Decisions on Stress Periods to be Used in Calibration of Eastern Snake Plain Aquifer Model Version 2

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ESPAM2 Design Document DDM-V2-0x "Stress Periods"

DESIGN DOCUMENT OVERVIEW

During calibration of the Eastern Snake River Plain Aquifer Model Version 1.1 (ESPAM1.1), a series of Design Documents were produced to document data sources, conceptual model decisions and calculation methods. These documents serve two important purposes; they provided a vehicle to communicate decisions and solicit input from members of the Eastern Snake Hydrologic Modeling Committee (ESHMC) and other interested parties, and they provided far greater detail of particular aspects of the modeling process than would have been possible in a single final report. Many of the Design Documents were presented first in draft form, then in revised form following input and discussion, and finally in an "as-built" form describing actual implementation.

This report is a Design Document for the calibration of the Eastern Snake Plain Aquifer Model Version 2 (ESPAM2). Its goals are similar to the goals of Design Documents for ESPAM 1.1: to provide full transparency of modeling data, decisions and calibration; and to seek input from representatives of various stakeholders so that the resulting product can be the best possible technical representation of the physical system (given constraints of time, funding and personnel). It is anticipated that for some topics, a single Design Document will serve these purposes prior to issuance of a final report. For other topics, a draft document will be followed by one or more revisions and a final "as-built" Design Document. Superseded Design Documents will be maintained in a "superseded" file folder on the project website, and successive versions will be maintained in a "current" folder. This will provide additional documentation of project history and the development of ideas.

INTRODUCTION

The ESPAM 1.1 model was calibrated in 6-month stress periods over the 1980-2001 period and model results were matched to both long term and seasonal variations in aquifer head and Snake River gains and losses. All recharge and discharge events and river stage are assumed constant for the length of a stress period, although aquifer heads may be computed at more frequent time steps. In ESPAM 1.1, the stress periods were selected as May through October (higher recharge irrigation season), and November through April (lower recharge non-irrigation season). Recharge and discharge data for each stress period are assembled and processed in the GIS-Fortran based Recharge Program which will work on stress periods of different lengths. In most cases recharge and discharge data and stream stage are available at a higher frequency than semi-annual periods.

During model calibration the outputs of aquifer head and river gains and losses are compared to measured or estimated values. Estimates of the aquifer properties of transmissivity (or hydraulic conductivity) and storativity are adjusted to achieve a good fit between simulated and measured values. These property estimates subsequently control model results in simulations performed to guide aquifer management and administration. A more accurate description of recharge and discharge and river stage as model input should result in a better fit to historic measured values and improved calibration of aquifer properties, ultimately generating greater reliability of management and administrative simulation results.

Since recharge, discharge, and river stage must be assumed constant during a stress period, it would seem that the shorter the stress period the more accurate the representation of reality. This is true to the extent that a) data are collected at short intervals, and b) there are not unknown or unrepresented elements of storage or lag in the system.

DECISION ON STRESS PERIOD LENGTH

The Eastern Snake Hydrologic Modeling Committee (ESHMC) has determined that the ESPAM Version 2 will be calibrated with monthly stress periods over the period of May 1980 through October 2008 (corresponding to well measurement). Monthly stress periods were selected because: a) much of the recharge and discharge data are available in monthly increments, b) data processing is still a manageable task, and c) the higher temporal resolution should improve model representation relative to ESPAM 1.1. The ESHMC also determined that each month should be represented by the actual number of days in that month as opposed to a uniform length of 30.4375 days.

IMPLICATIONS AND LIMITATIONS OF THE DECISION

For the majority of the recharge and discharge data that are available or measured in monthly or more frequent intervals, the change to monthly stress periods will mean additional effort in data compilation and processing and will result in substantially larger computer files for the GIS/Fortran Recharge Program and for the Model calibration data set. These however are manageable concerns.

There are a few recharge components to the model that are not available on a monthly basis. These include: tributary valley underflow, land use classification, and irrigation diversions in some tributary valleys. Little is known about the temporal variation in tributary underflow. There is likely some seasonal as well as some longer term variation. Regardless of the length of stress period used in model calibration, assumptions would be needed relative to variation in tributary underflow. Land use classification (e.g. irrigated agriculture, non-irrigated, etc.) has only been observed at a few discrete times in the calibration period. Changing from 6-month to monthly stress periods will have no impact on the difficulty of representing land use. Land use changes are likely to be incremented on an annual basis regardless of the stress period length. A more detailed discussion of representing changes in land use is provide in other Design Documents. Irrigation diversions in some tributary valleys are only recorded on an annual basis. Assumptions will be required to distribute these diversions into monthly periods. These diversions are relatively small, however, and model results will not be greatly affected by these assumptions.

Storage in the physical system creates lags in the movement of water through the system and possibly in the ultimate destiny of the water. Water storage in depressions on land surface, in snowpack, in the root zone, and in the vadose zone above the water table are not represented in the Recharge Program nor in ESPAM 1.1. The delay in water movement associated with storage becomes more important as stress periods become shorter because the time scale of the lag becomes significant relative to the stress period and the volume stored becomes larger relative to the volumes of water moving during a stress period. Assumptions will be required relative to representing all of these lags which will be addressed in other Design Documents.