

TECHNICAL REQUIREMENTS FOR RECLAIMING DISTURBED LANDS: A FUNCTIONAL-LANDSCAPE APPROACH

Nafisa Rustamovna Samatova

Jizzax davlat pedagogika universiteti doktoranti

E-mail: nafisasamatova198727@gmail.com

<https://doi.org/10.5281/zenodo.17810336>

Abstract

This paper describes how the technical stage of land reclamation can be organised when disturbed areas are planned for different types of use such as agriculture, forestry, water management, nature protection and recreation. Relying on national practice and a landscape-geographical view, we outline the main engineering steps that link relief shaping, soil reconstruction and water regime control to the needs of each land-use type. The approach is compared with international work on quarry and open-pit restoration, including safer re-profiling of steep slopes, construction of soil-ameliorative layers and methods for evaluating reclamation quality (Milgrom, 2008; Wang et al., 2018; Oggeri et al., 2019; Baikalov et al., 2022; Özçelik, 2023; Végsöová & Glova, 2025). The paper shows that if the technical stage is adapted to landscape conditions and future use, disturbed lands can regain their productive and ecological functions and long-term risks for the environment can be reduced.

Keywords: disturbed lands; land reclamation; technical stage; fertile soil layer; overburden; quarry rehabilitation; landscape planning

Introduction

Open-pit mining, large construction projects and linear infrastructure such as roads, pipelines and canals often leave behind extensive disturbed areas: stripped soil, spoil heaps and deep pits. If these areas are not specially reclaimed, they can remain for many years as sources of erosion, pollution and landscape fragmentation. For this reason, many studies focus on the environmental impacts of quarries and open pits and on methods of restoring them.

In many regions, including Central Asia, disturbed lands are expected to be returned to productive use – for example as agricultural fields, protective or commercial forests, water bodies for economic purposes, or recreational zones. This means that the technical stage of reclamation cannot be the same everywhere; it needs to be adapted to the type of future land use and to local relief, geology and hydrogeology.

The aim of this paper is to summarise and structure the technical requirements for reclaiming disturbed lands under different functional directions (agriculture, forestry, water management, nature protection and recreation)

within a landscape-based framework. The analysis is based on national practice and is compared with international approaches to quarry and open-pit restoration.

Methodological basis

The approach is built on a functional-landscape principle. First, disturbed lands are grouped according to their planned future use:

- agricultural production (arable land, perennial crops, fodder fields);
- forestry and protective green belts;
- water-management facilities (reservoirs, fish ponds, cooling and settling basins);
- nature-protection and sanitary-hygienic zones;
- recreational areas and reserve lands near large settlements.

For each group, the technical stage is seen as a package of engineering measures that prepares the relief, soil cover and water regime for the next, biological stage of reclamation. This package may include reshaping slopes, creating a fertile or ameliorative layer, stabilising spoil heaps and organising surface and groundwater conditions.

The requirements formulated here are compared with solutions described in international studies on quarry and open-pit rehabilitation, where similar problems of steep slopes, poor substrates and unstable hydrological regimes are analysed. In this way, local practice is interpreted in a broader context.

Results and discussion

Agricultural reclamation. For agricultural use, the main goal of reclamation is to restore the agrobiological productivity of disturbed land and to create conditions for stable farming. This involves both the soil and the field geometry.

At the technical stage, several key tasks are carried out:

Differentiation of disturbed areas. Fragments of the landscape are sorted according to relief, size, presence of remaining fertile soil and availability of overburden rocks that are suitable for use as an ameliorative layer.

Relief re-shaping. Spoil heaps and depressions are smoothed to an acceptable slope. Fields are given shapes that are as close as possible to rectangles, so that agricultural machinery can work efficiently.

Construction of an ameliorative soil layer. A designed thickness of fertile soil and/or workable rocks is spread over the prepared surface. Direct placement of topsoil on chemically or physically incompatible rock is avoided.

Timing of soil placement. Where spoil heaps have been compacted by bulldozers or excavators, soil can be spread in the same year. Where they have

formed without compaction, a settling period of about 1.5–2 years is recommended before soil placement, taking into account heap height, pit depth and rock density.

Determination of layer thickness. The thickness of the fertile layer depends on rock properties, slope exposure, the planned type of crop and climate. As a guideline, 80–100 cm is used for vegetables, 70–80 cm for cereals, 30–50 cm for perennial and annual grasses, while for fruit trees each planting pit should contain more than 1 m³ of soil or workable rock.

As a result of such measures, disturbed lands are physically and chemically adapted to agriculture, the ecological functions of the soil are re-established and stable crop production becomes possible. Experience from other countries also shows that success in agricultural reclamation strongly depends on adequate layer thickness and appropriate relief preparation.

Forestry-oriented reclamation. When disturbed lands are to be used for forestry, the technical stage must mainly provide a suitable growth substrate for trees and shrubs and ensure slope stability.

The basic requirements are:

Creation of a planting layer. On surfaces where natural regeneration is impossible or bedrock is exposed, a meliorative soil layer of sufficient thickness and suitable grain-size composition is created. Its parameters are chosen according to rock properties, planned water regime (drainage/irrigation) and the biological needs of the selected species.

Stabilisation of spoil heaps. Multilayer spoil heaps with steep slopes are covered with fine-grained, non-toxic materials and stabilised through grading or terracing. This reduces the risk of erosion, debris flows and suffosion or karst phenomena.

