Practice note:

Reach Conceptualisation - Identification of key fluxes

This practice note is one of a set developed to provide consistency and transparency of river system models being used within the Murray-Darling Basin. The notes cover modelling practices, such as naming conventions for folder structures, to model methods, such as for flow routing and residual inflow estimation, and have been developed through a collaboration between the MDBA and Basin States.
This practice note, 'Reach Conceptualisation', describes the general principles that should be followed when conceptualising the reach water balance. This note focuses on the need to decide how the different fluxes in a final calibration model will be represented and have a particular focus on the need to conceptualise both flow and demand components before calibration.

Background
Reach conceptualisation begins with choosing the flow gauges that define the upstream and downstream location for each river reach. After choosing the broad scope of the reach, a detailed conceptualisation for the reach is required that describes how each component (flux) of the water balance (Figure 1) will be represented in the final calibrated model.

The initial flow calibration (routing, losses, net evaporation) may focus on using metered diversions to get a good match of flows at the downstream gauge. This initial flow calibration may not consider water use from unmetered sources (such as diversions from floodwaters or on-farm rainfall runoff harvesting). How the take from unmetered sources will be incorporated into the final model calibration needs to be considered during the conceptualisation of each reach model to ensure that water diverted from unmetered sources are adequately represented where it is known to be an important component of the water balance. Any demand model calibrations that will be required should be considered during the reach conceptualisation phase.

Figure 1: Fluxes that may occur on a river reach

General principles
Before calibration of the reach water balance commences:

1. A conceptualisation of the key fluxes in the reach should be undertaken
2. A conceptualisation for demand modelling for the reach should be undertaken
3. Data should be obtained to aid in the development of the model conceptualisation for each flux.
Recommended high-level method

1. If available, reaches should be defined based on the location of long-term gauges.
2. Determine the key fluxes that need to be included in the reach water balance and decided on how these will be modelled. The conceptualisation of the key fluxes should include:
   a. Identifying the location of any intermediate gauging stations and gauged tributary inflows.
   b. Identifying the location of consumptive and non-consumptive demands (e.g. town water supplies, irrigation demands, other industry demands, environmental demands and floodplain harvesting farms).
   c. Consideration of the magnitude of the surface-groundwater interactions in the reach and if these need to be modelled.
   d. Identifying breakouts and returns that are important for modelling the reach water balance.
   e. Understanding the maximum flow extent and floodway mapping where overland flows or diversions from overland flows are an important component of the water balance.
   f. Deciding on the location of routing links and modelling of net evaporation.
   g. A decision on how, and if, seepage needs to be included in the reach water balance.
3. Conceptualisation for demand modelling should consider:
   a. The types of demand models required for the reach:
      i. Irrigation.
      ii. Urban demands.
      iii. Environmental demands (instream and extractive).
   b. If any of the demands require models to support simulation modelling and if these demand models will require calibration. The flowchart in Figure 2 can provide some assistance in determining how irrigation demands should be represented in each reach when using crop models.
   c. The appropriate scale for modelling each of the demands.
   d. Different sources of water available to the different water users (e.g. groundwater, runoff harvesting, take from a different stream or lakes etc.).
   e. If there is significant water use from unmetered water sources (e.g. flow from overland flows or rainfall runoff harvesting) that needs to be included in the modelling.
   f. If any changes that will be required to demand models between calibration and simulation modelling.
4. Determine what data are available for modelling each of the fluxes, data collation should include:
   a. Flow data.
   b. Climate data.
   c. Residual area of reach.
   d. Location of major irrigation developments including the physical location of supply points.
   e. Diversion data (metered), plus an estimate of unmetered diversions.
   f. Data for irrigation demand model calibration (if required):
      i. Metered diversions (surface and groundwater diversions).
      ii. Planted areas and crop types.
      iii. Permanent on-farm storage information.
      iv. The capacity to have temporary on-farm storage during flood events.
   g. Information relating to breakout relationships.
   h. Information relating to known losses.
i. Information on known surface and groundwater interactions (where this has been identified as important).

5. The conceptualisation process should develop:
   a. A node-link diagram that details the location of:
      i. Breakouts and returns.
      ii. Routing links.
      iii. Known losses (e.g. net evaporation).
      iv. Surface-groundwater interactions.
      v. Consumptive demands (irrigation, town water supplies, industry).
      vi. Environmental demands.
   b. A document to support the node-link diagram, that details:
      i. How demands will be represented in the final calibration model and during simulation.
      ii. If any conceptual changes will be needed to the representation of demands between calibration and long term simulation modelling.

Figure 2: Deciding how to represent irrigation demands using crop models

Companion Practice Notes

- Modelling a reach water balance
- Estimation of unmetered irrigation diversions
- Calibration of crop models
- Modelling urban demands