



RECLAMATION PROTOCOLS FOR INACTIVE MINING SITES IN THE REPUBLIC OF CROATIA

Review
DOI: 10.5937/RGD24005F

Farkaš Branimir¹, Hrastov Ana², Štefičar Iva²

¹Faculty of Mining, Geology and Petroleum Engineering, Zagreb, Croatia

²Rudar Projekt d.o.o, Zagreb, Croatia
ana.hrastov@rudar-projekt.hr

Abstract: *To mitigate risks to human health, environmental integrity, biodiversity, and property, the reclamation of mining sites is imperative. The previous Mining Act delineated two categories of reclamation: planned reclamation, conducted concurrently with mining operations, and unplanned reclamation, executed when planned reclamation was neglected or when unauthorized exploitation of mineral resources occurred. The revised Mining Act integrates inactive mining sites into the reclamation framework. These sites are characterized by the permanent cessation of mining activities without adequate safety measures to safeguard human health, property, biodiversity, and environmental quality, and they remain listed in the Register of Mining Sites. For inactive mining sites, two reclamation strategies are outlined: reclamation without exploitation and reclamation with exploitation. This study scrutinizes the inactive mining sites of solid mineral resources in the Republic of Croatia, as documented in the Unified Information System of Mineral Resources. Additionally, an overview of the updated Mining Act is presented, highlighting the newly established reclamation protocols for inactive mining sites and outlining the requisite procedures for their implementation.*

Key words: RISK, RECLAMATION, INACTIVE MINING SITES, MINING ACT

INTRODUCTION

To prevent danger to people, the environment, nature, and property during and after the mining works, the mining works area must be rehabilitated. According to the former Mining Act and its amendments [1], the reclamation of the mining works area is defined in such a way that it is carried out successively, i.e. conducted parallel with the mining works, and is considered planned reclamation. If planned reclamation of mining works has not been carried out or if the person/mining company who exploited the mineral resources is unknown i.e. unauthorized exploitation, unplanned reclamation is conducted. According to the revised Mining Act from 2023 [1], the term reclamation of

inactive exploitation fields is introduced. Also, the Mining Act foresees two new models (strategies) of reclamation: reclamation without exploitation and reclamation with exploitation [1].

This paper provides a brief review of former and newly adopted mining legislation in the Republic of Croatia regarding reclamation, an overview of the necessary steps provided i.e. protocols in the updated Mining Act for the newly established reclamation of inactive mining sites. Further, an overview and analysis of inactive mining sites in the Republic of Croatia was conducted [2]. Also, in this study, the possibilities of repurposing inactive exploitation sites after reclamation are presented and some positive examples of mining reclamation are shown.

REVIEW OF THE MINING LEGISLATION REGARDING THE IMPLEMENTATION OF RECLAMATION

Mining Act and its amendments [1] regulates the management of mineral resources, planning of mining economic activities, exploration and determination of reserves, development, and verification of projects, and many other issues in the field of mining, including reclamation of mining works area.

Under the term reclamation, according to the Mining Act [1], mining works are carried out to implement measures to secure the areas affected by mining works, which exclude the possibility of danger for people and property, for nature and the environment, and to implement land use determined by spatial planning documents.

Mining Act [1], which was in force until 2023, defines the reclamation of the area through two possible strategies: planned reclamation and unplanned reclamation.

The first strategy i.e. planned reclamation is conducted parallel with the mining works. The second strategy - unplanned reclamation – is carried out when the mineral raw material is exploited by an unauthorized person, and no planned reclamation is implemented. This second strategy of reclamation (unplanned reclamation) was removed from the Mining Act and in the new Mining Act amendments is no longer implemented.

The updated Mining Act from 2023 [1] introduces, in addition to planned reclamation, the reclamation of inactive mining sites. The reclamation of inactive mining sites is divided into two separate stages: reclamation without exploitation and reclamation with exploitation.

RECLAMATION PROTOCOLS FOR INACTIVE EXPLOITATION SIDES

Inactive exploitation sites are mining sites where the performance of mining works has been permanently suspended, where no security measures have been implemented to prevent the occurrence of danger, and which have still not been removed (deleted) from the Register of Exploitation Fields of mineral raw materials under the authority of the Ministry of Economy. The Republic of Croatia is registered as the holder of the inactive mining sites.

For all inactive mining sites in the Republic of Croatia, as mentioned, the new Mining Act envisages two new stages of reclamation (reclamation without exploitation and reclamation with exploitation) for which the protocols are described below.

RECLAMATION WITH EXPLOITATION

The procedure for the implementation of reclamation with exploitation (Figure 1) is initiated by the ministry (Ministry of Economy) in the following situations:

- By the official duty of the ministry,
- At the request of the Local Government Unit (LGU) on whose territory an inactive exploitation side is located or
- At the request of a legal or physical entity.

