

Basinwide Surface Water Modeling in South Carolina

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Introduction

Reliable and sustainable supplies of water are crucial to the quality of life, protection of natural resources, and the continuing prosperity of the State. Although South Carolina presently has adequate water, it is a limited and irreplaceable resource that will be increasingly stressed as the State's population increases. Competition for water, intensified by seemingly more frequent and severe droughts, could lead to water shortages, overallocation, environmental degradation, or other problems if the resource is not properly managed.

One of the most important tools that water-resource managers, regulators, and planners use to effectively evaluate water resources is the surface-water model. Unfortunately, surface-water models have not yet been developed for most areas of the State. Because the "whole system" for surface water is the basin, the S.C. Department of Natural Resources (DNR) recommended that surface-water models be developed for each of the State's major river basins. DNR further recommended that the surface-water modeling regions be aligned with S.C. Department of Health and Environmental Control (DHEC) Watershed Water Quality Assessment (WWQA) basins to enhance the integration of the separate water-quality management and water-availability planning programs (Figure 1).

What are surface-water models?

Hydrologic models are computer programs designed to simulate complex water systems by solving mathematical equations that approximate the physical behavior of water in those systems. Surface-water models simulate streamflow conditions throughout a watershed, taking into account numerous parameters, such as precipitation, temperature, climatic patterns, tributary inflows, evaporation, land use, and water withdrawals and discharges. Models are a resource assessment and management tool, for use by regulators and planners; the models are not, by themselves, water planning nor water allocation mechanisms.

Why basinwide models?

In order to understand how a water user's actions may impact the water resources of an entire basin, it is important to understand the surface-water system as a whole (Figure 1). The surface-water modeling process addresses a basin as a whole and would be the same for each basin. South Carolina comprises four major river basins: the Pee Dee, Santee, Savannah, and ACE basins. Because of the size and complexity of these four basins, however, the larger basins needed to be subdivided into smaller sub-basin areas to be more manageable. For its WWQA program, DHEC divided South Carolina into eight management areas, each defined by river basin boundaries. The basins are the Broad, Catawba, Edisto, Pee Dee, Salkehatchie, Saluda, Santee, and Savannah watersheds. These eight basins also correspond to those basins defined by DHEC for the purposes of managing interbasin transfers of water.

Developing basinwide surface-water models

DNR, in cooperation with the DHEC, has initiated a program to develop surface-water models for each of the State's eight major basins (Figure 1). The models will use data from monitoring networks to determine the amount of surface water available in each basin during dry, normal, and wet years. The models also will be capable of simulating water levels and streamflows of the major reservoirs and rivers

in each basin and, as such, will be used as decision-support tools for surface-water permitting, water-policy development, water planning, and drought management.

Who will do the work?

A consulting company will be hired to develop and calibrate each basin model, as well as collect and prepare all necessary input data. This work will be done in coordination with the oversight of DNR and DHEC hydrologists. Because the models will be used by both agencies, it is expected that at least two DNR hydrologists and one DHEC hydrologist will become proficient with the models. The consultant also will work with DNR and DHEC IT personnel to ensure that the models will be available to both agencies. At this time, neither the specific water model nor consultant has been selected.

How long will it take?

Development of each model is essentially a one-time process, but use of each model will continue for many years afterward. It is possible that the surface-water models for all eight basins would be developed in two years after the work begins. The consultant will train DNR and DHEC staff on the use of the model while it is being developed, and afterward the consultant will be less involved once the models are complete. Input data, such as water withdrawals, will be updated regularly so that the models are kept up-to-date. The consultant who develops the model may be brought in again at a later date if significant updates or refinements are needed. The modeling software and data will be housed on a DNR server and will be accessible to those involved in the project.

Benefits of a surface-water modeling program

Surface-water models provide insight about the hydrology of a watershed or for complex water-management strategies that otherwise may not be apparent. These models give planners and regulators the ability to quantify the impact of new or increased water withdrawals (including interbasin water transfers) or changes in reservoir operations on the water resources of an entire watershed. DHEC will apply these models to objectively evaluate the impacts of proposed surface-water withdrawals when that agency makes decisions about surface-water withdrawal permit applications.

Effective water planning is dependent on understanding how much water will be reliably available in any particular area. The proposed models will provide resource managers with the ability to anticipate future water shortages or other water problems that might result from new or increased water withdrawals, droughts, or other changes in physical conditions. Identifying these problems before they occur allows time to develop and objectively evaluate potential solutions before the problems become critical. Unforeseen problems with existing drought plans also may be identified before the drought plans have to be activated.

Another benefit of the modeling program is that the myriad set of hydrologic data collected over many years by different groups and used as input to the models will be consolidated and integrated into a single database, easily accessible for review and analysis.

Reliable water supplies are vital to the quality of life, economic development, and preservation of the natural resources in South Carolina. Surface-water models are one of the most important tools that resource managers, regulators, and planners have for managing water resources and avoiding water shortages. Development of these models will significantly improve the State's ability to manage its water resources, protect its natural resources, and ensure adequate water availability for future generations.



Figure 1. The eight surface-water basins to be modeled in South Carolina.