danger than closed ones, but less than active and abandoned ones.

The updated value of THI_{Man} is determined according to Table 1:.

Table 1: Evaluation of the management conditions

Management status	THI_{Man}
Rehabilitated	0
Closed	1
Suspended	2
Abandoned, orphaned	3
Active	3

For the calculations, the updated index was used.

The ranking of Kyrgyz TMFs for 62 TMFs by THI was made. Average THI for Kyrgyzstan is 13.6, Maximum THI is 16.6. For better analyses the ranking of TOP 10 hazardous TMFs by THI was made additionally and is shown on Figure 1.

More detailed information concerning the distribution of THI for these TMFs can be found in Table 2.

Figure 1: Ranking of TOP 10 hazardous TMFs by THI

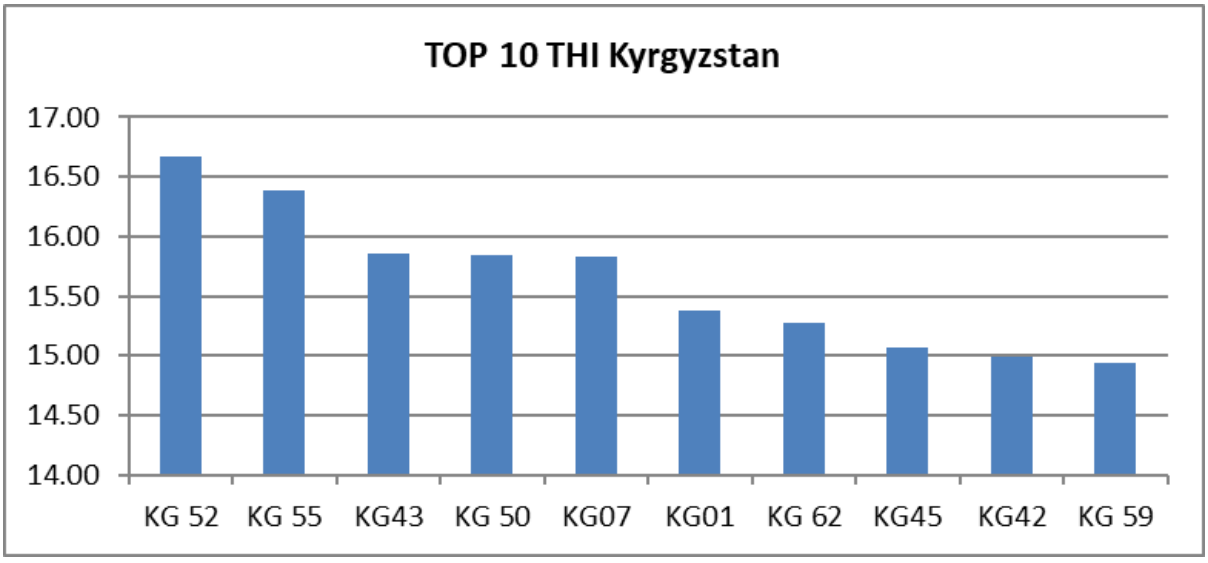


Table 2: Distribution of the TMFs in Kyrgyzstan according to THI

Number by ranking	TMF name	THI value	Ranking-Nr.
KG 52	TMF LLC "Altyn-Ken"	16.67	1
KG 55	Tailings storage facility of Alliance Altyn LLC, Jerui deposit.	16.38	2
KG43	TMF at Makmal deposit of open JSC "Kyrgyzaltyn", the branch of gold mining combine "Makmal-zoloto"	15.85	3
KG 50	TMF of Kichi-Chaarat JSC	15.85	4
KG07	TMF at the Kumtor deposit of closed JSC "Kumtor Gold Company"	15.83	5
KG01	TMF nr. 4 of Ak-Tyuz dressing plant, CJSC TK "Geo Reserve"	15.37	6
KG 62	LLC "Chauwai-Ken"	15.28	7
KG45	Salt storage of open JSK "KAP"	15.07	8
KG42	TMF of LLC "Kazakhmys Gold Kyrgyzstan"	14.99	9
KG 59	TMF No. 2 of JSC "KHMZ"	14.94	10

Figure 2: Breakdown of THI constituents

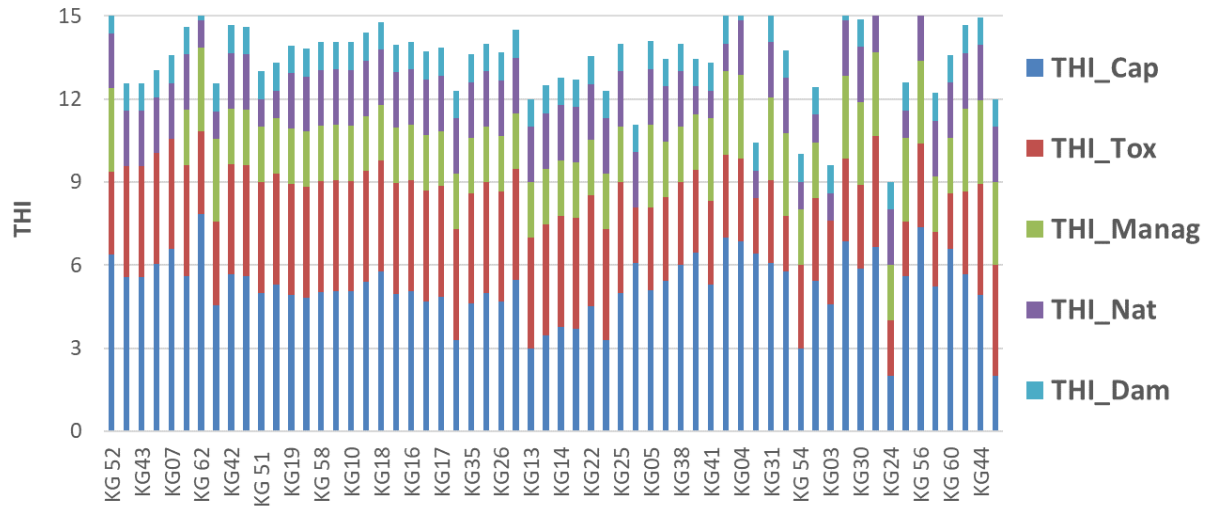


Figure 2 demonstrates the breakdown of THI constituents for all TMFs.

Analysis of the breakdown of THI constituents allows drawing the following conclusions:

1. The hazard due to TMF capacity is high because of a larger than average size of facilities and this factor has the biggest influence on the total THI.

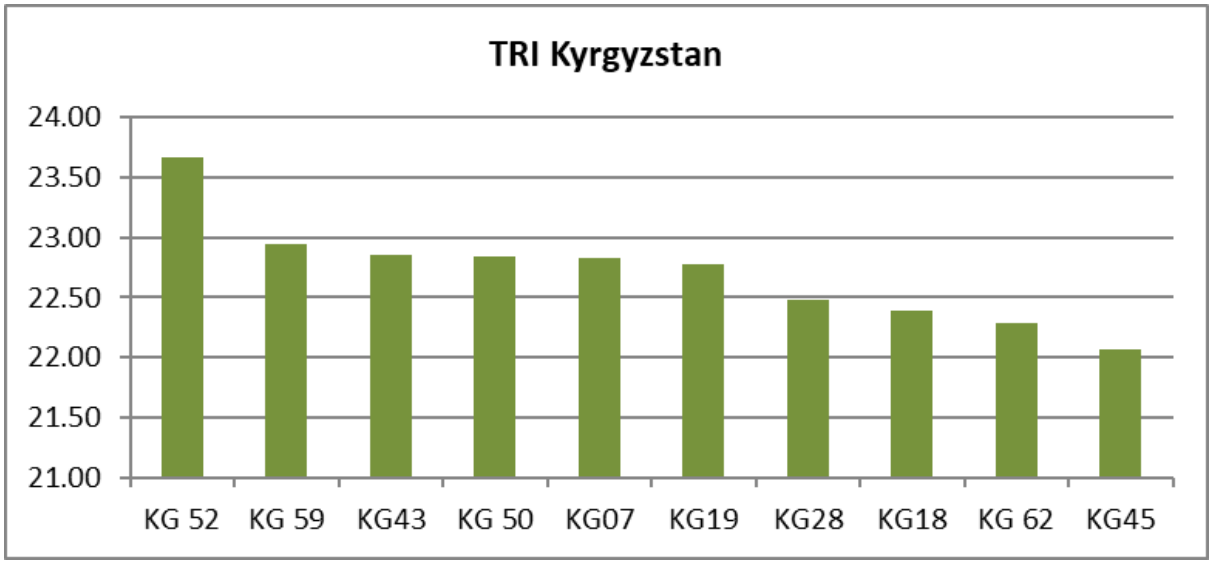
2. The hazard due to tailings toxicity is also quite high because some Kyrgyz TMFs store radioactive waste and materials with toxic heavy metals like Pb, Zn, and Hg.

3. Seismic and flood hazards are relatively high as it is a mountainous country.

3.3 Preliminary risk assessment of TMFs in Kyrgyzstan (TRI approach)

The THI approach does not consider important land-use planning criteria such as the distance to waterbodies and settlements, downstream. To support land-use planning activities, the Tailings Risk Index (TRI) methodology has been developed during the project of German Environment Agency (UBA) in Danube River Countries (UBA 2020b) to assess the risks of potential accidents on different receptors. Average TRI for the country is 20. TMF distribution according of TOP 10 hazardous TMFs by TRI is shown on Figure 3. At the same time average TEI $_{Pop}$ is 5,2 and average TEI $_{env}$ is only 3.5 that clearly shows that the TEI value has less impact on the overall TRI then on the THI. Nevertheless, at least 22 settlements are located in a 10 km zone downstream of Kyrgyz TMFs and there are 16 waterbodies that can be polluted in case of a failure.

Figure 3: Ranking of TOP 10 hazardous TMFs by THI



The TOP 10 of the most dangerous TMFs sorted by TRI rank ascending order can be found in Table 3.

Table 3: TOP 10 of hazardous TMFs ranked by TRI

Number by ranking	TMF code	TMF name	THI value
1	KG 52	TMF LLC "Altyn-Ken"	23.67
2	KG 59	TMF No. 2 of JSC "KHMZ"	22.94
3	KG43	TMF at Makmal deposit of open JSC "Kyrgyzaltyn", the branch of gold mining combine "Makmalzoloto"	22.85
4	KG 50	TMF of Kichi-Chaarat JSC	22.85
5	KG07	TMF at the Kumtor deposit of closed JSC "Kumtor Gold Company"	22.83
6	KG19	TMF nr. 7, Ministry of emergency	22.78
7	KG28	TMF nr. 16, Ministry of emergency	22.48

Number by ranking	TMF code	TMF name	THI value
8	KG18	TMF nr. 6, Ministry of emergency	22.39
9	KG 62	LLC "Chauwai-Ken"	22.28
10	KG45	Salt storage of open JSK "KAP"	22.07

As can be seeing from the Tables 2 and 3 the “TMF LLC "Altyn-Ken"” facility ranks first place both, in THI and TRI ranking.

Therefore this TMF was subsequently selected to perform a Safety-training at it.

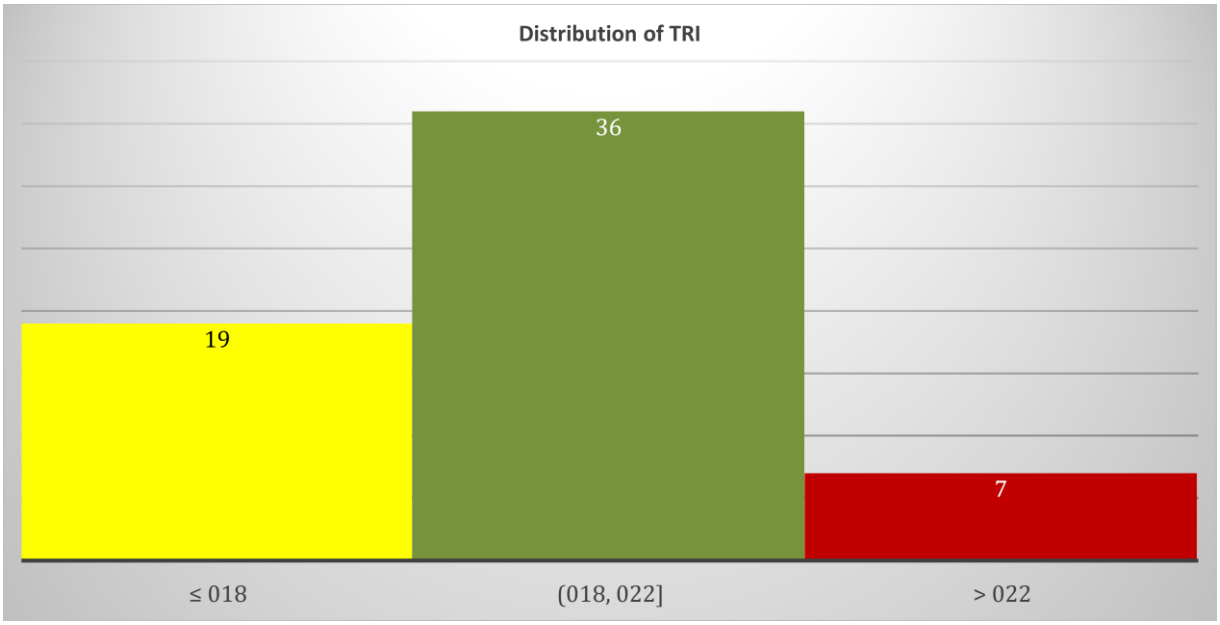
The prioritization of TMFs according to the TRI can be used at the international, national and regional levels.

For convenience and a pragmatic approach at the national level, competent authorities can use the ranking of TRI in example in the following ranges of risk

- ≤ 18 – low level
- 18 – 22 – medium level
- ≥ 22 – high level

The prioritization of TMFs according to the TRI for the national use is shown on Figure 4.

Figure 4: Distribution of TMFs according to the TRI for the national level (only in Kyrgyzstan).



3.4 TMF mapping for Kyrgyzstan

Mapping is a necessary part of land-use planning that clearly illustrates existing environmental conditions, urban locations, and helps to evaluate potential hazards (UNECE, 2017). The database created during the inventory became the basis for creating a preliminary hazard map of TMFs. By developing an online and offline map, the intention was to create a pragmatic and easy-to-use tool, also for those people without specific knowledge on mapping. For this, the

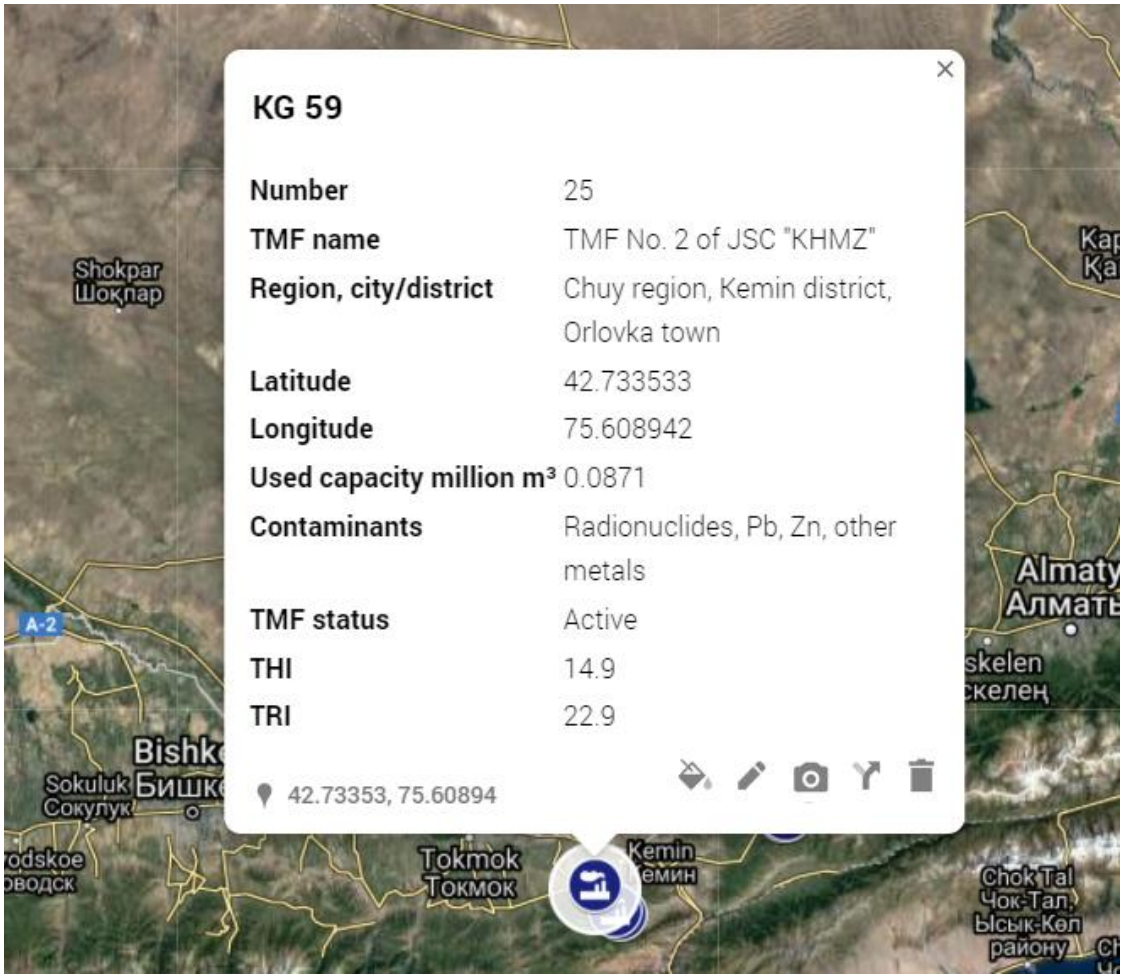
Google Maps service has been selected as the mapping program. The map will be further improved to become a helpful tool for competent authorities for collecting and analysing information regarding TMF safety and it will help to easily identify the most dangerous transboundary TMFs in order to improve the cross-border emergency measures in case of TMF failure, as the affected areas including settlements and polluted waterbodies can be easily seen thanks to visual inspection.