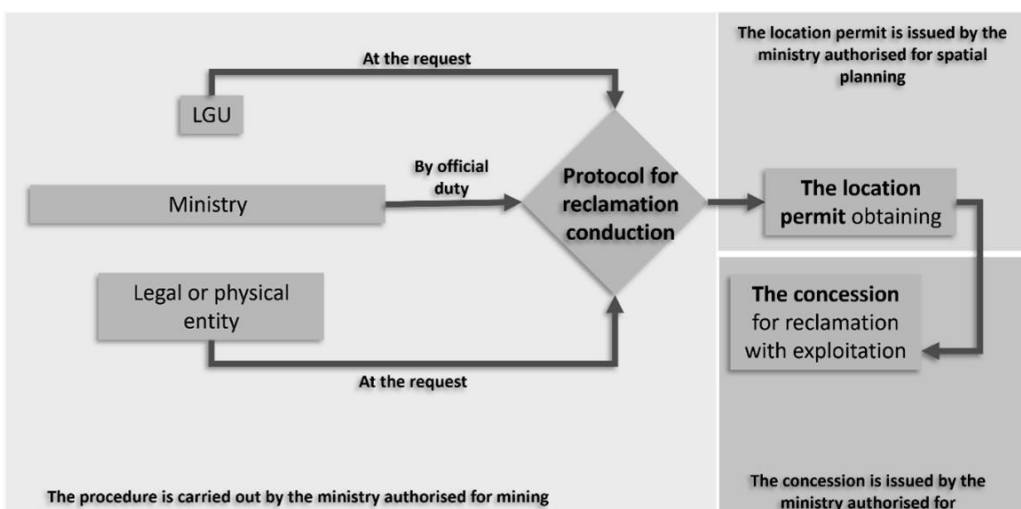


Figure 1, The reclamation with exploitation procedure

To carry out the reclamation of an inactive mining site, this protocol must carry out additional exploration works on an established exploitation field, based on which the conditions for granting the mining concession are determined. Also, before granting a concession for reclamation with the exploitation of mineral resources, it is necessary to obtain a location permit from the ministry authorized for spatial planning (Ministry of Physical Planning, Construction, and State Assets). According to the obtained location permit, the term and scope of mining works required for carrying out reclamation of the inactive mining site are determined.

RECLAMATION WITHOUT EXPLOITATION - TECHNICAL RECLAMATION

Reclamation of inactive mining sites without exploitation is also outlined as technical reclamation [2]. The reclamation protocol without the exploitation of mineral resources (Figure 2) is carried out exclusively at the request of the Local Government Unit (LGU) on whose territory an inactive mining site is located. The entire reclamation process is

coordinated by the Ministry of Economy, which also provides all funds for the implementation of the reclamation.

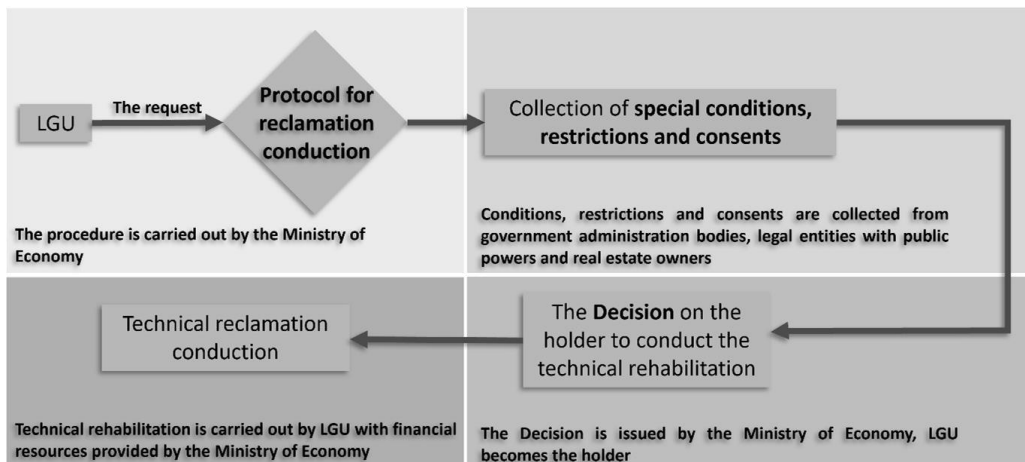


Figure 2, The reclamation without exploitation procedure

The application i.e. requests for the implementation of reclamation without exploitation procedure submitted by the LGU must contain the following information:

- Spatial coverage of mining works within an inactive mining field,
- The opinion from the ministry authorized for environmental and nature protection and authority for spatial planning of the regional government unit on the possibility of implementing technical reclamation,
- Proof of ownership of land parcels on which technical reclamation is planned.

