ÖkoRess III

Pilot Screening of Environmental Hazard Potentials of Mine Sites

Factsheet:

Bingham Canyon Mine

Rio Tinto , USA

ID: 47

German Environment Agency

Umwelt Bundesamt

Note

The qualitative assessment of Environmental Hazard Potentials (EHPs) in this factsheet was conducted according to the method developed in the precursor project ÖkoRess I "Discussion of the environmental limits of primary raw material extraction and development of a method for assessing the environmental availability of raw materials to further develop the criticality concept"[1] (Dehoust et al. 2017a). The measurement instructions applied here are described in Dehoust et al. 2017b. The method is tested and further developed within this project (ÖkoRess III).

The information in this factsheet refers exclusively to publicly available, designated sources that have been classified as serious by the authors. It is specifically pointed out that no statement is made about the implementation and quality of agreements or standards that are applied. The implementation of agreements through memberships, certifications, etc. is the responsibility of the companies.

The surface extension of each mine area has been estimated based on publically accessible satellite images as official land-use plans from the public authorities or mine operators are not consistently available. It therefore only corresponds to the apparent area where mining, processing facilities, heaps, etc. and related infrastructure are clearly identifiable.

The fact sheets make no claim to completeness of all relevant voluntary standards. Mentioning a membership in one of the listed voluntary standards does not imply an assessment of the suitability of the standard in itself, nor does it make any statement about the member's success in implementation.

[1]TEXTE 87/2017 https://www.umweltbundesamt.de/publikationen/discussion-of-the-environmental-limits-of-primary

Bingham Canyon Mine

Copper

General information

Indicator or criteria	Description and values
Name of mine	Bingham Canyon Mine
Description of mining area	Bingham Canyon Mine is situated in the Oquirrh Mountains, 25 miles southwest of Salt Lake City, Utah. It is the largest man-made excavation in the world, with a width of 4 km and a depth of about 1 km (EPA 2017a). The pit is located directly in the mountains and other facilities for processing are located in the basin close to the Great Salt Lake. The climate is characterised as humid continental, which differs from the mainly semiarid climate in Utah. Mineralization in the district is genetically related to a small Eocene quartz monzonite porphyry stock. At the beginning, only lead, silver and gold were mined. The production of high-grade copper-gold ore started in 1897. In 1904, Utah Copper became the first flourishing low-grade porphyry copper operation in the world using block caving, but soon switched to large-scale open pit methods (Krahulec 2018). The Bingham Canyon ore is delivered to an in-pit crusher and leaves the pit on a 5-mile-long (partly underground) conveyor to the Copperton Concentrator. At Copperton, the ore is milled and a copper concentrate and separate molybdenite concentrate is produced (Krahulec 2018). The concentrate is further processed in the Kennecott Garfield smelter (14 miles north) and tailings are stored in the impoundment north of Magna (12 miles north).
Surface extension	140.16km^2 140.16 km^2 (Image date: 19.07.2019; Viewing height: 15.80 km) (Google Earth)
In operation since	1863 1863 (EPA 2017b)
Operator	Rio Tinto Kennecott
Owner	Rio Tinto
Closest town	Located 25 km southwest of Salt Lake City (Utah) in the Oquirrh Mountains.

Province	Utah
Country	USA
Longitude	-112.1493862°
Latitude	40.5221679°
Altitude	2450 m a.s.l. The elevation of the mine drops from 2450 m to 1340 m a.s.l. (Google Earth)
Main product and by-products	Main: Copper, By-products: Molybdenum, Sulfuric acid, gold, silver (Rio Tinto Kennecott n.d.)
On-site processing stages	Crushing. milling and flotation (Rio Tinto Kennecott n.d.).
Annual production	In 2018: copper: 203.9 kt, molybdenum: 5.8 kt, gold: 196,700 ounces, silver: 2,520,000 ounces (Rio Tinto 2019).
Proven Reserves	2018: 394 Mt copper ore, leads to a copper content of: 1.773 Mt (0.45 %) (Rio Tinto 2018).
Probable Reserves	2018: 225 Mt copper ore, leads to a copper content of: 0.8325 Mt (0.37 %) (Rio Tinto 2018)

