Representation of Soil Type for Calibration of Eastern Snake Plain Aquifer Model Version 2, As Built Revision 1

University of Idaho
Idaho Water Resources Research Institute

Bryce A. Contor
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ESPAM2 Design Document DDW-V2-06 As Built Rev 1 “Soil Type”

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DESIGN DOCUMENT OVERVIEW

During calibration of the Eastern Snake 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 served 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 a draft form, then in revised form following input and discussion, and finally in an "as-built" form describing the 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 ESPAM1.1: 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 Superseded Design Documents will be maintained in a "superseded" file folder on the project Website, and successive versions will be maintained in a "current" folder.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

In automated aquifer model calibration, investigators may instruct the software to attempt improvement in meeting calibration targets by adjusting specified input data. For the Non-irrigated Lands recharge data set, the desire was to give the calibration team the capability to multiply the depth of recharge by a specified factor. It was felt that it would be desirable to identify zones which could be assigned to different multipliers. Since the non-irrigated recharge calculation is based upon generalized soil type, it was desired to associate the zones for multipliers with regions of similar general soil characteristics.

This design document describes the ESPAM2 representation of soil type for each model cell. It is anticipated that calculation of non-irrigated recharge and parameter estimation will be discussed in future Design Documents by IDWR personnel.

REVIEW OF ESPAM1.1 APPROACH

In ESPAM1.1, the non-irrigated recharge data set included recharge from precipitation on lava rock, thin soil, thick soil, and dry farm areas. It also included the net effect of pumping for cities and industrial areas, and the net effect of precipitation and evapotranspiration on wetlands. The data, assumptions and calculations are described in ESPAM1.1 Design Document Recharge on Non-irrigated Lands (Contor, 2004). General locations of lava rock, thin soil and thick soil were obtained from USGS published reports (Garabedian, 1992). Locations of other land cover types were obtained from other data sets, as described in the ESPAM1.1 Design Document. That document also discussed the significant processing considerations and small marginal gains that would have been expected from using more detailed soil-type data sets.

ESPAM1.1 required an adjustment for wetlands, due to the effects of cell-wide averaging of depths and values, when a model cell contained both irrigated lands and wetlands.

In ESPAM1.1, data were tabulated in an ESRI polygon feature class in a personal geodatabase. A GIS Recharge Tool calculated the majority soil type in each model cell and produced an intermediate file with extension “sol” for input into recharge calculations. This is because the water-budget calculation algorithms were designed to accommodate only a single value per model cell.

ESPAM1.1 calculation algorithms incorporated the ability for automated parameter-estimation software to modify non-irrigated recharge depths by general soil class. Four soil classes were provided; Thick Soil, Thin Soil, Lava Rock, and Other. The input-data depths for all cells of a given class would have been adjusted simultaneously by the same factor. This capability was not used in final ESPAM1.1 calibration, however.

ESPAM2 CHANGES

No substantial changes in general soils data were made for ESPAM2. However, changes in processing necessitated construction of a new data set:

1. Wetlands, cities and industrial areas were moved from the non-irrigated lands data set to the fixed point data set. This avoids carrying wetlands data in two different data sets (since in ESPAM1.1 wetlands also required

adjustment points in the Fixed Point data set) and eliminates the "other" classification used in ESPAM1.1. Since MODFLOW applies all fluxes as if they occur exactly and only at the cell center, there is no practical effect of using a point data set to represent fluxes that are physically spatially distributed.

2. All dry farms were assumed to be thick soil, and the recharge on dry farms was calculated using the non-irrigated recharge algorithm instead of being estimated as a separate class.
3. Provision was made for independent parameter adjustment in 11 zones.
4. The ESPAM1.1 GIS tool received a polygon feature class and produced the finished *.sol file. Failure of the revision of this tool required that the data be delivered as a finished *.sol input file, rather than a polygon feature class.
5. IDWR experimented with different underlying algorithms for producing the Non-irrigated Recharge data to which the multipliers would be applied.

