Daily River Operations Model (DROM)

River Operations Center (ROC) – Lower Colorado River Authority (LCRA)

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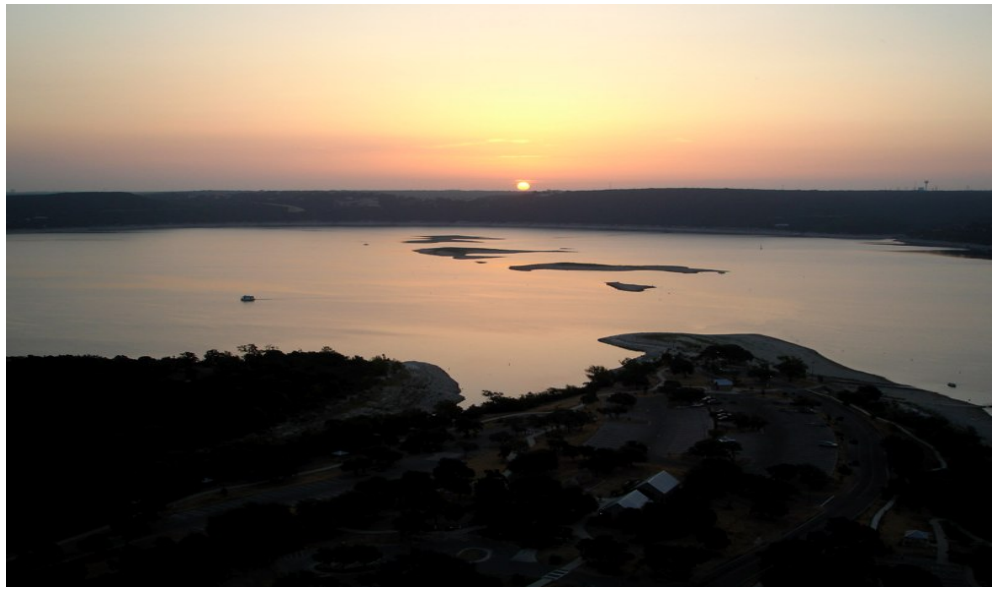
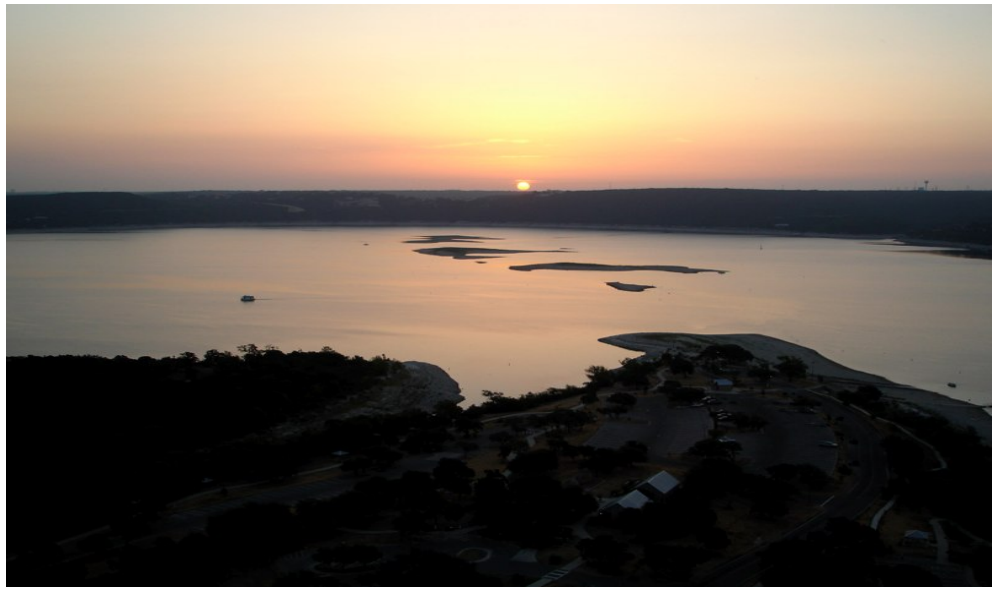
Outline