Currently, both, online and offline maps include the following set of parameters for each TMF:

- TMF name;
- TMF number;
- Tailings capacity;
- Management conditions;
- THI value;
- TRI value.

A snapshot of the map is presented in**Fehler! Verweisquelle konnte nicht gefunden werden.**.

Figure 5: Display of the parameters for an example TMF



© Google

The TMF hazard map for Kyrgyzstan contains 6 layers.

1) The general view of the TMFs in Kyrgyzstan (**Fehler! Verweisquelle konnte nicht gefunden werden.**);
2) The map with TMFs ranked by TRI (high level of risk) (**Fehler! Verweisquelle konnte nicht gefunden werden.**);
3) The map with TMFs ranked by TRI (medium level of risk) (**Fehler! Verweisquelle konnte nicht gefunden werden.**);
4) The map with TMFs ranked by TRI (low level of risk) (Figure 9);
5) The map with transboundary TMFs by UNECE approach (Figure 10);
6) The map with transboundary TMFs by "10 km zone" approach (Figure 11).

The entire map (online) is available on the link:
https://www.google.com/maps/d/u/1/edit?mid=1eTXiHV0Mn7dHH9lH9moZFo-vWzDa7mHee&usp=sharing

Thanks to this online map, the user can get basic information about the TMFs for a more detailed assessment. At the same time, layers that are not of interest to the user can be disabled and not rendered. This map can also be used for integration into the country's cadastral system. At the same time, the user cannot change the data on the online map. In case you need to make any changes, we recommend contacting German Environment Agency (Umweltbundesamt, UBA) for providing offline maps that provide more functionality.

Figure 6: The general view of the TMFs in Kyrgyzstan

Color scheme: blue dots – TMFs of Kyrgyzstan.

Figure 7: The map with TMFs ranked by TRI (high level of risk)

Color scheme: orange circles – TMFs of Kyrgyzstan with high level of TRI (TRI ≥ 22) .

© Google

Figure 8: The map with TMFs ranked by TRI (medium level of risk)

Color scheme: green circles – TMFs of Kyrgyzstan with medium level of TRI (22>TRI> 18)

© Google

Figure 9: The map with TMFs ranked by TRI (low level of risk)

Color scheme: yellow circles – TMFs of Kyrgyzstan with low level of TRI (TRI≤ 18)

© Google

Figure 10: The map with transboundary TMFs by UNECE approach

Color scheme: blue circles – Transboundary TMFs

© Google

Figure 11: The map with transboundary TMFs by "10 km zone" approach

Color scheme: green circles – Transboundary TMFs

© Google

3.5 Transboundary effect assessment

According to the international classification, surface or ground waters are considered transboundary if they mark or cross the borders between two or more states. The largest transboundary rivers of the Central Asia - the Amudarya, Syrdarya, Chu, Talas, Tarim, Karkara - originate on the territory of the republic, providing water to Kyrgyzstan and neighbouring states: Kazakhstan, Uzbekistan, Tajikistan, Turkmenistan and China (Mamatkanov D.M et al, 2019).

3.5.1 UNECE approach

The following two location criteria shall apply for the purpose of identifying hazardous activities capable of causing transboundary effects under the UNECE Accident Convention) (UNECE, 2000):

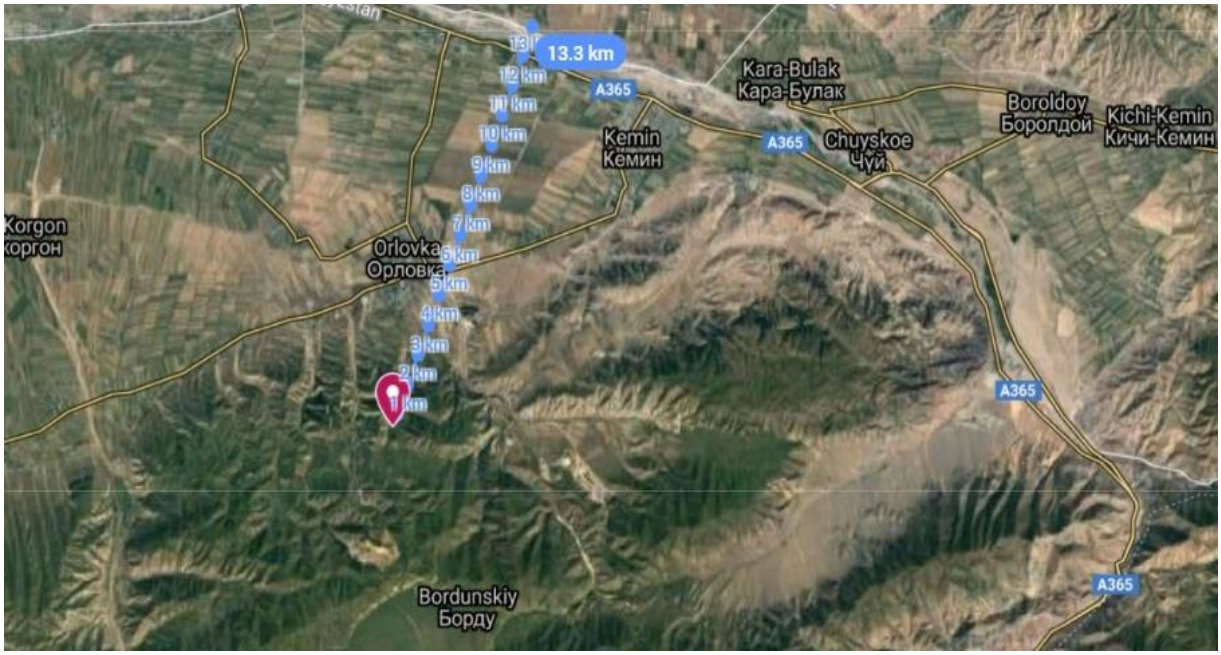
- Within 15 kilometres from the border for activities involving substances that may cause a fire or explosion or involving toxic substances that may be released into the air in the event of an accident
- Along or within the catchment areas of transboundary and border rivers, transboundary or international lakes, or within the catchment areas of transboundary groundwaters, for activities involving substances falling under category 3, 4, 5 or 8 of part I of Annex I to the Convention and that may be released into watercourses in the event of an accident. The distance should correspond to approx. a flowing period of two days of average flow velocity.

Using the created map, an assessment was made of TMFs that may have a transboundary effect in case of a failure.

In general, after analysing the available information, 38 TMFs were classified as TMFs that may have a transboundary effect. At the same time, 13 of these TMFs are located at a distance of up to

15 km in the air to the border with other states. A list of these TMFs can be found in Table 4. It should be noted that the TMFs KG 42 and KG 57 are located near the border with Tajikistan, the rest of the TMFs are located not far from Kazakhstan border, which in this area runs along the transboundary Chu River (Figure 12).

Figure 12: Transboundary TMF located near to border with Kazakhstan



Color scheme: blue line – distance from TMF to the border with Kazakhstan

© Google

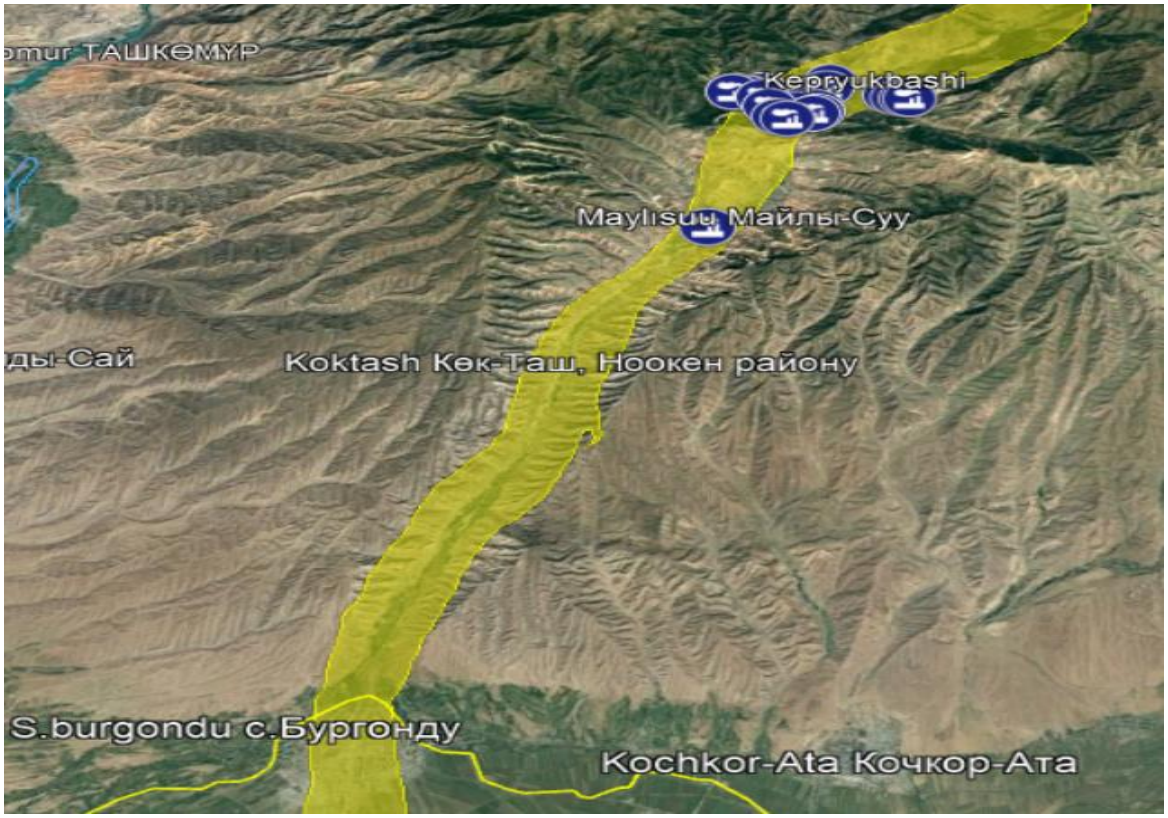
Table 4: Transboundary TMFs withing 15 km zone by air from the border

Number	TMF name	Remark
KG01	TMF nr. 4 of Ak-Tyuz dressing plant, CJSC TK "Geo Reserve"	~ 10 km to the border with Kazakhstan
KG02	TMF nr. 1 of Ak-Tyuz mine, of the dressing plant of JSC "Kyrgyz Chemical Metallurgical Plant" (KCMP)	~ 5,4 km to the border with Kazakh-stan
KG03	TMF nr. 2 of Ak-Tyuz mine, of the dressing plant of JSC "KCMP"	~ 6 km to the border with Kazakhstan
KG04	TMF nr. 3 of Ak-Tyuz mine, of the dressing plant of JSC "KCMP"	~ 5 km to the border with Kazakhstan
KG05	Buurdinskoe TMF of JSC "KCMP"	~ 12 km to the border with Kazakh-stan
KG42	TMF of LLC "Kazakhmys Gold Kyrgyzstan"	~ 1.6 km to the border with Tajikistan
KG 49	OJSC "Kara-Balta mining plant"	~ 0.5 km to the border with Kazakh-stan
KG 51	Cyanide TMF Altyn-Ken LLC	~ 15 km to the border with Kazakh-stan

Number	TMF name	Remark
KG 52	TMF LLC "Altyn-Ken"	~ 15 km to the border with Kazakh-stan
KG 56	Khaidarkan mercury plant "Simap"	~ 2.3 km to the border with Tajikistan
KG 57	TMF LLC "Altyn-Ken"	~ 7.7 km to the border with Tajikistan
KG 59	TMF No. 2 of JSC "KHMZ"	~ 9 km to the border with Kazakhstan
KG 60	Salt accumulators of JSC "KHMZ"	~ 9 km to the border with Kazakhstan

In total, 22 transboundary TMFs are located in the vicinity of transboundary MayliSuu river, which length is 87 km, basin area 748 km^2. The average flow velocity of MayliSuu river is 1.94 m/s (7 km/h). According to the UNECE Transboundary Convention, the path length of the TMFs in this case is 336 km long. This means that the distance to the border can be 336 km. In this case, all TMFs are located in the river basin and the distance to the border is approximately 28 km (Figure 13).

Figure 13: Transboundary TMFs located near to MayliSuu river



Color scheme: blue circles – transboundary TMFs, yellow area – part of catchment area of MayliSuu river, yellow line – border line with Tajikistan.

© Google

A list of TMFs that pose a threat of transboundary pollution through water resources can be found in Table 5. The same table contains the information about 3 TMFs, which are located in the vicinity of transboundary river Shakhimardan, which length is 112 km. The distance to the border with Uzbekistan is only 4 km, that shows that the TMFs can pose the transboundary affect in case of the accident.

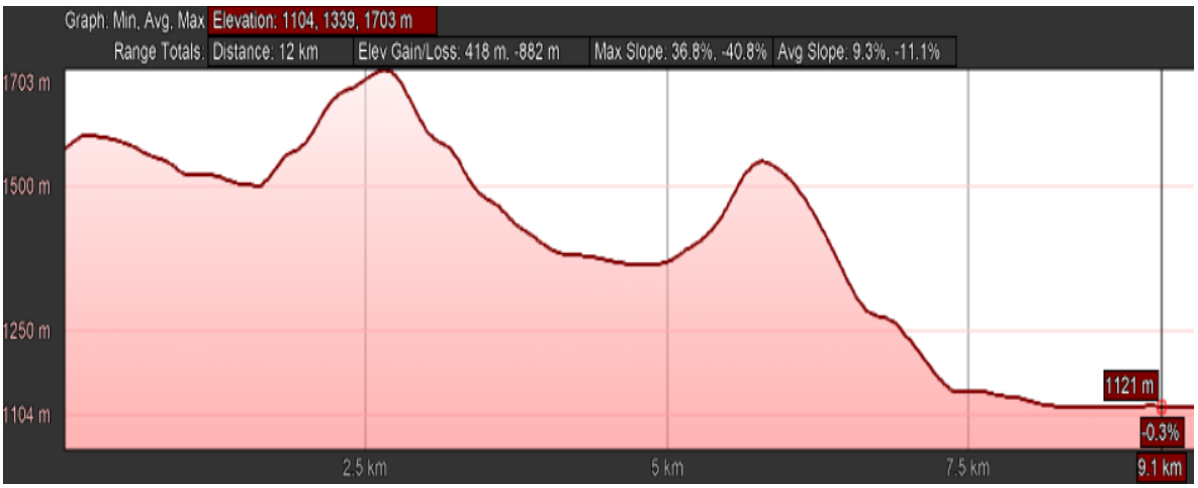
Table 5: Transboundary TMFs that can pose a threat of transboundary pollution through water resources

Number	TMF name	Remark
KG13-35	TMF nr. 1-22, Ministry of emergency	TMFs in the vicinity of transboundary MayliSuu river
KG44	TMF of open JSK "Kadamzhay antimony plant" (KAP)	~ 0.5 km to the river Shakhimardan
KG45	Salt storage of open JSK "KAP"	~ 0.5 km to the river Shakhimardan
KG46	Slagheap of open JSK "KAP"	~ 0.5 km to the river Shakhimardan

3.5.2 10 km zone approach

The TMFs from Table 4 were further analysed. In fact, the greatest harm of pollution through TMFs can occur not through the air, but in the event of a dam break or tailings leakage. Therefore, the topography of the area below the TMFs is of greatest importance in assessing transboundary impact. There are obstacles on the way of the TMFs KG 51, KG52, KG5 that will prevent the tailing materials from reaching the border with Kazakhstan in case of an accident. As an example, the evaluation profile is shown in Figure 14 for TMF KG 51.

Figure 14: Evaluation profile for TMFs on the example of TMF KG 51



Color scheme: red line –elevation change, m.

© Google Earth

In addition, TMF KG 57 is also located lower than the Tajik border.

This allows us to assume that the above mentioned TMFs (KG 51,52,05,57) do not pose the risk of transboundary pollution.

Assessment of the past accidents shows that the proportion of direct runout distances (transport distance of the released surface water body or retained by landscape objects or terrain barriers) is less than 10 km in almost 90%. This indicates that a distance of 10 km could be a suitable threshold for delineation of a direct risk zone downstream of TMFs (UBA, 2020)

Based on the above, to assess the transboundary hazard of TMFs, it is better to use the “10 km zone” approach, which is part of the TMF Methodology and developed specifically for assessing the hazard of TMFs, in order to take into account land-use planning aspects. At the same time, TMFs located in the zone 10 km upstream of the transboundary river will also be considered transboundary, regardless of its flow velocity. As analysis of accidents in the past shows, tailings that have fallen into the water of a river can spread hundreds of kilometres downstream. As an example, consider the accident in Brazil in 2019 when mud flowed down through several rivers towards the Atlantic Ocean (WISE, 2020).

Using the "10 km approach", 35 TMFs in Kyrgyzstan can be classified as transboundary. These include all TMFs from the Table 5, as well as TMFs presented in the Table 6.

