CSREES National Water Quality Program

Title: A watershed model to compare alternative phosphorus control strategies.

Name: Nancy Mesner **Email:** nancy.mesner@usu.edu

Organization: Utah State University

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Theme: Watershed Management

Situation: One of the challenges of watershed managers is to apply the limited funding available in ways that most effectively improve water quality. In a watershed with complex land uses and multiple impacts, we need to understand the long-term responses of the entire system to alternative pollutant reduction strategies. The Beaver Watershed phosphorus model predicts annual average phosphorus outputs and allows decision makers and landowners to compare the long-term effectiveness of alternative phosphorus reduction strategies.

Objectives: The objectives of the project were to: 1. model annual fluxes of phosphorus within and between different land use areas of the Beaver River (Utah) watershed to predict long term changes in phosphorus loading to the river; 2. use the model to compare the phosphorus reduction potential of different management strategies, such as the types, timing and targeted land uses of implementation projects; and 3. evaluate the usefulness of this model as a planning tool for other western watersheds.

Methods: We used STELLA 5.1.1 programming software to modify a dynamic simulation model developed by Cassell, Kort and Braun (1998) for a small eastern watershed. Modifications to the model reflected the watershed characteristics, hydrology and land uses of the Beaver River watershed, located in central Utah. We populated and calibrated the model with data collected for a Coordinated Resource Management Plan and a TMDL study of the watershed. Alternative management scenarios for comparative model runs were obtained from the partner agencies and the Beaver technical advisory committee.

Partnerships: This project was a response to interest by NRCS and Utah DWQ on the usefulness of this modeling approach to western landscapes. Model inputs and feedback were provided by all the resource agencies involved in the watershed, local Extension agents and private landowners.

Research: The model was developed, parameterized and calibrated as an undergraduate research project. Further model runs and sensitivity analyses indicate that this model is applicable to western landscapes. At a practical level, watershed managers can query the model to evaluate different restoration strategies. These results will be shared with landowners and stakeholders to help demonstrate the long-term consequences of water quality implementations. In addition, the addition of a user interface to the model will allow it to be more easily modified and applied in other watersheds.

Resources: The project was funded through EPA 319 project funds and CSREES Water Quality Programs funding, with match in time and in-kind support from USU Extension, and the different partner agencies including NRCS, UDWQ, USFS, BLM and conservation districts.

Results: Outputs from this project include model outputs that compare different long-term restoration strategies and emphases, and help evaluate phosphorus movement and response within specific sectors of the watershed. In addition, the model can be modified for use as a planning tool in other western watersheds. Long-term outcomes should be more effective management of watersheds for phosphorus reduction, a better understanding by watershed managers and the public on how our land uses affect downstream water quality, and ultimately improved water quality in the Beaver River.