Report for 2003AR48B: Development of techniques for identifying and linking physical characteristics to surface runoff source areas

There are no reported publications resulting from this project.

Report Follows

PROBLEMS AND RESEARCH OBJECTIVES

Runoff contributing to the transport of nonpoint source pollution is highly nonlinear and spatially variable, involving surface and subsurface pathways (Hoover, 1990). Runoff originating from landscape is spatially and temporally variable and is a function of rainfall intensity and duration antecedent soil moisture conditions, soils, topography, and groundwater levels (Wolock, 1993; Wood et al., 1990). Freeze (1974) reported that spatially variable runoff originates from small but consistent portions of upstream areas that constitute less than 10% (usually 1-3%) of the watershed area, and even on these areas, only 10-30% of the rainfall causes overland flow. The areas that do contribute to the runoff and potentially nonpoint source pollution are called 'runoff contributing areas' or 'runoff-source areas.'

Although the runoff-source areas concept is not a new one, minimal research has been conducted towards integrating the idea into current nonpoint source pollution management techniques. In particular, this concept has not been integrating into watershed computer models that predict constituent inputs based on terrestrial management. This limits modeling accuracy and increases uncertainty in modeling results; which can be crucial when managing a specific constituent that is highly correlated with surface runoff. This project is a step in developing the knowledge needed to predict runoff-source areas as a function of soil, topographical, and hydrological characteristics.

The project objectives are to 1.) develop and test a field-scale methodology to measure the location of different runoff-source areas from pastureland and 2.) related the spatial variability of field runoff to soil, topographical, and hydrological characteristics.

METHODOLOGY

The objectives are accomplished through field data collection, GIS analysis, and statistical evaluations. Twenty subsurface saturation sensors, twenty surface runoff sensors, and a rain gage are installed on a 0.25 ha plot at Savoy Experimental Watershed located in Ozark Highlands. Sensors are connected to a series of multiplexors and CR-21X data loggers (Campbell Scientific, Inc.) for real time data collection. To obtain initial moisture content of the soil, a hand held soil moisture probe is used to measure initial moisture content at each subsurface sensor prior to rainfall events. These results are used to calibrate and interpret the data collected from the subsurface sensors. Soil moisture information, runoff sensors, and rain gage data will be used to interpret runoff source areas. We will link this hydrologic information to measured topographic (percent slope, shape, and direction) and soil characteristics data (hydraulic conductivity, bulk density, depth of soil, antecedent soil moisture) to develop relationships between the spatial variability of field runoff and topographic and soil characteristics. A GIS system will be used to derive the relationship among spatial physical date (e.g., topography, surface management, slope), antecedent soil moisture conditions, and runoff-contributing areas. Since pasture is the only land use type in the field, land use will not be treated as an independent variable in predicting runoff-source areas. Geostatistical techniques (Chiles and Delfiner, 1999) will be used to quantify spatial variability in topographic index and soil properties and to correlate it to spatial varability of runoff-source areas.

PRINCIPAL FINDINGS AND SIGNIFICANCE

We have collected preliminary runoff data. The data analyses is currently underway for this project. The results should be available by December, 2004.