- Colorado River Background
- Overview of 3 DROM models
- How the models work together
- Benefits of using one platform (RiverWare)

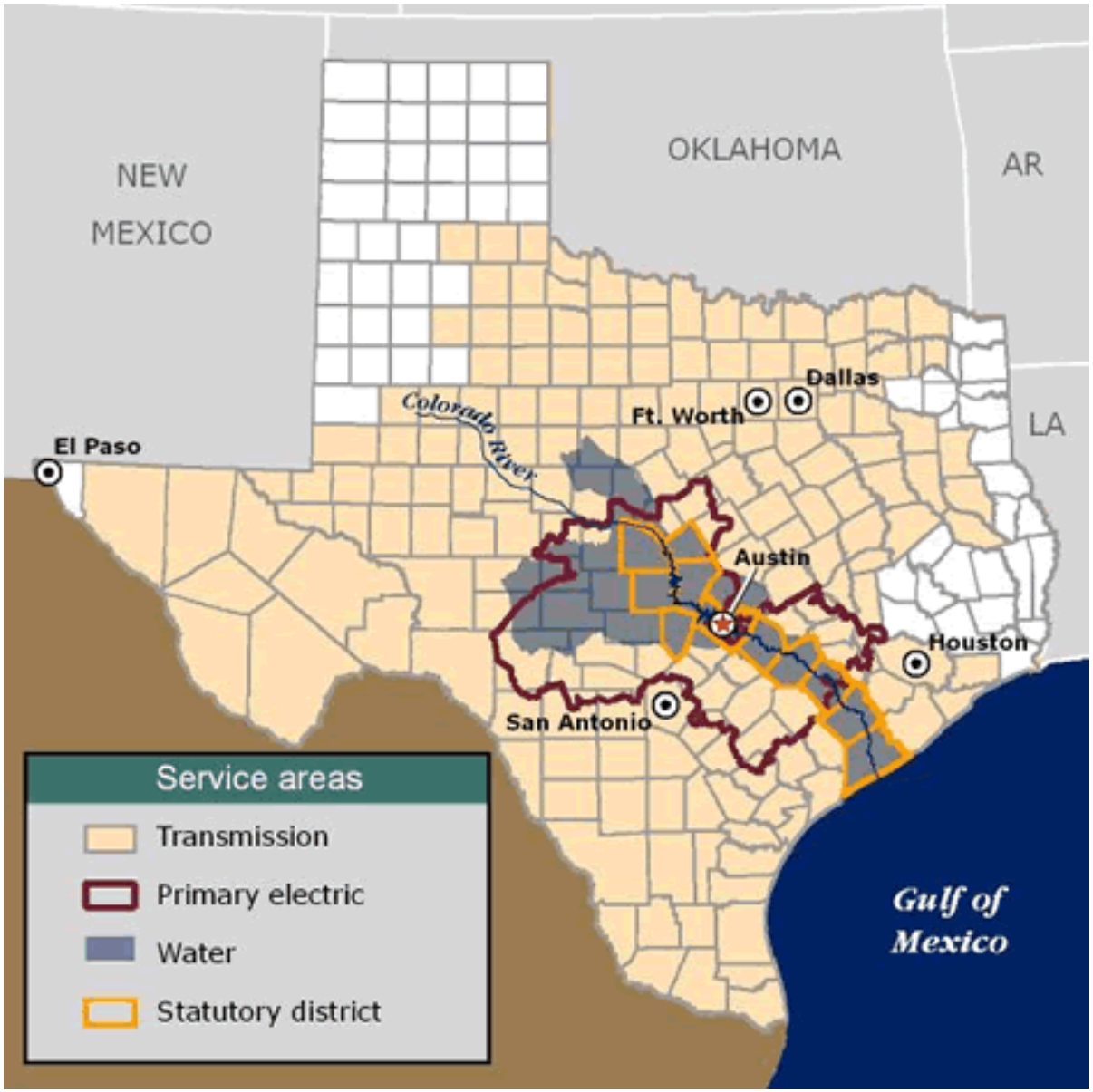


Background

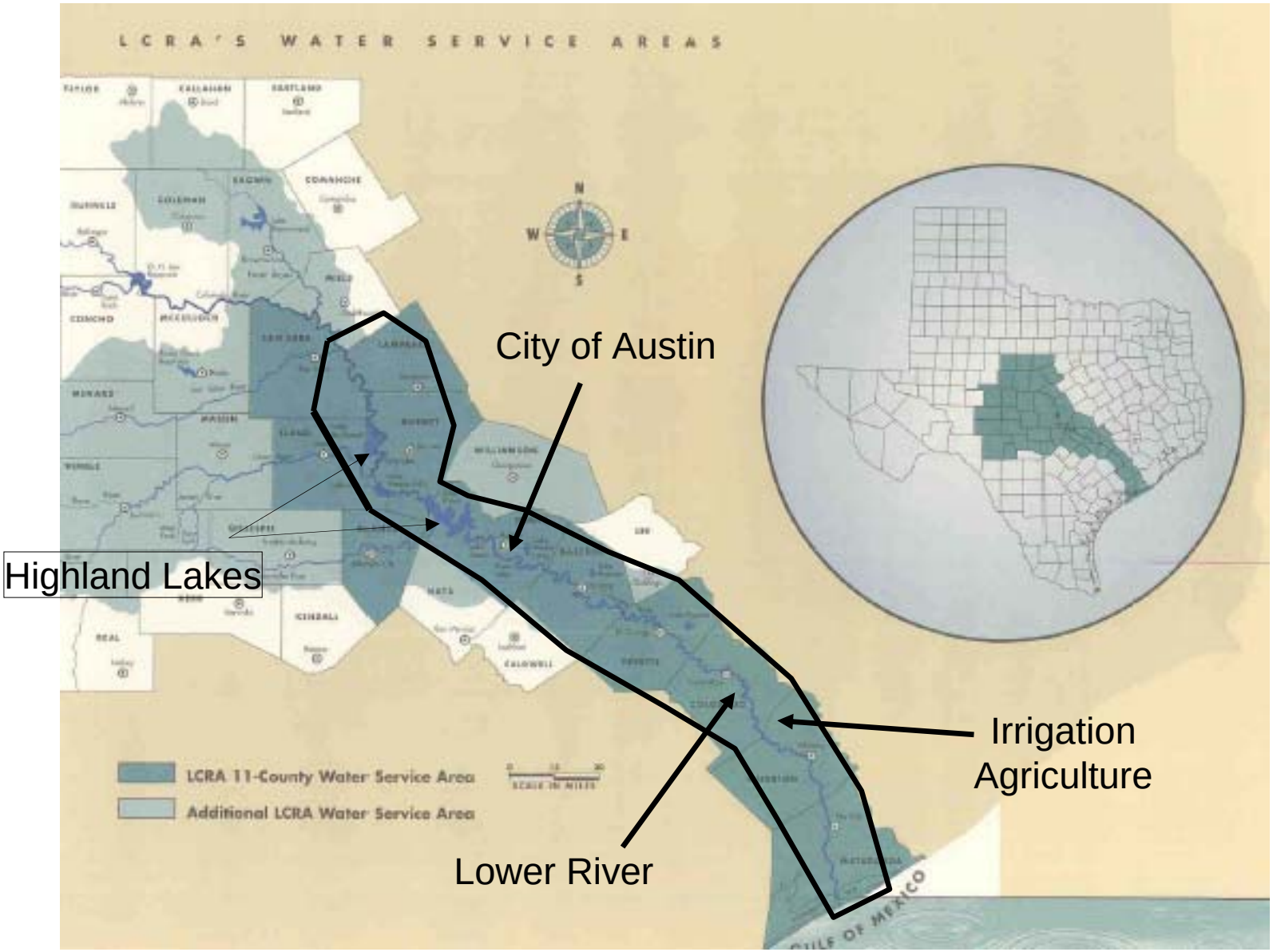
- Previously, RiverWare planning model developed for LCRA Planning Group (LCRA – Brad Vickers – AMEC)
- River Operations Center (ROC) required a daily operations model
  - Determine Daily Releases, hourly routing, monthly/annual accounting
- AMEC retained by Lower Colorado River Authority (LCRA) - River Operations Center (ROC)
- Develop 3 RiverWare Models (DROM)
  1. Daily Release Model (daily timestep)
  2. Routing Model (1 hour timestep)
  3. Accounting Model (daily timestep)



