Initial Recording of Abandoned Mine Damage Incidents

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1 Preliminary remarks

Practical experience has shown how essential and decisive it is, from an operational and regulatory point of view, to record abandoned mine damage events as completely and comprehensively as possible. Working Group 4.6 has therefore addressed this issue and drawn up the present recommendation on the initial recording of abandoned mine damage incidents.

The document sets out which information must always be collected during the initial recording of abandoned mine damage events and suspected mining damage, and must be recorded for documentation purposes and as a basis for decision-making. The proposed structure does not claim to be exhaustive and is to be adapted to the specific needs of the company or authority.

The document begins with the recording and documentation of the event and lists the essential points regarding its characteristics. This includes information on the initial report and the initial inspection as well as on the recording of the event. Existing mine plans and other relevant documents are collected and reviewed at this stage. At this point, the question of responsibility for settling the damage does not yet arise. As a rule, the relevant police or public order authority acts here within the framework of the competences of the respective federal state.

After immediate hazard prevention in the form of initial securing, which includes the hazard assessment, the cause is assessed and responsibility for eliminating the hazard or damage is determined. On this basis, first steps for the further measures to eliminate the hazard are derived. In view of ongoing movements and deformations and the resulting hazards arising from a damage or collapse process, safety precautions for residents and neighbours, public order forces, commissioned experts and specialist companies must be observed. During documentation and surveying work on site, a further development of the damage process and an extension of the zone of influence or hazard zone must always be expected. In particular, overhanging collapse edges, loose material, the formation of fissures and cracks, but also water discharges indicate further possible movements.

Depending on their location and extent, abandoned mine damage events may attract media interest. In such cases, targeted media information should be provided at the discretion of the competent public order authorities or the legal successors.

2 Recording and documentation

This section of the document lists the essential information that should always be recorded during the initial recording of abandoned mine damage incidents. Since the terms used to determine the territorial location differ between Germany and Austria, the respective terms have been marked (Germany = [D], Austria = [A]).

A flow chart defined in advance can be used quickly by companies/authorities in an emergency. It should be adapted to the operational/regulatory requirements. An example diagram is shown in Fig. 1.

2.1 Initial report

The documentation of the initial report should contain at least

- the date of the initial report with the time (if relevant),
- the content of the initial report (e.g. type of damage),
- the time when the anomaly occurred, changes and developments,
- the person (name, contact details, function) who made the initial report,
- the parties affected as identified on site (residents, neighbours, infrastructure),
- the initial securing measures (cordoning off already carried out with barrier tape, construction fencing or similar),
- as well as the time of initial securing.

2.2 Information on the territorial location

In order to identify the territorial location unambiguously, the following are to be recorded:

- the federal state,
- the district [D] / judicial district [A],
- the municipality,
- the cadastral district [D] / cadastral municipality [A],
- the land parcel [D] / plot no. [A],
- the owners and users of the parcel/plot (if known),
- the official map designation / map sheet according to the BEV sheet layout[1] [A],
- the operator's/authority's mine plan designation,
- the coordinates (easting, northing, height),
- the reference system (stating the EPSG[2] code, height reference system),
- as well as the accuracy of the horizontal and vertical coordinates.

2.3 Preliminary information

In order to gain an overview of the affected area, the records are to be researched in advance; the following points may form part of the research results:

- occurrence of abandoned mine damage incidents in the area concerned,
- remediation of abandoned mine damage incidents in the area concerned,
- potential for possible mining damage,
- research results obtained by using digital resources such as geographic information systems, document databases, etc. (rapid digital assessment),
- geological particularities,

[1] BEV: Bundesamt für Eich- und Vermessungswesen (Federal Office of Metrology and Surveying), Austria. Federal authority responsible for surveying, cadastre, etc.
[2] EPSG: European Petroleum Survey Group; standardised code system for identifying coordinate reference systems

- exposures in the vicinity (boreholes, dynamic probing and small-diameter percussion drilling, trial pits),
- analogue/digital data (keyword: mobile mining GIS),
- presence of possible further mine cavities with an influence on the damage area.

