## Section 7-3

## Model Parameters for other Headwaters and Local Areas

Introduction

This section discusses procedures for determining parameters for drainage areas for which a full calibration is not possible. These are portions of the river basin where the hydrograph for the drainage area, either headwater or local, contains considerable noise and those areas where there is not even sufficient information to derive the flow contribution from the area, e.g. the area above a reservoir that doesn't have storage or outflow data. For such areas the general approach is to assign snow and soil moisture parameters from the most similar previously calibrated watershed and then see if it is possible to make any adjustments to those parameter values to remove bias in the resulting simulation. In some cases it may not even be possible to produce a historical simulation for these drainage areas.

Strategy

The recommended strategy to follow for these drainage areas is as follows:

1. Determine the period to be used for possible calibration. It is best to use the same period as was used for the initial headwater area and all, or at least most, of the other locations within the river basin that have previously been calibrated, but in some cases this is not possible. Needed observed data may not be available for this area for that period or there may have been changes within the drainage area over time that dictate that another period be used for calibration. For downstream local areas it is best to use a period for which not only downstream flow data are available, but also observed upstream flows so that errors in upstream calibrations are not propagated downstream.

2. Attempt to derive a hydrograph for the drainage area as discussed in Section 7-2 to determine to what extent a calibration can be performed. In some cases it will not be possible to calculate the flows for the drainage area due to a lack of sufficient information. Examples include reservoirs lacking storage (or pool elevation to compute storage) or outflow data and areas with large diversions for which data are not available. If a hydrograph for the drainage area can be derived, make a judgement as to what level of calibration is possible based on the amount of noise in the calculated flows. This may range from a full calibration (in that case refer to Section 7-2 for the strategy to follow), to the possible adjustment of selected parameters, to only the chance of a crude adjustment to remove any bias in the simulation results at the downstream location. If a full calibration is not possible based on your judgment proceed to the next step.

3. Assign initial parameter values to the models used to simulate the local area contribution to the flow. Initial values for the snow and Sacramento models should be those determined for the most similar area for which a full calibration was possible. Similarity is generally a s

ubjective decision based on the assessment of spatial variability of physiographic features tha t was described in Chapter 4. When the hydrograph for the drainage area can be calculated with sufficient reliability, at least at certain flow levels, parameter sets from several calibrate d areas can be tried in order to see which best represents this area. Different values could b e used for some of the minor snow model parameters if there are significant differences in th e typical amount of snow from one area to the next. Soils or vegetation information could p ossibly be used to alter some of the Sacramento model parameters if there is enough confi dence in the relationships between the parameters and these data. Also, the ET-Demand cur ves could vary based on elevation and vegetation cover as described in Section 6-5. A uniq ue channel response function (unit hydrograph) should be derived for each new watershed as described in Section 7-6 as drainage areas and the channel network will vary from one area t o the next.

4. There are two basic cases at this point. The first is that a historical simulation is possible and calculated values can be compared with computed, adjusted, or observed data. The sec ond is that a historical simulation is not possible due to a lack of information.

a. Historical Simulation Possible – In this case two basic situations exist. The first is th at the natural flow from the drainage area, either headwater or local, can be determined. The second is that the effect of the control structures will be included as part of the histo rical simulation as opposed to just modeling natural flow.

When natural flow can be calculated it could be for a headwater reservoir where inflows are derived from storage, outflow, and possibly precipitation and evaporation data; for a headwater location where observed discharges have been adjusted to natural flow conditi ons to correct for diversions, changes in storage, and other factors; or for a downstream l ocation where both local (total minus routed) and total flow, possibly first adjusted for th e effect of control structures, are available. In this situation simulated streamflow is co mpared to these computed “observed” natural flow values. Simulating the flow should only involve the use of snow, soil moisture, and channel response models for the drainag e area and routing models if this is a downstream location.

When the effect of the control structures are being modeled, total simulated discharge is c ompared directly to the total measured observed flow data which contains the effect of th e structures. This involves modeling everything of significance that occurs within the dr ainage area. In addition to snow, soil moisture, channel response, and routing models; r eservoir operations, irrigation usage, and diversions will be modeled.

In both of these situations the aim is produce an unbiased estimate of flow taking into acc ount errors and noise in the data. Water balance components should be examined to ma ke sure they are consistent with adjacent drainages. Precipitation and evaporation value s should be reasonable if the guidelines in Sections 6-3 and 6-5 were followed when the MAP time series and evaporation estimates were generated. Computed runoff values wi ll contain considerable uncertainty when there are large diversions, reservoir effects, or ir

rigated areas or when the local area is small relative to the upstream area. Changes are generally not made to individual snow and soil moisture model parameters unless the hydrograph for the drainage area being modeled can be derived and is of sufficient quality to clearly indicate that such change is justified. When this occurs the magnitude of the change should be significant since the hydrograph is not of sufficient reliability to make minor adjustments. Even if the hydrograph is not well enough defined to isolate the effects and make changes to individual parameters, some general adjustments can often be made to correct for any bias that exists between the computed and "observed" values. This should only be done if there is reasonable confidence that the long term runoff is realistic. In that case, the following types of parameter changes can be considered:

- For volume bias, either overall or seasonal, adjustments can be made to the overall amount of precipitation, the snowfall correction factor, and/or the amount or seasonal variation in ET-Demand.

- For bias related to the magnitude of the flow (e.g. under simulation of low flows and over simulation of high flows), the Sacramento model percolation curve can be shifted upwards or downwards. This is done by changing LZFWM and LZFPM by the same ratio.

If any of these changes are made, it is important to make sure that the resulting values are physically reasonable compared to those for nearby drainage areas.

In this situation most of the effort is involved in calculating the "observed" flow to use and/or in determining parameters for the routing, reservoir, irrigation, or diversion models. The data are not of sufficient quality to allow for many changes to the snow, soil moisture, and local channel response models.

b. Historical Simulation Not Possible – A historical simulation is not possible when there is insufficient information to compute inflows to a reservoir, adjust discharges to natural flow conditions, or model everything of significance that occurred within the drainage area. In many of these cases the information and data necessary to simulate streamflow are available for operational forecasting use, but not historically. In a few cases the data may exist, but the method of operating the control structures are not included in any available modeling operation. One option in these cases is to add a new operation to NWSRFS that will handle the situation. When historical simulation is not possible at a given location within the river basin, the snow, soil moisture, and channel model parameters that were assigned to the drainage area cannot be adjusted. Also, simulated and adjusted instantaneous flows cannot be computed in the normal manner for routing to subsequent downstream locations. In these cases, instantaneous discharges must be generated from mean daily observed flows at the downstream location using the special feature in the CHANGE-T operation for use in calibrating the next point down the river system.