Table 6: Transboundary TMFs according to the “10 km zone“ approach

Number	TMF name	Remark
KG01	TMF nr. 4 of Ak-Tyuz dressing plant, CJSC TK "Geo Reserve"	~ 10 km to the border with Kazakhstan
KG02	TMF nr. 1 of Ak-Tyuz mine, of the dressing plant of JSC "Kyrgyz Chemical Metallurgical Plant" (KCMP)	~ 5.4 km to the border with Kazakhstan
KG03	TMF nr. 2 of Ak-Tyuz mine, of the dressing plant of JSC "KCMP"	~ 6 km to the border with Kazakhstan
KG04	TMF nr. 3 of Ak-Tyuz mine, of the dressing plant of JSC "KCMP"	~ 5 km to the border with Kazakhstan
KG42	TMF of LLC "Kazakhmys Gold Kyrgyzstan"	~ 1.6 km to the border with Tajikistan
KG 43	TMF at Makmal deposit of open JSC "Kyrgyzaltyn", the branch of gold mining combine "Makmalzoloto"	Near to the Naryn river
KG 49	OJSC "Kara-Balta mining plant"	~ 0.5 km to the border with Kazakhstan
KG 56	Khaidarkan mercury plant "Simap"	~ 2.3 km to the border with Tajikistan
KG 59	TMF No. 2 of JSC "KHMZ"	~ 9 km to the border with Kazakhstan
KG 60	Salt accumulators of JSC "KHMZ"	~ 9 km to the border with Kazakhstan
KG 61	TMF No. 1 Makmal	~ 6.5 km to the Naryn river

As can be seen from the analysis of the TMFs in Table 6, TMFs KG 03, 04, 59, 60, 42 were also classified as transboundary and according to the UNECE approach. But, at the same time, when using the "10 km approach", the additional TMF KG 43, which is located next to the transboundary Naryn River, is also classified as transboundary. Since the length of the river before crossing the border is about 280 km, according to the UNECE approach, this TMF is not transboundary. However, based on the "10 km approach, it may pose such a risk.

In summary, it can be concluded that with regard to tailings hazard assessment, UBA's "10 km approach" is easier and more accurate to use.

In total, at least 58% of Kyrgyz TMFs can lead to a transboundary accident. This number is relatively high, which shows the need for coordinated actions between Central Asian countries, as well as the implementation of well-done contingency planning.

3.6 TMF mapping for UNECE region

In order to prioritize the risk of the large number of TMFs throughout the UNECE region, 898 TMFs were assessed by TRI. This assessment was carried out during the implementation of the UBA Danube project (for the Danube countries) and the UBA project in Armenia (assessment based on THI only). All data was merged and an upgrade was performed. As a result, the assessment was updated, and a new map was created that includes all countries. The data for individual TMFs are the same as for the map of Kyrgyzstan.

The TMF hazard map for UNECE region contains 3 layers and available on the link

https://www.google.com/maps/d/u/1/edit?mid=1w2C4_p2TjH1SJweug4HWKv0ucZq5vVw_&usp=sharing TMFs for countries;

1) The map with TMFs ranked by THI (high, medium and low level of hazard).

For the international assessment by THI the next categories were agreed, as an example, with international experts:

Hazard categories (Tailings Hazard Index, THI)

Very high level (THI ≥ 13)
High level (11 <THI < 13)
Medium level (THI ≤ 11)

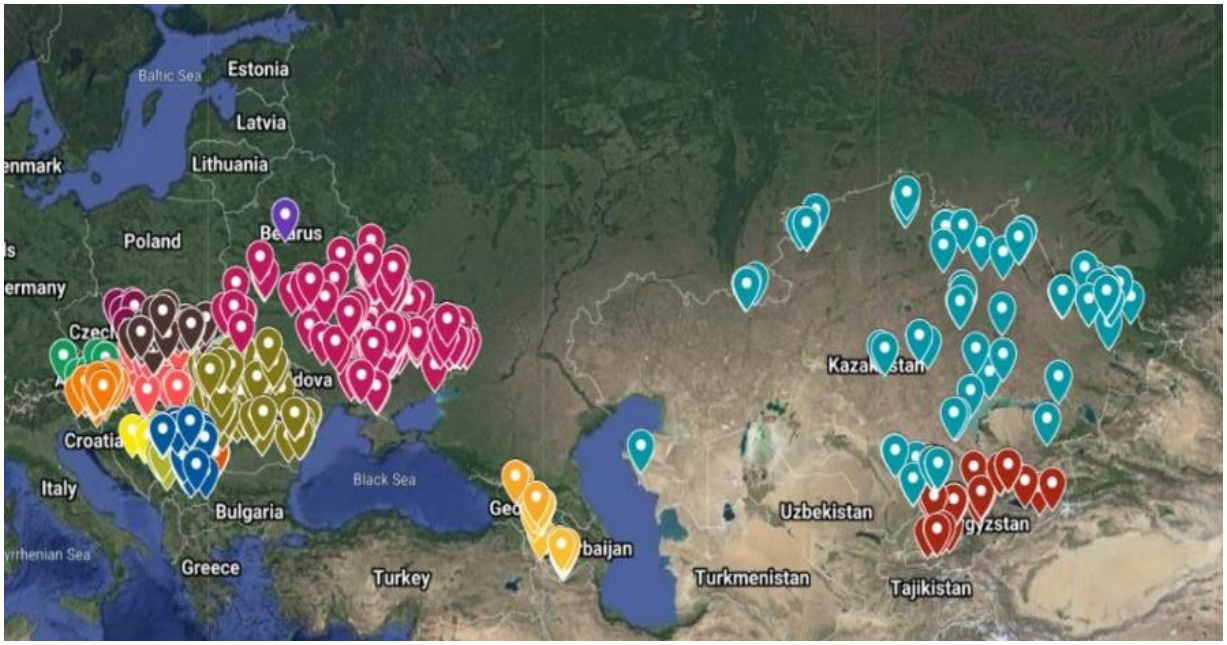
2) The map with TMFs ranked by TRI (high, medium and low level of risk). For the international assessment by TRI the next categories were agreed with international experts

Risk categories (Tailings Risk Index, TRI):

Very high level (TRI ≥ 20)
Medium level (15 <TRI < 20)
Low level (TRI ≤ 15)

A snapshot of the map is presented in **Fehler! Verweisquelle konnte nicht gefunden werden.**

Figure 15: The TMF hazard map for TMFs of the countries in UNECE region



Color scheme: TMFs of : - Austria; -Armenia; -Bosnia and Herzegovina; - Bulgaria; - Belorus; -Czechia; - Georgia; -Hungary; -Kyrgyzstan; -Kazakhstan; -Montenegro; -Romania; -Serbia; -Slovakia; - Slovenia; - Ukraine.

According to this map countries with high TMF activities can be easily identified. The map allows countries to receive a fast overview on the number of TMFs with the highest risk potential so that additional safety measures needed at the respective TMFs can be implemented subsequently.

4 Cadastre system of the Kyrgyzstan

At present, various state bodies maintain their registers of TMFs and there is clearly a need for harmonization and the establishment of a comprehensive electronic database, accessible to the interested agencies. As noticed already the last inventory of TMFs in the Kyrgyz Republic contains 92 entries for TMFs and waste heaps, but this number not been updated since the 1990s. Most of the information contained in this inventory is already outdated and does not meet modern standards. According to the data, which had been provided in the year 2020, only 56 of the 92 facilities are TMFs, but due to the information collected during the project the number of TMFs is 62.

It is necessary that Competent Authorities (CA) must have an accurate and actual overview to all national mining activities. The worldwide trend is to create a separate cadastre for mining.

The reasons for this separation are:

- the relatively short-term nature of the mining rights, the mining laws relating exclusively to the right of exploiting minerals and are not modifying the property right;
- the boundaries of these rights are not linked to the limits of the property rights;
- the need for independence of decision making regarding minerals and mining.

Historically mining and property cadastres in Kyrgyzstan have been treated separately. Traditionally, the lease was referenced on the cadastral unit to show the part of the plot of land that is subject to the lease. Nowadays, GIS technology provides a platform to integrate mineral and property cadastres – thereby showing the complete legal situation in situ, including surface and subsurface public rights and restrictions.

The Law of KR "On TMFs and Mining Dumps" regulates the following Requirements for state accounting of TMFs and Mining Dumps:

Article 9:

In order to obtain operative information on TMFs and mining dumps on the territory of the republic, they are subject to accounting according to the unified form (register) approved by the Government of the Kyrgyz Republic.

Article 10:

The register shall be compiled on the basis of the inventory and shall contain systematized data characterizing tailings and mining dumps, places and volumes of their storage and burial.

Article 11:

Specialized and operating organizations shall be responsible for timeliness, completeness of accounting of tailings and mining dumps in accordance with this Law.

These articles of the Law of KR "On TMFs and Mining Dumps" (Articles 9, 10, 11) are currently not implemented in full.

State registration of TMFs and waste dumps is carried out in common with other hazardous production facilities in accordance with the Law of KR "On industrial safety of hazardous production facilities", without separating them into a separate register, registry or cadastre.

Registration of facilities in the state register is carried out by the authorized controlling body - the executive authority empowered with control and supervisory functions in the field of industrial safety.

Registration is carried out on the basis of the "Regulations on registration of facilities in the state register of hazardous production facilities and maintenance of the state register", approved by the Decree of the Government of the KR dated June 8, 2017 №356.

The result of identification of a hazardous production facility for its registration in the state register is a Record Card of the facility in the state register drawn up by the operating organization. Hazardous production facilities registered in the state register shall be re-registered at least once every 5 years.

The last inventory and the State Cadastre of Mining Wastes of the Kyrgyz Republic, which contains 92 passports for tailings and mining dumps, has not been updated since the 1990s. It was compiled for the purpose of possible use of tailings and waste dumps as promising technogenic deposits for secondary extraction of useful components from them. Much of the information contained in these records is already outdated and does not meet modern standards.

Within the project activities a very detailed inventory of Kyrgyz TMFs was elaborated based on to consultation with national experts and internet research. This inventory, which contains a list of 62 TMFs could be the basis for an advanced national TMF Cadastral system.
As a basis for an advanced national Cadastral System, the questionnaires for active and closed TMFs may be used. These questionnaires were developed within the framework of the project and contain questions which in future can be easily integrated into the Cadastral system. The questionnaires are the parts of the developed and proposed policy recommendations (attached as a separate document).

5 Transboundary cooperation and alarm systems

The Kyrgyz Republic is a high mountainous country. Over half of its territory lies at an altitude of more than 2,500 meters above sea level, while only 1/8 of the country is located below 1,500 meters. Due to its geographical location, Kyrgyzstan is prone to a large number of natural disasters. Severe geological, anthropogenic, climatic threats and global climate change issues make a persistent negative impact on the people and economy of the republic. Both the population and infrastructure are vulnerable to disaster risks. Major vulnerability factors include non-compliance with environmental safety standards and regulations by the population, economic facilities, irrational land-use planning, deterioration of general infrastructure, and deterioration of industrial equipment, which increase vulnerability to disasters.

In Kyrgyzstan, almost all mining enterprises are classified as hazardous production facilities that use dangerous substances and generate and store hazardous wastes. The location of industrial enterprises at high elevations, in the zones of formation of water runoff, causes an increased need for prevention and management of anthropogenic accidents, effective and rapid response to them, coherence and coordination of actions when eliminating the consequences of accidents. In addition to this, the design and construction of TMF in the past did not provide for long-term measures to protect facilities against natural hazards (landslides, floods and mudslides), measures to protect the population (sanitary protection zones, etc.). These risks are worsened by an increase in the frequency and intensity of extreme weather events and dangerous natural processes due to climate change.

In order to create an institutional and legal basis for the Unified System of Comprehensive Monitoring and Forecasting of Emergency Situations in the Kyrgyz Republic, the Government of the Kyrgyz Republic approved the Decree of October 23, 2019 #569 "On the Unified System of Comprehensive Monitoring and Forecasting of Emergency Situations in the Kyrgyz Republic". This unified system is aimed at timely forecasting of emergencies, determination of possible scale and nature of emergency, development of recommendations for taking necessary measures to prevent emergencies and mitigation of their consequences. In addition, in order to strengthen the capacity of MES in risk assessment, early warning and information management through improving its technical readiness (infrastructure), a Data Processing Center of the Unified System for Complex Monitoring, Forecasting Emergencies has been established, which is designed to

- automation of the Emergency Situations Monitoring, Forecasting Department MES,
- improving the efficiency and reliability of adopting information about the threat or occurrence of emergency situations of natural or man-made origin, and
- improving efficiency, soundness and quality of decision-making on population protection issues in case of a threat or emergency.

Currently, the Kyrgyz Republic is not a party to the UNECE Convention on the Transboundary Effects of Industrial Accidents. Nevertheless, it was ratified by the Law of the Kyrgyz Republic of July 12, 2005 No. 98 "Agreement on cooperation in the field of industrial safety at hazardous production facilities" of the CIS countries.

According to the Classification of Emergencies and the Criteria for their Assessment in the Kyrgyz Republic (Resolution (2011 N 733)), the status of transboundary is given by the decision of the Government of the Kyrgyz Republic. The Emergency Response Plan for the Kyrgyz Republic (ERPKR, 2018) is posted on the website of the Ministry of Emergency Situations. The Response Plan summarizes key emergency response procedures, while clearly distinguishing between disasters requiring local response from national disasters based on the adopted Classification of

Emergencies, including those of a transboundary nature. Unforunetaly, this plan doesn't take TMF accidents into account.

"In four of the five Central Asian countries, the point of contact for the AMS (Industrial Accident Notification System under the Convention) has already been identified, and, accordingly, these countries have access to the System and, thus, will be warned in the event of an accident that could potentially touch them. In Kazakhstan, the point of contact is the Crisis Management Center (CMC) of the Committee for Emergency Situations (CES) of the Ministry of Internal Affairs, in Kyrgyzstan - CMC under the Ministry of Emergencies, in Tajikistan - CES and in Uzbekistan - the Ministry of Emergencies. " (UNECE, 2019a).

The Kyrgyz Republic has concluded a number of bilateral and multilateral agreements with neighbouring countries on assistance in emergency response and information exchange. Joint meetings of the boards of emergency departments of bordering states are held on a regular basis: Kyrgyzstan-Kazakhstan, Kyrgyzstan-Tajikistan, during which the improvement of cross-border cooperation is discussed. The Law of KR "On international emergency assistance" (from 17.06.2017 № 104 with amendments from 25.08.2020 № 144) provides: establishment of procedures, order, functions, powers and responsibilities, correlated with the promotion and settlement of international emergency assistance. However, there were no activities on contingency planning in case of TMF accidents between the neighbouring countries.

Therefore, in the course of the TMF project, there were conducted some discussions on contingency planning for accidents at TMFs. In particular, there was approbated the UNECE Checklist for Transboundary Contingency Planning. Developed and endorsed by UNECE, the Checklist provides a systematic and unified approach both for examining and evaluating the main principles for contingency planning. It aimed to help competent authorities to put in place effective and efficient contingency planning. The checklist is designed to help competent authorities for the preparation of operational and effective contingency planning, aiming at providing methodological support to CAs for the preparation of off-site emergency plans, especially in a transboundary context; at identifying gaps or deficiencies in transboundary contingency planning and to determine specific areas where further actions to strengthen contingency planning need to be taken, including legal and institutional conditions; and at serving as a tool for training stakeholders involved in transboundary contingency planning on international watersheds.

Representatives of the MES and the MNRETS conducted approbation of the checklist (attached at Annex B). According to the results of the approbation, it was concluded that Kyrgyzstan has and operates an infrastructural and legal basis for the introduction of transboundary contingency planning for accidents and emergencies. Nevertheless, the available bases do not address the issues of TMF. The majority of participants in the discussion suggested to conduct a thorough analysis and comparison with national policies and regulations, as well as international agreements for possible implementation and use in a transboundary context. Also, it is of great im-portance to synchronize existing alert systems on a national level as per the procedures of each country.

According to the results of the approbation, it was concluded that Kyrgyzstan has and operates an infrastructural and legal basis for the introduction of transboundary contingency planning for accidents and emergencies. However, the available bases do not cover the issues related to tailings management facilities.

Despite the above-mentioned cooperation with neighbouring countries, there is insufficient work on coordination of revision or updating of contingency plans and their testing with neighbouring countries. Insufficient technical and human capacities contribute to this.

Although the respective MES of the neighbouring countries work closely together, no regional notification centers in the region have been identified for emergencies of a transboundary character.

One of the main problems is that the real threats of rapid spread of contamination along the transboundary rivers in cases of accidents at TMFs are not taken into account.

Probably another main problem is that the threshold values of water pollution in transboundary watersheds (adopted in UNECE countries) which indicate with a high degree of probability an accident at a TMF upstream, promptly activate the system of early warning of transboundary countries about a volley of hazardous substances in a river and initiate emergency response measures, have not been adopted.

Based on the results of testing of the UNECE Checklist for Transboundary Contingency Planning, it was concluded that Kyrgyzstan needs to develop and implement a International Alert System similar to the Danube Accident Emergency Warning System (AEWS).

The AEWS is activated whenever there is a risk of transboundary water pollution based on threshold danger levels of hazardous substances. The threshold reflects a 'level beyond which there is a risk to human health from brief exposure for the general population'. When the threshold is exceeded, national authorities are required to inform the public and give advice. (https://www.eea.europa.eu/highlights/themes/air/air-quality/resources/glossary/alert-threshold).