Also, the ministry authorized for mining is obliged to request special conditions, restrictions, and approvals for the needs of reclamation protocol. If no state government administration bodies, legal entities with public powers, or real estate owners come forward within the deadline provided by the Mining Act, it is considered that they agree to the implementation of reclamation without exploitation and that they have no special conditions or restrictions.

In the procedure for reclamation without exploitation (technical reclamation), the ministry designates the LGU in charge of conducting technical reclamation and the necessary actions for the preparation of documentation following the collected special conditions and restrictions.

OVERVIEW OF INACTIVE MINING SITES IN THE REPUBLIC OF CROATIA AND THE EXAMPLES OF LAND REPURPOSING AFTER RECLAMATION

The Ministry of Economy announced [2] that in the Republic of Croatia, there are over 130 inactive mining sites, which in total occupy an area of 33 559.24 ha (Figure 3).



Figure 3, Inactive exploitation fields in the Republic of Croatia, [2]

The data were announced in the Unified Information System of Mineral Resources (UISMR) by Ministry for the year 2023. Considering that procedures for reclamation of inactive mining sites are already being carried out, i.e. some mining sites have been rehabilitated, so the number of them constantly changes.

Table 1 shows the number of exploitation fields according to the type of mineral raw materials that were exploited, and which were inactive for the year 2023. Also, the total area of exploitation fields for each mineral raw material is shown.

Table 1, Inactive exploitation fields by type of mineral raw material [2]

Mineral raw material	Number of mining sites	Area, ha
Architectural-building stone - block	8	62,76
Architectural-building stone - slab	10	401,98
Barite	0	0,00
Bauxite	11	31710,21
Brick clay	3	12,53
Gypsum	2	27,56
Construction sand and gravel	4	48,00
Carbonate mineral raw materials for industrial processing	1	14,93
Ceramic and fire-resistant clay	2	160,55
Flint	1	7,37
Flint sand	2	125,50
Mineral raw materials for cement production	0	0,00
Technical-building stone	24	387,12
Coal	3	600,73
Total:	71	33559,24

As can be seen from Table 1, the most inactive mining sites are precisely those mineral raw materials that are most often or most exploited in the Republic of Croatia. The largest number of inactive mining sites is technical-building stone, as many as 24 of them. Next comes architectural-building stone (block and slab) with a total of 18 inactive mining sites, followed by bauxite with 11 inactive mining sites. Additionally, from the obtained data (Table 1) can be seen that some mining sites are completely reclaimed for example mining sites of barite and flint sand.

Based on data obtained from the Ministry of Economy (Table 1) the analysis of shares in the total area and the total number of inactive mining sites was conducted depending on the type of mineral raw material. The results are presented in Table 2 and are also shown graphically in Figure 4.

Table 2, The shares in the total number and area depending on the type of mineral raw material

Mineral raw material	Share in total number, %	Share in total area, %
Architectural-building stone - block	11,27	0,19
Architectural-building stone - slab	14,08	1,20
Barite	0,00	0,00
Bauxite	15,49	94,49
Brick clay	4,23	0,04
Gypsum	2,82	0,08
Construction sand and gravel	5,63	0,14
Carbonate mineral raw materials for industrial processing	1,41	0,04
Ceramic and fire-resistant clay	2,82	0,48
Flint	1,41	0,02
Flint sand	2,82	0,37
Mineral raw materials for cement production	0,00	0,00
Technical-building stone	33,80	1,15
Coal	4,23	1,79
Total:	100,00	100,00

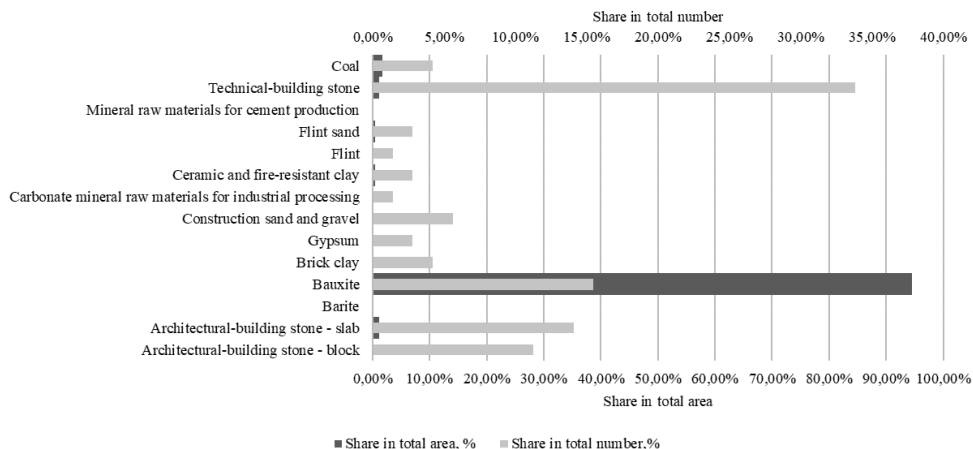


Figure 4, The shares of inactive exploitation fields depending on the type of mineral raw material

The largest share of the total area of inactive mining sites (94,49%) is occupied by bauxite, followed by coal with about 1,8% share in the total area for each of the mineral raw materials.