Colorado River – State of Texas



Lower Colorado River – Basin Map



Background

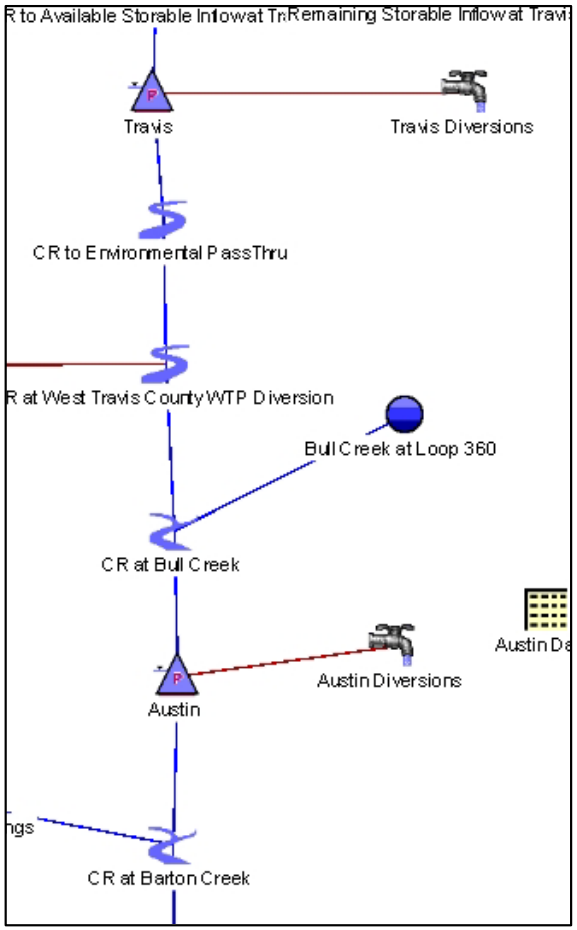
- Lower Colorado River Administered as Prior Appropriation Water Rights System – Use RiverWare's Water Rights Solver
- Run-of-River (natural flows) and Stored Water (Firm and Interruptible Contracts as backup)
- Municipal, Industrial, Irrigation, Agriculture
- Instream Flow Targets
- Environmental Flows to Bay (monthly volume)