The changes are described and discussed below.

Elimination of Wetlands, Cities, Industrial Areas and Dry Farms. This was accomplished by manual GIS manipulation of the ESPAM1.1 data and input files. Due the fact that the original GIS data sets were hand-digitized from scanned images of small paper maps (Garabedian, 1992), the horizontal resolution and accuracy of these data is expected to be no better than hundreds of meters. Figure 1 illustrates the general soil map used, with minor uses/land cover types removed.

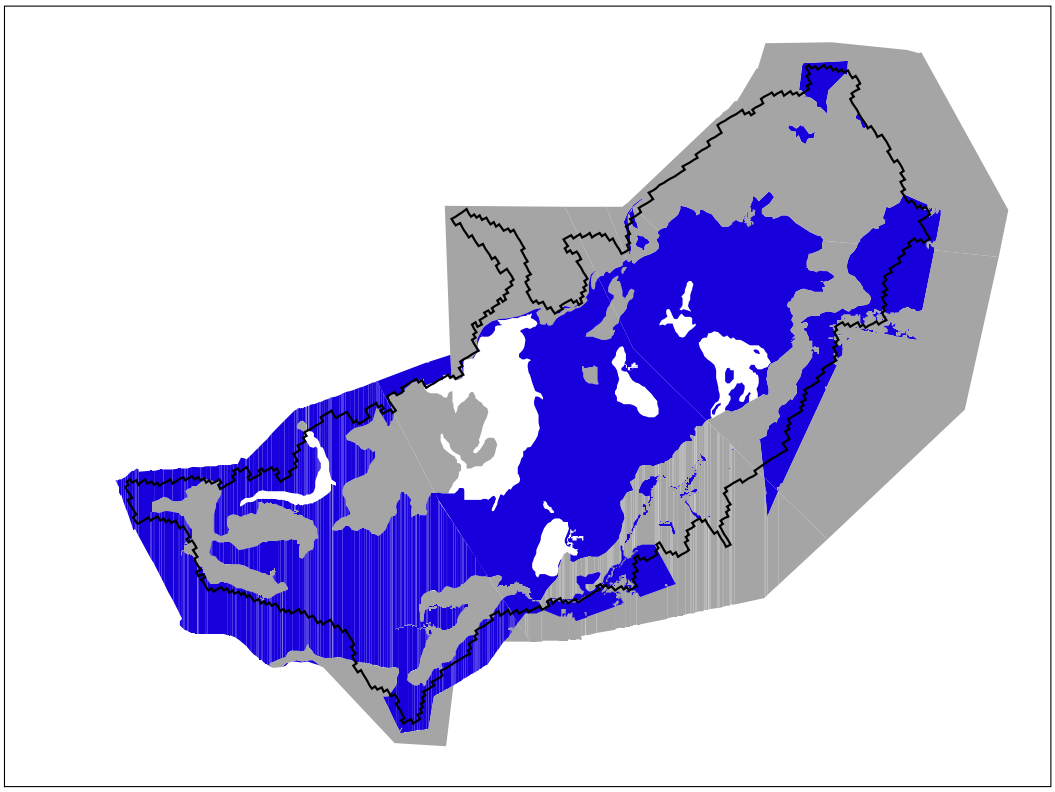

Figure 1. Generalized soil type. White areas are represented as lava rock, gray areas as thin soil and blue areas as thick soil. The faint stray lines are GIS artifacts.

Creation of Parameter Estimation Zones. A map of general soil types was projected on the white board at the October 2008 ESHMC meeting. Allan Wylie of IDWR sketched zones within the soil types, with the guidance and concurrence of meeting attendees. IWRRI constructed zones by hand in GIS, with visual reference to a photo of Wylie's sketch. The photo is shown in Figure 2, and resulting zones are shown in Figure 3.

