REVITALISATION OF DRAINED FOREST AREA

Jana Marková, Petr Pelikán
Department of Landscape Management, Faculty of Forestry and Wood Technology, Mendel University in Brno, Zemědělská 3, 613 00 Brno, Czechia

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Abstract
The article deals with a possible way of revitalisation of the drainage system established in the past in the locality "Křížovna" in the cadastral area of Čejkov in the Vysočina region. The area is located at an altitude of 649 - 657 m above sea level, the affected area is 1.33 ha and has the character of a spring area. Currently, there is a mixed forest with a predominance of conifers of approximately 50 - 100 years of age. In the past, the site was drained by a system of ditches which were connected to a sunken unnamed stream. In the context of ongoing climate change, the drainage system has lost its purpose. It is desirable to retain water rather than to facilitate its accelerated runoff. Revitalisation measures of a purely natural manners have been implemented using local materials. Simple types of measures have been used to create, among other things, pools, loosened flow paths, cross dams, etc. The text describes the individual types of solutions. In the design process, the individual measures were sensitively chosen so as to minimise interference with mature vegetation. The technical element was the implementation of a ford on the existing logging road and the reconstruction of a culvert under the forest road. The revitalisation measures aim to initiate naturalisation processes both in the stream bed and in the ditches.

Key words: Drainage, ditch, pool, ford

Introduction

The drive for intensive farming has not escaped forest complexes in the past. In order to be able to plant economic forest in the form of a predominantly spruce monoculture, some areas had to be intensively drained. In the area in question, a network of drainage ditches was built, connected to a nameless stream whose bed was straightened and deepened. The single network was easy to maintain (cleaning the channel of sediment), drained rainwater more quickly and lowered the water table.
In the context of the climate change we are facing today, the emphasis is on retaining water in the landscape and slowing down the flow of rainwater. The revitalisation of sites where drainage on forest land has been carried out in the past is therefore very topical.

Materials and methods

The area is located in the district of Pelhřimov, west of the village of Čejkov, in an undeveloped area at an altitude of 649 - 657 m above sea level (Křížovka forest complex, GPS localization: 49.376 N,15.310 E). The area affected by the project (1.33 ha) has the character of a spring area in which a network of sunken, straight drainage ditches has been built in the forest complex. An unnamed left sided tributary of the Nemojovský stream flows through the area and is the subject of revitalisation measures together with the drainage network. The stream itself is straightened and deepened. At present, there is a mixed forest with a predominance of conifers of approximately 50 to 100 years of age (*Picea abies*, *Abies alba*, *Fagus sylvatica*, *Alnus glutinosa*, *Betula alba*). The stand is accessible via the forest transport network - forest road 2L Do Křížovky, logging roads and extraction racks. On the transport network there are necessary elements of transverse drainage - concrete and steel pipe culverts without headwalls.

Hydrology

The territory is located in the Vltava river basin, sub-basin of the IV. category of the ČHP 1-09-02-011. The watercourse affected by the project is an unnamed watercourse (IDVT 10256758), LP Nemojovský stream. The revitalisation measures are situated in the source area (approx. river km 1.375-1.740 according to the existing stationing), where the construction works were realized in the forest complex in the past – excavation of a network of sunken, straight drainage ditches. The site suffers from accelerated surface runoff from the source area. At stationing r.km 1.475, the unnamed stream is crossed by a forest road and a non-capacitated pipe culvert in poor technical condition, carried through the earthen road body. The administrator of the affected section of the watercourse is the Lesy ČR s.p. organization.

Results

The purpose of the proposed measures is to modify the water regime of the site in the form of simple terrain modifications with the aim of slowing down the surface water runoff through the existing network of sunken drainage ditches with accompanying effects (increasing the retention capacity and ecological stability of the landscape, restoring the diversity of biotopes and increasing the biodiversity of the site).

On the unnamed stream in the stationing km 1.375 - 1.740, controlled renaturation will take place in the approximate length of 450 m (Fig. 1) - adjustment of the parameters of the sunken channel, restoration and creation of nature-like shapes and natural functions.