The AEWS sends out international warning messages to countries downstream based on a predefined routing scheme. Details about each incident, such as time, place, involved substances, causes, observed effects, and counter measures taken, are collected in predefined forms.

For this, the first step should be the formation of an interdepartmental working group from representatives of relevant competent authorities: MES, MNRETS, including the Department of Geology and Subsoil Use and the Environmental and Technical Supervision Service under the MNRETS; Ministry of Agriculture, including the Water Resources Service under the Ministry. Representatives of specialized institutions of the National Academy of Sciences of the Kyrgyz Republic (Institute of Water Problems and Hydropower) were also recommended for inclusion. It is suggested that this interdepartmental working group can develop proposals for the creation of a warning system in the watersheds of rivers in case of emergency of a transboundary nature at the TMFs.

The Ministry of Emergency Situations of the Kyrgyz Republic can coordinate the process of implementation of the contingency planning in Kyrgyzstan.

Representatives of the competent authorities, the participants of the discussion recommended to determine and adopt the threshold values of pollutants, which in case of an accident, are released into the water and activate the warning system of transboundary countries about the massive discharge of hazardous substances into the river.

Beside the discussion of the threshold values, during the contingency planning seminar, which was held on 21st October 2021, an agreement on threshold values for alerting in the case of an accident at a TMF, including thresholds for radioactive TMFs (Table 7). As a basis for the proposed threshold values, the thresholds for the Danube International AEWS were used.

Table 7: Specific threshold levels of transboundary TMFs.

Number	River flow rates < 1000 m^3 / s	River low rates > 1000 m^3 / s
Tailings waste (in TMF)	≥ 1 00.000	≥ 10 00.000
Radioactive waste	1250 gigabequerels (Gbg)	1250 gigabequerels (Gbg)

The threshold value for the tailings waste were taking the same like for the released substance mixture for the suspended ash in the thresholds for the Danube International AEWS. Besides, it is at the moment under discussion also to add tailing waste to the consideration also for the AEWS. To identify the hazard classes of the tailings waste, a database maintained by German Environment Agency (Umweltbundesamt, UBA) in Germany that contains data of polluting substances may be used. All substances already allocated to a water hazard class or classified as non-hazardous to water can be searched using the UBA's online database Rigoletto. The substances are classified for their water-hazardous properties. Classification is carried out on the basis of the Administrative Regulation on the Classification of Substances hazardous to waters into Water Hazard Classes (Verwaltungssvorschrift wassergefährdende Stoffe (VwVwS) of 17 May 1999. The amendment to the VwVwS of 27 July 2005 entered into force on 1 August 2005. There are three water hazard classes (WHC):

Water hazard class 1: slightly hazardous to water;

Water hazard class 2: significantly hazardous to water;

Water hazard class 3: highly hazardous to water

Since Kyrgyzstan use a classification system which was used in the former USSR countries (Hazard Class (HC)), the HC system can also be used for alert system.
Due to the inventory, that was already made, most of the TMFs in the Kyrgyz Republic belongs to the Water hazard class 3 by German WHC.

Further, these thresholds may be revised or may differ depending on the characteristics and hazard and risk indices of the upstream TMFs.

The proposed threshold values are the part of the policy recommendations and were agreed to be implemented by the representative of the Ministry of Emergency Situations.

Further, it is necessary to accurately identify the transboundary/boundary nature of the country's water bodies (rivers, lakes) and tailings facilities, the consequences of accidents at which hazardous substances are released, can have a transboundary effect. Next, it is necessary to define regional warning centers for transboundary emergencies, their structure and operating procedures (communication points). It is proposed to determine the location of control stations on transboundary watercourses, in which threshold values of water pollution will be directly monitored and which will be implemented in the system of early warning in the watersheds of rivers in case of emergency of transboundary nature at the TMFs.

The more detailed results of the Contingency Checklist application can be found in Appendix B.

6 Land use planning aspects

Negative statistics on accidents at tailings management facilities, terrible and irreparable consequences of these accidents for the population, farmland, and infrastructure facilities require a constant search for effective solutions and proactive measures. Environmental pollution, because of improper mining activities, smelting and waste disposal practices has occurred and is still occurring around the world. Environmental impact assessments and environmental protection are essential parts of modern mining operations. These aspects become increasingly important because waste produced by the mining industry is significant in volume and diverse in composition when compared to waste from other industries

The UNECE Guidelines emphasize a need to consider land-use planning aspects taken into account when assessing the location of new tailings facilities, as well as the need for environmental impact assessment and risk assessment prior to construction works.

The TMF Methodology which was developed, tested and fine-tuned in several projects in UNECE countries contains the TRI which considers the total hazard potential to the population and the environment on surrounding territory with lower altitude than the TMF, potentially being exposed in case of an accident.

This general assessment is limited to a distance of 10 km, as historical analysis of failures demonstrates that the effects are limited to population within this distance.

Any land-use planning within an area up to 10 km must be based on a specific and detailed risk assessment for each individual TMF.

The same is true for potential environmental threats. Within the TRI assessment only water bodies within an area of 10 km were considered.

The Industrial Accidents Convention recommends an exchange of information between parties, consultation with each other on an ongoing basis, and adoption of joint measures. Data on the industrial safety of tailings management facilities, received and exchanged in accordance with article 15 of the Convention, are recommended to be used in land-use planning and site selection for tailings management facilities to consider the environmental and public health risks of accidents at tailings management facilities.

6.1 Sanitary protection zones

Environmental pollution as a result of improper mining, smelting and waste disposal practices have occurred and still occur around the world. Environmental impact assessments and environmental protection are essential parts of a modern mining operation. These aspects become increasingly important because waste produced from the mining industry is significant in volume and diverse in composition when compared to wastes from other industries (Lottermoser, 2010).

For example, more than 4700 Mt of mining waste and 1200 Mt of tailings are stored all over the European Union (BRGM, 2001).

Flotation tailings are defined as the processing waste and present waste product from the flotation process of copper ores. The physical and chemical characteristics of flotation tailings vary according to the mineralogy and geochemistry of the treated resource, type of processing technology, particle size of the crushed material, and the type of process chemicals (Lottermoser, 2010). Flotation tailings contain a considerably lower concentrations of useful components compared to those concentrations in the primary copper ore. (Stanojlović, R. D.,2014).

Air, one of the most important recipients in human environment, is being intensively polluted by mining wastes, not only in the direct working environment but also in wider areas. The degree of pollution depends on the concentration of polluting materials in the air and their harmness, ie. the degree of hazadous metals contained in them. (Stanojlović, R. D.,2014)..

Soil pollution is caused by spreading with fine-grain particles of the wastes due to the air-streams. Depending on the airstream intensities, these grain size particles can reach distances of more than ten kilometers away (LEAP, 2002; ERM, 2006),

Since the beginning of the last century, the protection of the population from the negative impact of production facilities began to be implemented in former USSR countries in the form of the organization of sanitary protection zones (SPZ) of enterprises (Popov F V, 1934) .

The first classification of enterprises in relation to their SPZ identified three types of construction objects. They were objects with zones of 200 and of 250 meters, as well as those enterprises which can officially operate in residential areas. Further research conducted in 1932-1939 made it possible to produce a new classification of industrial enterprises, which included six types of construction objects, that is objects with sanitary protection zones of 1000, 500, 300, 100 and 0 meters. The sanitary classification, developed later, included 259 types of various production facilities. (Strelkov, 2020).

In the Kyrgyz Republic, installation of strict regime zones, security zones around TMFs is regulated. As a rule, size of these zones does not go beyond the industrial sites of mines.

In order to protect the population and the environment of potential TMF failures, it is necessary that relevant authorities follow specific licensing procedures, and take the risk zones in the vicinity of the respective TMF into account.

All TMFs is Kyrgyzstan have already been evaluated and ranked according to the TRI index and the TMF Methodology.

However, it is necessary to define risk zones also closer to a TMF as the potential hazard is increasing exponentially with decreasing distance to a TMF.

This document contains the basic TMF design rules and standards for the sanitary protection zones of industrial facilities and enterprises.

Significant restrictions in construction near production facilities, including tailings sites, are regulated by the SanPiN "Sanitary and epidemiological rules and standards, Sanitary protection zones and sanitary classification of enterprises, structures and other facilities", approved by the Decree of the Government of the Kyrgyz Republic dated 11.04.2016 No.201. This document was developed in implementation of Article 22-1 of the Law of the Kyrgyz Republic "On Public Health.

The size of sanitary protection zones (SPZ) is 50, 100, 300, 500 and 1000 m, depending on the sanitary class of the production facility.

It is not permitted to locate within the SPZ:

- Residential development, including individual residential buildings, barracks for military contingents, prisons (settlement colonies);
- Landscape and recreation areas, recreation zones, territories of resorts, sanatoriums and recreation centers;

- Territories of gardening associations and cottage development, collective or individual dacha and garden-plots, as well as other areas with normalized indicators of the quality of habitat;
- Sports facilities, playgrounds;
- Educational organizations;
- Specialized medical and preventive treatment organizations, hospitals;
- Tourism and recreation facilities.
- At the same time, a significant drawback of this document, in our opinion, is that it does not mention the name of the object "tailing site" at all.

Investors, designers and experts are guided by the following names:

- Dumps and sludge collectors in non-ferrous metal mining (500 m);
- Dumps and sludge collectors for iron mining (300 m);
- Landfills for disposal, decontamination, burial of toxic wastes of production and consumption 1-2 hazard classes (1000 m).

Another current document regulating the size of protected zones of water bodies (rivers, canals, lakes, ponds), within which the location of any industrial plants and other hazardous facilities and installations is "Regulations on water protection zones and strips of water bodies in the Kyrgyz Republic", approved by the Decree of the Government of the Kyrgyz Republic from 7.07.1995 №271.

In it, the maximum width of water protection zones for rivers is 150 m, for canals - 100 m, for reservoirs (lakes, ponds, reservoirs) - 500 m.

Taking into account average parameters of breakthrough wave propagation as a result of accidents at TMFs, heavy consequences from them, these restrictions seem to be insufficient.

6.2 Risk zones

It is necessary to define risk zones also nearer to a TMF as the potential hazard is rising exponentially with decreasing distance to the TMF.

It is advisable to zone the area in vicinity of the tailings, within which a number of restrictions would apply:

- Zone A - up to 1 km
- Zone B - 1 to 5 km
- Zone C - 5 to 10 km
- Zone D - beyond 10 km

These zones should be considered as potentially affected by possible accidents at the tailings management facility. When determining the zones it is necessary to take into consideration the terrain relief, gorges, river beds, forests, the site topography below the marks. According to specific conditions, some adjustment of zone sizes is possible.

Zoning restrictions are proposed for the construction of new tailings facilities (Table 8) and additional precautionary measures for existing tailings facilities as well (Table 9).

Similar precautions are required for inactive tailings facilities, abandoned, mothballed, or reclaimed in the event of unsatisfactory operations.

Table 8: Proposed restrictions for new tailings facilities

Zone	Distance, m	Recommendation on restrictions
A	< 1000	No waterbodies, to build infrastructure facilities used by people is not allowed
B	1000 - 5000	No waterbodies, not allowed to build residential educational or medical institutions, placement of recreational centres, tent camps, parking for hunters, fishermen and tourists
C	5000 - 10000	placement of stadiums, national parks and airports, shopping centers, other objects with a mass presence of people is not allowed
D	>10000	No restrictions

Table 9: Proposed restrictions for existing tailings facilities

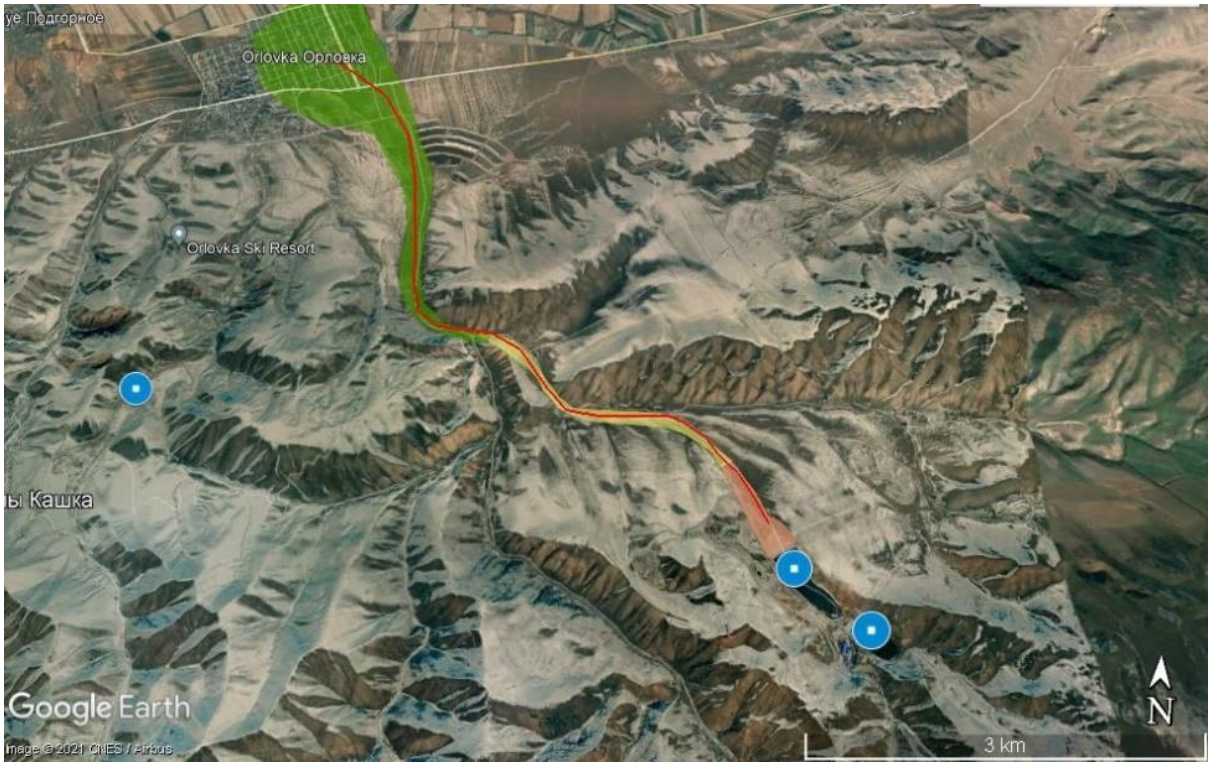
Zone	Distance, m	Recommendation on restrictions
A	No waterbodies, buildings with infrastructure (except technical buildings) used by people are not allowed	For waterbody: build additional protection dams. An alert system is required. For buildings: develop a plan to move them to a safer area. The territory of the TMF should be fenced off with barbed wire and identification signs and illuminated billboards should be placed in the risk zone, notifying of the possible grave and immediate danger.
B	No waterbodies, not allowed to build residential educational or medical institutions, placement of recreational centres, tent camps, parking for hunters, fishermen and tourists	For waterbodies: automatic monitoring stations are needed, dependent to protective measures For buildings: the construction of a protective wall or a ditch is required, which can protect the population, and especially children, in the case of an accident at TMF.
C	placement of stadiums, national parks and airports, shopping centers, other objects with a mass presence of people is not allowed	develop an emergency evacuation plan, establish a communication system between operators and representatives of the airport, stadium or park

This is a proposal which can be adjusted according to individual risk assessment, to established safety measures or other individual factors.

6.3 Example of application of risk zones

For demonstrating the risk zones' application, the "Altyn-Ken" TMF at the Taldybulak Levoberezhny gold deposit was chosen. Deposit Taldybulak Levoberezhny is located in the southeastern side of the Chui Valley, in the valley of the Taldybulak River. It contains two tailings management facilities. The calculated distance downstream of 10 km considers topography of the territory (Figure 16) and shows the potential spill of tailings in the case of the accident.

Figure 16: The distance downstream of "Altyn-Ken" TMF



The red zone outlines the risk zone A (0-1 km), the yellow zone outlines the risk zone B (1-5 km), the green zone outlines the risk zone D (5-10 km) downstream territory which can be potentially affected within the risk zones in case of an accident.

In zone A (5 km zone, the Tadibulak river is located. The city Orlovka with population of 6260 people is in zone C (10 km). In the same one, a school, kindergarten and hospital are located. According to the recommendations the following restrictions should be considered:

- For Tadibulak river: build additional protection dam. To develop a warning system in the case of an accident.
- For the hospital, school and kindergarten– develop an evacuation plan in case of an accident.

7 Adaptation of the Checklist Methodology to country conditions

The Federal Environment Agency of the Federal Republic of Germany (UBA), together with the Secretariat of the UNECE Convention on Transboundary Effects of Industrial Accidents, has developed the so-called "Guidelines and Good Practices for Tailings Management Facilities". To support implementation of the document, UBA has developed a Tailings Management Facility Safety Methodology, which consists of a Checklist for verifying the actual safety situation of tailings management facilities and the Tailings Management Facility Hazard and Risk Indexes (THI or TRI) for assessment of TMFs on regional, national and international basis.

About 1,000 tailings management facilities located in the UNECE region are possible object to be checked using this Methodology; training in the Methodology has been conducted in a number of countries, including Ukraine, Armenia, Georgia, DRB, and in Central Asia region - Kazakhstan, Tajikistan, Uzbekistan.

The TMF checklist is adapted to the legislation, licensing and permitting system, regulatory and technical documents of a particular country, the actual conditions of the location of facilities, other specific conditions and features. Questions of the checklists are differentiated for active and inactive tailings facilities.