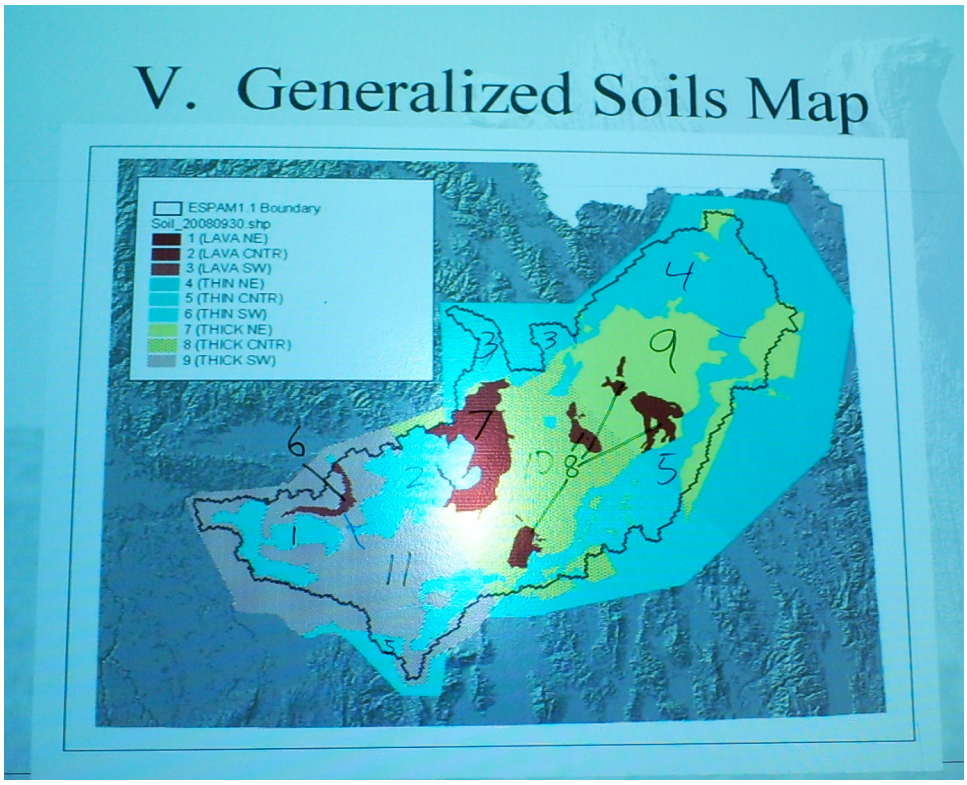

Figure 2. Whiteboard sketch of zones from October 2008 ESHMC meeting.