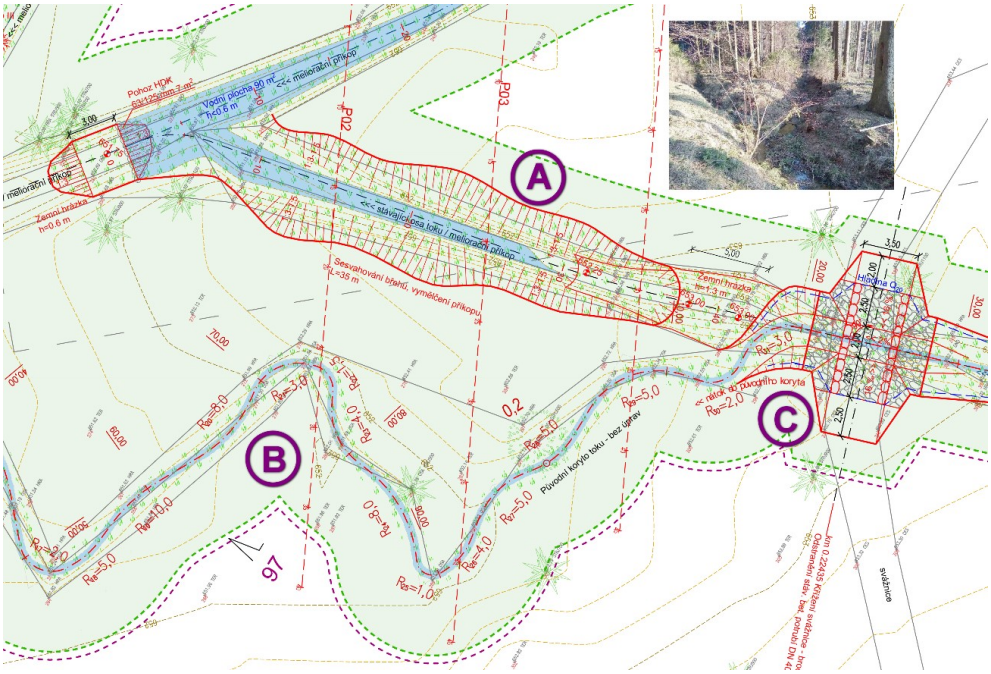

Fig. 1: The part of the project situation plan: A - revitalisation of drainage ditches; B - stream original alignment support; C - rockfill ford

The aim of the proposed routing solution is to return the channel to its original alignment, which is still visible in the terrain. The proposed alignment is characterised by its irregularity, with alternating counter-curves of small radii that follow the original trace and local depressions. The existing bed of the stream channel will be raised by sloping the steep side slopes to create a shallow natural channel with irregularly alternating slopes with maximum slopes of 1:3 - 1:5 or less. Grading and earthworks will not be carried out along the entire length, but only in sections, locally.

In the sections following the original alignment, i.e. outside the current channel, these shallow depressions of variable widths of 0.5 - 1.5 m will only be stripped of organic matter with a thickness of 0.10 - 0.15 m. Due to the nature of the expected revitalisation effects, manual execution is recommended in these sections (Fig. 2).

At the point where the proposed alignment diverges from the existing deepened channel, a dike will be created or filled with surplus soil in a length of at least 5 m, in order to prevent preferential flow of water through the deepened channel and, on the contrary, to direct the flow into the original shallow channel.

By modifying the directional design, the resulting route will be lengthened and the longitudinal slope of the bottom will be reduced, which has a positive effect on the water regime of the site - slowing down the runoff and increasing the retention capacity of the area, restoring natural hydrological processes.

Revitalisation measures on the network of drainage ditches in the scope of the construction include their local widening and raising of the bottom - partial or full backfilling with soil together with the insertion of stumps into the existing channel. Excess soil will be deposited, resulting from the modification of the transverse profile of the ditches (reducing the slope of the steep side slopes), or by excavating pools in local depressions. In total, approximately 200 m of the drainage ditches will be rehabilitated, which will have the character of shallow depressions or their flow profile will be filled in completely.

