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HEIDELBERGCEMENTGroup

INCREASING BIODIVERSITY IN ARU-LÕUNA LIMESTONE QUARRY BY RECLAMATION

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Abstract

This project describes reclamation of Aru-Lõuna limestone quarry. This quarry was opened in 1960s and mining is still in progress. Project started with proposal to participate in Quarry Life Award 2016. After successful first round it was necessary to focus more precisely on the objective and fieldworks were held to gain some important information. Based on collected data it was analysed where different ecosystems could be located. Main target was to create suitable living environment for sand martins by making different types of heaps for nesting. In addition, there will be lake, bog, fen, transitional bog, forest, meadow, grassland, beach, self recovering area to increase biodiversity. Furthermore, locals and tourists can spend their time with activities like swimming, diving, hiking, bird watching, fishing etc.

Keywords: reclamation, quarry, biodiversity, sand martin.

Introduction

This report is about restoring and increasing biodiversity in Aru-Lõuna limestone quarry by reclamation. In this report detailed description of different ecosystems and their location around Aru-Lõuna quarry is described.

Objectives

This project is focused on reclamation of Aru-Lõuna limestone quarry in a way that biodiversity will increase. Main objective was to be different from other reclamated quarries where the quarry is filled by water only. In our project we planned as many ecosystems around the quarry as possible. Another objective was to create an area for watersports and other leisure activities. Furthermore, by reclamation like described in this project the reputation of mining industry will improve.

Background information

Aru-Lõuna limestone quarry (317,34 ha) is located in Sõmeru parish, Lääne-Viru county. Quarry is situated about 8 km from Kunda city and around 12 km from Rakvere city. Aru-Lõuna limestone quarry was opened in 1960-s and in 1992 AS Kunda Nordic was founded, which is a part of HeidelbergCement Group.

Figure 1 Location

Limestone from the quarry is mined for producing cement and aggregate. Upper bench (10-15 m) of limestone is used for producing cement and lower bench (3-4 m) is used for aggregate production.

Limestone is extracted with drilling and blasting. Limestone for cement production is transported out of the quarry by train and crushed in factory, limestone for aggregate production is crushed to different fractions in crushing and screening plant, which is located inside quarry. Oversized limestone rocks are crushed by hydraulic hammer.

It is necessary to pump out water from the bottom of the quarry, in 2015 ~12,6 million m3 water was pumped out of the quarry. There are 5 pumps in pumping station, with productivity of 3050 m3/h. Pumping station is fully automatic, depending on water level the productivity of pumps varies.

Methods

We observed and analyzed sand martins (Riparia riparia) way of life and construction of their nests, because in Aru-Lõuna limestone quarry the population of sand martins is quite large. In our research we counted the number of nests in heaps, measured the inclination and the diameter of the nests.

Altitude data was also analyzed to figure out water level rise, with that we could decide where is the best location for each ecosystem.

Another observation was done in quarry to analyze the movement of wild animals. Game trail map made by local hunters was also studied and taken into consideration.

Results

As a result of several fieldworks and consultations initial plan had to be changed. To rise biological diversity we needed to relocate different ecosystems. Relocation was caused by lower water level that we had considered and KNC plan to extend the quarry from south-western side. For an example at first sand martins nesting area was planned exactly where KNC is expanding the quarry. Sand martins nesting site is now planned to be located on island, at first we did not consider that there will be an island when the quarry is filled with water. Island should be the perfect spot for sand martins because of the privacy. As we are mining engineers we did not consider the danger little animals would have if the bog would be placed next to the forest. It was brought to our attention that raptorials would have a perfect way to skulk their prey on top of the trees by the bog, because of that we changed the location of bog.