7.1 Practical test at the Altynken TMF in Kyrgyzstan

In the framework of the Kyrgyz TMF project, a regional demonstration training event was organised in 27-29 September 2021 in Bishkek and at the Altynken TMF site for invited national and international TMF operators and environmental inspectors. The training event included theoretical lectures on the Checklist methodology in Bishkek, site visit and field exercises at the Altynken TMF site (Taldybulak Levoberezhniy deposit) and desk exercises to test, discuss and amend a detailed checklist methodology (again in Bishkek). In total, 35 trainees from Kyrgyzstan and Kazakhstan, and other EECCA countries, international experts and project partners participated in the training event.

As it was mentioned already in chapters 3, 4 and 6 of this report, mining industry is and has been one of the major sectors of the Kyrgyz economy, producing precious and non-ferrous ore minerals and uranium ore in large quantities. Consequently, utilization of these ore deposits led to significant number of TMF sites, in most of the cases with large quantities of stored tailing materials. Moreover, a considerable amount of uranium ore extracted in Kazakhstan was processed in Kyrgyzstan, adding a large additional number of radioactive tailings in the territory of the Kyrgyz Republic.

Policies in relation with TMFs in Kyrgyzstan show two different pathways. On one side, improvement of the safety conditions of closed, abandoned, suspended – i.e. non-active sites which are expected not to be used as active sites in the future – and maintenance of the safety level of these sites in the future is a key issue from environmental, nature protection and human safety points of view. On the other side, safe and up-to-date management of TMFs of active mining sites which contribute to the Kyrgyz economy has a high importance both from environmental and economic aspects. High safety level of active TMF sites is a key issue for future mining operations as well.

Additional specific issue of the TMF safety and management in Kyrgyzstan is the geography of the country, as most of the TMFs are located in high-mountain areas, some of them (e.g. Kumtor)

at extreme high altitudes. These sites need consideration of specific safety aspects such as seismic sensitivity, extreme cold temperature, high risk of landslides.

For the authorities interested in safe tailings management in Kyrgyzstan, all three aspects are important, which had to be taken to set up the program of the training. Improvement and remediation of non-active sites and specialties of Kyrgyz TMFs were discussed in detail during the theoretical part of the training (day 1), providing examples of site deteriorations, solutions for improvement and management of the specific high-mountain-related issues.

Practical part however focused on the active TMFs to introduce the concept, constituents, and management practice of a TMF site which corresponds to the globally recognized BAT requirements. The logistically feasible site from Bishkek for this purpose was the Altynken TMF.

The major objective of the practical training was to demonstrate the applicability of the Checklist methodology to the trainees, understand the qualifiers based on visual assessment, use of the Measure catalogue and assess the safety conditions of the TMF, applying Group B section of the checklist. For these objectives, the Altynken TMF commenced in 2015 became a feasible site with high-level safety standards, equipped and designed to meet BAT requirements.

On the first day, a comprehensive programme of lectures was provided to familiarise the participants with the checklist methodology as well as with examples of signs of deterioration of TMF components. In addition, a site visit was organised to the Altynken site on the second day to test the Group 1 part of the checklist designed for visual inspection. During the site visit, participants were divided into two teams and each team performed a separate inspection on the facility. The trainees had their own checklist and answered the questions independently. Each group was accompanied by two trainers and local TMF operators who provided explanations of the questions. Finally, a practical evaluation exercise on the third day completed the training programme. The site visit work was supported by an itinerary indicating the issues and number of questions which can be observed at the current stop. On the third day of the training, participants evaluated the overall and categorical safety conditions of the TMF, compared the results of the visual inspections, exchanged their impressions on the site visit and provided recommendations on how to improve the checklist methodology. The outcomes of the training event significantly contributed to the revision and update of the Checklist, in particular the questionnaire and the measure catalogue.

Evaluation of the results showed the robustness of the checklist methodology as aggregated indicators obtained by the two teams differ only within 5% (Table 10). It shows that the results can accepted as reliable and reproducible, independent from which competent team will complete the checklist.

Table 10: Evaluation key indicators received by the two training groups on detailed visual inspection, visiting the Altynken TMF site

Key indicators	Results from training team 1	Results from training team 2
Meeting Safety requirements, MSR (%)	92.9	95.2
Credibility (%)	70.6	72.7
Share of answers „Yes” (%)	63.2	63.2
Share of answers „Mostly yes” (%)	26.3	23.7
Share of answers „Mostly no” (%)	0.0	0.0

Key indicators	Results from training team 1	Results from training team 2
Share of answers „No" (%)	0.0	0.0
Share of answers „Not applicable" (%)	10.5	13.2

Based on the feedback from the trainees, eight questions (Q2Q3, Q11, Q14, Q17, Q34, Q36, Q38) have been improved in the Group 1 part of the checklist. These were mainly improvements for better applicability of the questions. Regarding question 2, the improvements included to consider the rock erosion next to soil erosion in the zone of TMF impact. The inclusion of rock erosion was approved by the specific geomorphological conditions of Kyrgyzstan as this issue might be relevant at high-mountain conditions.

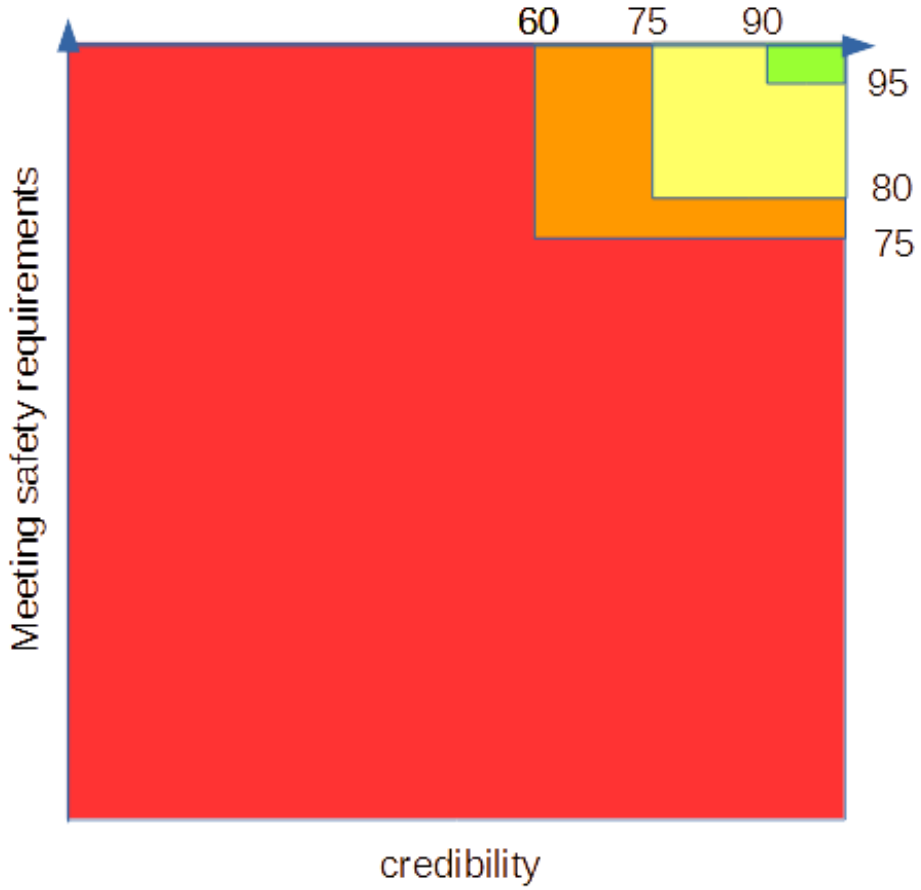
The question of compliance with the TMF safety requirements ("meeting safety requirements" – MSR and "credibility" grades CR) was revised based on remarks of trainees. The overall evaluation of the TMF's safety factor is calculated by the excel sheet based on the grade of positive answers ("yes" or "mostly yes") and the "Acceptable" qualification was given only reaching the 100% MSR grade. In case the MSR factor is less than 100% but only "yes" or "mostly yes" answers were given, the assessment will be "Acceptable with conditions", indicating that some of the questions with ambiguous answers need to be further investigated. In all other cases, the assessment will result in "Non-compliant" safety level indicating that some of the standards are not met and the reliability of the information sources needs to be improved.

Based on remarks given by trainees, the acceptability grades were improved considering MSR and CR values as follows:

- Green: MSR>95%; credibility > 90%: Acceptable with conditions, improvements recommended,
- Yellow: MSR>80%; credibility > 75%: Acceptable with conditions, short-term improvements recommended, mid-term action plan should be developed or revised,
- Orange: MSR>75%; credibility > 60%: Acceptable with conditions, short-term improvements strongly recommended, mid-term action plan should be developed or improved,
- Red: MSR<75%; credibility < 60%: Non-compliant, short-term actions are required.

This assessment criteria gives more flexibility for the experts who do the assessment, on the other hand it is still rather strict as below 75% MSR and below 60% credibility the TMF fells in the non-compliant category, at least one "no" or "mostly no" answer leads also to non-compliance.

Figure 17: Categories of intervention based on the results of MSR and CR values (%)



In order to make the evaluation even more robust, four “killing questions” were selected from Group 1 questions of the detiled questionnaire. Questions Q21, Q23, Q27 and Q30 should have definitely positive ("yes”) answer to avoid the “Non-compliant” qualification status. These four “killing questions” have specific importance to dam stability and cannot be answered as not relevant. Therefore, if any of these questions does not receive the “yes” answer, the status of the TMF safety shall be considered as “Non-compliant”.

7.2 Benefits of TMF Checklist application

The Checklist was conceived as a toolkit to improve TMF safety level and to ensure public safety in the areas potentially affected by tailings spills. On the top of enhancing technical quality and safety, it may also bring many organizational and managerial benefits listed below:

- The TMF Checklist imposes standardised, unified qualification requirements both to TMF operators and state inspectors. Thus, systematic application of TMF the Checklist can permanently enhance the skills and qualification of both, TMF operators and state inspectors.
- The TMF Checklist unifies the procedure to evaluate the safety of various TMFs, which ensures a consistent assessment and complies with the relevant international standards.
- The Checklist covers the entire life cycle of the TMFs so that it can reveal design deficiencies and inappropriate operation conditions, can improve emergency preparedness, and can support implementing an adequate closure and rehabilitation plan.

- Regular training for the TMF personnel can enhance staff knowledge on preventive measures and their preparedness to emergencies.
- Systematic application of the Checklist to various TMFs in different countries will contribute to better understanding the risks posed by TMFs across geographic regions or river basins.
- Reliability and Reproducibility of the evaluation results approves the robustness of the Checklist methodology and the resulting benefits for operators and CA

Communicating the TMF Checklist results to the public – both the directly affected and the wider society – and discussing safety issues with local communities in the form of public hearings can help raise awareness in society of TMF safety, accident prevention and emergency management. On the other hand, openness and communication of the Checklist results can demonstrate the high level of management, environmental protection and safety of the site and thus improve the public acceptance of the resources industry.

7.3 TMF Checklist application in the Kyrgyz Republic

When using the TMF Checklist on specific TMF of the Taldybulak Levoberezhny mine in the Chui region (which has a potential transboundary impact), the checklist was largely adjusted by the training participants.

Some questions were adjusted in the TMF Checklist to take into account the specific conditions of the Kyrgyz Republic.

Aim of this project, as stated, is to improve the overall level of safety of Kyrgyz TMFs, while achieving the goal requires implementation of a set of certain measures and actions. Group B questionnaire is highly recommended for safety assessment of active TMF sites and recommended for consideration during planning and design of future TMFs. On the other hand, Group C questionnaire is important for assessment of non-active sites which are also plenty in Kyrgyzstan.

Analysis of the situation has shown that it is necessary to significantly raise the level of awareness of TMF operators, state inspectors, representatives of other competent bodies responsible for this sphere of activity about possible shortcomings and violations in the safety systems of tailings facilities to timely and proactively identify problems which may lead to industrial accidents, including those with transboundary effect.

The proposed policy recommendations regarding the education on and integrating of the TMF methodology were discussed by a wide range of participants from government agencies, business community, civil sector, clarified after the training held with the participation of representatives of the countries where these trainings had been held earlier and certain practical steps based on the results of the trainings have already been made.

The participants agreed that improvements should be systematic rather than ad-hoc, become part of functions and practices of the competent state bodies, and make the process of assessment and accounting of tailings management facilities regular and sustainable, preferably without attracting external funds. It is proposed to establish an Interdepartmental Working Group (IWG) in charge of implementing the TMF Methodology and the TMF Checklist within the Kyrgyz regulatory framework.

At the same time, the TMF methodology can be used as the basis for respective national and regional training programs. It is proposed to establish a center of training for TMF operators which will directly utilize the results of the project and will use the TMF methodology as a basis

for training. This center will ensure the quality and sustainability of safety education to inspectors and also will be a center of excellence keeping Kyrgyz technology and standards on a high international level.

8 Conclusions and Recommendations

Based on the discussions during the Final Workshop, the following recommendations were proposed by the competent authorities of the Kyrgyz Republic for implementation in order to achieve the goals that were proposed in the policy recommendations developed during the project:

8.1 Planned measures for TMF inventory holding and establishing the cadastre system

- To introduce amendments and additions to the "Regulation on Registration of Facilities in the State Register of Hazardous Production Facilities and Maintenance of the State Register", approved by the KR Government Decree No.356 of 8.06.2017, in order to ensure full implementation of the KR Law "On TMFs and Mining Dumps" (Articles 9, 10, 11);
- it is recommended to entrust the task of separating the TMFs into a separate section of the register of hazardous facilities;
- in case of maintaining a register, it is advisable to provide a field in the database indicating a possible transboundary impact of consequences of an accident at a given TMF;
- to compile the cadastre and passports for tailings management facilities, a working group should be formed consisting of representatives of the Ministry of Natural Resources, its specialized departments and services for active tailings management facilities and representatives of the Ministry of Emergencies for inactive tailings management facilities;
- the cadastre must be compiled on a basis of the inventory carried out during the project, using GIS technologies. The passports must contain systematized data characterizing TMFs and mining dumps, places and volumes of their storage and disposal, hazard and risk indexes (THR and TRI) calculated according to the Methodology, information obtained from the attached questionnaires, other data;
- it is necessary to study issues of openness of the cadastre and access to it by third parties. It is considered to establish a 3-stage system of access and obtaining information similar to the system of access to the stock materials of the Department of Geology, access to the materials of the cadastre in the amount of 2 and 3 stages of completeness of information should be paid;
- it is necessary to determine and appoint the structure and persons responsible for maintaining the cadastre, for tracking changes and regular updating of the cadastre. A procedure for maintaining the cadastre should be developed and approved in the prescribed manner.

To solve these tasks, it is advisable to form an interagency working group of the WG from representatives of the following ministries and agencies:

- the Ministry of Natural Resources Ecology and Technical Supervision, including the Department of Geology and Subsoil Use and the Environmental and Technical Supervision Service under the Ministry;
- the Ministry of Emergency Situations;
- the Ministry of Health;

- Representatives of specialized institutions of the National Academy of Sciences of the Kyrgyz Republic can be invited to the WG upon agreement.

It is proposed to entrust the coordination of works to the Ministry of Natural Resources of the Kyrgyz Republic.

8.2 Planned measures for establishing the alert systems in river catchments

- Formation of an interagency working group of the WG from representatives of the following ministries and agencies:
  - the Ministry of Emergencies;
  - the Ministry of Natural Resources Ecology and Technical Supervision, including the Department of Geology and Subsoil Use and the Environmental and Technical Supervision Service under the Ministry;
  - the Ministry of Agriculture, including the Water Resources Service under the Ministry;
  - Representatives of specialized institutions of the National Academy of Sciences of the Kyrgyz Republic (the Institute of Water Problems and Hydropower) can be invited to the WG upon agreement.
- The Terms of Reference of the WG should include the tasks of elaboration of proposals on creation of a warning system in the river basins in case of emergency of transboundary nature at the TMFs, based on the Danube emergency warning system, for which it is necessary:
  - define and adopt threshold levels of pollution discharged into the transboundary watercourse activating the system of early warning of transboundary countries about the salvo discharge of hazardous substances into the river and initiating emergency response measures;
  - accurate identification of transboundary/boundary nature of water bodies of the country (rivers, lakes);
  - accurate identification of tailings facilities, consequences of accidents involving the release of hazardous substances, which may have a transboundary effect.
- When identifying tailings management facilities with a transboundary impact, the following criteria should be applied (decision 2000/3 on guidelines to facilitate identification of hazardous activities for the purposes of the Convention):
  - within 15 km of the border for activities involving the use of substances that may cause a fire or explosion, or the use of toxic substances that may enter the atmosphere in the event of an accident;
  - along or within the catchment area of transboundary or boundary rivers, transboundary or international lakes or within the catchment area;
  - 15 km - distance corresponding to approximately two days' flow at an average flow rate;
- The catchment area of a transboundary river or lake is defined as the total catchment area of this river or lake.

- Develop proposals on determining the number, jurisdiction, and operating procedures of regional warning centers in the event of a transboundary emergency (points of communication).
- Develop proposals on the location of control sections in transboundary watercourses, in which the threshold values of water pollution will be directly monitored and which will be implemented in the system of early warning in the catchment basins of rivers in case of emergency of transboundary nature at the TMF.

Suggested that the Ministry of Emergency Situations of the Kyrgyz Republic should coordinate the work in this direction.

8.3 Planned measures on land-use aspects

- Formation of an interagency working group (IAWG) from representatives of the following ministries and agencies:
  - the Ministry of Natural Resources Ecology and Technical Supervision, including the Environmental and Technical Supervision Service under the Ministry;
  - the Ministry of Emergency Situations;
  - the Ministry of Health;
  - the State Agency of Architecture, Construction and Housing and Communal Services under the Cabinet of Ministers of the KR (Gosstroy);
  - the Ministry of Agriculture, including the Water Resources Service under the Ministry.

