Questions for Natural Resources Committee's Interim Studies Hearing:

LR 177

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North Platte, NE
Compiled by Sen. Mark Christensen

Department of Natural Resources Proposed Testimony

1. **What are the specific inputs and accounting to the ground water model? How are they calculated?**

The primary inputs for the groundwater model annual runs are: groundwater pumping, irrigated acres, precipitation recharge, groundwater return flows, surface water return flows, canal seepage, reservoir stages, and potential evapotranspiration (ET).

GROUNDWATER PUMPING:
For the groundwater calibration period (1918-2000), the groundwater pumping was determined using an electrical power-record methodology.

Metered pumping volumes have been used in the groundwater model since 2001 for the Upper Republican (UR) Natural Resources District (NRD). Outside of the UR, for the time period 2001 through 2005, the electrical power-record methodology was used to calculate pumping.

Beginning in 2006, metered pumping volumes have been used as model inputs for those portions of the Lower Republican, Middle Republican, and Tri-basin NRDS lying within the Republican River surface-water basin. For areas lying outside the surface-water basin, pumping continues to be computed using electrical records. There are some small areas outside of the surface-water basin for which metered pumping volumes have been reported by NRDs; in cases where these data are available, they are used as model inputs instead of power-record methodology pumping estimates. In cases where metered volumes for a well known to have been pumped are unavailable, electrical power records are used to estimate the pumping volume.

IRRIGATED ACRES:
As of 2006, certified groundwater-irrigated acres are reported annually by the portions of the Lower, Middle and Upper Republican and Tri-Basin NRDs in the Republican River surface-water basin portion of the groundwater model. Portions of the groundwater model outside of this area are reported as National Agricultural Statistics Service (NASS) irrigated harvested acres, adjusted to reflect just those portions of each county in the groundwater model region. Before

2006, NASS acres were used for all portions of the groundwater model except the Upper Republican, where certified acres have been used since 2001. All groundwater-irrigated acres were estimated based on NASS previous to 2001.

Surface-water irrigated acres are compiled by the NE DNR on a yearly basis and entered into the model.

PRECIPITATION RECHARGE:
To estimate precipitation recharge, annual precipitation is first obtained for 34 National Weather Service stations across the groundwater model region. These point precipitation depths are then distributed across the model grid through an interpolation procedure called kriging. Precipitation recharge in each grid cell is then calculated using a set of curves that consider depth of precipitation, soil type, and whether the land is irrigated or non-irrigated.

GROUNDWATER IRRIGATION RETURN FLOWS:
Twenty percent of irrigation groundwater withdrawals are placed back into the model as return flows; therefore, 80% of irrigation groundwater withdrawals are considered consumptive uses in the model.

SURFACE WATER RETURN FLOWS:
Surface water return flows are calculated as a percentage of measured canal deliveries to the field, percentages that are based on estimated canal system efficiencies. Surface water return flows range from 18 to 40% of deliveries. In the case of direct river pumping, return flows are 25% of withdrawals from the river.

CANAL SEEPAGE:
Canal seepage is calculated as the canal water loss minus the calculated evaporative losses. The canal loss is the difference between the measured canal diversion and the field deliveries (or diversion into the next canal section).
For U.S. Bureau of Reclamation (USBR) canals, the evaporative loss is estimated as 18% of the canal loss. For NPPD and CNPPID canals, evaporative losses are estimated as 70% of pan evaporation.

RESERVOIR STAGES:
The reservoir stages are simply entered into the stream package of the model as monthly elevations above sea level, as measured by the USBR.

POTENTIAL EVAPOTRANSPIRATION:
Only the potential ET is entered into the model, which the model uses, along with the ET surface and ET extinction depth (static parameters), to compute the actual ET rate in each cell containing phreatophyte acres. To obtain the potential ET, reference crop ET is calculated using the temperature-based Hargreaves method calibrated to the Penman-Monteith method. The temperatures for the calculations are obtained from three climate stations: Red Cloud, NE, Akron, CO, and McCook, NE. The reference-crop ET is then adjusted to potential phreatophyte

ET using growing-day-based coefficients. The potential ET calculated for each climate station is then interpolated across the model grid using the potential ET computed at the three stations.

2. **Do you have concerns about the accuracy of any of the inputs and accounting for the ground water model? What are they?**

   The Republican River groundwater model is a well calibrated model that simulates the observed water levels and baseflows to a reasonable level of accuracy. That being said, DNR is constantly re-examining the model and questioning the validity of the model inputs and results. The model inputs that are currently being used are the best information currently available. As new and better information becomes available, we will work to incorporate that into the model, evaluate the impact of the new data on the model results, and fight to implement the new information into the annual accounting if appropriate. For example, the groundwater pumping data for Nebraska used to be estimated through the use of power records. Due to concern over the accuracy of this method, flow meters were installed on all groundwater wells within the surface water basin. We believe this will improve the accuracy of the model results in the future, and will be seeking approval from the Compact Administration to begin using the flow meter data.

3. **Looking at the ground water model comprehensively, including inputs and accounting, do you believe it fully takes into consideration all the factors that should be included to determine the fair implementation of the three state compact, or are there problems that should be addressed and examined? If so, what concerns do you have?**

   In general, there are no groundwater model input or output issues that need to be addressed.

   There are some areas where more knowledge could be beneficial; however, the following would have minor changes on model outputs. The model could be better calibrated with more knowledge of recharge due to precipitation, for example, with a comprehensive rainfall-runoff model. Recharge due to imported water may be better estimated with more knowledge of surface water operations. The effects of removing invasive species of plants next to the river are not well understood.