Daily Release Model

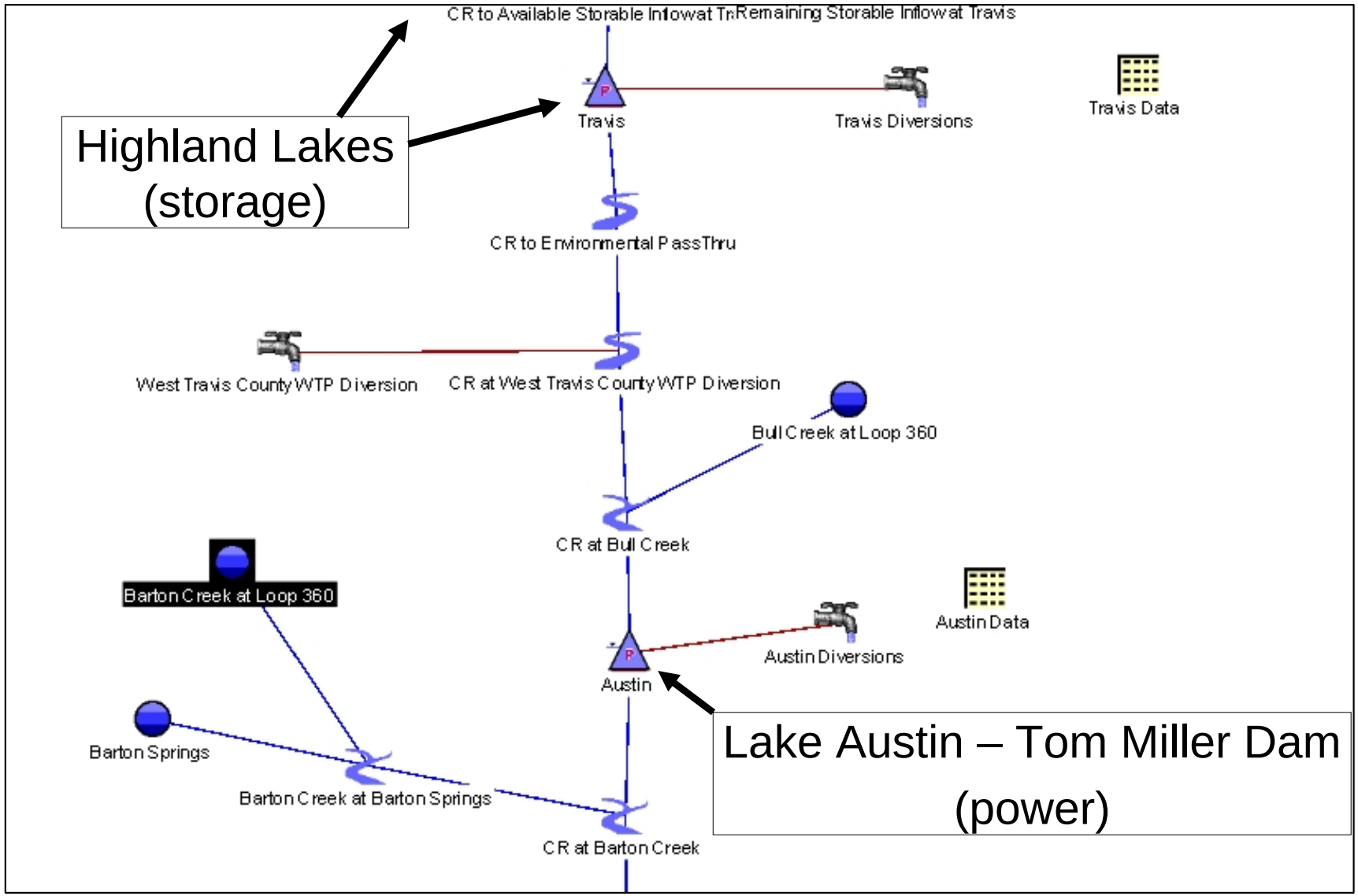
- Determine daily release volume from Lake Travis (Mansfield Dam) and Lake Austin (Tom Miller Dam)
  - Minimum required release to meet downstream demands, instream flow targets, and environmental flows to bay – Water Rights Solver
  - Suggested operation of Buchanan and intermediary lakes

- Inputs
  - Forecasted inflows to Highland Lakes and tributaries to lower river
  - Municipal and Irrigation Demands as orders

- Output
  - Projected daily releases at future timesteps (forecasted releases) 2-3 days out