One of the field observations was focused to study sand martin nesting sites. According to our results sand martins can make at least 30 nests in square meter. Only active sand martin colony was located by the crushing and screening plant, inside 0-4 mm fraction heap. Clearly noise and machinery movement do not disturb sand martins. Sand martins nesting heaps were measured to get a inclination that they prefer. Results were that minimal inclination is 60 degrees, maximum inclination was 90 degrees. It should be said that the only active sand martin nesting colonies inclination was around 80-90 degrees. Sand martins prefer fresh heaps because in time heaps surface hardens, at first the heaps are more soft and it is easier to build nests into. Material of the heaps does not seem to matter, over the years, inside the quarry, they have built nests into different 0-4 mm fraction heaps like granite and limestone, also into sand, mud and gravel.

Figure 2 Sand martin nests

Driving around in the quarry we ran into trails of brown bear (Ursus arctos), grey wolf (Canis lupus) and roe (Capreolus capreolus). Trails were found by the border of the quarry.

Most reasonable location to build beach area is at quarries east side. Locations of different ecosystems are shown on drawing in annexes.

Discussion

After quarry is closed water level will rise to 46 m from the sea level, most of the quarry will be covered by water. Reclamation will be done mostly on the sides of the quarry.

Forest

Forest is planned because animals that live in the quarry can migrate to forest. Forest will be on northwestern and southern side of the quarry. To increase the biodiversity, there will be planted different species of trees: pine (Pinus sylvestris), spruce (Picea abies), birch (Betula), aspen (Populus tremula) and if possible then also rare species.

Meadow

Nowadays meadow is one of the smallest and most endangered ecosystems in the Northern Europe. Meadow is mowed grassland where a lot of trees grow. Traditionally tree branches

cover around 20-40% of meadows surface. It is one of the most important measurement that is needed to take into account when establishing a meadow. There are no dominant tree species, prime tree species are: oak (Quercus), ash (Fraxinus), white birch (Betula pendula) and maple (Acer). These species should be planted equally around meadow.

Flora richness is favoured by calcareous soil, which is characteristic to meadows in western Estonia. Calcareous rich soil is found also in Aru-Lõuna limestone quarry.

When establishing a meadow it is necessary to plant trees with appropriate frequency. It is necessary to cover the trees with protective cylinders so animals can not damage the trees. Plants, which are common in meadow, should be planted to ensure the flora richness in meadow. In Estonia there has been found over 600 vascular plants growing in meadows.

Grassland

As in Estonia the most common poaceae species in grassland are: cocksfoot (Dactylis glomerata), fescue (Festuca), ryegrass (Lolium perenne), timothy grass (Phleum pratense), reed canary grass (Phalaris arundinacea). Most common legume species are: bur clover (Medicago polymorpha), red clover (Trifolium pratense) and white clover (Trifolium repens). Biological diversity will rise when grassland is completed. As a food source grassland is beneficial for different animals. To create the grassland, it is necessary to cover limestone outcrop with overburden and soil for planting.

Bog

Bog is going to be located in the northeastern part of the quarry. To create a bog there has to be stable water level and pit in the soil which depth is at least 2,6 meters. The lowest layer of the bog is silt which isolates bog from limestone array. Silt has sufficient amount of clay that makes it impermeable layer and also it is easy to install. Cross-section of bog is shown on following table.

Table 1 Bog cross-section

Degree of humification	Decomposition	Thickness, cm
H1	None	10
H4	Slight	50
H6	Moderately strong	50
H7	Strong	100
Silt	-	50

From the bottom to the top the degree of humification is decreasing (von Post humification index). To ensure the self-evolving bog, it is essential to plant most common species that occur there. For an example peat moss (Sphagnum), hare's-tail cottongrass (Eriophorum vaginatum), wild rosemary (Rhododendron tomentosum), heather (Calluna vulgaris) and some scots pines (Pinus sylvestris). Also, bog pools will be created inside of the bog.

On the both sides of the bog there are transitional zones. Transitional zone consists of transitional bog and fen. In transitional bog there is peat with humification degree of H5 with thickness of 60 cm. In fen there is peat with humification degree of H5 with thickness of 20 cm.

To bring better overview of bog, lake and sand martin nesting area, bird-watching tower will be constructed between bog and lake.

