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Effectiveness of water protection structures in forest drainage system: two years after construction

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Maintenance and renovation of the drainage network is carried out to ensure the functionality of the drainage system – to preserve high-quality forest stands, as well as provide safe access to forest resources. Nevertheless, the water quality of related waterbodies may be affected because of erosion during drainage network maintenance (DNM) operations. Therefore, water protection structures should be used to limit potentially negative effects by reducing the water flow velocity and minimizing the amount of eroded material and plant nutrients exiting a system.

This study was carried out in Latvia, in experimental forests of the Kalsnava Forest district in a catchment with dense drainage ditch network dominated by drained peatland forests. The effectiveness of two custom water protection structures – a peak flow control (PFC) structure and a sedimentation pond (SP) constructed during DNM was tested for two years. The catchment area of the forest drainage system is 791.3 ha.

Structures were built from August 2020 to January 2021 with sizes corresponding to related catchment size before proceeding with DNM operations upstream. pH, dissolved organic carbon, nitrate nitrogen, ammonium nitrogen, total nitrogen, phosphate phosphorus, total phosphorus and total suspended solids were measured in monthly water samples above and below the water protection structures.

Initial results when DNM was finished with six-month observation period revealed 65% mean effectiveness for the PFC (Klavina & Klavins 2021) and 68% mean effectiveness for the SP in reducing total suspended solids concentrations. Two years after the construction of the structures the mean effectiveness averaged to 61% for the PFC and 62% for the SP. Furthermore, PFC reduced dissolved organic carbon concentrations by 10% and total nitrogen by 4% on average. Looking at the study years separately, during the second year of observations mean effectiveness in detaining total suspended solids concentration was 25%, dissolved organic carbon – 26%, total nitrogen – 13% and phosphate phosphorus – 6% for the PFC; total suspended solids – 64%, total nitrogen – 1% and total phosphorus – 2% for the SP.

Both tested structures performed well during DNM detaining majority of total suspended solids from exiting the drainage system. During the second year of observations the PFC showed considerable effectiveness to detain dissolved organic carbon, total nitrogen and phosphate phosphorus. Although, concentrations of nitrogen and phosphorus compounds were generally low during all observation period. Observations are being continued to further investigate effectiveness of the structures.

References

Klavina, Z. & Klavins, I. (2021). Solutions and effectiveness of water protection structures in forest drainage system maintenance: examples from Latvia. Proceedings of the 10th International Scientific Conference Rural Development 2021: Challenges for Sustainable Bioeconomy and Climate Change. <http://doi.org/10.15544/RD.2021.017>

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