Architectural-building stone (slab) occupies 1,20%, and about 1,15% of the area is occupied by technical-building stone. Other mineral raw materials have a share of less than 1,0% of the total area of inactive mining sites.

According to the data from the Ministry of Economy on inactive mining sites (Figure 4, Table 1), the largest number of inactive mining sites was recorded in Dalmatia (Zadar, Šibenik-Knin and Split Counties) and Istria County. Also, the Republic of Croatia is registered as the holder of inactive mining sites for most of them, while the holders of the other inactive sites are private mining companies.

To increase the landscape value, and biological diversity or to add some social or touristic importance to the area (inactive mining sites), it is important to plan and consider the possibilities of repurposing the exploitation fields after reclamation in the spatial plans. In practice, the mining sites on which the reclamation was carried out are converted into landfills for inert construction waste, recreation centres, and so on.

Repurposing can be conducted in various ways, depending on the ultimate use of the space that is to be achieved, so only some of the possibilities are highlighted here:

- Increasing landscape value and biodiversity by converting it into parks (Figure 5a),
- Conversion of space for tourist purposes (Figures 5b and 5c),
- Embedding space (reclaimed mining sites) into urban environments by architectural interpolation (Figure 5d),
- Installation of facilities to produce energy from renewable sources (Figure 5e),
- Use of space for cultural and artistic events (Figure 5f).

For the mentioned approaches of possible repurposing of reclaimed mining sites Figure 5 shows examples from practice that are found in the Republic of Croatia and the world.



a) *Eden Project, Cornwall* [3]



b) *underground coal mine Raša, Raša, Croatia* [4]



c) *adrenaline park Radlovac, Orahovica, Croatia* [5]



d) *shopping centar Max City, Pula, Croatia* [6]



e) *solar power plant, Erzberg, Austria* [7]



f) *Cave Romane, Vinkuran, Croatia* [8]

Figure 5, Possible repurposing of reclaimed mining sites

CONCLUSION

The currently valid mining legal legislation foresees the reclamation of inactive mining sites, which until now were not defined by the Mining Act. The process of reclamation of inactive mining sites can be carried out in two strategies: reclamation without exploitation and reclamation with exploitation. For both forms of reclamation, the

Mining Act describes in detail all the necessary steps, documentation, and other relevant information to conduct one of the strategies of reclamation of inactive mining sites.

From the analysed data of the Ministry of Economy, it is evident that there is a total of 73 inactive mining sites of mineral raw materials in the Republic of Croatia, occupying an area of over 33 000 ha in total. The largest number of inactive mining sites is found in Dalmatia (Zadar, Šibenik-Knin, and Split Counties) and Istria County.

Carrying out the reclamation of inactive mining sites not only prevents the occurrence of dangers for people, the environment, nature, and property but also opens the possibility and provides a good starting point for repurposing these same areas and using them for other purposes.

LITERATURE

- [1] Vlada RH, Zakon o rudarstvu, Narodne Novine, no. NN 56/13, 14/14, 52/18, 115/18, 98/19, 83/23, 2013.
- [2] MINGOR, JISMS - WebGis portal, 2024, Ministarstvo gospodarstva i održivog razvoja, <https://jisms.gospodarstvo.gov.hr>.
- [3] GRIMSHAW, The Eden Project Master Plan, <https://grimshaw.global/projects/culture-and-exhibition-halls/the-eden-project-master-plan/>.
- [4] ARSIANA, Kova experience, <https://arsiana.hr/dozivi/kova-experience/>
- [5] R. Orahovica, U adrenalinskom parku tvrtke Radlovac postavlja se zip line koji će, kada se postavi, biti prvorazredna atrakcija, 2023, <https://radioorahovica.hr/?p=17912>.
- [6] E. Morina, Pismo investitora na području kamenoloma Max Stoja, *giornal.hr*, 2022, <https://www.giornal.hr/iz-sata-u-sat/pismo-investitora-na-podrucju-kamenoloma-max-stoja/>.
- [7] Energy3000, Erzberg, <https://energy3000.com/referenz/erzberg/>.
- [8] Medulinska rivijera, Rocks & Stars @ Cave Romane, 2019, May 27, 2024, <https://medulinskarivijera.hr/djelatnosti/manifestacije/rocks-and-stars-cave-romane/>.