A.1.2 Memorandum on the COHYST2010 Watershed Model Update – Run029

**COHYST2010 MODELING TOOL UPDATE
WATERSHED MODEL RUN029**

TECHNICAL MEMORANDUM

TO: Nebraska DNR Technical Staff
FROM: Marc Groff
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RE: COHYST2010 Watershed Model Update – Run029
DATE: 15 June 2018

Introduction
The COHYST modeling tool was initially developed in 1998 as part of the Cooperative
Hydrology Study (COHYST) which is a hydrologic study focused on the Platte River
drainage basin in Nebraska. The modeling tool has undergone several revisions since
that time. The original 1998 model was comprised of three ground water models
covering the area from the Wyoming border to approximately Duncan, NE. That tool
evolved into the Western Water Use Model (WWUM), which covers the Nebraska
Panhandle area, and COHYST2010, which covers the area from the Panhandle to
Duncan, NE. Both the WWUM and COHYST2010 tools are integrated models
comprised of a ground water model, a surface water operations model, and a watershed
response model. Run028 was the version of the watershed response model described in
the current COHYST2010 documentation (refer to http://cohyst.nebraska.gov/ for a copy
of that documentation).

The purpose of this memorandum is to document a couple of updates being made to
Run028 of the watershed response model in the COHYST2010 tool. The incorporation
of these changes will result in a new watershed model version, Run029, which will be
used within the COHYST2010 tool supporting the Robust Review modeling project.

Watershed Model Updates
As discussed in Section 5 of the COHYST2010 modeling report, the watershed model
has four components: a climate model; a point source soil water balance model; spatial
and temporal distribution routines; and a regionalized soil water balance model. The
Run029 updates affect two of these components: the climate model; and the point source
soil water balance model.

With respect to the climate model, the update reflects a change necessitated by changes in data availability. Specifically, two climate stations (Tryon and Arnold) are no longer supported. Therefore, the station located near Stapleton, NE (Stapleton_5W) was incorporated into the input dataset in their place. Figure 1 below (which is Figure 5.4 in Section 5 of the COHYST2010 modeling report) shows the locations of these stations.
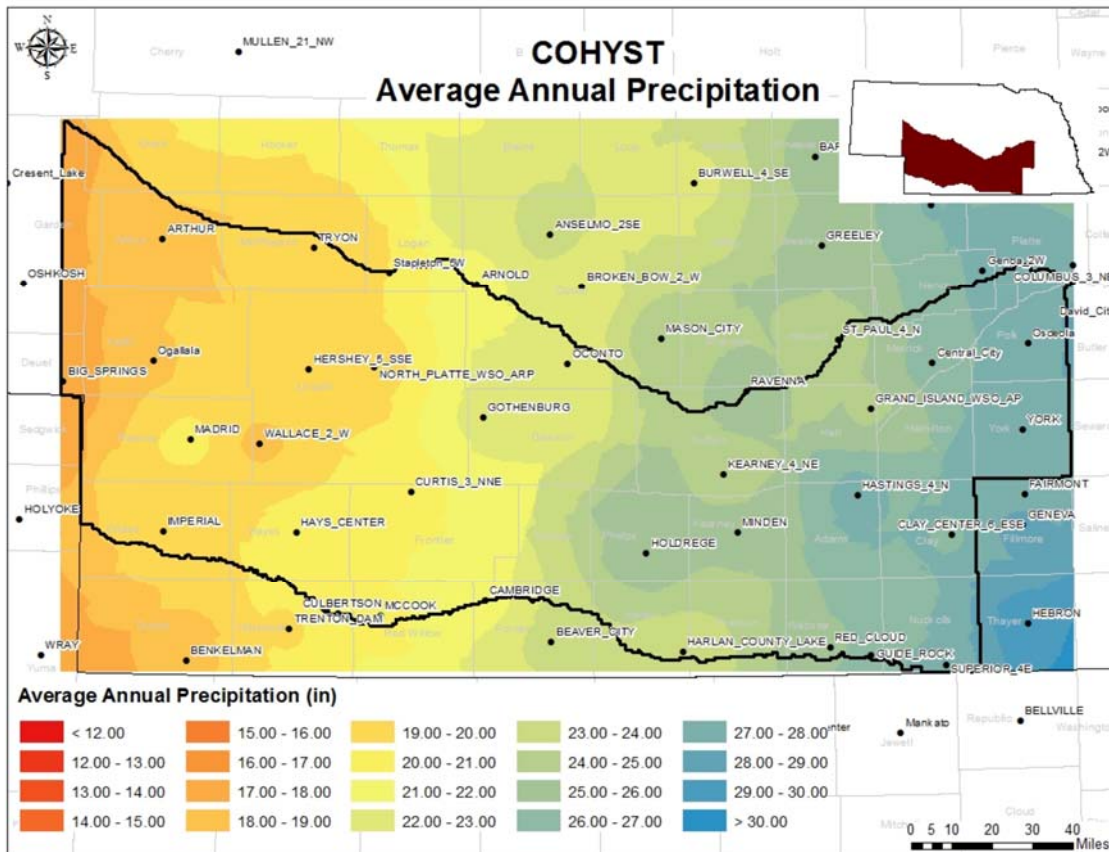
Figure 1: Climate Station Locations

