



Project solution for land reclamation and spatial arrangement of the 'Srebro' open pit mine at the Fruška Gora National Park

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Synopsis

The exploitation of stone (trachyte) at the 'Srebro' open pit mine, located on the northern slopes of the Fruška Gora National Park (Serbia) central area begun in 1964. Stone exploitation in this locality does not endanger the environment in an ecological sense, does not pose a threat to plants and animals, and apart from the terrain configuration changes, it did not leave behind permanent consequences to the environment. Projects for permanent cessation of mining operations and for land reclamation and spatial arrangement were completed in these circumstances. The paper gives a short review of the condition at the open pit mine; furthermore, the key problems and basic demands are presented, together with a concept of technical and biological land reclamation and the spatial arrangement of the mining complex.

Keywords

Open pit mine, land reclamation, spatial planning, spatial arrangement, National Park, Fruška Gora, Srebro.

Introduction

The stone deposit 'Srebro' is located on the northern slopes of the central area of Fruška Gora National Park, near Novi Sad city, Serbia (Figure 1). The geological surface of this location surveyed, is 1.8 km². The exploitation of trachyte begun during the second decade of the last century, whereas more intensive works begun in 1964. The stone from the deposit is being used for road construction, building of embankments at railroad tracks and construction of hydrotechnical objects.

The surface of the exploitation field amounts to 1 080 000 m², with a circumference at 4 200 m. The area encompassed by exploitation works is 61 880 m², the area of external deposition site 21 460 m² and the total area of the mine complex is 113 470 m². The highest elevation point in the area of mining operations conducted until now is +380 m, and the lowest is +230 m. The morphology of the area is characterized by a distinct relief, with elevation points at 470 m above sea level, and with some peaks in the range at approximately 500 m.

The vicinity of the deposit is characterized by a complex geological structure, with the following units: Palaeozoic serpentinites and low metamorphic shales, Mesozoic sediments of Triassic and Cretaceous origin, Tertiary products and Quaternary strata. The eruptive rocks present are trachytes, diabases, dacites, andesites and tuffs.

The exploitation field is intersected in south-north direction by two temporary (flood) water currents, the Sveti Luka and Kamenjarski streams. The basin of these streams is approximately 1.2 × 10⁶ m², hence during the rainy seasons they receive or pass through huge quantities of water, which is then delivered to the open pit contour, due to lack of a protective border canal. The overall surface of the river basin with waters gravitating to the open pit mine contour is 1.4 × 10⁶ m², and the intensity of flood streams is higher than 10 (l/s).

The immediate surrounding of the open pit mine is covered by the forest. The terrain of the deposit, together with near and far surrounding is overgrown with high deciduous forest and thickets. To the north of the open pit mine lies the village Stari Ledinci. The orthophoto snapshot, shown in Figure 2 presents the current situation of the 'Srebro' open pit mine.

The exploitation technology applied is of a discontinuous type, typical for such open pit mines. The exploitation of the rock mass is being accomplished by drilling, blasting and dropping the blasted material onto the lowest level, from where it is loaded on trucks by the

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Figure 1—Open pit mine 'Srebro' location