Geology

Indicator or criteria	Description and values	Explanation	Assessment result	Data quality
Preconditions for acid mine drainage (AMD)	The deposit at Bingham Canyon belongs to the porphyry copper type. Sulfide mineralization progresses outward from a low-grade core through the following zones: general, molybdenite, chalcopyrite–bornite, chalcopyrite–pyrite, pyrite, and sphalerite–galena (Borden 2003). Borden (2003) evaluates the net neutralization potential (NNP) of the	The mined ore is mainly sulfidic, moreover copper is a chalcophile element. Overall preconditions for generating acid mine drainage are given. Even though studies indicate that the mineral composition of the Bingham deposit has not a very high acid potential, the hazard still is given. Accordingly, the environmental hazard	High	B1 = medium, can be estimated on the basis of available information

	Bingham pit. It states that significant portions of the Pit may generate acid drainage but the current pit as a whole is unlikely to produce extremely low ph (Borden 2003)	potential resulting from AMD potential is high.		
Paragenesis with heavy metals	Large areas surrounding the Bingham mine are contaminated with heavy metals due to decades of mining operations and inappropriate dumping of waste material. Contaminants include arsenic, cadmium, chromium, copper, lead, nickel, selenium, silver, acids, sulfate and zinc (EPA 2017a).	Besides the presence of heavy metals emissions, copper is a heavy metal itself. The extraction of copper is consequently always evaluated with a high environmental hazard potential (EHP).	High	B1 = medium, can be estimated on the basis of available information
Paragenesis with radioactive components	No indication of paragenesis with thorium (Th) and uranium (U) could be determined.	In accordance with the measurement instructions, copper ore deposits are evaluated with a medium EHP, if no other information is available.	Low	B2 = medium, classified according to measurement instructions
Deposit size	Mudd and Jowit (2018) calculated the cumulative production of Bingham Canyon Mine from 1905 until 2015: 2,829.4 Mt copper at ~0.71 % Cu.	If the historic production of 2,829.4 Mt copper (M. Mudd / Jowitt 2018) is added to the current total reserves of 2.6 Mt copper (Rio Tinto 2018), the overall deposit size is 2,832 Mt copper. The deposit is classified as very large and, hence, is evaluated with a high EHP.	High	B2 = medium, classified according to measurement instructions
Ore grade	In 2018 the Bingham Canyon Mine has a relatively low ore grade of 0.42 % (Rio Tinto 2018) due to its late stage of production life.	With a copper ore grade of 0.42 %, the Bingham Canyon deposit is classified as an low grade deposit, leading to a high EHP	Medium	B1 = medium, can be estimated on the basis of available information

Technology

Indicator or criteria	Description and values	Explanation	Evaluation result	Data quality
Mine type	Hard-rock open pit mining (Rio Tinto Kennecott n.d.)	Conventional solid rock open pit mining is evaluated with a medium EHP. During open pit mining in solid rocks, the mining activities are restricted to the horizontal and vertical extension of the ore body/mineralized zone. The impact is higher than in underground mining but less pronounced then in mining of alluvial or unconsolidated sediments.	Medium	A = high, can be derived directly from available data
Use of auxiliary substances	In addition to drilling methods, trucks, shovels and loaders are used to extract the ore. The material is crushed and transported via a 5-mile-long (partly underground) conveyor to a conventional flotation circuit in Copperton where the copper and molybdenum is concentrated (Krahulec 2018).	Flotation is often conducted with the help of toxic additives such as organic hydrocarbons, leading to a high EHP in the evaluation result.	High	A = high, can be derived directly from available data
Mining waste	Historically mining waste was dumped in the creeks close to the mine. This led to a huge contamination problem of the area. The operator Rio Tinto Kennecott is obliged by the national authority EPA to follow a clean-up plan focusing on contaminated soils and waters in the region (EPA 2017b). Today, around 20 km north to the mine, a 37-km2 tailings impoundment contains the waste	Even though the disposal of waste at the Bingham mine is of large-volume, the mine is evaluated with a medium EHP. This is explained by the efforts taken by the operator to cooperate with the obligations by the local authorities. Nevertheless, a medium hazard potential still exits.	Medium	A = high, can be derived directly from available data