At the crossing point of the watercourse with the forest road 2L Do Křížovky (stationing km 1.475), the road will be excavated there and the existing concrete pipe culvert will be reconstructed, since the

technical condition and parameters do not comply with ČSN 73 6108 Forest road network. A pipe culvert will be built with a flow capacity of Q_{20} according to the applicable related regulations (dimensioned according to hydrological data of the Czech Hydrological Institute).
At the river km 1.550, the non-functional concrete pipe culvert on the existing logging road will be removed. A ford was proposed at the stream crossing, constructed as a rockfill with erosion resistant aprons (rockfill).

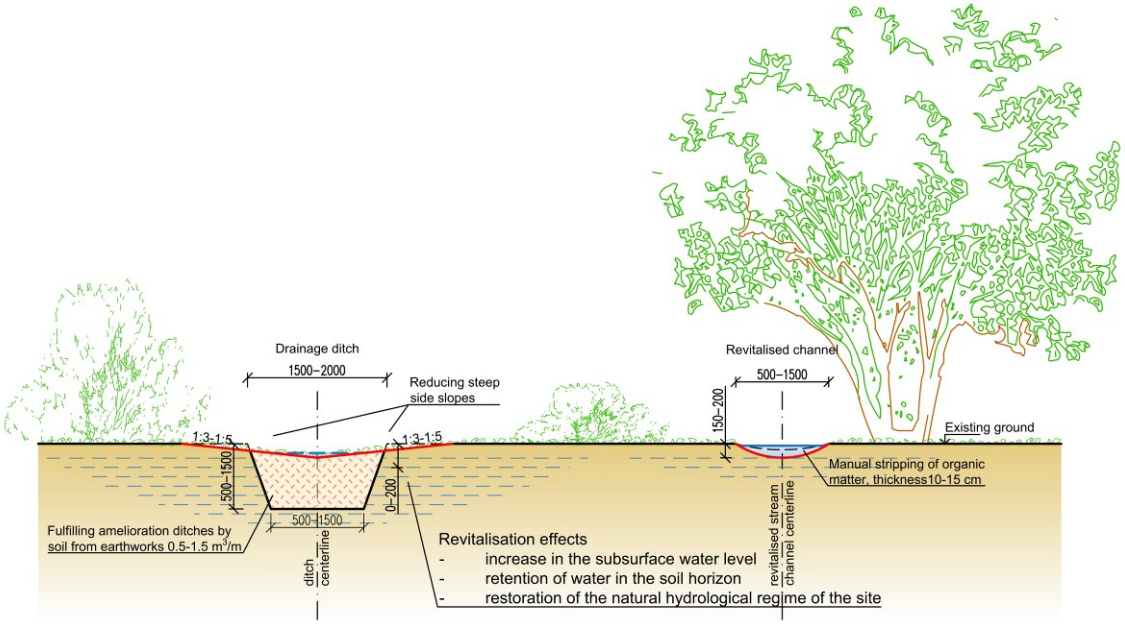

Fig. 2: The sample cross-section of selected revitalisation measures – the technical solution

Discussion
It is still very important to remind the public, both professional and non-professional, the important role ameliorations play in our now predominantly cultural landscape. Even today, there are places where we cannot operate economic activities without these measures. Ameliorations include drainage, irrigation, erosion control measures, damming of torrents and gullies, etc.
However, there are places where these structures have lost their significance and, in the light of today's climate changes, their function. Today's landscape management is no longer focused on 'yield' alone, but seeks to preserve the natural functions of the landscape as part of sustainable management development. Thus, even on some forest land, the revitalisation of amelioration systems is realized.
Even today, in a number of places, it is appropriate to make use of amelioration measures. But it doesn't always have to be technical solutions like in the past. Forestry ameliorations are intended to improve habitat conditions, particularly by applying the reclamation function of suitable forest trees and stands. This includes all types of protective afforestation, the establishment of buffer strips and the greening of buildings and settlements. Forest ameliorations also include the adjustment of the water and air regime on temporarily and especially permanently waterlogged forest soils. Drainage is an organic part of purpose-built forestry structures and the forest transport network.