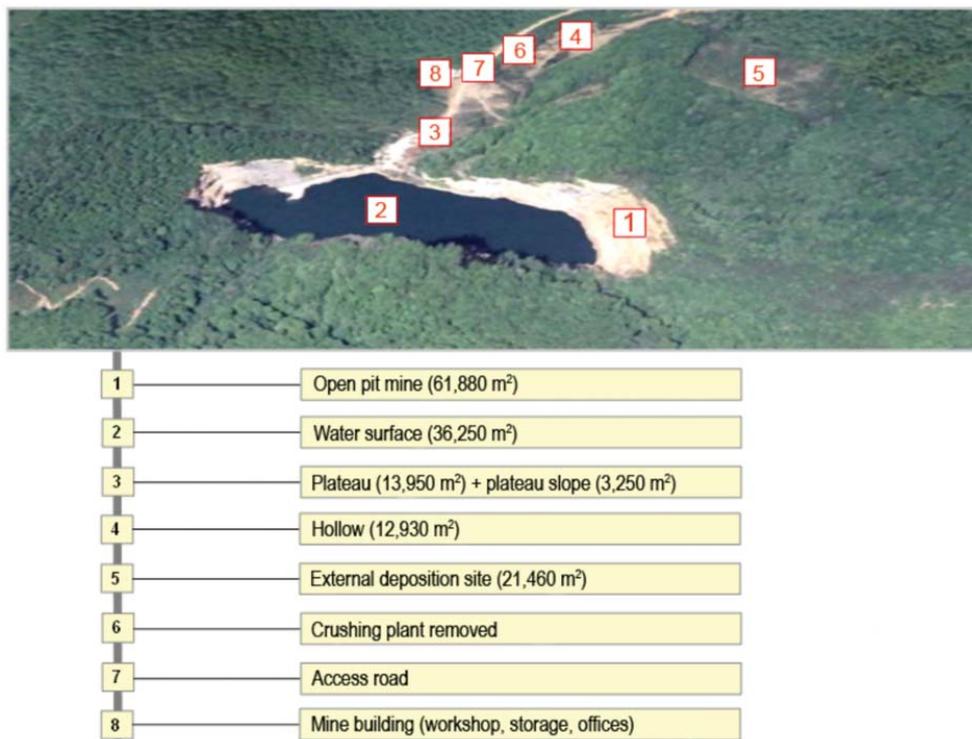


Figure 2—Orthophoto snapshot of the 'Srebro' open pit mine area

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excavator with a single operating element or the loader, and afterwards transported to the crushing plant located approximately 300 m north of the open pit mine border. The stationary crushing plant with its equipment and machinery for sieving is worn out and has been removed.

The overburden (humus and crushed stone of poorer quality) was disposed of at the external disposal site, located on the hillside north of the open pit mine (Figure 2) overgrown by forest and lower vegetation. The deposition was in depth from the elevation point of +275 m.

During the NATO aggression on Serbia in 1999, the dewatering of the 'Srebro' open pit mine was stopped, and a deeper area of the open pit was flooded. The 'lake' formed after this, became a popular vacation area and a swimming location during the summer. The level of water inside the accumulation varies slightly around +261.5 m. The water mirror surface is approximately 36 000 m².

Antropogenous effects of mining works

Trachyte opencast exploitation does not disturb the environment in an ecological sense, nor does it pose a threat to the plants or the animals. Apart from the changes in terrain configuration, it did not leave permanent consequences to the environment, which is confirmed by the orthophoto snapshot of the open pit mine area, presented in Figure 2. The trachyte is a chemically inert and non-toxic material which does not pollute the environment. The influences of the trachyte opencast mining on the environment in an ecological sense mostly relates to the temporary spatial and temporal degradation of the surface occupied by exploitation operations. As a consequence of trachyte open pit mining in this locality, the following intensities of environmental influences occur:

- Slight air pollution by dust, due to drilling, blasting, dropping of trachyte during blasting, load and transport to the mobile crushing plant and its operation. The influence of dust on air pollution is assessed as relatively low.
- It is assessed that the air pollution by exhaust gases from the internal combustion engines used for drilling machinery, load, transport and auxiliary works is low. The assessments rely on the fact that the machinery work takes place inside the open pit, that the number of machines is low, that the power of the engines is low, and that the intensity of machinery operation is relatively low.
- The air pollution by dust, exhaust gases from the engines and the noise along the public road 'Srebro'—Stari Ledinci—Novi Ledinci during the trachyte transport is assessed as high.
- The sources of noise are drilling machines, load, transport, auxiliary works, a mobile crushing plant and blasting. Taking the terrain configuration, geometry of the open pit mine, the vegetation and the forest in the environment into account, and also the fact that the technological operations are taking place within the mine complex, it is assessed that the intensity of noise influence is low.