2.4 Information on the initial inspection

To prepare for the initial inspection, a large-scale and a small-scale site plan as well as the damage report in accordance with the initial report and the preliminary information (Sections 2.2 and 2.3), together with one's own initial mining/geotechnical analysis, should be brought along if possible. In essence, the documentation should include the following:

- date of the initial inspection,
- participants in the initial inspection, if necessary with function/expertise,
- description of the conditions found, in particular previous barrier and securing measures,
- large vegetation close to structures,
- facilities for the discharge of surface water/stormwater,
- photo documentation (detailed photographic documentation, possibly drone images), if possible with position information,
- description of the local situation, sketches,
- surveying or mine-surveying record / accuracy of the record,
- interviews with residents and contemporary witnesses,
- time of occurrence according to witness statements/owners,
- utility/service lines in the vicinity of the damage site / camera surveys of the pipes available,
- subsoil investigation/geotechnical report available,
- results of ground movement measurements,
- groundwater levels/groundwater fluctuations,
- readings from gas measurements stating the gas and unit (e.g. CH_4 in coal mining or similar).

2.5 Classification of existing documents

Since it should be possible to trace the documents used during the ongoing process, they are to be divided into the following groups:

- official documents,
- operational documents,
- other archive documents (including private archives).

2.6 Investigation and surveying by type of damage

The investigation and recording of an abandoned mine damage incident depend on its characteristics. The type of damage can be classified as follows:

- crown hole (sinkhole),
- ground fissure/step, collapse fissure,
- zone of grain migration (suffosion),
- subsidence trough,
- water discharges,
- mud discharges,
- sliding/landslide,
- emissions,
- damage to buildings, cracks in infrastructure.

2.7 List of maps, mine plans and other documents

At this point, all documents used or researched that are directly related to the damage site (e.g. mine records, mine plans, literature) should be listed in a traceable manner with source references.

An allocation to the individual archives or “research locations” is required.