Self recovering area

Self recovering area is planned to leave without reclamation after mining is completed. That way it can be compared with areas that have been restored. If there is a plan to expand the quarry to Aru-Lõuna II section then it would be area that will be mined anyway, so there would be no unnecessary work. The way nature self recovers can already be seen in Aru-Lõuna limestone quarry. [Annex 1]

Lake

It is inevitable to avoid water level rise, so there will be a large lake, which was taken into account on reclamation planning. Before the water pumps are dismantled it is essential that the slope of the quarry is in acceptable angle and that bottom is cleaned.

Cleaning up bottom of the lake starts with removing buildings and railway. After that there will be constructed limestone heaps for fish and water flora so they can adapt more easily.

Quarry will be filled with water in 2-3 years after water pumps have been stopped, which is calculated in Aru-Lõuna reclamation project.

Beach and diving platform for local people are planned to northeastern side of the quarry and hiking trail starts from the beach, which leads through bog to birdwatching tower. Also there will be constructed pier by the beach.

There is a separated area in the lake for the divers. Railway in quarry can be used to transport old train or tram inside the quarry. As there is oil shale industry nearby, it may be possible to get some old mining machines like haul trucks, bulldozers, excavators, drill rig etc. If possible then also build some buildings where divers can safely look into, that way there will be more to observe underwater.

Perfect example is Rummu quarry, which was filled with water without removing machines or buildings. Now it is very popular among tourists. People go there to sunbathe, swim, dive and much more. It attracts with its clear blue water, which is unique in Estonia.

Conclusions

In this project there is plan for 10 different ecosystems, which are distributed around whole quarry area. These ecosystems are: lake, bog, fen, transitional bog, grassland, meadow, beach, forest, self recovering area, sand martin nesting site. With these areas biodiversity is widely risen.

With creation of sand martin nesting site ornithologists can observe sand martin nesting habits. This is beneficial for creating sand martin nesting areas in the future.

Construction of the bog is a great example to create similar bogs in the future and researchers can observe the development of the bog to understand how human created bog will adapt in these conditions.

Whole reclamation area is going to attract tourists from all over the world, because there is going to be so many different ecosystems in such a small area. Besides swimming and hiking place, locals will benefit economically from this project.

Annexes

Annex 1 self recovering area in Lõuna-Aru limestone quarry

N
W
E
S

X=6593000
Y=640000
Y=642000
X=6592500

grassland
grassland
fen
transitional bog
bog
birdwatching tower
bog
transitional bog
fen
grassland
forest
forest
sand martin nesting site
diving platform
beach
recreation area
limestone heap
limestone heap
self recovering area
recreation area
Kunda
parking lot
pier
limestone heap
limestone heap
self recovering area
meadow
dive site
meadow
forest
forest
Uhtna

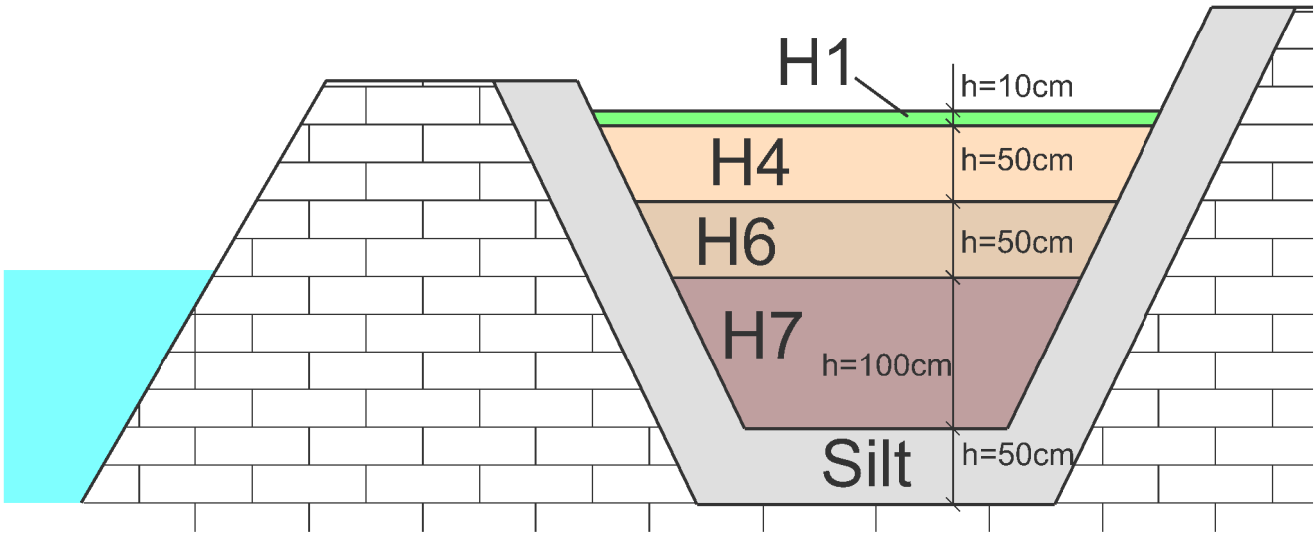
LEGEND:

- Reclamation area border
- Hicking trail
- Sectional line
- Beach
- Dive site
- Bog pool
- Ecosystem division line

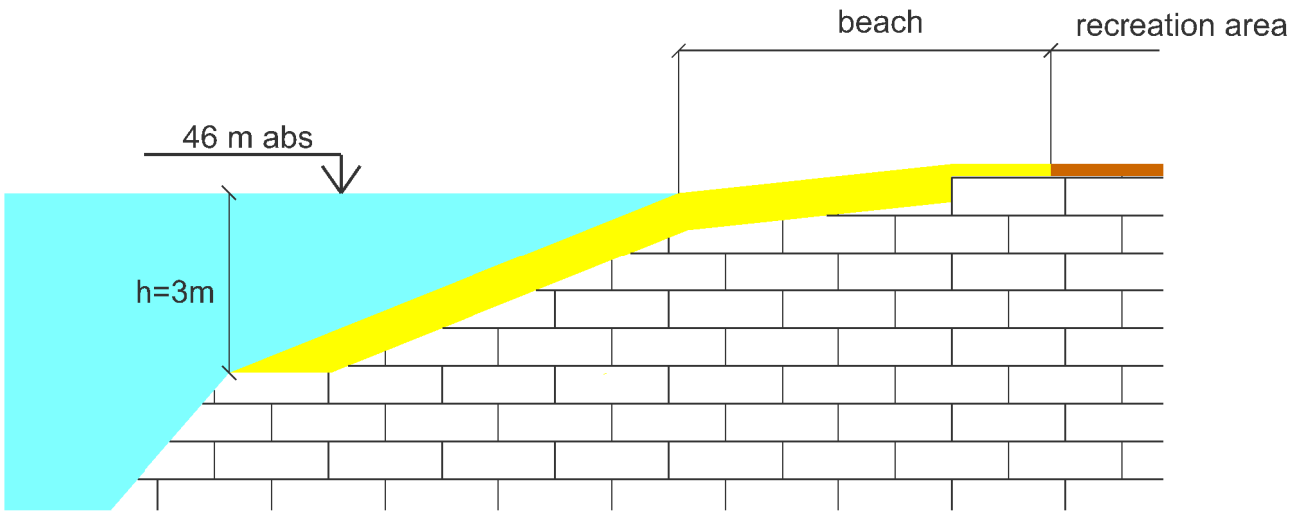
Coordinates are given in L-EST 97 coordinate system

Estonia Lääne-Viru County Sõmeru Parish Aru-Lõuna limestone quarry	Graphical annex nr 1
Quarry Life Award	Scale: 1: 5000
Sander Kanter Janno Lumiste Joosep Makke Carl-Richard Saks	Estonian basemap nr: 6434

Section I-I'



Section II-II'



Not in scale!

Estonia Lääne-Viru County Sõmeru Parish Aru-Lõuna limestone quarry	SECTIONS I-I', II-II'	Figure 1