	material. Tailings in the impoundment are primarily composed of silica sand, with a slightly higher concentration of copper than the general soil in the western United States (Hu et al. 2017). According to the Environmental Impact Statement (EIS) for the Kennecott Tailings Modernization Project in 1995. The impoundment will have a capacity of 1.9 billion tons of tailings additionally to the already stored 300-400 million tons) (U.S. Army Corps of Engineers Sacramento District 1995). Utah Department of Environmental Quality (UDEQ) and EPA claimed that the south pond, the outer embankments of the north pond, and the surface soils along the south side of Highway 201 appeared to be stable in their recent five-year review (UDEQ / EPA 2014). The new report is not available yet. The monitoring of the impoundment on a five year basis is criticized as insufficient (Hu et al. 2017).			
Remediation measures	The EPA required in its "Explanation of Significant Differences" a mine closure plan (EPA 2017b). But no official submission of such a plan could be found in the available sources. There are several activities by Kennecott regarding their clean-up agenda which can be linked to remediation measures (Rio Tinto Kennecott n.d.).	On the one hand, there seems to be a lot of effort to clean-up old sites in the area but on the other no official closure plan for the active sites could be found. Thus, the mine is evaluated with medium EHP.	Medium	B1 = medium, can be estimated on the basis of available information

Framework conditions natural environment

Indicator or criteria	Description and values	Explanation	Evaluation result	Data quality
Accident hazard due to floods, earthquake, storms, landslides	The rating system for the 4 sub-indicators uses georeferenced data from publicly available risk maps (see measurement instructions (Dehoust et al. 2017b)). Metrics are directly taken from the given risk assessment. The indicator total is determined by the highest hazard level of the sub-indicators.	The Magna tailing of the Bingham Copper mine has a high EHP for earthquakes which determines the evaluation result. Other sites of the mine have a medium EHP for earthquakes. Additionally, the pit has a high EHP for landslides. The other sub-indicators have a low EHP.	High	A = high, can be derived directly from available data
Water Stress Index (WSI) und desert areas	The WSI by Pfister et al. (2009) provides characterization factors on the relative water availablility at watershed level. Absolute water shortages in dry areas is supplemented by desert areas. The highest hazard level of the sub-indicators determines the total result.	The EHP for water stress is high and the mine is situated in a desert area. Both results alone already determine the high EHP result.	High	A = high, can be derived directly from available data
Protected areas and AZE sites	Georeferenced data for designated protected areas are used to assess hazards posed by mining extraction. The metric to evaluate EHPs corresponds to the method first described in the draft standard of the Initiative for Responsible Mining Assurance (IRMA 2014).	The Magna tailing of the Bingham Copper mine is situated in a protected area which determines a medium EHP.	Medium	A = high, can be derived directly from available data

State Governance

Indicators	
WGI 1 -Voice and Accountability	82.27 °°°
WGI 2 -Political Stability and Absence of Violence/ Terrorism	59.05 °°°
WGI 3 - Government Effectiveness	92.79 °°°
WGI 4 -Regulatory Quality	92.79 °°°
WGI 5 - Rule of Law	91.83 °°°
WGI 6 -Control of Corruption	88.94 °°°
EPI (Environmental Performance Index)	71.19
EITI membership	No (EITI 2019), the US joined the EITI in 2014 and withdrew from the EITI in 2017
International Agreements	
ILO 176	Yes, ratified in 2001

Others	OECD member
Legal framework	
Areas of Law: Environment	The National Environmental Policy Act (NEPA) is the principal environmental law implicated by mining on federal lands. It requires federal agencies to take a "hard look" at the environmental consequences of its projects before action is taken. An agency must prepare an Environmental Impact Statement (EIS) for all major federal actions significantly affecting the quality of the human environment. The analysis generally requires consideration of other substantive environmental statutes and regulations, including the Clean Air Act, the Clean Water Act and the Endangered Species Act. State laws may also require environmental analysis. Third parties may sue the federal agency completing the review to ensure that the agency considered all relevant factors and had a rational basis for the decisions made based on the facts found. Prosecuting the litigation would extend the project approval time, and if the agency loses, additional time would be required for the agency to redo its flawed NEPA analysis (Kahalley 2018). The Clean Air Act is administered by the Environmental Protection Agency (EPA) and states with delegated authority. The Clean Water Act is administered by the EPA, the US Army Corps of Engineers, and states with delegated authority. The US Fish and Wildlife Service and National Marine Fisheries Service administer the Endangered Species Act. States also have a wide range of environmental laws that govern permitting and reclamation on mining projects. A variety of federal and state laws govern the storage of tailings and other waste products on mining operations and for the closure of mines. In general, a mine plan must provide a detailed description of how the mine operations will comply with such requirements (Kahalley 2018). The Federal Land Policy and Management Act (FLPMA) requires the US Bureau of Land