- During the mining, the negative influences are manifested also through air blasts and seismic effects. It can be concluded that the intensity of the influence on the environment is low.
- The open pit mine changes, to a certain degree, the temporary water streams of the waters of atmospheric origin. It is assessed that the influence is low.
- The erosion influence of atmospheric waters can be manifested to a certain degree along the slopes of the open pit mine. The influence is low.
- With the development of the open pit mine, a degradation of the forest land occurs. Since the open pit mine belongs to the category of smaller open pit mines, the influence is low.
- The destruction of flora and fauna is assessed as medium to low, taking into account that the extent of open pit is not large, and that forest ecosystems are already poor due to the anthropogenic effects such as cutting down the forest, hunting, etc.
- Within the open pit depression, a formation of freezing points can be expected. This influence is assessed as medium,
- The limitation of the visual complexity holds significance, having in mind that this area is located within the Fruška Gora National Park. The influence is assessed as significant,
- The influence of taking up the environmentally protected surfaces is particularly important. By land reclamation, these negative influences can be minimized, or completely removed. It is assessed that all the measures named by the Land reclamation and spatial arrangement project will be accomplished. In this case, the influence is assessed as low.

Demands for cessation of mining operations

The reason for permanent cessation of the operations at 'Srebro' trachyte open pit mine is not the exhaustion of trachyte reserves, as generally it should be, but the pressure and persistence of individuals, groups, movements and some institutions, with the rationale that the exploitation works should be stopped due to ecological reasons.

The myths and fallacies about mining, i.e. mineral resources exploitation as an ecologically damaging operation being undesirable in the Fruška Gora National park are continuously spread in the public. The situation has become absurd, underlining damages brought by mining, and at the same time defending the flooded mine, i.e. the 'lake' created by mining operations and by flooding the deep regions of the 'Srebro' open pit mine, as the ecological pearl of Fruška Gora. Hence, it is contradictory for 'dirty and ecologically problematic' mining to leave behind the lake with pure water. Within this conglomerate many interests are interlaced, and an argumentative, professional dialogue is being avoided.

Admittedly, the negligence and indifference shown so far in land reclamation and revitalization of the surfaces degraded by trachyte exploitation, contributed to this situation. Apart from the mine, which has spent years in unenviable economic circumstances, partially explains this

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situation, equal guilt is shared with the Fruška Gora National Park. The national park has charged the mine with significant amounts of money, but these financial resources were not invested in the land reclamation of the degraded area.

According to the Rio de Janeiro Charter, development sustainability must be directed not only to ecological concerns, but also to social and economic development. To this end, the exploitation of mineral resources, trachyte in this case, apart from the ecological has a particularly significant business-economy dimension, since the autonomous region Vojvodina does not own other deposits of technical stone of such quality, necessary for civil engineering purposes. A question is asked: should the stone be transported from distant locations? Is the technical stone a resource that can bear the transport cost?

If the idea of banning the trachyte exploitation is realized, it would be a strategic business mistake. If the problem is approached in a professionally grounded manner, suggested by the Rio de Janeiro Charter, and experiences from countries that have already gone through circumstances like this one are accepted, a compromise solution can be achieved in opposition of ecological and business-economy goals. The compromise should be strived for, because without mineral resources there is no life, and empty tales about struggles against mining and exploitation of mineral resources are negated with the first shortages of mining products. Understandably, there is an ecological tolerance threshold that must not be violated.

Land reclamation and spatial arrangement

Land reclamation, in general, in opencast mining of hard mineral resources, means re-establishing herbal associations (vegetation) on the surfaces left after the exploitation of mineral resources. It is accomplished periodically, or continually by synchronization with the mining activities. In the conditions of the 'Srebro' open pit mine, land reclamation was not performed until now.

Most often, it is not possible, nor it is necessary, to restore the area into a condition identical to the original one (before the exploitation) by land reclamation. The selected purpose for using the degraded land must meet the needs of local community, in this particular case—especially the needs of natural habitat, stratigraphy after exploitation, expenses, etc. In order to understand this concept, a conservation concept must be apparent, main targets clearly defined (preservation of natural processes or species preservation—biodiversities), and solutions on coexistence of reclaimed land and its preservation must be found.

Therefore, the land reclamation should enable restoration of natural functions to the mining area, form new economic features of the area, and create conditions for financial support of land reclamation operations, with maximum considerations of local community interest, and the ambient surroundings of the Fruška Gora national park.

