Abstract

- VFDM is based on a spatial segmentation of the watershed provided by PHYSITEL [5,9].
- Watershed hydrological processes are simulated by HYDROTEL [4,7–8].
- Dimensions of VFMs calculated takes into account vegetation density, flow conditions and sediment characteristics.
- The model is based on Deletic's filtration equation[2].

Model Theory and Concepts

- Filter trapping efficiency depends on parameters like VF characteristics such as width and slope, vegetation height, vegetation density, species composition; (ii) flow characteristics such as runoff velocity, discharge volume, water height; and (iii) sediment characteristics such as particle size, aggregation, and concentration.

Introduction

- Vegetated filters (VFMs) reduce losses of sediments, pesticides, and nutrients from cropland to surface water bodies.
- Vegetation at the downstream edge of disturbed areas may effectively reduce runoff volume and velocity, initially because of increasing hydraulic roughness, and subsequently by enhancing water infiltration. Decreasing flow volume and velocity lead to sediment deposition in the vegetative filter (VF) as a result of reducing the transport capacity of runoff.
- Governing policies and regulations may include dimension and location of VFMs and/or a cropland percentage that needs to be converted into VF areas. The main objective of this paper is to describe the development of a mathematical model to determine the optimal dimensions of riparian vegetated filter strips (RVSs) in agricultural watersheds. The model calculates the optimal width with respect to vegetation, topographical, hydrological and sedimentological characteristics. Future work will involve linking the model to an economics model in order to evaluate the effectiveness of RVFs with respect to both water quality and economic objectives.

VFDM Equations and Algorithm

The behavior of the vegetative filters modeled in VFDM was derived from flume experiments performed by Deletic [1]. Deletic and Fletcher [3].

\[ T = \frac{N_f V_f}{V_s} \]

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Flow concentration diminishes effectiveness of VFMs by increasing water depth and flow velocity; hence, the width needs to be increased to maintain the same filtration efficiency.

Schematic Algorithm

Potential types of flow: either sheet (uniform), converging or diverging flow

VFDM Results

- Model Application

- VFDM is coupled with the Virtual Watershed model that can be showed in a spatially distributed way.
- The input VF widths are classified by color and their depth is given for different virtual watersheds. The result of simulation is that a 10-year simulated VFDM hydrology was used to perform this test.

References

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3. Adapted from Deletic A., Fletcher T.D. 2006. Performance of grass filters used for stormwater treatment - a field and modelling study.