Conclusion
The purpose of the proposed measures is to modify the water regime of the site in the form of simple terrain modifications with the aim of slowing down the surface water runoff through the existing network of sunken drainage ditches with accompanying effects (increasing the retention capacity and ecological stability of the landscape, restoring the diversity of biotopes and increasing the biodiversity of the site). In the stream channel, the parameters of the deepened and straightened channel will be adjusted in the approximate length of 450 m, restoring and creating nature-like shapes and natural functions. The aim of the proposed routing solution is to return the channel to its original alignment, which is still visible in the terrain.
The revitalisation measures on the network of drainage ditches in the scope of the construction consist of their local widening and raising of the bottom - partial to full backfilling with soil together with the insertion of stumps into the existing channel. Redundant soil from the modification of the transverse

profile of the ditches (reducing the slope of the steep side slopes) or by excavating pools in local depressions will be deposited in the deepened network of ditches. In total, approximately 200 m of the drainage ditches will be rehabilitated, which will have the character of shallow depressions or their flow profile will be filled in completely. Grading and earthworks will not be carried out along the entire length, but only in sections, locally.

References

Culek, M., et al. (2005). Biogeographic zonation of the Czech Republic, Part II. Edition 1. Prague: AOPK ČR, 2005. 590 p., 1 CD. ISBN 80-86064-82-4.
Pelikán, P., Marková, J. (2022). Revitalisation of the water regime of forest soils – Křížovna. Project documentation for a building permit, 2022.
Quitt, E. (1971). Climatic regions of Czechoslovakia. Prague, Academia, 1971. Studia geographica, 16.
Act No. 183/2006 Coll., on spatial planning and building code (Building Act)
Act No. 254/2001 Coll., on water and on amendments to certain acts (Water Act)
Act No. 541/2020 Coll., on waste
Decree No. 146/2008 Coll., on the scope and content of project documentation for transport structures
Decree No. 239/2017 Coll., on technical requirements for constructions for the performance of forest functions
Decree No. 499/2006 Coll., on construction documentation
ČSN 73 6108 Forest road network
https://www.mezistromy.cz/slovnik/meliorace

Souhrn

Řešená lokalita nedaleko obce Čejkov v okrese Pehřimov, má charakter pramenné oblasti, ve které byla v lesním komplexu zbudována síť zahloubených, napřímených odvodňovacích příkopů. Územím protéká bezejmenný levostranný přítok Nemojovského potoka, který je spolu s meliorační sítí předmětem revitalizačních opatření.
Účelem navržených opatření je úprava vodního režimu lokality formou jednoduchých terénních úprav s cílem zpomalení povrchového odtoku vody stávající sítí zahloubených odvodňovacích příkopů s doprovodnými efekty (zvýšení retenční schopnosti a ekologické stability krajiny, obnova rozmanitosti biotopů a zvýšení biodiverzity lokality). Na bezejmenném toku proběhne v přibližné délce 450 m úprava parametrů zahloubeného koryta, obnova a tvorba přírodě blízkých tvarů a přirozených funkcí. Cílem navrženého směrového řešení je návrat koryta do své původní trati, která je v terénu stále patrná.
Revitalizační opatření na síti melioračních příkopů v rozsahu stavby představuje jejich lokální rozšíření a zvýšení dna – částečný až úplný zásyp zeminou spolu s vložením pařezů do stávajícího koryta. Uložena bude přebytečná zemina, vzniklá úpravou příčného profilu příkopů (zmírnění sklonu bočních svahů), případně hloubením tůní v lokálních depresích. Celkově bude sanováno cca 200 m melioračních příkopů, které budou mít charakter mělkých průlehů, případně bude jejich průtočný profil vyplněn zcela. Terénní úpravy a zemní práce nebudou prováděny v celé délce, ale pouze úsekově, lokálně.
V kontextu klimatických změn, kterým jsme dnes vystaveni, je kladen důraz na zadržování vody v krajině a zpomalení odtoku srážkových vod. Revitalizace lokalit, kde bylo v minulosti provedeno odvodnění na lesních půdách je tedy velmi aktuální.

Contact:
Ing. Jana Marková, Ph.D.
E-mail: jana.markova@mendelu.cz