The analysis of the surrounding conditions and spatial capabilities of the 'Srebro' (Figure 2.) has directed the concept of mining complex land reclamation to the integration

of the following goals: creation of an ambience that fits into the landscape, maximally suitable for the restoration of natural functions to the area and the construction of a sport-recreational-tourist complex for water and underwater sports, during the summer for sun exposure, swimming, for small sports (tennis, volleyball, handball, basketball, futsal, etc.), for free climbing and mountain climbing training, hill cycling, walking and running in nature, ice skating and sleighing during the winter, etc.

In order to create an ambience that provides capabilities for the achievement of the goals set, the existing contour of the open pit mine should be moved east for about 120 m, and north for 25 m, Figure 3. Thus, the contour of the open pit mine with the plateau shall be formed at the elevation level of +262 m, for the beach with water entries and accessory features, with a capacity of approximately 1 000 swimmers (Figure 4). The cascade slopes of the open pit contour with benches 10 m high are suitable for afforestation. The slopes in the central and eastern part of the open pit will be overhauled and preserved in the present condition, while the slope in the west wing will be prepared for free climbing. Levelling operations and preparations for sport field construction, a walking area and a park will be performed at the plateau to the north of the open pit, and further to the north preparations for parking construction. The access road that should be built for to connect the mining plateau at 270 m and the etaza of the open pit mine can be used after operations cease, as a walkway, cycling track or sleighing during the winter. For the purpose of creating the contour of the open pit mine, suitable for biological land reclamation and spatial arrangement, overall amount of the excavated material amounts to 5 659 502 52 m³ (trachyte and waste). The operations should last for eight years, and the financing is to be realized from the income of trachyte sales. The overall value of the operations investment is 2.6 million euros. Figures 3 and 4 present the condition of the open pit after the permanent cessation of operations, i.e. technical land reclamation.

A concept of biological land reclamation is based on the valorization of newly formed natural and created conditions. Therefore, in the area previously occupied and by new operations created, six entities with similar ecological structures and unique ecological system of influence are separated. Afforestation and natural succession of bench planes within the open pit contour is planned, together with park formation of the mining plateau and partially of the beach plateau, the hydro planting of slopes for planting vegetation works and erosion protection. The selection of herbal species is adjusted to habitat conditions and limitations defined by the special conditions of the Fruška Gora National Park. Figures 4 and 5 present the plan for planting vegetation at the open pit mine contour, and a plan of the mining plateau arrangement.

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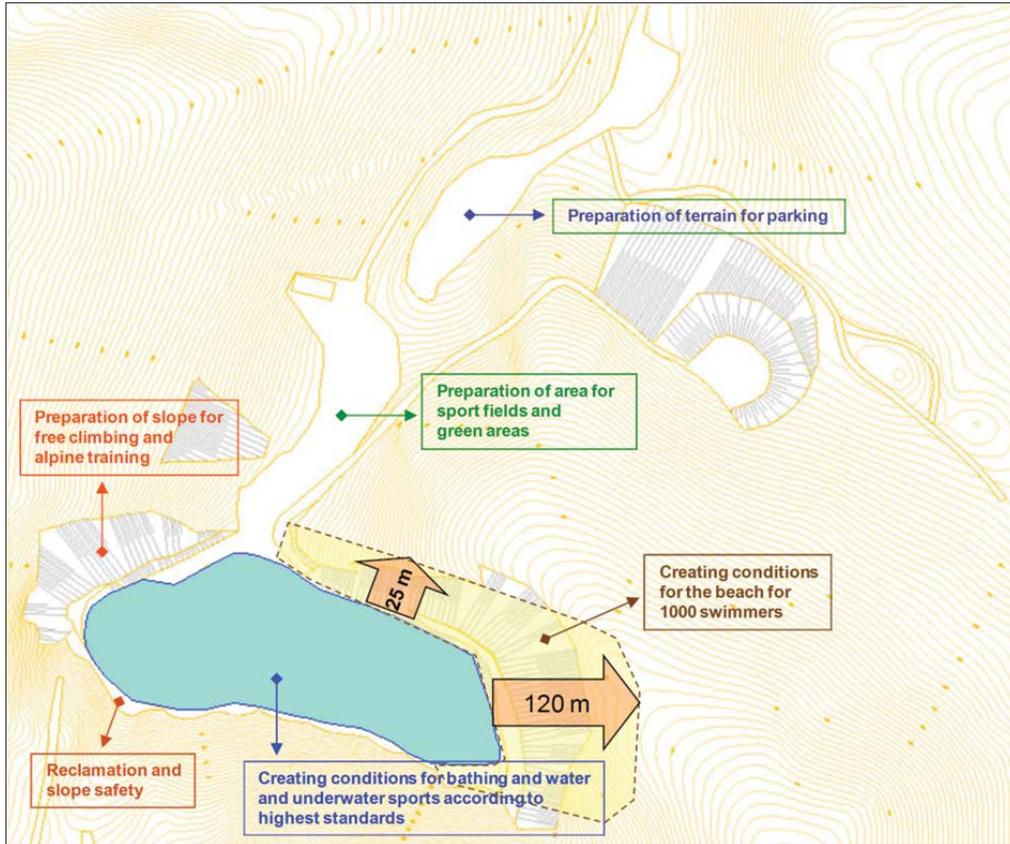