The Terms of Reference of the IAWG should include the development of proposals for amendments and additions to the Decree of the Government of the Kyrgyz Republic № 201 dated 11.04.2016 on SanPiNs on SPZs:

- include in the section of terms and definitions a notion “Tailing Management Facility”;
- include in Section 3 “Ore and non-metallic minerals mining”", as production facilities, the object “Tailing management facility” with the following size of the SPZ:
- attribute TMFs to Hazard Class 1 with a SPZ equal to 1000 m, if toxic reagents are used at milling factories, there is no press-filtering of tailings pulp, and there is no preliminary treatment of tailings prior to their discharge into the TMFs;
- classify the TMFs as Hazard Class 2 with the SPZ equal to 500 m, if no toxic reagents are used at the milling factories and the tailings slurry is not press-filtered;
- attribute the tailings facilities to the 3rd hazard class with SPZ, equal to 300 m, with no application of toxic reagents at milling factories, with press-filtering of tailing pulp and semi-dry storing of tailings with humidity not exceeding 20 % and with future processing of tailings waste into secondary raw materials.
- to introduce an additional subsection to Section 3 “Ore and non-metallic minerals mining” with recommended restrictions for zones A, B, C, D.

- Development of proposals on introducing amendments and additions to the Decree of the KR Government No.271 as of 7.07.1995 on water protection zones in order to reasonably increase the size of water protection zones for water bodies.
- Development of proposals on amendments and additions to the Resolution of the KR Government #12 as of 17.01.2020 "On Approval of Regulations on Issuance of Documents for Design, Construction and Other Changes of Real Estate and Assessment of Compliance of Completed Facilities in the Kyrgyz Republic", and in Rules of Construction and Land-Use in Urban and Rural Residential Areas:
    - additional sections shall take into account recommended restrictions for zones A, B, C, D when selecting sites for construction of tailings facilities, when developing district planning projects, master plans, schemes, detailed planning projects, etc.;
    - commissions selecting sites for construction of hazardous industrial facilities should include representatives of the Service of Ecological and Technical Supervision of the Ministry of Natural Resources, Environment and Technical Supervision.

Coordination of work in this area, proposed to delegate to the Ministry of Emergencies of the Kyrgyz Republic.

- Facilitate the development of information management strategies adapted to the consumer (focused specialist, decision-makers, media, public). To collect the open source information regarding the safety of TMFs on one web page.

8.4 Planned measures to implement the Checklist Methodology

- Set up of the cross-agency working group (WG) from representatives of following ministries and agencies:
    - the Ministry of Natural Resources, Environment and Technical Supervision including the Department of Geology and Subsoil Use and the Service of environmental and technical Supervision under the Ministry;
    - the Ministry of Emergency;
    - the Ministry of Health.
    - Representatives of specialized institutions of the National Academy of Sciences of the Kyrgyz Republic (Institute of Geomechanics and Subsoil Development) and public organizations may be invited to the WG upon agreement.
- Terms of Reference for WG should include the following tasks:

Finalization of adaptation of issues of the checklist to conditions and legislation KR:

- development of training programs on the provisions of the Methodology for state inspectors, tailings management facility operators, representatives of regulatory state bodies;
- development of proposals on organization and equipping of the training centers in the regions (at least two) or at the regional subdivisions of the Ministry of Natural Resources or (options) the use for this purpose of the resources of existing Interindustry Training Center at the Department of Geology and Subsoil Use, or other options, or

the Training and Retraining Center for specialists at the Ministry of Emergency Situations;

- development of proposals on how to implement the Methodology - options: development of an independent normative legal act; or determination of NLA, in which the necessary changes and additions will be made, other ways.

8.5 Additional recommendations

- One of the important tasks was noted that it is necessary to develop leaflets on TMFs, accidents at TMFs, to create a scheme of interaction between companies - subsoil users (mining companies) and government agencies. Create new detailed instructions and guidelines for TMFs management;
- Another problem of the emergence of risks in this area is the lack of transparency of work and media coverage, it is important to maintain a policy of close interaction with civil society, the population and companies - subsoil users (mining companies) ;
- The need to introduce electronic submission of applications for obtaining licenses and permits, professional development of civil society employees and local authorities in the field of subsoil use, increasing the responsibility of civil society employees, improving the system of public administration;
- Weak current regulations and regulations for tailings management needs improvement and implementation the international standards. Develop work on EITI and CRISCO;
- Improve the Action Plan of the authorized bodies for subsoil use and environmental protection, LSG of the Kyrgyz Republic for the management of TMFs;
- Conduct an inventory and update the database on subsoil use objects (future reclamation), cartography for lands in need of reclamation, for the management of TMFs;
- In turn, conditions should be created for accountability and accountability of authorities to society, transparency of government procedures and strict adherence to the principle of safe management of TMFs;
- Open platforms for discussion of anti-corruption policy in terms of reclamation of disturbed lands after mining operations, management of tailings and environmental protection for the exchange of views and views between all stakeholders (Tailing Safety CA Hub).

9 Concepts of a follow-up projects

After the project implementation the Ministry of the Natural resources, Ecology and Technical Supervision of the Kyrgyz Republic extended its acknowledgment to the project team for all the work done and expressed its interest in continuing and expanding the project on capacity building and transferring new knowledge and technologies for ensuring environmental safety in Kyrgyzstan. During and also at the end of the project, several high-level meetings were held with heads of departments and Deputy Ministers, who expressed their wishes for further fruitful cooperation in ensuring sustainable development. The concepts of a follow-up projects was compiled based on the feedback and recommendations received during the Final Workshop discussions, as well as the recommendations of the Deputy Ministers of the Ministry of the Natural resources, Ecology and Technical Supervision of the Kyrgyz Republic, Mr. K.R. Sadykov and Mr. Ibraimov which were received during the meetings with them.

The concepts of a follow-up projects on environmental safety in the mining sector in Kyrgyzstan is presented below:

9.1 Proposal 1. Building capacity to improve TMF safety by establishing a Center of Excellence in Kyrgyzstan.

Background

There are about 90 objects in Kyrgyzstan, including active, abandoned, and conserved TMFs, waste dumps, etc. While there are no environmental safety norms and requirements are always observed. Some efforts made to raise awareness of stakeholders and improve the qualification of TMF operators, inspectors of technical and environmental supervision remain limited. These activities are conducted spontaneously and sporadically. There is no systematic work to improve the qualification of inspectors and TMF operators. Moreover, there is a lack of an adequate systematic knowledge base in this field. Developed training materials are often random, they are not stored and are not properly handed over. This problem is relevant not only for Kyrgyzstan, but also for other countries of Central Asia, the Caucasus and countries of Eastern Europe.

The analysis of the situation in the field of TMFs management carried out within the framework of the project showed that there is a great need to create a unified training course based on the TMF Methodology, which can be used to train TMF operators, government inspectors, representatives of other competent authorities and TMFs to improve their skills and eliminate shortcomings in assessing the safety of TMFs, which can lead to industrial accidents, including those with a transboundary effect. At the same time, in the case of training according to a unified methodology for both representatives of regulatory authorities and representatives of enterprises, mutual understanding will significantly improve, which will lead to an increase in the safety of TMFs. Conducted training of trainers during the project "Improving the safety of tailings management facilities in Kyrgyzstan" showed the high interest of operators and inspectors of TMFs in the introduction of a unified course for their training in new and effective tools for assessing the safety of tailings. In addition, various stakeholders from Ukraine, Kazakhstan, Romania, Belarus and Armenia have expressed a desire to learn from best practices in the management of TMFs. The TMF Methodology developed earlier by UBA can be an ideal basis for creating such a course.

In particular, the Deputy Minister of Natural Resources, Ecology, and Technical Supervision of the Kyrgyz Republic raised the issue of strengthening the capacity of environmental and tech-

nical surveillance inspectors of TMF. Discussions within the framework of the project "Improving TMF Safety in Kyrgyzstan" have shown that capacity-building efforts must be systematic rather than ad hoc and should be a part of the functions and activities of the relevant government bodies and make the process of assessment and registration of TMF a regular and sustainable activity. To this end, it is proposed to establish a Center of Excellence, which will be supervised by the Ministry of Natural Resources, Ecology and Technical Supervision of the Kyrgyz Republic, which will serve to create and strengthen the capacity of TMFs. On the basis of this Center, not only inspectors and TMFs workers from Kyrgyzstan, but also from Kazakhstan, Tajikistan, Turkmenistan, Uzbekistan and Mongolia can improve their skills. The Center of Excellence will act as a knowledge base where universal international methods for better tailings management will be stored and made available to users.

Aim and tasks

The project aims to build and strengthen the capacity to improve TMFs safety in Central Asia and Eastern Europe by establishing a Center of Excellence and developing a training course for TMFs inspectors and representatives.

Short concept of the Center of Excellency

The Center will provide courses for specialists of competent authorities, representatives of mining companies in the country. The Ministry of Natural Resources, Ecology, and Technical Supervision of the Kyrgyz Republic will coordinate the project.

The project includes the development of training and certification programs for personnel and companies involved in the management and operation of TMF and the mining sector. The Centre will use the experience accumulated by the developed countries in safe operation and management of TMFs. Besides, the centre will also act as a knowledge base.

Another objective of the Center is to promote a large-scale implementation of the Methodology of TMF Safety Improvement and its tools in the mining companies of the republic to ensure environmental safety. The project will institutionalize a system of capacity building for environmental inspectors.

At the first stage, the Center will focus on the development of a training curriculum, educational and training materials, institutionalizing the training process, and delivering training for inspectors on ecological and technical supervision. Afterward, the Center will expand its directions, improving the qualification of ecologists and specialists of competent bodies on the issues of air quality control, water resources quality assurance, biodiversity conservation, and management of protected areas. To ensure sustainability, the Center will also provide training services to improve the qualifications of employees of private mining companies. In addition, there will be initiated and organized the procedure of harmonization of the regulatory framework related to the safety of TMFs and the mining operations. For design engineers of TMF, there will be organized consultations on the proper application of national and international standards.

It is expected that the ecologists, specialists of competent authorities, inspectors, operators, and other interested persons will be able to use the library of guidelines and standards, as well as attend online classes, video lectures. In addition to consultations with Center experts, this group of trainees will have the opportunity to exchange experiences with representatives of other institutions, organizations, and companies. Subsequently, close cooperation will be established with the Ministry of Education of the Kyrgyz Republic and the Ministry of Labor to accredit the activities of the Center, thereby certifying the course to be accredited by the competent authorities in the republic.

The main directions of the advanced training courses would be:

- Ensuring the safety of TMFs
- Regulatory and legal base in environmental field
- Monitoring of air quality, quality of water and soil
- Biodiversity conservation and protected areas management

The Center will have four main functions:

1. training, attestation and certification of environmental and technical inspectors
2. consultation and expertise, particularly in the use of best practices for the safety of TMFs
3. creation of a knowledge base of training materials
4. platform for the exchange of experiences between specialists from different competent authorities, TMF operators, and other specialists at the national and international level.

By combining hands-on training and certification with the accumulation of experience in developing and implementing advanced methodologies and tools, the Center will be an ideal opportunity for private and public entities to showcase innovative technologies, advanced technical solutions, promising components, controls and operating methods.

A key feature of the center will be extensive cooperation with governments, private suppliers, and educational institutions operating internationally, with national professional associations. In addition to private partners, the Center will engage international non-governmental organizations, associations, and educational institutions involved in the development of curricula and standards in the environmental sector.

Modular distance learning will also be organized at the center. In the beginning it is planned to use the materials available in the public domain, the experience of realized and being realized projects, including the project " Improving the Safety of TMF in Kyrgyzstan ". In the first year of operation, the Center will develop its own materials in Russian and Kyrgyz.

Special attention will be given to the development, adaptation and translation of certified training courses together with international organizations.

Planned work packages

- Work package 1. Preparatory work which includes elaboration of the Center regulations, formation of the legal entity
- Work package 2. Development of training program, format, etc.
- Work package 3. Acquisition of necessary equipment and facilities (computers, blackboards, etc.), hiring of staff
- Work package 4. Launching the first bunch of trainings for compenent authorities, TMF operator on TMF safety methodology
- Work package 5. Expanding the training programs by developing training curriculum on environmental monitoring of air, water and soil qualities
- Work package 6. Organizing online library of advanced tools and best practices, hosted in the website of the Ministry

National partners and participants of the project

- Sustainable Development Platform NGO, Ukraine

- Ministry of Natural Resources, Ecology and Technical Supervision of the Kyrgyz Republic, Office of Industrial Safety Regulation
- Service of Environmental and Technical Supervision under the Ministry of Natural Resources, Ecology and Technical Supervision of the Kyrgyz Republic
- Department of Geology and Subsoil Use under the Ministry of Natural Resources, Ecology and Technical Supervision of the Kyrgyz Republic
- Ministry of Emergency Situations of the Kyrgyz Republic
- Department of Monitoring and Forecasting of Emergencies and the Agency for the Management of TMF under the Ministry of Emergency Situations.
- Ministry of Health of the Kyrgyz Republic
- Ministry of Education of the Kyrgyz Republic
- CAREC Country office in Kyrgyzstan
- TMF operators
- Etc.

Coordination of these works shall be entrusted to the Ministry of Natural Resources, Ecology and Technical Supervision of the Kyrgyz Republic.

9.2 Proposal 2. Increasing environmental safety of TMFs by mainstreaming the risk zone methodology to the local planning process and awareness rising of local communities

Background

The management of industrial waste is a problem in Kyrgyzstan. There are about ninety mining sites in Kyrgyzstan that contain 250 million cubic meters of toxic and radioactive waste. Long-term human exposure to highly toxic and/or carcinogenic heavy metals and other persistent pollutants leads to long-term health consequences. There are 27 settlements in Kyrgyzstan in which about 100,000 people are in constant contact with persistent and highly toxic pollutants, mainly heavy metals such as uranium, lead, arsenic, cadmium, and mercury. In such communities, a special project needs to be developed and implemented to provide a long-term solution. Currently, national and local authorities do not have the funding and expertise to carry out such projects and require support.

The public's perception of the legacy problems of former uranium production facilities and contaminated territories is not objective. Various groups of people perceive the health and environmental risks associated with legacy sites very differently. Local populations near contaminated sites are often too indifferent to the threats to their health. For example, in Mail-Suu, Shekaftar, Min-Kush, Ak-Tuz, the local population, accustomed to being in the constant neighborhood and staying near TMFs, very often has an inadequate attitude toward their real or potential danger. On the one hand, there is no proper fencing for public access to the facilities, and on the other hand, educational work with the population has little or no impact. People graze livestock on the surface of the tailings, water cattle from the very contaminated drainage water of the TMFs, use TMF drainage water for irrigation of gardens and local water supply, materials of dumps and tailings are used by the local population in construction. There is a need for substantial work with all stakeholder groups to find a way out in situations like this; there is a need for additional information specifically tailored to the target populations.

In order to protect the people and environment from potential TMF accidents, the authorities should follow certain licensing procedures and consider the risk zones near the respective TMF. In this regard, the project "Improving the Safety of TMFs in Kyrgyzstan", which is implemented

under the auspices of the German Federal Environment Agency, has developed recommendations for determining risk zones near tailings facilities in the country and amending the relevant regulations.

This project is a direct continuation of the Project "Improving the Safety of TMFs in Kyrgyzstan" and focuses on the implementation of the proposed policy recommendations. As described in the report, the competent authorities expressed their interest in accepting the recommendations of the project team and their commitment in this direction.

Aim and tasks

The project aims to ensure the environmental safety by awareness-rising and piloting and mainstreaming the land-use planning aspects into local development plans

There will be several pilot TMFs selected for this project: one active TMF, one abandoned TMF and one radioactive TMF.

The project has the following objectives:

1. Raising awareness of local communities, local authorities and other local stakeholders surrounding the pilot tailings dams on tailings safety issues
2. Elaboration and implementation of comprehensive recommendations for the three pilot TMFs on land-use planning aspects
3. Expert support in development and enactment of changes in respective regulations

Planned work packages

- Work package 1. Conducting a kick-off workshop where the Project participants gather to discuss the planned project activities and the strategy for their implementation. The project team will develop selection criteria and carry out the identification of pilot TMF sites for the project activities implementation. Competent authorities and project implementers will participate in the selection process and will take into account factors such as availability of local authorities, availability of local communities in the area, availability of various forms of land-use, etc.

- Work package 2. Visiting pilot TMFs to conduct situational review and data collection. The project team with representatives of competent authorities will visit the three pilot TMFs, conduct a rapid rural assessment, identify stakeholders, meet representatives of local authorities, TMF management, etc. Also using rapid assessment tools, they will assess the needs and interests.

- Work package 3. Raising awareness of local communities and stakeholders on TMF safety issues. For this task, there will be conducted a stakeholder analysis and an assessment in order to develop an outreach strategy, outreach objectives, communication channels and means, etc. Informational leaflets, posters, short videos and other outreach materials in accessible language and format designed for local communities and local authorities will be developed with the participation of experts on TMF. Beyond the main communication message, the information materials will also include climate change and gender justice issues.

- Work package 4. Development and implementation of in-depth recommendations for the three pilot tailgates on aspects of land-use planning. This package includes expert assistance in developing specific proposals for the pilot TMFs based on local features and context. Experts with international experience and expertise, representatives of competent authorities and also representatives of local organizations and authorities are expected to be involved. Afterwards, the developed recommendations will be incorporated into the development

plans of the aiyl aimak, and into the District Socio-Economic Development Plans of the respective municipality as an approbation.