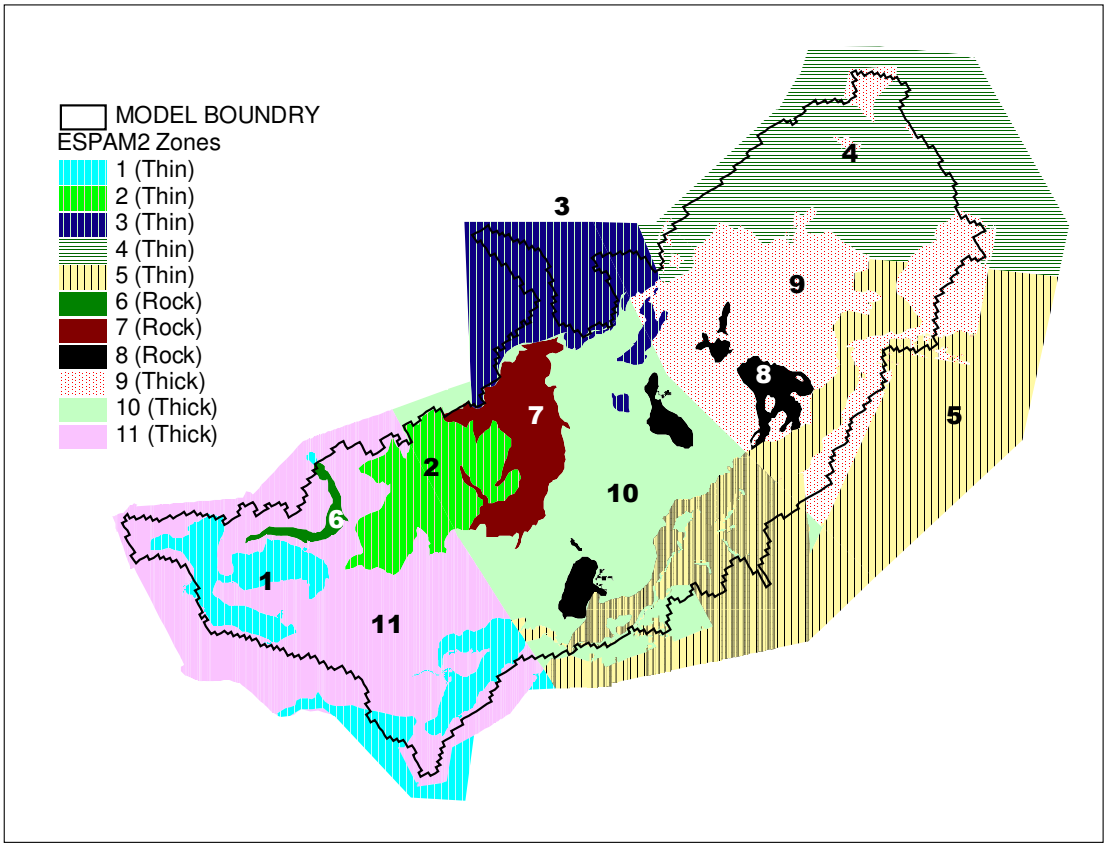

Figure 3. ESPAM2 Zones for parameter estimation adjustment of Non-irrigated Recharge. Note that only polygons within the model boundary will be used in calibration calculations.

Construction of Intermediate Data Set. In ESPAM2.0, the *.sol file was produced manually rather than using a custom-built tool. To reduce complexity, opportunities for blunders, and processing times, the *.sol file was constructed based on the soil type of the centroid of each cell, rather than the majority type. Given the horizontal imprecision of the GIS data set and the fact that there are no longer small minor-use polygons that might bias an individual cell result, IWRRI felt this did not impair the data.

Calculation of Non-irrigated Recharge Values. It is expected that IDWR will provide a Design Document describing the calculations and values used, and the calibration adjustments made.

DESIGN DECISION

The following design decision is proposed:

1. The generalized soil map illustrated in Figure 1 will be used to define soil type for calculation of non-irrigated recharge.

2. The zones illustrated in Figure 3 will be used to define parameter-estimation zones.
3. Soil types and zones will be matched to model cells using the centroid value.
4. Whether and how the 11 zones and associated multipliers are used in final model calibration is anticipated to be reported in the final model report and perhaps in an IDWR-written Design Document.
5. GIS data are available from IDWR (2010).

REFERENCES

Contor, B.A. 2004. Recharge on Non-irrigated Lands. IWRRI Technical Completion Report 04-006. ESPAM1.1 Design Document DDW-003. http://www.if.uidaho.edu/~johnson/DDW003_NIR_09_1_04.pdf, accessed 26 July 2010.

Garabedian, S.P. 1992. Hydrology and Digital Simulation of the Regional Aquifer System, Eastern Snake River Plain, Idaho. USGS RASA report 1408 F.

IDWR, 2010. Internet data folder http://www.idwr.idaho.gov/WaterInformation/Projects/espam/d/model_files/Version_2.0_Development/Current_Data/ESPAM2_Soils_08-26-09.zip, accessed 26 July 2010.