The influence of channel network silting up at Žitný Ostrov to range of interaction between surface and groundwater in this area

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Introduction

The movement of water resources, especially the possibilities its regulation by interaction between surface and groundwater are the subject matter of attention particularly during the occurrence of extreme hydrologic situation. This contribution presents the results which were achieved at IH SAS in this question. It can show the ways how to optimalize the adjudicated processes which emerge during requirement of emergency intervention. Žitný Ostrov (ŽO) is the area between the Danube River and the Small Danube. Its average slope is only about $2{,}5.10^{-4}$ and it was reason for building a channel network here. This channel network was built up for drainage and to safeguard irrigation water, too. The water level in the whole channel network system has effect to groundwater level on the ŽO and in reverse. It was been necessary to judge the impact of channel network silting up by bed silts on the interaction between channel network and groundwater on the ŽO. Aim of this work was to evaluate the changes of bed silt state of ŽO channel network and consecutively their influence on interaction processes between groundwater and surface water along the channels in the period from 1993 to 2016.

Materials and methods

In 1993 the initial measurements of bed silt thickness in ŽO channel network started. Then in 2004 these measurements continued at selected profiles of three main channels – Gabčíkovo-Topoľníky (G-T), Chotárny (CH) and Komárňanský (K) channel. From 2008 to 2016 the detailed field measurements of cross-section profiles aggradations along these three channels continued. The objective of detailed field measurements was the determination of the silt permeability, which is expressed by parameter of saturated hydraulic conductivity (SHC). This parameter was determined by two ways – as SHC from disturbed samples of silt - K_p and as SHC from undisturbed samples - K_n. In the first case the granularity of silts was determined initially and then was computed their K_p according Bayer-Schweiger and Spacek formulas. From undisturbed samples were determined the values K_n by the laboratory falling head method. Simultaneously was judged the bed silts impact on the groundwater recharge. Determination of the total recharge amount was done by a numerical simulation (model SKOKY) and by the so-called method of interaction formulas, both approaches were applied at ŽO channel network. The field measurements were performed in monitored three main channels and adjacent to obtain correct input data. These characteristics SHC - K_p and K_n were used for simulation and computation of total recharge along these channels. The total recharge amount was calculated for 4 alternatives of the surface water levels in the channel and the surroundings groundwater respectively. We chose four simplified variants with the same geological conditions in surroundings area of channels, only water level of groundwater and in channels were modified – Fig. 1.

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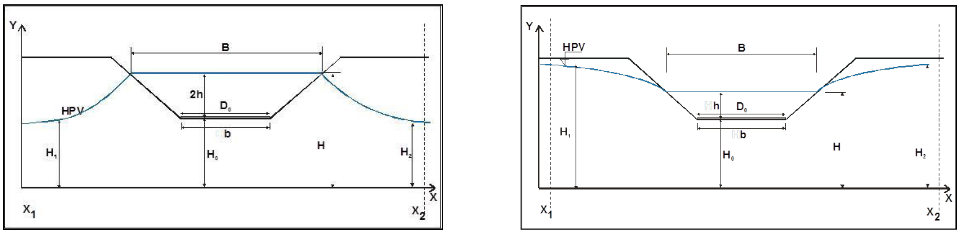

Figure 1: The alternative of outflow from channel to surroundings (left) and inflow from surroundings to channel (right) - used for simulation of total recharge

Results and discussion

The results of silting up measurements at selected channels are demonstrated on Fig. 2.

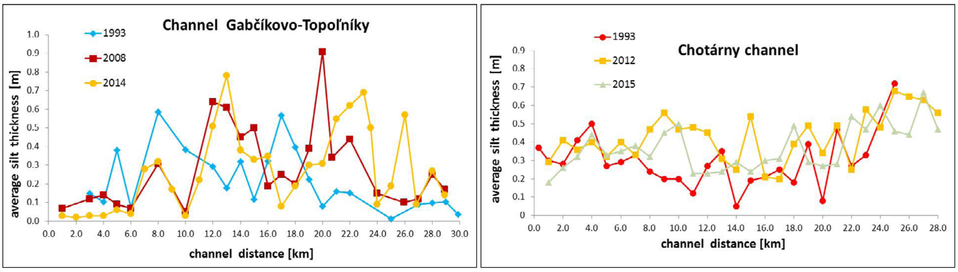

Figure 2: Comparison of average silt thickness in monitored period. at channel G-T and Chotárny channel

On K channel also was observed increased trend of silting up during whole monitored period 1993 to 2016. The presumed linear increasing of silting up did not confirmed. In generally the channel network aggradation gradually enlarged (excepting local parts in which the purification was carried on) and the silt thicknesses increased. The valid values K_p on G-T channel ranged from 4,33 10^{-7} to 4,46.10^{-5} m.s^{-1}, on CH channel from 5,98.10^{-05} to 2,14.10^{-06} m.s^{-1} and on K channel fluctuated from 1,92.10^{-06} – 6,09.10^{-05} m.s^{-1}. The valid values K_n on CH channel ranged from 8,54.10^{-08} – 2,7.10^{-04} m.s^{-1}, on K channel these values fluctuated from 4,72.10^{-07} – 1,26.10^{-05} m.s^{-1}.

Conclusions

The results of the simulations and computation of total recharge along these channels seem to show greater impact of the silt in the case of outflow from the channels to the surroundings than the inflow into the channel from the surroundings.

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