- Work package 5. Based on the results of the piloting of the implementation of land-use planning aspects, there will be prepared appropriate amendments and modifications to the corresponding regulations. These activities will be carried out mainly by representatives of the competent authorities, with the participation of an international expert.
- Work package 6. A final event will be held at the national level with the participation of all stakeholders: competent authorities, international organizations, TMF, local authorities in the pilot areas, representatives of local communities, NGOs, media, etc. This work package will also focus on the dissemination of information at the national level.

National partners and participants of the project

- Sustainable Development Platform NGO, Ukraine
- Ministry of Natural Resources, Ecology and Technical Supervision of the Kyrgyz Republic, Office of Industrial Safety Regulation
- Service of Environmental and Technical Supervision under the Ministry of Natural Resources, Ecology and Technical Supervision of the Kyrgyz Republic
- Department of Geology and Subsoil Use under the Ministry of Natural Resources, Ecology and Technical Supervision of the Kyrgyz Republic
- Ministry of Emergency Situations of the Kyrgyz Republic
- Department of Monitoring and Forecasting of Emergencies and the Agency for the Management of TMF under the Ministry of Emergency Situations.
- Ministry of Health of the Kyrgyz Republic
- Ministry of Education of the Kyrgyz Republic
- CAREC Country office in Kyrgyzstan
- TMF operators
- Etc.

Coordination of these works shall be entrusted to the Ministry of Natural Resources, Ecology and Technical Supervision of the Kyrgyz Republic.

9.3 Proposal 3. Enhancing the Environmental Monitoring System to Ensure Environmental Safety in Kyrgyzstan

Background

Environmental Monitoring is a cornerstone for the development and implementation of state environmental policy. However, over the past two decades, the organizational structure of environmental monitoring in the Kyrgyz Republic had been largely fragmented, and the status of this work was downgraded. Thus, water resources condition was monitored by the Laboratory of Environmental Monitoring, which for a long time functioned as a provincial unit of the State Agency for Environmental Protection and Forestry of the Kyrgyz Republic, while monitoring of atmospheric air condition was carried out by the Hydrometeorological Service under the Ministry of Emergency Situations. Poor coordination among agencies, limited resources, and poor capacity or its absence made it impossible to obtain reliable data.

Over the past few years, Bishkek has been at the top of the world' s air pollution rankings. The main factor of air pollution in Bishkek, especially in the cold season, is a high concentration of suspended solids, which are a complex mixture of solid and liquid particles suspended in the air

and include a wide range of sub-stances - from sulfates to soot. The main reasons for the formation of winter smog are the in-tensive combustion of coal for heating in private sector stoves and thermal power plants, cold calm weather and air temperature inversions, due to which air pollutants cannot rise high from the surface and dissipate, but accumulate in the surface layer of urban air.

Another major source of air pollution in Bishkek is the Bishkek sanitary landfill, which is the only place to receive and dispose of garbage and household waste brought in from the city. The landfill is in operation since 1978 and functions without compliance with technical, sanitary and environmental safety standards. It has long exceeded its operating life and design capacity. With a projected volume of 3.3 million m^3 of waste deposited, in fact, more than 24 million m^3 was deposited. Every day, the city landfill takes solid waste from municipal facilities and other organizations in volume of 2300 m^3 - 3500 m^3.

The landfill base does not contain an isolation layer to restrict leachate, the area of the location is characterized by high groundwater table, intermediate isolation layers are not laid between the working layers, and there are no gas-exhaust ducts. Due to bio-organic processes, the cavities formed in the body of the landfill fill with methane and hydrogen sulfide, which are the causes of frequent waste fires. The area is not fenced off, there is no water, no disinfection area for vehicles, no disinsection and deratization, no recultivation of filled areas of the dump and no monitoring of the environment around the dump. The sanitary protection zone of the landfill location from the city is not respected, as residential areas by squatters have been built around it. Unfortunately, there is no reliable information on the actual pollution of atmospheric air in the area of the Bishkek sanitary landfill.

There is a need to strengthen the monitoring of wastewater condition of industrial, economic facilities, including TMFs. Wastewater, drainage contaminated water is used to irrigate orchards, vegetable gardens and for domestic needs of the villagers living downstream of large cities.

In connection with environmental deterioration in the country, today the state political agenda is focused on ecological issues. This led to the formation of the Ministry of Natural Resources, Ecology and Technical Supervision of the Kyrgyz Republic. With the formation of the Ministry, the relevant measures have also been initiated - the status of monitoring activities has raised - the Department of Environmental Monitoring has been established with the additional functions of monitoring and assessment of the quality of air and heating fuel (coal). Obviously this is most encouraging, however, to set up the work of the Department of Environmental Monitoring it is necessary to strengthen its capacity and provide it with methodological tools.

Aim and tasks

The project goal is to improve environmental safety and environmental monitoring system through increasing the construction and capacity of the Department of Environmental Monitoring.

- The project will provide methodological support to the Department for organizing systematic environmental monitoring of air, water, and soil quality. Methodological support from the German Federal Environment Agency is expected
- Training staff in new monitoring methods
- Technical equipment, including a GANK-4A portable gas analyzer (kit) and equipment for coal quality analysis.

- Organization of experience exchange and acquiring of best practices of other developed countries

9.4 Proposal 4. Biomining: Environmentally friendly "green" technologies in mining

Background

Biomining is an innovative and case-sensitive biotechnology in the field of responsible mining, environmental engineering and renewable resources. It covers the wide range of environmentally friendly "green" technologies in the mining industry, based on the processes of bioleaching, biological treatment of mine water, bacterial coal desulphurization, phytoremediation of contaminated territories etc.

The **main objective** of the research is the development of eco-innovative, cost effective and environmentally acceptable technologies, which will be applied on an industrial (large) scale, in order to:

- prevent weathering of heavy metals and rare elements from hazardous mining waste dumps;
- use mining wastes as the second mineral sources of valuable elements;
- investigate available oxide – redox geochemical conditions of weathered rock substrata in order to start in second step of land reclamation;
- select appropriate approaches for fast biomelioration of reclaimed minelands;
- investigate more prospective plants to cultivate them in the minelands;
- evaluate and compare stand establishment of potential biofuel/bioproduct crops (miscanthus, switchgrass, sugar sorghum) on reclaimed mine lands (lysimetric experiments);
- test in model laboratory experiments examples of biochars/sludge as biosorbent and biomeliorant;
- perform remote sensing and distance Earth assessment using vegetation and other indices;
- make decision and forecast for environmental stable development.

The **technologies** that will be examined involve:

- Minimization of environmental hazards due to heavy metals from waste depositories by application of phytostabilization (and other phytoremediation) measures.
- Decontamination of hazardous wastes by phytoextraction including phytomining of commercially valuable elements to permanently select toxic metals and rare elements.
- Assessment of possibility to cultivate the energetic crops and trees in the reclaimed minelands in the future.

Expected outcome

The project is expected to deliver outcomes from a scientific, environmental, energy and socio-economic point of view:

- recommendation of energy plant species suitable for phytoremediation of waste dumps with respect to their potential for biofuel/biochar production and phytomining.
- recommendation of soil treatment (e.g. site preparation, soil amendments) for effective phytoremediation and/or phytomining.

Research questions

- Which way of chemical stabilization or immobilization of heavy metals is more prospective?
- Is it feasible to combine three components including stabilization amendment, plant and soil properties to achieve suitable geochemical conditions in reclaimed minelands;
- Can energetic crops be the raw material to prepare biochar instead of woody trees?
- Which energy crops can be successfully grown on reclaimed minelands and marginal lands under the certain climatic conditions?
- Do these plant species also show a potential for phytoremediation of polluted soils?
- Which kind of treatments is necessary to manipulate (bio-)availability of toxic and economically valuable elements in the substrates? (e.g. fertilization, biochar amendments)?
- What may be specific limitations for a successful biomelioration of abandoned minelands?
- How can these limitations be overcome?

National partners and participants of the project

- Sustainable Development Platform NGO, Ukraine
- Dnipro University of Technology, Ukraine
- Federal Ministry on Ecology, Germany
- Mebrach Mining company, Germany
- TU Bergakademie Freiberg, Germany
- Ministry of Natural Resources, Ecology and Technical Supervision of the Kyrgyz Republic, Office of Industrial Safety Regulation
- Service of Environmental and Technical Supervision under the Ministry of Natural Resources, Ecology and Technical Supervision of the Kyrgyz Republic
- Department of Geology and Subsoil Use under the Ministry of Natural Resources, Ecology and Technical Supervision of the Kyrgyz Republic
- Ministry of Emergency Situations of the Kyrgyz Republic
- Department of Monitoring and Forecasting of Emergencies and the Agency for the Management of TMF under the Ministry of Emergency Situations.
- Ministry of Health of the Kyrgyz Republic
- Ministry of Education of the Kyrgyz Republic
- CAREC Country office in Kyrgyzstan
- TMF operators
- Etc.

Coordination of these works shall be entrusted to the Ministry of Natural Resources, Ecology and Technical Supervision of the Kyrgyz Republic.

9.5 Proposal 5. Reclamation of the TMFs and Mining Sites to Ensure Environmental Safety in Kyrgyzstan

Background

Mining activities are an extremely important branch of the economy in the Kyrgyz Republic, which contributes significantly to the gross national product of the entire country. Despite the Kyrgyz Republic has rich deposits of mineral resources, the retention of mine waste has very low safety levels, with a corresponding risk to people and the environment in the vicinity of these facilities. Mining in Kyrgyzstan is largely focused on coal and gold. The mining companies operate without clearly detailed land remediation law and regulations. Many unresolved and partially resolved issues on disposal, reclamation of disturbed lands after mining, including radioactive waste, have been dealt in a case-by-case manner. A modern mining enterprise is an economically monostructural economic entity with one main type of activity - mining. However, with the depletion of available mineral reserves, sooner or later there is the problem of liquidation of the mine as an enterprise, and with it the problems of environmental and social nature. To ensure the sustainable development of the surrounding area and to continue the operation of the mine for as long as possible, there are various ways to diversify its activities. Reclamation of mining sites is the combined process by which adverse environmental effects of surface mining are minimized and mined lands are returned to a beneficial end use. Some components of reclamation include practices that control erosion and sedimentation, stablize slopes, and avoid and repair impacts to wildlife habitat. The final step is usually topsoil replacement and revegetation with suitable plant species. Reclamation is often phased to e concurrent throughout the life of the mining project.

The project goal – to improve the environmental safety measures and to implement sustainable reclamation policy in Kyrgyzstan

Aim and tasks:

- To overview of the current situation of the reclamation status of TMFs and mining sites from the environmental safety measures prospective.
- To analyse of the national legislation framework which focus on sustainable reclamation on environmental safety of the TMFs and mining sites;
- To study new technologies and best practices environmental safety measures according to the international standards;
- To organize and conduct learning from the field trip to the reclamation site in Germany (WISUTEC);
- To pilot case implementation of the best practice/technology after the field trip;
- To prepare and publish an analytical paper/research findings regarding the possible solutions to improve the environmental safety measures.

National partners and participants of the project

- Sustainable Development Platform NGO, Ukraine
- Ministry of Natural Resources, Ecology and Technical Supervision of the Kyrgyz Republic, Office of Industrial Safety Regulation
- Service of Environmental and Technical Supervision under the Ministry of Natural Resources, Ecology and Technical Supervision of the Kyrgyz Republic

- Department of Geology and Subsoil Use under the Ministry of Natural Resources, Ecology and Technical Supervision of the Kyrgyz Republic
- Ministry of Emergency Situations of the Kyrgyz Republic
- Department of Monitoring and Forecasting of Emergencies and the Agency for the Management of TMF under the Ministry of Emergency Situations.
- Ministry of Health of the Kyrgyz Republic
- Ministry of Education of the Kyrgyz Republic
- CAREC Country office in Kyrgyzstan
- TMF operators
- Etc.

Coordination of these works shall be entrusted to the Ministry of Natural Resources, Ecology and Technical Supervision of the Kyrgyz Republic.

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Appendixes

A. TMF Inventory for Kyrgyzstan.

TMF		THI										TRI
TMF number	TMF name	THI Cap	THI Tox	THI Man	THI Nat		THI Dam	THI	TEI Pop	TEI Env	TEI	TRI
					THI Seism	THI Flood						
KG01	TMF nr. 4 of Ak-Tyuz dressing plant, CJSC TK "Geo Reserve"	6.4	3	3	1	1	1	15.4	1.0	1.0	2.0	17.4
KG02	TMF nr. 1 of Ak-Tyuz mine, of the dressing plant of JSC "Kyrgyz Chemical Metallurgical Plant" (KCMP)	5.6	4	0	1	1	1	12.6	1.0	1.0	2.0	14.6
KG03	TMF nr. 2 of Ak-Tyuz mine, of the dressing plant of JSC "KCMP"	5.6	4	0	1	1	1	12.6	1.0	1.0	2.0	14.6
KG04	TMF nr. 3 of Ak-Tyuz mine, of the dressing plant of JSC "KCMP"	6.0	4	0	1	1	1	13.0	1.0	2.0	3.0	16.0
KG05	Buurdinskoe TMF of JSC "KCMP"	6.6	4	0	1	1	1	13.6	4.0	3.0	7.0	20.6
KG06	TMF "Kaji-Say", Ministry of emergency	5.6	4	2	1	1	1	14.6	1.0	2.0	3.0	17.6
KG07	TMF at the Kumtor deposit of closed JSC "Kumtor Gold Company"	7.8	3	3	1	0	1	15.8	3.0	4.0	7.0	22.8
KG08	TMF at the At-Jailoo deposit of Kyrgyz-Russian Enterprise "Tian-Shanolovo"	4.6	3	3	1	0	1	12.6	4.0	2.0	6.0	18.6
KG09	TMF "Tuyuk-Suu", Ministry of emergency	5.7	4	2	1	1	1	14.7	1.0	2.0	3.0	17.7
KG10	TMF "Taldy-Bulak", Ministry of emergency	5.6	4	2	1	1	1	14.6	1.0	3.0	4.0	18.6

KG11	TMF "Kak", Ministry of emergency	5.0	4	2	1	0	1	13.0	1.0	3.0	4.0	17.0
KG12	TMF "Dalnee", Ministry of emergency	5.3	4	2	1	0	1	13.3	5.0	3.0	8.0	21.3
KG13	TMF nr. 1, Ministry of emergency	4.9	4	2	1	1	1	13.9	5.0	3.0	8.0	21.9
KG14	TMF nr. 2, Ministry of emergency	4.8	4	2	1	1	1	13.8	5.0	3.0	8.0	21.8
KG15	TMF nr. 3, Ministry of emergency	5.0	4	2	1	1	1	14.0	5.0	3.0	8.0	22.0
KG16	TMF nr. 4, Ministry of emergency	5.1	4	2	1	1	1	14.1	5.0	3.0	8.0	22.1
KG17	TMF nr. 5, Ministry of emergency	5.0	4	2	1	1	1	14.0	5.0	3.0	8.0	22.0
KG18	TMF nr. 6, Ministry of emergency	5.4	4	2	1	1	1	14.4	5.0	3.0	8.0	22.4
KG19	TMF nr. 7, Ministry of emergency	5.8	4	2	1	1	1	14.8	5.0	3.0	8.0	22.8
KG20	TMF nr. 8, Ministry of emergency	5.0	4	2	1	1	1	14.0	5.0	3.0	8.0	22.0
KG21	TMF nr. 9, Ministry of emergency	5.1	4	2	1	1	1	14.1	5.0	3.0	8.0	22.1
KG22	TMF nr. 10, Ministry of emergency	4.7	4	2	1	1	1	13.7	5.0	3.0	8.0	21.7
KG23	TMF nr. 11, Ministry of emergency	4.8	4	2	1	1	1	13.8	5.0	3.0	8.0	21.8
KG24	TMF nr. 12, Ministry of emergency	3.3	4	2	1	1	1	12.3	5.0	3.0	8.0	20.3
KG25	TMF nr. 13, Ministry of emergency	4.6	4	2	1	1	1	13.6	5.0	3.0	8.0	21.6
KG26	TMF nr. 14, Ministry of emergency	5.0	4	2	1	1	1	14.0	5.0	3.0	8.0	22.0
KG27	TMF nr. 15, Ministry of emergency	4.7	4	2	1	1	1	13.7	5.0	3.0	8.0	21.7