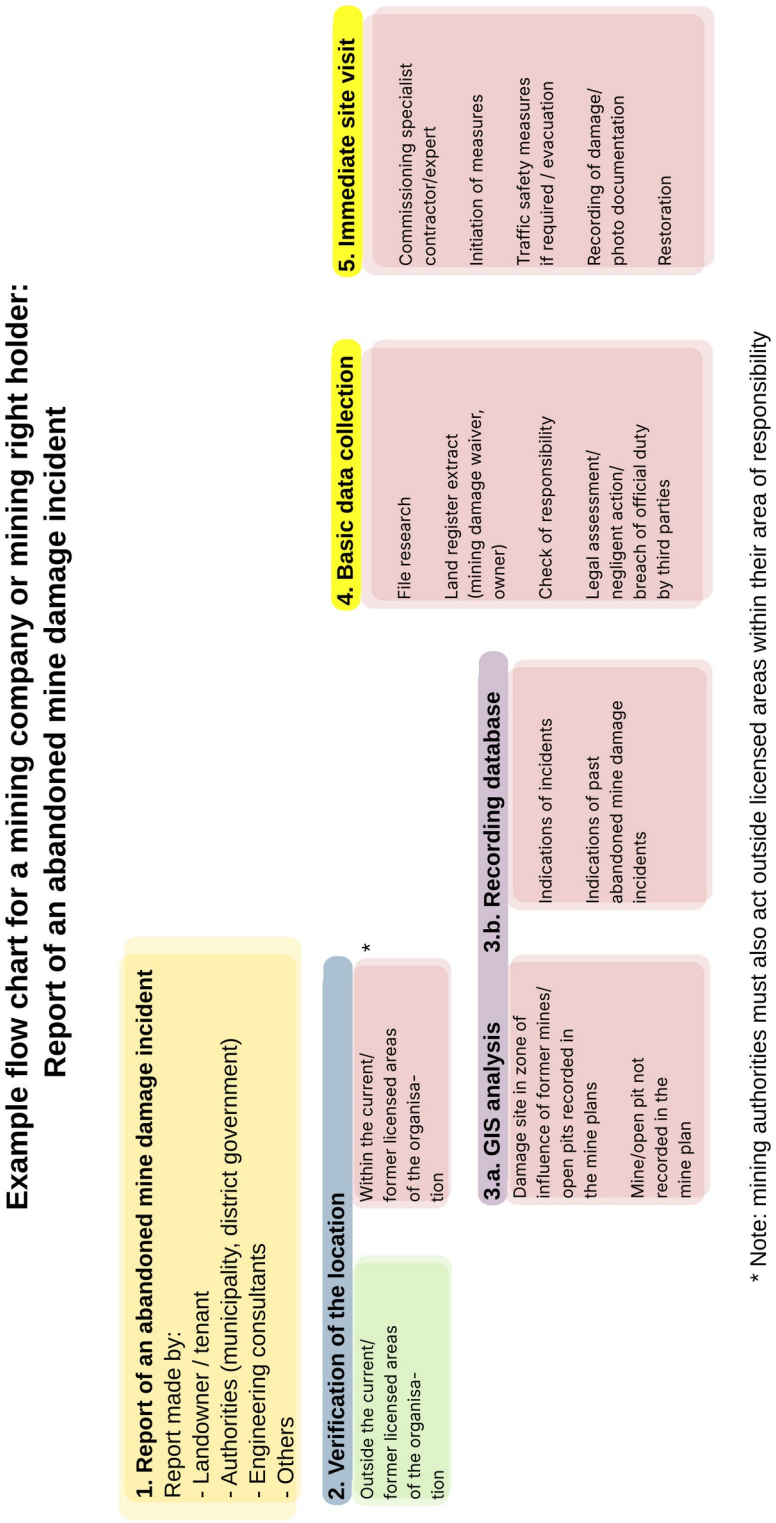

Fig. 1: Example flow chart: report of an abandoned mine damage incident

3 Hazard assessment, hazard prevention measures

Hazard prevention comprises measures to avoid and combat any danger to persons or property arising from the event that has occurred or from the abandoned mine object. Using suitable countermeasures, it is intended to restore safety and order and to stabilise unstable situations (“immediate measures” or “initial securing measures”). As a rule, hazard prevention measures are initiated by the mining authorities or in accordance with the relevant legal powers, or are supported by security authorities such as the police, the public order offices of the municipalities and district offices as well as the fire brigade and the Federal Agency for Technical Relief (THW). This section describes the procedure using the example of a crown hole.

Assessing the hazard potential

First, the hazard potential should be assessed:

- Which assets requiring protection are affected?
- Can the zone of influence be delimited?
- Is there imminent danger?
- How is the hazard to be classified?

Technical aids such as camera surveys are helpful in gaining an impression of the hazard potential. Subsequently, the images obtained can be used to preserve evidence. It should be noted that the hazard assessment must be carried out by a qualified person from the specialist authority or the legal successor, or by an appropriate expert.

Initial securing of the damage site

Initial securing of the damage site (imminent danger) in the event of a crown hole risk

Depending on the damage that has occurred and the local use, various hazard prevention measures can be applied.

Examples of initial securing measures:

- cordoning off against unauthorised access, initially by means of warning, marking or barrier tape or similar, construction fencing (take into account the zone of influence or the extension of the hazard zone; improve where necessary),
- monitoring (e.g. surveying of installed measuring points, observation of crack and fissure formation).

Further measures

Are further measures required to prevent or slow down collapse processes?

This is to be decided on a case-by-case basis, since every crown hole – depending on the circumstances – has its own specific dynamic collapse process. In principle, measures that are also reversible are advisable.

Examples are:

- backfilling with (round) gravel or drainage ballast,

- diversion of water pipes, drains and surface channels whose water accelerates the collapse process,
- if necessary, direct commissioning of engineers and construction companies: e.g. securing the collapse funnel with reinforced shotcrete.

