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Model links ground, surface water

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Connie Jo Discoe

Riger Patterson (center, back to camera) speaks with a group of Culbertson-area irrigators in McCook on Friday (from left) Sean Lacey, Tom Gohl, Jerry Repass and Russ Gohl. (Connie Jo Discoe/McCook Daily Gazette)

Nebraska, Kansas and Colorado water officials agree that the water model developed by the three states to calculate the depletion of stream flows in the Republican River Basin caused by ground water pumping is "a decent model" ... "one of the best."

"Is it perfect? No," Ann Bleed, deputy director of Nebraska's Department of Natural Resources, told a group of about 100 water users during a DNR meeting in McCook Friday morning.

"Can improvements be made? Yes," Bleed said. "The model was developed to determine the states' depletion of the stream flow and to calculate allocation credits. The model does a good job of this."

The development of the ground water model was part of the settlement of a 1998 lawsuit filed by Kansas against Nebraska and Colorado. Kansas charged that upstream states were overusing their allocations of water in the Republican River

Basin, as outlined in the 1943 Republican River Compact.

A Supreme Court special master ruled that upland and alluvial wells must be counted if the water they pump depletes stream flow, and the three states agreed to develop a model that would compute depletions to stream flow from ground water pumping.

Bleed said the finished model has 53,000 cells, each representing one square mile of the Republican River Basin.

The domain of the model is the Republican River Basin in Nebraska, Kansas and Colorado. In Nebraska, it expands slightly north beyond the Basin, to the Platte River, and slightly east, to the Little Blue River.

The model calculates the water inflows and outflows and changes in water storage of each cell.

"If 10 acre-feet of water flow went into that cell," Bleed said, "and two acre-feet went out, then eight acre-feet went into storage."

"If 10 acre-feet go in, and 20 acre-feet go out," she said, "then storage is down 10 acre-feet."

The model assumes no increase in the number of wells or the number of irrigated acres.

Some areas of the Basin show declines in the water table, Bleed said, and increased pumping will only make it worse. "An increase in consumptive use that affects stream flow will make matters worse," Bleed said.

The model runs calculations for every cell from 1920 until the present, Bleed said, eliminating having to do these calculations by hand.

"The model is a simplified version of reality," Bleed said, and its estimates are proving to be within a specific range of actuality. "The model is not perfect, yet what has been observed and the model's estimates are tracking pretty closely," Bleed said.

These details of the Republican River Basin are the inputs needed by the model for calculations and estimates:

* Hydraulic conductivity: The ease with which water moves through materials in the ground, measured anywhere from 0 to 300 feet per day.

* Saturated thickness: The amount of water in the aquifer above the Pierre Shale.

* Precipitation: The yearly average from 1940 through 2000, ranging from 15.20 inches in the western Basin to 27.4 inches in the east.

* Soil-type distributions: How moisture seeps into the aquifer through different soil types. Because the model is simplified, Bleed said, it does not consider soil-type variances within each grid. "Simplified works well for the computer and for Compact compliance," she said.

* Recharge from precipitation, averages, from 1940 until 2000: Ranging from zero to more than eight inches per year.

* Distribution of recharge from excess surface water irrigation from 1980 through 2000. Nebraska gets "credit" in compliance calculations for irrigation water that seeps back into the aquifer from surface water irrigation within the Republican River Basin and for water that seeps into the basin from surface water projects on the Platte River.

* Location of irrigation wells in the Basin as of 2000, and pumping estimates.

Bleed said that alluvial wells, those close to the Republican and its tributaries, have an almost immediately impact on stream flow, and can affect stream flow within weeks or months.

Alluvial wells are called "quick response wells," Bleed said, because they can have a rapid impact on stream flow.

Natural Resources Districts will determine the boundaries of "quick response" areas, she said.

"Wells further from the streams have a slower impact on stream flow," she said, "but, over time, each one of those wells will have what it has consumed show up as a depletion to the river."

This delayed, or "lag," affect is what worries Nebraska water experts, Bleed said. The impact of what upland wells pumped, as an example, in 1990, she said, will begin to show up in 10, 15, 20 years.

"The lag effect of wells has to be determined for Nebraska to be in compliance with the Compact," she said.