KG28	TMF nr. 16, Ministry of emergency	5.5	4	2	1	1	1	14.5	5.0	3.0	8.0	22.5
KG29	TMF nr. 17, Ministry of emergency	3.0	4	2	1	1	1	12.0	5.0	3.0	8.0	20.0
KG30	TMF nr. 18, Ministry of emergency	3.5	4	2	1	1	1	12.5	5.0	3.0	8.0	20.5
KG31	TMF nr. 19, Ministry of emergency	3.8	4	2	1	1	1	12.8	5.0	3.0	8.0	20.8
KG32	TMF nr. 20, Ministry of emergency	3.7	4	2	1	1	1	12.7	5.0	3.0	8.0	20.7
KG33	TMF nr. 21, Ministry of emergency	4.5	4	2	1	1	1	13.5	5.0	3.0	8.0	21.5
KG34	TMF nr. 22, Ministry of emergency	3.3	4	2	1	1	1	12.3	5.0	3.0	8.0	20.3
KG35	TMF nr. 23, Ministry of emergency	5.0	4	2	1	1	1	14.0	4.0	3.0	7.0	21.0
KG36	TMF "Terek", JSC "Kyrgyzaltyn"	6.1	2	0	1	1	1	11.1	4.0	3.0	7.0	18.1
KG37	TMF of the Terek-Say dressing plant, JSC "Kyrgyzaltyn"	5.1	3	3	1	1	1	14.1	4.0	3.0	7.0	21.1
KG38	TMF nr.1, Ministry of emergency	5.4	3	2	1	1	1	13.4	2.0	3.0	5.0	18.4
KG39	TMF nr.2, Ministry of emergency	6.0	3	2	1	1	1	14.0	2.0	3.0	5.0	19.0
KG40	TMF nr.3, Ministry of emergency	6.4	3	2	1	0	1	13.4	2.0	3.0	5.0	18.4
KG41	TMF of LLC "Full Golg Mining"	5.3	3	3	1	0	1	13.3	2.0	3.0	5.0	18.3
KG42	TMF of LLC "Kazakhmys Gold Kyrgyzstan"	7.0	3	3	1	0	1	15.0	5.0	1.0	6.0	21.0
KG43	TMF at Makmal deposit of open JSC "Kyrgyzaltyn", the branch of gold	6.9	3	3	1	1	1	15.9	4.0	3.0	7.0	22.9

	mining combine "Makmalzoloto"											
KG44	TMF of open JSK "Kadamzhay antimony plant" (KAP)	6.4	2	0	1	0	1	10.4	4.0	3.0	7.0	17.4
KG45	Salt storage of open JSK "KAP"	6.1	3	3	1	1	1	15.1	4.0	3.0	7.0	22.1
KG46	Slagheap of open JSK "KAP"	5.8	2	3	1	1	1	13.8	4.0	4.0	8.0	21.8
KG47	TMF Nr.1, Ministry of emergency	3.0	3	2	1	0	1	10.0	1.0	1.0	2.0	12.0
KG48	TMF Nr.2, Ministry of emergency	5.4	3	2	1	0	1	12.4	1.0	1.0	2.0	14.4
KG 49	OJSC "Kara-Balta mining plant"	4.6	3	0	1	0	1	9.6	1.0	3.0	4.0	13.6
KG 50	TMF of Kichi-Chaarat JSC	6.8	3	3	1	1	1	15.8	4.0	3.0	7.0	22.8
KG 51	Cyanide TMF Altyn-Ken LLC	5.9	3	3	1	1	1	14.9	4.0	3.0	7.0	21.9
KG 52	TMF LLC "Altyn-Ken"	6.7	4	3	1	1	1	16.7	4.0	3.0	7.0	23.7
KG 53	Tuya-Muyun 2 heaps of the uranium-vanadium mine Tuya-Muyun	2.0	2	2	1	1	1	9.0	1.0	3.0	4.0	13.0
KG 54	Branch of OJSC "Kyrgyzaltyn" Mine "Solton-Sary"	5.6	2	3	1	0	1	12.6	1.0	3.0	4.0	16.6
KG 55	Tailings storage facility of Alliance Altyn LLC, Jerui deposit.	7.4	3	3	1	1	1	16.4	2.0	2.0	4.0	20.4
KG 56	Khaidarkan mercury plant "Simap"	5.2	2	2	1	1	1	12.2	1.0	1.0	2.0	14.2
KG 57	Khaidarkan mercury plant "Su-Tash".	6.6	2	2	1	1	1	13.6	1.0	3.0	4.0	17.6
KG 58	TMF of "Kaidi" LLC	5.7	3	3	1	1	1	14.7	0.0	1.0	1.0	15.7
KG 59	TMF No. 2 of JSC "KHMZ"	4.9	4	3	1	1	1	14.9	5.0	3.0	8.0	22.9
KG 60	Salt accumulators of JSC "KHMZ"	2.0	4	3	1	1	1	12.0	5.0	3.0	8.0	20.0

KG 61	TMF No. 1 Makmal	6.9	3	2	1	1	1	14.9	1.0	1.0	2.0	16.9
KG 62	LLC "Chauwai-Ken"	6.3	3	3	1	1	1	15.3	4.0	3.0	7.0	22.3

B. Checklist for contingency planning for transboundary waters completed by the MES KR representatives

ISSUES THAT SHOULD BE INCLUDED AND DESCRIBED IN THE CONTINGENCY PLAN	POINTS TO BE CHECKED	YES	PARTLY	NO
1. Countries should ensure that the definitions in the legislation are in line with those from the Water and Industrial Accidents Conventions.	Are the definitions set out in accordance with the Industrial Accidents and Water Conventions (see chapter I.D)?	✓		
DESCRIPTION OF THE WATERSHED				
2. Geographic location	Is there a map of the area potentially affected by accidental pollution? Is there an agreement on what the base delineation of the affected area is?		✓	✓
3. Main characteristics of the watershed	Is there a description of the main characteristics of the watershed?		✓	
4. Topography and other aspects	Is there a description of the topography (relief), flora, hydrography, urban areas and transportation?		✓	
5. Geology and soil structure	Is there a description of the geology and soil structure?		✓	
6. Climate	Is there a description of the climate and, in particular, precipitation?		✓	
7. Groundwater and aquifers	Is there a description of the groundwater status and aquifers in the potentially affected area?		✓	
8. Surface waters	Is there a description of the surface waters (rivers, drainage system, abandoned river beds, oxbows, lakes, reservoirs)?		✓	
9. Natural protected values and areas	Is there a description of the natural protected values and areas in the affected area?		✓	
POTENTIAL SOURCES OF ACCIDENTAL POLLUTION				
10. List of potential accidental water pollution sources	Are facilities with significant impact listed?	✓		
Pollution propagation	Does this list include the following? • Wastewater treatment plants • Industrial plants • Agrochemical establishments • Hydrocarbon storage facilities • Animal farms	✓ ✓ ✓ ✓ ✓		

	Are these potential sources presented on a map?		✓	
	Is there an adequate model for simulating the pollution propagation in the contingency plan?			✓
	Are the travel (spreading) times of the pollution counted in extreme hydrological conditions?			✓
11. Surface and groundwater quality	Is there a description of the classification related to water quality?		✓	
12. Surface water quality	Does it contain the characterization of the water quality categories?		✓	
13. Groundwater quality	Is there a description of the groundwater quality in the potentially affected area?		✓	
14. Drinking water supply	Is there a description of the drinking water supply? Are surface waters used as drinkingwater?	✓ ✓		
15. Industrial water supply	Is there a description of the industrial water supply?		✓	
16. Agriculture uses	Is there a comprehensive description of agricultural water uses?			✓
17. Recreational sites	Is there a description of recreational water uses?			✓
18. Fishing activities	Are fishing activities described?			✓
19. Water intakes for fish-farms	Are the water intakes for fish-farms described?			✓
WATER MANAGEMENT ORGANIZATION/COMPETENT AUTHORITIES				
20. Responsibilities and activities of the competent authorities	Is there a comprehensive description of how the water management is organized?		✓	
Identification of the competent authorities	Is there a list of the competent authorities in the contingency plan?		✓	
	Is there a list of the tasks of the authorities related to the response to accidental pollution?		✓	
	Is there an authority responsible for preparation of the contingency plan?	✓		
	If yes, is it named in the contingency plan?		✓	
	Is the authority responsible for the execution of the response to accidental water pollution named in the contingency plan?		✓	

EMERGENCY PREPAREDNESS				
21. On-site emergency plans for hazardous facilities need to be established prior to the acceptance by the authorities of construction, operation or closure. Hence, they should be drawn up within the periods set by national or international legislation.	Does the national legislation give a proper frame for the contribution of emergency planning to the permitting procedure?			✓
22. Emergency plans should be established and tested by the hazardous facility operator (on-site emergency plans) and by authorities (off-site emergency plans). Eventually, upon request of the competent authorities, they should be tested together, to verify interrelationships and interdependencies	Does the national legislation contain the requirement that internal and external emergency plans should be tested together?	✓		
23. Emergency plans should be reviewed and updated when needed and where relevant but at least at every 5 years.	Are the emergency plans reviewed and updated when needed or where relevant but at least every 5 years?		✓	
	Have the emergency plans been reviewed and updated at least in the following situations:			
	After occurrence of accidents or emergency situations at the site or on the basis of lessons learned from accidents at other similar sites?	✓		
	When the emergency service organization has changed?			
	When new hazards associated with the hazardous facility are identified?	✓		
	When new technical knowledge or new technology is being developed that is considered relevant to the operation of the hazardous facility?	✓		
	When design parameters (e.g., temperature, pressure) have approached or exceeded their limits as a result of changes, mismanagement, structural problems, equipment modification or natural events?	✓		
24. On-site emergency plans should consider all natural hazards, such as flooding hazards, and accidents in the immediate vicinity of the hazardous facility. Relevant additional information from natural hazards should preferably be provided in an annex (e.g., inundation maps in case of flooding hazards).	Does the off-site emergency plan consider natural hazards, such as • Flooding hazards? • Storm risks? • Fires? • Accidents in the immediate vicinity of the hazardous facility?	✓ ✓ ✓ ✓ ✓		

Competent authorities should ensure that operators draw up on-site emergency plans and put them into effect without delay when an accident occurs; and supply the authorities designated for that purpose with the necessary information to enable them to draw up off-site emergency plans.	Has the operator drawn up on-site emergency plans? Did the operator put the emergency plan into effect without delay when an accident occurred? Did the operator supply the authorities with the necessary information to enable them to draw up off-site emergency plans?		✓ ✓ ✓	
25. On-site and off-site emergency plans should include and address generic parameters.	Do the on-and off-site emergency plans include the following issues:		✓	
	• Scope and objective of the emergency plan		✓	
	• Description and evaluation of emergency scenarios, hazards (including natural hazards), potentially affected areas, etc.		✓	
	• Names, positions and contact data of persons authorized to set emergency procedures in motion and of the person in charge of coordinating the internal mitigation actions		✓	
	• Responsibilities of each member of the organization being part of the emergency management, the chain of responsibility and any other authority involved		✓	
	• Conduct of a needs identification and, based on the outcome, definition of the required equipment and human resources for effective interventions		✓	
	• Involvement of ship crews (for communication and action)			
	• Procedures for emergency response or remediation for each of the determined emergency scenarios, including the necessary warning of and interaction with local emergency services		✓	
	• Requirements for annual emergency drills and practices with external agencies involved (fire brigade, police, ambulance, local hospitals)		✓	
	• Interactions and interface with other intervention plans, either externally (e.g., from neighboring plants, a national crisis plan, a disaster plan) or internally (e.g., the company's crisis plan, business continuity plan or recovery plan)		✓	

RELATED TO OFF-SITE EMERGENCY PLANS				
26. Off-site emergency plans should be prepared and implemented by the competent authority. Operators of hazardous activities are obliged to provide the local authorities with all necessary information on the potentially affected area to evaluate the impact on man and the environment.	Are there regulations on off-site emergency plans in the riparian countries? If yes, is there information on where to find the regulations? If no, the revision of the bi- or multilateral agreement is recommended. Have the riparian countries had the opportunity to comment on the off-site emergency plans?	✓		✓
27. In border areas, the contingency plans of two regions of neighbouring countries should be compatible with each other and include contact details to allow for proper notification in case of an industrial accident. The public of neighbouring or affected countries should be given the same rights as the public of the country of origin to participate in the preparation and revision of external emergency plans.	Has the compatibility of the contingency plan been checked with that of the neighbouring or potentially affected country? Have the experts of the neighbouring or potentially affected country had the possibility to check the content of the contingency plan? Has the public of the neighbouring or potential affected country enough possibility to check the content of the contingency plan?			✓ ✓ ✓
28. Off-site emergency plans should detail all relevant information to ensure adequate emergency response.	Does the off-site emergency plan include: • Names, positions and contact data of persons authorized to take charge of and coordinate actions?			✓ ✓
	• Arrangements for coordinating the resources necessary to implement the off-site emergency plan?			✓
	• Lists or maps of vulnerable areas and objects with their specifications?			✓
	• List of the agencies and organizations that can assist with the management of the incident?			✓
	• Arrangements for providing the public with specific information on the accident and the actions it should take?			✓
	• Arrangements for notifying the emergency services of neighbouring countries in the event of a major accident with possible transboundary consequences, in accordance with internationally accepted and established warning and alert systems?			✓
29. National authorities should ensure the preparation and implementation of off-site emergency plans for hazardous activities, covering measures to be taken within	Is a joint off-site emergency plan available and is it harmonized? Are the obstacles to the preparation of the joint off-site emergency plan described in the contingency plan?			✓ ✓ ✓

their territory to prevent and minimize transboundary effects. Countries of origin and countries potentially affected by an industrial accident should endeavour to make such plans compatible. Where appropriate, joint external emergency plans should be drawn up in order to facilitate the adoption of adequate response measures.	If there is no joint off-site emergency plan, is it planned in the future? If yes, when?			
30. Countries of origin are required to ensure that adequate information is given to the public capable of being affected by accidental pollution arising out of a hazardous activity.	Is information available to the public about accidental pollution that has occurred in the past?		✓	
	Is the link to the above information given in the off-site emergency plan?			✓
	Are the accidental pollution events that occurred previously described in the contingency plan?			✓
	If yes, have the consequences been evaluated?			✓
	Have the operators responsible for accidental pollution events been identified?			✓
	Were there any legal consequences of the events?			✓
	Has the operator taken part in mitigation of the adverse consequences?			✓
	Is there a regulated procedure for informing the public in the procedure of permitting and operation control of the hazardous technology?		✓	
	Is the involvement of the representatives of the public from riparian countries regulated?		✓	
	If yes, is direct reference given in the contingency plan?			✓
	If no, has a revision of the bi- or multilateral agreement been commenced or conducted?			✓
31. Off-site emergency plans should include the measures for treatment, collection, clean-up, storage, removal and safe disposal of hazardous substances and contaminated material and restoration.	Are the following measures discussed in the contingency plan? • Treatment of hazardous substances • Collection of hazardous substances • Clean-up of hazardous substances • Storage of hazardous substances • Removal of hazardous substances • Safe disposal of hazardous substances		✓ ✓ ✓ ✓ ✓ ✓ ✓	

	• Restoration			
32. Off-site emergency plans should identify the appropriate spots and intervention sites for protection along recipient water bodies.	Are the appropriate intervention or response sites for response activities and their facilities along the water body introduced in the off-site emergency plan?		✓	
33. Competent authorities are responsible for establishing, maintaining and testing external emergency plans and for ensuring their capacity to respond to emergencies in accordance with the provisions of those plans.	Is there a clear distribution of the response activities among the operators and competent authorities in the contingency plan? Is there a statement in the contingency plan that the authorities are responsible for establishing, maintaining and testing external emergency plans?	✓	✓	
34. Off-site emergency plans should be reviewed regularly, or when circumstances so require, taking into account the experience gained in dealing with actual emergencies.	Is review of the joint or harmonized offsite emergency plan regulated in bi- or multilateral agreement(s)? Is there information related to the periodicity or the occasions when the review is necessary in the contingency plan?			✓ ✓
WARNING AND ALERT SYSTEM				
35. For emergency preparedness it is essential to have early warning and alert systems in place. Early warning systems imply a double requirement: a suitable organization (distribution of the measuring devices, involving a network of stations linked one another, etc.), and suitable technical equipment for event detection and assessment of warning and alert relevance.	Is there a clear description of the early warning and alert system? Is the distribution of the measuring devices explained? Is the communication with the measuring stations described? Are the elements of technical equipment harmonized, with a special focus on: • Event detection? • Assessment of warning? • Alert relevance?		✓ ✓ ✓ ✓ ✓ ✓ ✓	
36. Early warning systems should be set up by the operator at the hazardous facility and the competent authorities for the whole river catchment. These early warning systems are often integrated in international warning and alarm plans established by joint bodies.	Does each operator at the respective hazardous facility have one warning station connected to the national warning systems? Is there an international warning and alarm plan in operation? If yes, is it introduced in the contingency plan? If not, completing it asap			✓ ✓ ✓
37. At hazardous facilities, continuous online monitoring should be set up and adjusted to different alarm levels. These alarm levels have to be agreed with the competent authorities and should be in line with the respective threshold	Is there continuous online monitoring operated by the operator of the hazardous facility? Are the alarm levels agreed with the competent authorities of the riparian countries? Is an international alarm plan available?	✓ ✓		✓

levels of international alarm plans (e.g., for Rhine, Maas and Danube Rivers). For scenario calculations regarding a discharge, established flow-time modelling should be used.	Are the respective threshold levels in accordance with the international alarm plan? Is flow-time modelling available for scenario calculations? Is it introduced in the contingency plan?			✓ ✓ ✓
MUTUAL ASSISTANCE				
38. To the extent practicable, competent authorities should attempt to provide assistance to other countries that have requested help related to the preparedness for, or response to, accidental pollution.	Is there an agreement between competent authorities on mutual assistance? Is this agreement consistent with the mutual assistance provisions of the Industrial Accidents and Water Conventions?		✓ ✓	
39. Competent authorities should develop procedures to facilitate the transit through their territory of personnel and equipment to be used for mutual aid in the event of accidental pollution.	Have the competent authorities procedures in place to facilitate the transit through their territory of personnel and equipment?		✓	
40. Competent authorities should facilitate the exchange of technology related to the prevention of, preparedness for, and response to transboundary accidental pollution.	Is the exchange of technology regulated between competent authorities in the transboundary cooperation? Does it cover the fields of: • Exchange of available technology? • Exchange of information and experience? • Provision of technical assistance?		✓ ✓ ✓ ✓	