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Seepage loss from unlined, lined, and cracked-lined canals: a case study of Ismailia canal reach from 28.00–49.00 Km, Egypt

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Water resources face global and local challenges. In Egypt, for example, the negative impacts of climatic changes and the Grand Ethiopian Renaissance Dam (GERD), cause a shortage of water resources. Shortage of water resources is considered an urgent issue particularly in semiarid regions (like many MENA countries) and arid ones (like Egypt). Therefore, the Egyptian Ministry of Water Resources and Irrigation has launched the national project of canals rehabilitation and lining for effective water resource management and decreasing seepage losses. This study dealt with three different lining techniques, as well cracked-liner for the Ismailia canal, which is considered the largest end of the Nile in Egypt. A steady-state 2-D seep/w model was established for the Ismailia canal section, at the stretch from 28 to 49 km. The results showed that the amount of seepage was considerably depending on the hydraulic characteristics of the lining material. Pumping from aquifers through wells also has a significant influence on the seepage rate from the unlined canal. Nevertheless, a negligible effect was present in the lined canal case. The highest efficiency was obtained with the concrete liner, after that the geomembrane liner, and then the bentonite liner; with nearly 99%, 96%, and 54%, respectively, in the case of no pumping from aquifer via wells. The efficiency decreased by 4% for the bentonite and geomembrane liners during pumping from the aquifer, but the concrete liner efficiency did not change significantly. However, in the case of deterioration of the lining material through cracks, the efficiency strictly decreased to 25%, irrespective of the utilized lining technique. The dual effect of both cracked-liner material and extraction from the aquifer via pumping wells revealed an efficiency of 16%, regardless of the utilized liner type.