Figure 3—Plan of moving open pit mine boundaries and purpose of space

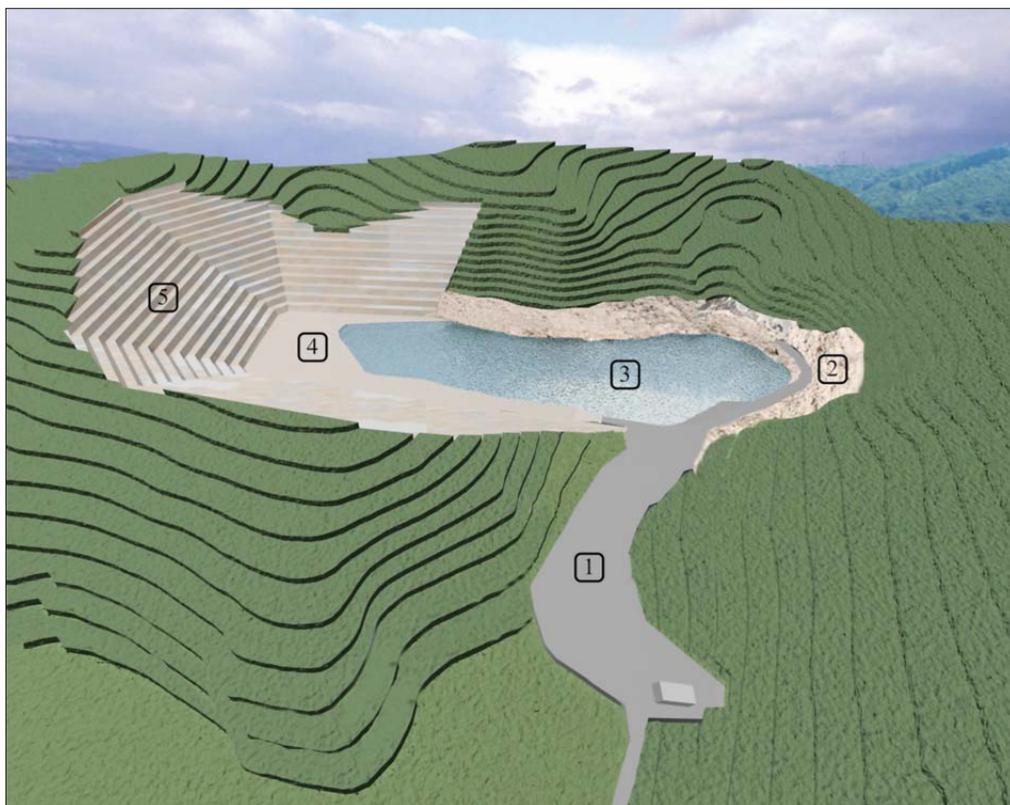


Figure 4—Outline of the contour and surroundings of the open pit mine after completion of the technical land reclamation (3D MODEL), (1)– mining plateau; (2) free climbing area; (3) lake; (4) beach; (5) amphitheater