With respect to the point source soil water balance model, the soil water balance model CropSim is used within the watershed response model. Run028 used CropSim version 7.9 and Run029 uses CropSim version 8.0. The version 8.0 update to CropSim addressed two coding issues: ensuring that a variable used to track the partitioning of soil water within CropSim's 10 layer soil model properly resets; and normalizing the numeric format of data being read and written to the data file which stores the initial water content in the soil profile prior to a simulation being run. The first coding update corrects an issue which occurred under wet conditions on irrigated lands that resulted in potentially more recharge being allowed out of the root zone than should have been. The general effect of implementing the update was a small reduction in recharge under the identified condition. The second issue updated coding statements such that data would be both read

and written to three decimals of precision. Previously, data was being written to two decimals of precision.

Impacts to Modeling Results

In general, updating the watershed response model with COHYST2010 to Run029 has a minimal impact on the overall results from the watershed model. Table 1 below shows the change in long term average water balance values for select terms of interest. Table 1 is based on Table 5.4 in the current COHYST2010 documentation.

Table 1: Comparison of long term average water balance terms

Parameter	Run028	Run029	Change in Average
Precipitation	24,112,174	24,133,809	21,635
Surface Water Deliveries	221,170	221,341	171
Groundwater Pumping	2,448,889	2,461,605	12,716
Total Applied Water	26,782,233	26,816,756	34,522
Field Evapotranspiration	21,994,798	22,292,473	297,675
Field Recharge	2,647,784	2,507,367	(140,418)
Field Runoff	2,011,730	1,965,506	(46,223)
Surface Losses	129,080	129,721	641
Lateral Losses	15,038	15,039	1
Field Water Balance	(1,158)	(78,311)	(77,153)
Field Runoff Balance	2,011,730	1,965,506	(46,223)
Runoff Losses to Recharge	436,584	426,936	(9,648)
Runoff Contributions to Streamflow	1,138,562	1,111,635	(26,927)
Runoff Losses to Evapotranspiration	436,584	426,936	(9,648)
*Units are in Acre-Feet (AF)			

There are localized areas within the model domain which do reflect a greater response to the updates. A presentation developed by the technical staff at the Nebraska Department of Natural Resources (DNR) highlights the changes in these areas through an evaluation of relative water level changes and predicted streamflow changes output from COHYST 2010 when using Run029 versus Run028 of the watershed model . Even in these locations, it is TFG's belief that the magnitude of change does not rise to the level of warranting any type of COHYST2010 recalibration.

Summary

The COHYST2010 toolset is comprised of several individual models and their associated datasets. This modular construction is a major advantage to keep COHYST2010 current with changing inputs and updated modeling tools. The updates discussed in the memorandum reflect proper model and input dataset maintenance. Incorporating these changes now will ensure that the Robust Review project is evaluated with the most current and up to date toolset available.