4 Assessment of causes

Determining the cause responsible for the abandoned mine damage incident is the greatest challenge. Initially, it is often unclear whether the damage is mining damage, abandoned mine damage or pseudo mining damage. The effects of pseudo mining damage are comparable to those of actual mining damage, but in this case there is no causal link to mining. Determining the cause often also determines responsibility for remedying the damage. A fundamental distinction is made between mining-induced and non-mining influences that ultimately caused the damage pattern. Reference is also made here to Chapter 7 of the recommendation “Geotechnisch-markscheiderische Untersuchung und Bewertung von Altbergbau” [Geotechnical and mine-surveying investigation and assessment of abandoned mines] (2004).

4.1 Mining-induced influences

The following aspects are to be taken into account when delimiting or assessing mining influences:

4.1.1 Possible sources of influence

- active mining,
- abandoned mining,
- old workings without map records.

4.1.2 Classification of depth for mining damage purposes

- very shallow depth,
- shallow (near-surface) depth,
- mining at great depth.

4.1.3 Evaluation of existing documents

- mine plans,
- mine-surveying and geodetic observations,
- geological and geotechnical documents.

4.1.4 Determination of the extracted areas

- spatial location and extent,
- dip of the strata,
- mining method,
- extracted thicknesses,
- type of backfill,

- mining progress,
- start and end of mining,
- other.

4.1.5 Degree of extraction

4.1.6 Time factor

- cessation of mining,
- time factor for shallow mining,
- time factor for deep mining (possibly mine-surveying observations).

4.1.7 Determination of the size of the zone of influence

- angle of break,
- limit angle,
- angle of influence.

4.1.8 Influences/ground movements at the surface

- rock-mechanical considerations,
- evaluation of mine-surveying observations,
- back-calculation of the influence.

4.1.9 Water discharges at the surface

- hydrogeological model,
- gauge and well measurements,
- water samples/analysis.

4.2 Non-mining influences

Ground movements and the associated damage patterns cannot always be attributed to mining influences. Artificial or natural causes must also be considered.

4.2.1 Geologically induced influences

- tectonics, earthquakes,
- overburden load, settlement,
- rock creep, slope slides, sliding,
- erosion, subrosion, shrinkage, swelling,
- natural cavities (caves, karst, washouts).

4.2.2 Influences caused by subsoil and structures

- heterogeneous subsoil (peat lenses, partly cohesive, partly sandy),
- structural defects of the building,
- defects in construction,

- known damage events.

4.2.3 Hydraulic influences

- groundwater abstraction,
- groundwater fluctuations,
- rainwater, flooding,
- loss of water, softening,
- river and receiving-water regulation,
- chemical effects (leaching) of groundwater and surface water,
- escaping liquids and gases,
- climate (frost).

4.2.4 Mechanical influences

- alternating loads,
- vibrations from traffic (road, rail, supersonic aircraft),
- vibrations from blasting/explosions,
- vibrations from oscillating machines and installations (drives, generators, etc.),
- excavation, embankment,
- effects of war,
- other influences.

5 Determination of responsibility

The basis for hazard prevention or damage elimination is the determination of the responsibility of the disturber (Störer) for the abandoned mine damage event that has occurred or the hazard identified, and ultimately his being called upon to carry out the necessary measures.

As a rule, the mining authorities are only responsible for eliminating hazards, not for eliminating damage. In addition to the obligation under public order law, the hazard may also be eliminated by mining companies and their legal successors if they can establish their responsibility for it.

It should be noted at this point that competences and responsibilities vary depending on the federal state or country.

1. Allocation

1.1 Local allocation of the abandoned mine damage to the mine working or the abandoned mine facility or the underground cavity,

1.2 allocation to the mining entitlement/grant, the mining company or the landowner, and examination of a possible legal succession for the mine working relevant to the damage,

1.3 relationship of the current damage to the driving/operating phases of the mining object, or influence of subsequent operating phases on securing/backfilling measures,

1.4 examination of any subsequent use and possible appropriation of relevant mine workings as well as the performance of unauthorised and unlawful or damaging activities.

2. Selection of the disturber, legal assessment

2.1 Selection of the disturber by the competent public order authority/mining authority (disturber by conduct/disturber by condition), taking into account the conditions for intervention and the exercise of discretion,

2.2 legal assessment by the mining entrepreneur and the holder of the entitlement and their legal successors.