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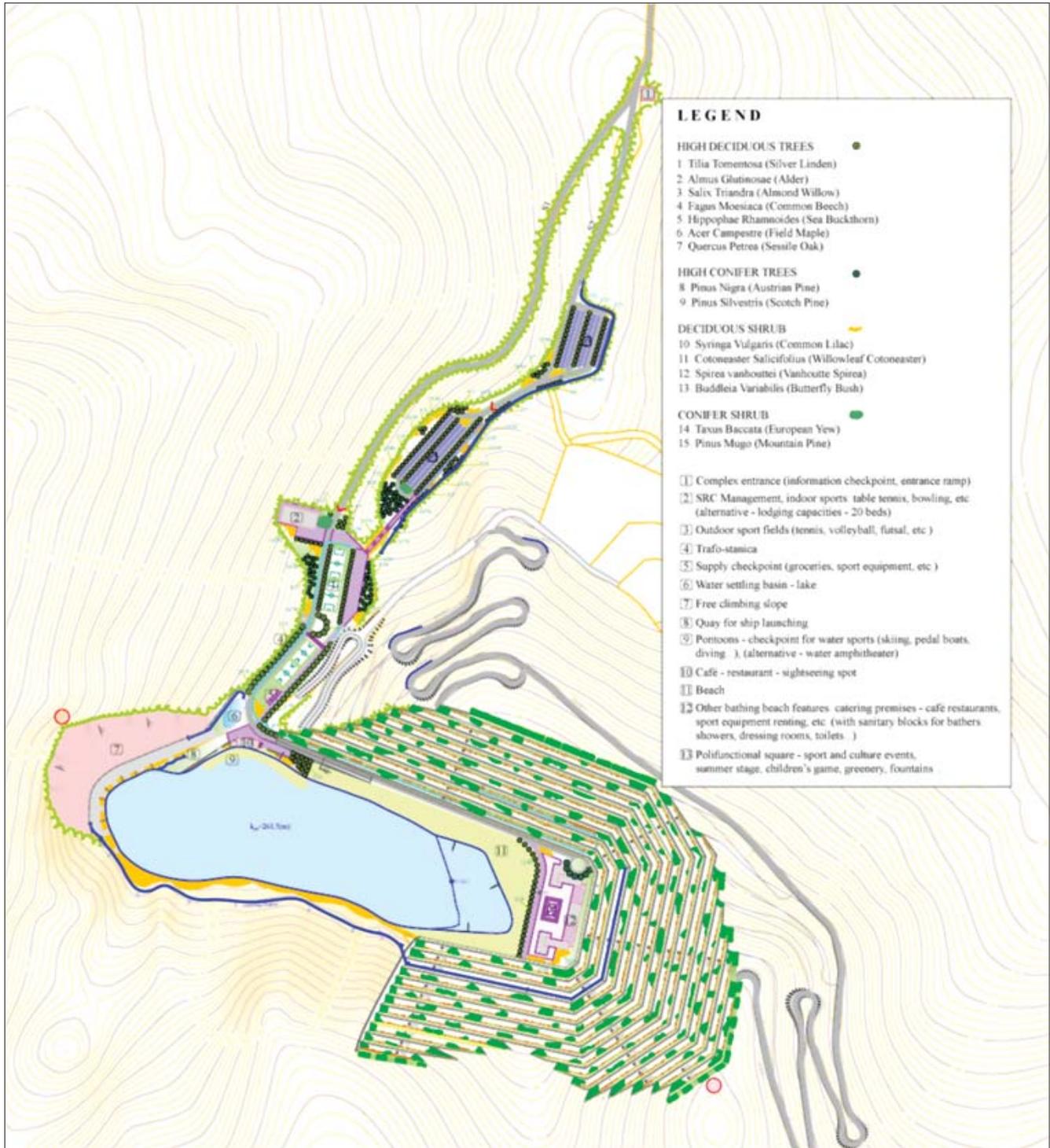


Figure 5—Plan of spatial arrangement and vegetation at the open pit mine and the mine plateau

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