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## **Effects of vegetation density and wetland aspect ratio variation on hydraulic efficiency of wetlands**

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### **ABSTRACT**

Hydraulic efficiency of wetlands, evaluated through retention time and mixing levels, was investigated as a function of wetland shape and vegetation density using a two-dimensional numerical model. The numerical model was applied to four different aspect ratios of a rectangular wetland (i.e. 1:1 to 1:4) with 1-hectare area and vegetation density varying from 20 to 1500 stems/m<sup>2</sup>. The results, modeled velocity field and the simulated transport of a continuously injected tracer, were used to develop Residence Time Distribution graphs (RTDs). Analysis of RTDs showed that the efficiency measure related to retention time,  $e$ , and the measure of mixing,  $\lambda_p$ , improved for denser vegetation before reaching to a constant value. It was also observed that narrow rectangular-shaped wetlands (higher aspect ratio) have better efficiency than square wetlands. The results from the study provide a quantitative understanding of hydraulic efficiency in connection with wetland vegetation and shape which may help engineers to design more efficient and cost-effective water systems.