Relief adjustment for orchards and vineyards. Where disturbed land is to be used as orchards or vineyards, the surface is shaped into gently undulating relief without closed depressions, so that agricultural machinery can work safely and irrigation water can be distributed evenly. Slopes are designed within stable angles, and existing tree and shrub stands are removed only where absolutely necessary.

Fire safety near settlements. On reclaimed forested lands close to settlements, mixed protective shelterbelts are established, and regular maintenance is organised to reduce fire risks.

These measures make it possible to transform unstable spoil heaps and bare rock surfaces into stable planting sites, which can later be afforested or developed as protective belts.

Reclamation for water-management purposes. Deep pits and artificial depressions left after extraction can be converted into water bodies for industrial and agricultural water supply, fish farming, recreation, cooling of industrial water, settling of suspended solids or multi-purpose reservoirs.

At the technical stage, the following issues are addressed:

- ✓ whether it is technically and economically reasonable to fill the depression with water;
- ✓ protection of underground workings and adjacent areas from uncontrolled flooding;
- ✓ ensuring long-term stability of the reservoir banks and preventing shoreline retreat and abrasion;
- ✓ compliance of water quality with the intended use;
- ✓ landscaping and greening of the surroundings to improve the visual and ecological state of the site.

Such conversion is widely used in many countries, but the safety and ecological value of the resulting reservoirs depend strongly on the detailed design of slopes, liners and water inflow–outflow regimes.

Nature protection and sanitary-hygienic reclamation. Where disturbed lands contain toxic spoil heaps, tailings, sludges or other industrial wastes, the main aim of reclamation is to reduce environmental and sanitary risks and to prevent the spread of pollutants.

Typical technical measures include:

compacting the surface and covering it with clay or other low-permeability materials, placing a protective fertile soil layer on top, applying technical, biological and, where necessary, chemical stabilisation measures to immobilise contaminants.

After such conservation, the site can often be used only in a limited way, for example as a protective green strip, but the risk to groundwater, surface water, soils and the local population is significantly reduced.

Recreational and reserve land uses. For recreational reclamation, the stability of both natural and anthropogenic geosystems is especially important. Where possible, the relief is kept close to its natural form, and earthworks are kept to a minimum. Disturbed lands created by open-pit extraction and located near large settlements can be seen in two ways: as potential recreational zones,

where reshaped relief and water bodies can be used for leisure and tourism, as reserve sites for future industrial or civil construction.

In both cases, the technical stage has to transform unsafe, broken relief into stable platforms and gentle slopes, while preserving as much as possible of the natural landscape. Detailed functional planning is then carried out at later stages.

Conclusions

The technical stage of reclamation cannot be reduced to a simple, standard scheme of “levelling and spreading soil”. It has to be differentiated according to the future use of the land and adapted to the natural–geographical conditions of each site.

For agricultural reclamation, the priority is to create an adequate fertile layer and field geometry suitable for mechanisation. For forestry, the main task is to provide stable slopes and a planting substrate that allows trees and shrubs to grow. Water-management reclamation requires careful attention to bank stability and hydrogeological safety. Nature protection and sanitary–hygienic reclamation focuses on isolating and stabilising hazardous materials. Recreational and reserve uses demand minimal but precise relief correction, so that future planning remains flexible.

In this way, a functional–landscape approach to the technical stage becomes a key link between engineering operations and sustainable post-mining land use. Properly designed technical measures allow disturbed lands to be returned to safe, productive and ecologically more stable conditions, and they reduce long-term risks for both the environment and local communities.

References:

1. Baikalov, Y., Dzhygyrey, I., Bendiuh, V., Proskurnin, O., Berezenko, K., Boichenko, S., Kryuchkov, A., Serhienko, M., Danilin, O., & Kutniashenko, O. (2022). Improvement of quarry and slagheap reclamation technology. *Eastern-European Journal of Enterprise Technologies*, 4(10), 38–50. <https://doi.org/10.15587/1729-4061.2022.263513>
2. Milgrom, T. (2008). Environmental aspects of rehabilitating abandoned quarries: Israel as a case study. *Landscape and Urban Planning*, 87(3), 172–179. <https://doi.org/10.1016/j.landurbplan.2008.06.007>
3. Oggeri, C., Fenoglio, T. M., Godio, A., & Vinai, R. (2019). Overburden management in open pits: Options and limits in large limestone quarries. *International Journal of Mining Science and Technology*, 29(2), 217–228. <https://doi.org/10.1016/j.ijmst.2018.06.011>
4. Özçelik, M. (2023). Environmental effects of marble quarry operations in Burdur Lake Basin (Burdur–Turkey). *Journal of Degraded and Mining Lands*

- Management, 10(3), 4517–4525.
<https://doi.org/10.15243/jdmlm.2023.103.4517>
5. Végsöová, O. G., & Glova, J. (2025). Methodological framework for evaluating quarry reclamation based on the Reclamation Quality Index. *Land*, 14(8), 1557.
<https://doi.org/10.3390/land14081557>
6. Wang, H., Zhang, B., Bai, X., & Shi, L. (2018). A novel environmental restoration method for an abandoned limestone quarry with a deep open pit and steep palisades: A case study. *Royal Society Open Science*, 5(8), 180365.
<https://doi.org/10.1098/rsos.180365>



WOC
WORLD
ONLINE
CONFERENCES

