4.3.5.2. Model Management

DWR and Reclamation will also seek new opportunities and avenues, both private and public, to broaden the management base for the existing and future model developments. Currently there is an interagency team coordinating this effort.

4.3.5.3. Peer Review

DWR and Reclamation believe that peer review enhances the acceptability of the modeling tool. The agencies may suggest peer reviews of modeling components it deems necessary.

4.3.5.4. Public Involvement

DWR and Reclamation will work with all interested parties, both public and private, to seek technical input in developing and enhancing the current and future modeling components.

4.3.5.5. Sustainability

The proposed Model Management Team (DWR, Reclamation and others) will work to develop a strategy in this important area.

4.3.5.6. Training and Education

The agencies modelers will continue to support, to the extent resources permit, to broaden the model users' base for appropriate use of models. The Proposed Model Management Team may also be charged with this responsibility.

4.4. Model Testing

4.4.1. Calibration and Validation

Model calibration is the process of fine-tuning the value of various model parameters, so that model results match the observed data. Validation is the subsequent testing of the model against data that has not been used in the calibration to obtain an independent assessment of the model's accuracy.

The need for testing, calibration and validation of CalSim-II is one of the most controversial issues raised in the Strategic Review. Some of the peer review panel recommended that further validation of the model is required through the comparison of model results to recent historical data. However some in the modeling community express their doubts on the usefulness of such a comparison (CalSim-II in California's Water Community – Musing on a Model, p158). The Strategic Review (p129) notes that for the Murray-Darling Basin model, validation is considered to be less important. The Murray-Darling Basin model is calibrated using a long period of data. In contrast validation is carried out using only two to three years of data.

In discussing the merits of calibration it is important to distinguish between physical parameters that remain essentially constant (e.g. stream-bed conductance), and behavioral parameters that may change and adapt (e.g. reservoir operating policy). Water use parameters such as irrigation efficiency may fall somewhere in between these two extremes. Where possible the value of parameters should be determined from direct observation. This may not be possible for some parameters such as regional scale reuse of water.

DWR and Reclamation believe that model calibration to determine the value of physical parameters, and parameters such as irrigation efficiency, is a valuable exercise, and benefits model accuracy and model credibility. However, DWR and Reclamation suggest that a more reasonable approach to defining behavioral parameters is through discussions with system operators to define *current* operational policy or rules. California's water system, especially with regard to the Delta, has undergone many changes in the 1990s (Delta Water Quality Control Plan, CalFed, ESA actions, CVPIA (b)(2), Environmental Water Account) so that calibration to historical practice has limited value. It would appear more reasonable to define operating rules in conversations with operators and subsequently use a recent wet, normal and dry year in a validation exercise.

The debate on calibration stems partly from a misunderstanding of the hydrology development. The CalSim-II hydrology is tied to historical stream gage data. The following points explain what calibration has been undertaken for the Sacramento Valley:

- The accretions and depletions between the project reservoirs and the Delta *are* calibration terms. They have been determined so that at a historical level CalSim-II will exactly match historical gage data if reservoir releases are fixed at their historical level and groundwater pumping and stream-aquifer interaction are fixed at their assumed historical values.
- Calibration of groundwater use has not been carried-out due to the lack of historical data.
- The stream-aquifer model in CalSim-II is calibrated to the more sophisticated Central Valley Groundwater Surface Water Model (CVGSM).
- The CalSim-II hydrology is calibrated to net consumptive use rather than stream diversions and return flows. CalSim-II may therefore not simulate well diversions to particular irrigation districts.
- The hydrology adjustment to account for the impact of land-use change on rainfall-runoff has not been calibrated or validated.
- Calibration or validation of district-scale diversions in CalSim-II cannot be undertaken without increasing the resolution of the model.

DWR and Reclamation recommend the following approach to CalSim-II calibration and validation:

- DWR and Reclamation modeling staff continue to work with project operators to define operating rules that correctly capture current (rather than historical) operational policies.
- Following re-calibration of CVGSM[1], the CalSim-II groundwater model is refined and re-calibrated.
- DWR and Reclamation develop methods to validate assumptions regarding land use change impacts on rainfall-runoff.

[1] Major revisions to the underlying IGSM software and the input data sets to CVGSM have been made by DWR since the development and calibration of the CalSim-II groundwater module.

- DWR and Reclamation work with local irrigation districts and their consultants to refine the spatial scale of CalSim-II and calibrate/validate local projects operations through comparison of model output with historical data,
- Modeling groundwater pumping is modified to a land-use based approach. DWR has identified through land use surveys areas that are dependent on groundwater, areas that rely on surface water and areas that use groundwater as a contingent supply. The spatial resolution of CalSim-II should be refined to distinguish between these three land types.

After the completion of the above, CalSim-II should undergo a limited validation exercise using different recent year types.

Validation of local project operations has been shown to work well with the recent model enhancements to the San Joaquin Valley. Working with local districts has resulted in successfully calibrated hydrologic parameters so that CalSim-II has matched recent historical storage and flow data.

4.4.2. Sensitivity Analysis

The primary goal of CalSim-II sensitivity analysis is three-fold: (1) to verify if the key model input parameters are working properly within their reasonable range of variations; (2) to determine the impact of each parameter on selected model results; and (3) to set up priorities for potential refinements of model input parameters. Some of the parameters being evaluated are: SWP demands, target carryover storages, reservoir inflows, agricultural and urban water use, water use efficiencies, Delta water quality requirements etc. This sensitivity analysis had been undertaken by DWR and will be coordinated with Reclamation.

4.4.3. Uncertainty Analysis

Uncertainty analysis uses probabilistic descriptions of model inputs to derive probability distributions of model outputs and system performance indices (Strategic Review, p73). CalSim-II users need not only stand alone for absolute model results but also the degree of confidence they can place them. For example, what is the 95% confidence limit on the exceedence curve of project exports from the Delta? Hydrologic uncertainty is expressed through the use of a 73-year time series. There is currently no measure of data input uncertainty. Appendix H of the Strategic Review focuses on ways to identify and quantify uncertainty.

DWR and Reclamation agree that a method of implementing uncertainty analysis for CalSim-II needs to be defined. One approach is to simulate historical operations and use the statistics of goodness of fit to identify the uncertainty. An alternate approach is to identify plausible ranges of input parameters and to repeat model runs using high and low values of complimentary parameters (e.g. low efficiency in conjunction with high demands). This approach is more akin to the multiple future scenarios adopted by the California Water Plan Update.