CRSS-Lite Status Update

November 3, 2004
Las Vegas, NV

Carly S. Jerla
CADSWES/CEAE
University of Colorado

Introduction

- Revisit Requirements
  - Simple, flexible, accurate & fast
- Update of Current Status
  - Historical Ruleset in place
  - Lower Basin detail same as CRSS
  - Accurate results, good runtime

Presentation Overview

- Physical Layout & Methods
- Historical Ruleset
- Data Requirements
- Performance
- Demonstrations
- Possible Scenarios
- Upcoming Work

Physical Layout & Methods (1 of 2)

- Upper Basin above Powell not modeled
  - Monthly data needed from UB, disaggregation scheme would introduce inaccuracies
  - Monthly operation would increase run-time
- Lower Basin detail same as CRSS
- All objects dispatch (solve) annually (flow units: acre-ft/year)
- Power production not modeled in reservoirs, but will be included
- No sedimentation or salt modeled

Physical Layout & Methods (2 of 2)

- Bank storage calculation same as CRSS
  - Coefficient applied to difference of previous and current storage
- Evaporation calculation same as CRSS
  - New evaporation method: MonthlyEvapCalcInAnnualTimestep
  - Requires monthly storages and evaporation coefficients, returns annual evaporation and average coefficient
- Monthly flow requirement of 10 AF/month can't be satisfied
- Mohave & Havasu operated by guide curves

Historical Ruleset – *Design*

- The eight CRSS Operational Rules for Powell & Mead have been combined into one rule that performs monthly computations.
  - Monthly storages are saved on each reservoir
  - Another rule sets the storage slot on the reservoir (used in dispatching) with December's storage
- Rules that set demand schedules on diversion objects (Normal, Surplus, Shortage) & Compute 602a Storage are annual
- With the exception of Mead's operations, all rules are written in RPL (Riverware's rule language) and may be modified by the user.

Historical Ruleset – *Powell*

- Six CRSS Operational Rules for Powell (Spike Flow, Equalization, Limit Outflow, Smooth July Operation, MOR and Operations) have been replaced by functions and are called from one rule.
- Diagnostics are most effective in determining which policy set Powell's storage *(Demonstration)*
- Computation of Powell's spill for Spike Flow

Historical Ruleset – *Mead*

- Two CRSS Operational Rules for Mead (Mead Flood Control & Set Mead Outflow For Demands) are performed in C++ and invoked through a pre-defined function
- Pre-defined function calls a method on Computational Subbasin that accesses needed data on other objects
- Diagnostics can be used to determine if a flood control release was made during the month *(Demonstration)*

Historical Ruleset – *Shortage & Surplus*

- Shortage Rules (80P1050, 80P1083, Level II Shortage) & Surplus Rules (7 States Plan, Assurance Level, Flood Control) set Total Diversion Requested & Total Depletion Requested on Diversion Objects
- Rules fire at the start of each timestep and set the demand schedules which are used by the rule that computes Powell & Mead's storage
- Model Run Analysis most effective in determining how schedules were set *(Demonstration)*

Data Requirements (1 of 2)

- Hydrology
  - Annual local inflows
  - Monthly sums of gains between Powell & Mead
  - Monthly sums of gains below Mead
  - Monthly Qsum (April – July local inflow totals) & TotVal (local inflow totals between reservoirs)
- Demands
  - Annual diversion & depletion schedules
  - Percents to disaggregate all demand schedules to monthly

Data Requirements (2 of 2)

- Other
  - Monthly regulated inflows to Powell
  - Monthly storages for Flaming Gorge, Fontenelle, Blue Mesa & Navajo
  - Initial storages (or pool elevations) for Powell, Mead, Mohave & Havasu

Performance

- Results are within 10^{-4} % of CRSS
- Testing procedure for Mead & Powell rule
  - Comparing monthly storages with CRSS
- Testing procedure for Schedule rules
  - Comparing annual adjusted schedules with CRSS
  - If schedules are wrong, Mead & Powell storages will be wrong
- Testing procedure for reservoir operations
  - Comparing annual inflow, outflow, bankstorage & evaporation with CRSS
- Run-time for 90 traces, 60 years each, approx. 20 minutes

Interpreting & Viewing Model Output

- Many tools available to analyze model results
  - System Control Table (SCT): View current state of the model in compact, easy way
  - Data Management Interface (DMI) Routines, Output Manager and Individual Slot Export as a way to transfer model results to another application for analysis
  - Snapshots & Plotting: powerful tool for analysis within the model

Demonstrations

- Scenario 1: Increase 80P1083 Shortage Trigger
  - Run first with statistically determined triggers
  - Run twice more increasing trigger to 1150 ft & 1175 ft
  - Using Snapshot & Plotting tools, view changes in Mead's pool elevation
  - Using Model Run Analysis, view occurrence of shortages

Demonstrations

- Scenario 2: Operate Powell Without Minimum Objective Release
  - Run first with MOR
  - Delete MOR operation (& Equalization) and rerun
  - Using Snapshot & Plotting tools, view what happens to Powell's pool elevation

Demonstrations

- Scenario 3: Add Diversion Object in Lower Basin
  - Add diversion object, configure and link to reach
  - Import, via DMI, Depletion & Diversion schedules
  - Add new diversion to appropriate subbasin
  - Add monthly disaggregation percents so that diversion will be included in determining demands below Mead.

Discuss Possible Scenarios

Upcoming Work

- More robust testing is needed
- DMI routines refined
- Run multiple hydrologic traces
- Development of an annual power method
- Incorporate comment lines throughout ruleset
- Delivery & training class
- User test plan