	Management (BLM) and the US Forest Service (USFS) to prevent unnecessary or undue degradation of public lands. BLM and USFS reclamation standards include saving topsoil for reshaping disturbed areas, erosion and water control measures, toxic materials measures, reshaping and re-vegetation where reasonably practicable, and rehabilitation of fish and wildlife habitat. State laws may also include closure and reclamation requirements. Federal and state laws generally require financial guarantees prior to commencing operations to cover closure and reclamation costs (Kahalley 2018).
Areas of Law: Occupational Health and Safety (OHS)	The Federal Mine Safety and Health Act requires the Mine Safety and Health Administration (MSHA) to inspect all mines each year to ensure safe and healthy work environments. MSHA is prohibited from giving advance notice of an inspection, and may enter mine property without a warrant. MSHA regulations set out detailed safety and health standards for preventing hazardous and unhealthy conditions, including measures addressing fire prevention, air quality, explosives and others. MSHA regulations also establish requirements for: testing, evaluating, and approving mining products; miner and rescue team training programmes; and notification of accidents, injuries, and illnesses at the mine. Owners, employers, managers and employees all have obligations under the laws described in question (Kahalley 2018).

Corporate Social Responsibility (CSR)

Voluntary Standards	
Aluminium Stewardship Initiative (ASI): Is the mine owning company a member?	Not applicable Not applicable
Aluminium Stewardship Initiative (ASI): Is the mine certified?	Not applicable Not applicable
International Council of Mining & Metals (ICMM): Is the mine owning company a member?	Yes Yes (ICMM 2019)
Towards Sustainable Mining (TSM) Is the mine owning company a member of the Mining Association of Canada (MAC)?	Yes Yes, Rio Tinto Canada (MAC 2019) (Rio Tinto recently announced that its Montreal office, currently the global headquarters for the aluminum business, would also serve as a global hub for Rio Tinto operation)
Towards Sustainable Mining (TSM) outside Canada: Are TSM standards implemented*?	No information available Not specifically mentioned
Initiative for Responsible Mining Assurance (IRMA): Is the mine owning company a member?	No No (IRMA 2018)
Initiative for Responsible Mining Assurance (IRMA): Is the mine certified?	No No (IRMA 2018)
Responsible Copper (RC): Is the mine owning company a member of RC?	No No
Responsible Copper (RC): Is the mine certified?	No No
Responsible Mining Index (RMI): Has the mine been rated?	No No

Responsible Mining Index Company indicator „Working conditions“	0.570 0.570 / 1.000 (RMI 2018)
Responsible Mining Index Company indicator „Environmental sustainability“	0.447 0.447 / 1.000 (RMI 2018)
Responsible Steel (RS): Is the mine owner a member of the RS?	Not applicable Not applicable
Responsible Steel (RS): Is the mine certified?	Not applicable Not applicable
Australian Steel Stewardship Forum (ASSF): Is the owner a member of the ASSF?	Not applicable Not applicable
Australian Steel Stewardship Forum: Is the mine certified?	Not applicable Not applicable
ISO and CSR reporting	
ISO 14001 (ISO 14004): Is the mine ISO 14001 certified?	Yes Yes (EPA 2006)
CSR-directive 2014/95/EU: Does the mine owning company have its headquarters in an EU country?	No No
OECD Guidelines: Does the company have its headquarters in a signatory state?	Yes Yes
ISO 26000: Does the mine implement ISO 26000?*	No information obtained No information available
Banking Standards	
WB Standards / IFC Performance Standards: Is the mine financed to a major extend by the world bank?	No information obtained No information available

Equator Principles (EP): Is the mine financed to a major extend by a bank adherent to the EP?	No information obtained No information available

*by companies own account.

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A Glossary

Table 1 Legend

Environmental hazard potential

low

medium

high

Data quality

low

medium

high

- No concrete information, no general specifications of the measurement instructions, expert estimation.
- Assessment not possible due to lack of data at the site, as there is also no evidence for an assessment and there are no generalized assessment rules.

- Assessable on the basis of available information.
- Generalized classification according to measurement instructions.

- Can be derived directly from available data.

B Abbreviations

EHP	Environmental hazard potential
FY	Financial year
kt	Kilo tonnes
m a.s.l.	Meters above sea level
Mt	Million tonnes
OHS	Occupational Health and Safety
t	tonnes
TSF	Tailing Storage Facility
WGI	World Governance Indicators
WHS	Work Health and Safety

C Imprint

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