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Questions Addressed with Single-Discipline Simulation Models

In the previous chapters, traditions in hydrology and ecology were introduced and associated with sample simulation models developed out of those traditions. This chapter takes a more management-centric view and approaches models from sample management decisions and questions. Each section is introduced with a small number of representative questions and decisions, and then identifies how simulation modeling can be effective in addressing those management needs. You are encouraged to extend the issues posed with issues that might currently concern you and then develop solutions that might be afforded by the models presented in this book.

5.1 Questions Addressed by Surface Water Erosion and Pollution Models

Sample management questions/concerns:

- How are my land management patterns and practices related to stream hydrographs in severe storms?
- What water quality is expected downstream as a result of my land management practices and patterns?
- If we rezone to allow a particular land management practice, what will be the consequences to surface water, groundwater, and downstream water quality?
- How can I plant grasses in a field to get the maximum decrease in expected sediment downstream?

Local watershed management groups can come into existence as a result of these types of concerns. Individuals and businesses located near a stream or river are concerned with the flooding potentials that change as a result of upstream land management. Those who make use of the water in those streams for drinking or recreation are concerned with upstream deposits of chemicals and nutrients that might degrade the water quality. The types of
questions posed here are readily addressed by existing water simulation models. Some of those models are identified below, but they do not exhaust the growing list of possibilities.

Erosion associated with agricultural practices has been responsible for the development of a large number of computer software–based modeling and simulation products. They seek to predict erosion based on current or expected land management (cropping) practices. A number of software products have been developed to evaluate alternative land management practices at the level of a farm field. The Water Erosion Prediction Project (WEPP) run under DOS and Windows 95, 98, and NT environments. Its spatially explicit input requirements include topography, crop management, storm characteristics, and soils. WEPP generates erosion and deposition predictions associated with sheet, rill, and water channel processes at the level of a field. Simulation of Water Erosion (SIMWE) uses similar inputs and computes the spatial distribution of flow, erosion, and sedimentation rates during a steady rain. It runs in a number of computer hardware and operating system environments and is useful for optimizing land-use patterns for minimizing erosion and deposition problems. Chemicals, Runoff, and Erosion from Agricultural Management Systems (CREAMS) is also a field-level system, but it is not spatially explicit. Nonpoint source pollution prediction for agriculture watersheds is the focus of the Agricultural Non-Point Source (AGNPS) pollution model (Young et al. 1989). It is a spatially explicit simulation model that requires a large number of inputs, including topology derivatives, soil characteristics, land cover, watershed channels and impoundments, fertilization information, chemical factors, and storm characteristics. AGNPS outputs watershed information on erosion and deposition, chemical concentrations over time, sediment mass loads, and concentration of materials. The watershed manager can compare alternative land management scenarios with respect to the output information.

The U.S. Environmental Protection Agency’s (EPA’s) premier software for evaluating pollution in drainage water is Better Assessment Science Integrating Point and Nonpoint Sources (BASINS). BASINS combines a commercial GIS (ArcView from ESRI) with national environmental databases, watershed assessment extensions, and characterization reports to ArcView, and models for stream water quality and nonpoint source simulation. Data for driving BASINS can be downloaded from the main BASINS World Wide Web (WWW) site. The data include political boundaries, watershed delineation, digital elevation maps, soils, land cover, ecoregions, water quality and gauging, wildlife, minerals, and others. BASINS can

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