3. Elimination of the hazard

3.1 Calling upon the disturber and official order to eliminate the hazard against the person who caused the hazard or the person exercising actual control, taking into account proportionality and suitable means,

3.2 own measures to eliminate the hazard/damage or to restrict use by the mining entrepreneur and the holder of the entitlement and their legal successors or the landowner within the scope of the duty to maintain safety,

3.3 possible elimination of the hazard in the case of ownerless mine workings without an identifiable legal successor by the respective federal state (in accordance with state-specific laws and budgetary requirements).

6 Measures to eliminate hazards and damage

The recommendation “Geotechnisch-markscheiderische Untersuchung und Bewertung von Altbergbau” [Geotechnical and mine-surveying investigation and assessment of abandoned mines] (2004) describes the manifestations at the surface caused by abandoned mines. Depending on the damage that has occurred and the local use, various damage elimination measures can be applied.

The various remediation options or measures for eliminating damage are described in Chapter 5 of the recommendation “Sicherungs- und Verwahrungsarbeiten im Altbergbau” [Securing and closure works in abandoned mines] (2010). Damage can be eliminated in accordance with this recommendation.

To establish safety, taking into account the respective use of the surface, a distinction is made between:

- initial securing,
- permanent securing/closure.

7 References, applicable legal provisions

Austria:

Mineralrohstoffgesetz (MinroG) [Mineral Raw Materials Act], §§ 160–169

Allgemeine Bergpolizeiverordnung (ABPV) [General Mining Police Ordinance]

Germany:

Bundesberggesetz [Federal Mining Act], historical mining ordinances

State laws and ordinances

- Landesstraf- und Verordnungsgesetz Bayern of 9 December 2024 (GVBl. p. 570) [Bavarian State Criminal and Ordinance Act]
- Ordnungsbehördengesetz NRW of 1 May 2025 [Public Order Authorities Act, North Rhine-Westphalia]
- Ordnungsbehördengesetz Brandenburg of 5 March 2024 [Public Order Authorities Act, Brandenburg]
- Sächsische Hohlraumverordnung of 28 February 2022 (SächsGVBl. p. 187) [Saxon Cavities Ordinance]
- Verordnung zur Übertragung von Zuständigkeiten im Altbergbau of 19 December 2007 in Saxony-Anhalt (GVBl. LSA 2007, 475) [Ordinance on the transfer of competences in abandoned mines]
- Thüringer Altbergbau- und Unterirdische-Hohlräume-Gesetz (ThürABbUHG) of 23 May 2001 (GVBl. 2001, 41) [Thuringian Abandoned Mines and Underground Cavities Act]

Operating plans and approvals

Recommendations

Arbeitskreis 4.6 „Altbergbau“ der Fachsektion Ingenieurgeologie in der DGGT (2004): Empfehlung „Geotechnisch-markscheiderische Untersuchung und Bewertung von Altbergbau“ [Working Group 4.6 “Abandoned Mines”: Recommendation “Geotechnical and mine-surveying investigation and assessment of abandoned mines”]

Arbeitskreis 4.6 „Altbergbau“ der Fachsektion Ingenieurgeologie in der DGGT (2010): „Sicherungs- und Verwahrungsarbeiten im Altbergbau“ [Working Group 4.6 “Abandoned Mines”: “Securing and closure works in abandoned mines”]

8 Annexes to be attached

All relevant documents, as known at the time of recording, are to be attached as annexes to the initial recording of abandoned mine damage incidents. This includes, among others:

Annex	Content	Scale
1	Topographic maps	1:10,000
2	Geological/deposit maps	1:10,000
3.1	Plan view with cadastral/parcel map	1:1,000
3.2	Plan view with current mine plans (operational plans or mining damage plans)	1:1,000
3.3	Plan view with historical mine plans in chronological order	1:1,000
4.1	Detailed plan view	1:100 / 200
4.2	Vertical section / cross-section	1:100 / 200
5	Detailed photographic documentation	–