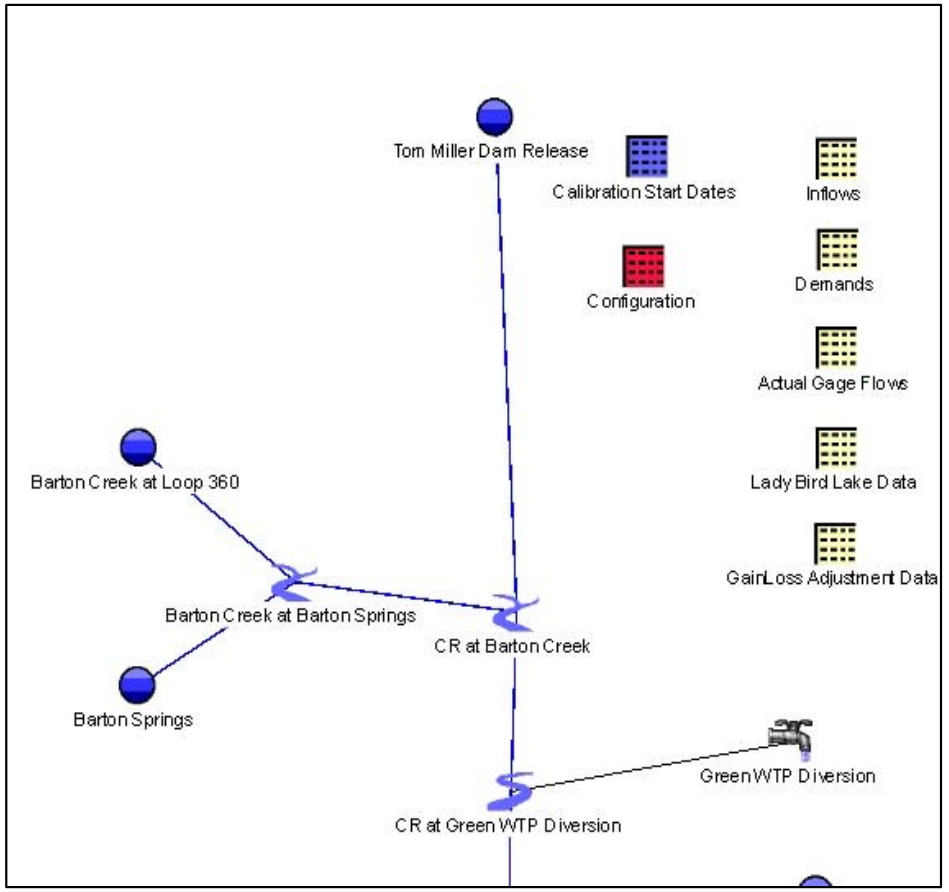


RiverWare Schematic



Routing Model

- Hourly timestep
- Begins at Tom Miller Dam
- Variable Time Lag Routing
  - Travel time study performed by LCRA at various flow rates
- Storage routing for flow attenuation
  - Added during calibration process
- Inputs
  - Hourly Tom Miller Dam Release schedule
  - Diversion orders
  - Lower river inflows
  - Base flow (gains/losses)
- Outputs
  - Flow rate at gage locations (ISF targets)
  - Flow rate a diversion locations (shortage)



Routing Model Results

- Given hourly release schedule:
  - “Gaps” at the instream flow locations
  - “Gaps” at the diversion locations
- Given actual gage flows:
  - Calculate ungaged surface inflows
  - Calculate base flows
- Two Main Purposes:
  1. Primary – ensure that hourly release schedule does not result in “holes” downstream
  2. Secondary (unintended) – use for base flow studies to adjust base flows seasonally

Accounting Model

- Performs “after the fact” accounting to allocate run-of-river and stored water – Water Rights Solver
- Very Similar to Daily Release model
  - Daily timestep
  - Releases input, computes resulting breakdown of RoR/Stored Water use

- Run monthly to determine water use and purpose of releases
- Run annually to determine annual water use and accounting
- Two “Modes”
  1. Reporting customer use of run-of-river vs. stored water
  2. Reporting on reservoir releases
     - Run-of-river bypass
     - Stored water release
     - Purpose of releases (irrigation, municipal, environmental and instream flows)

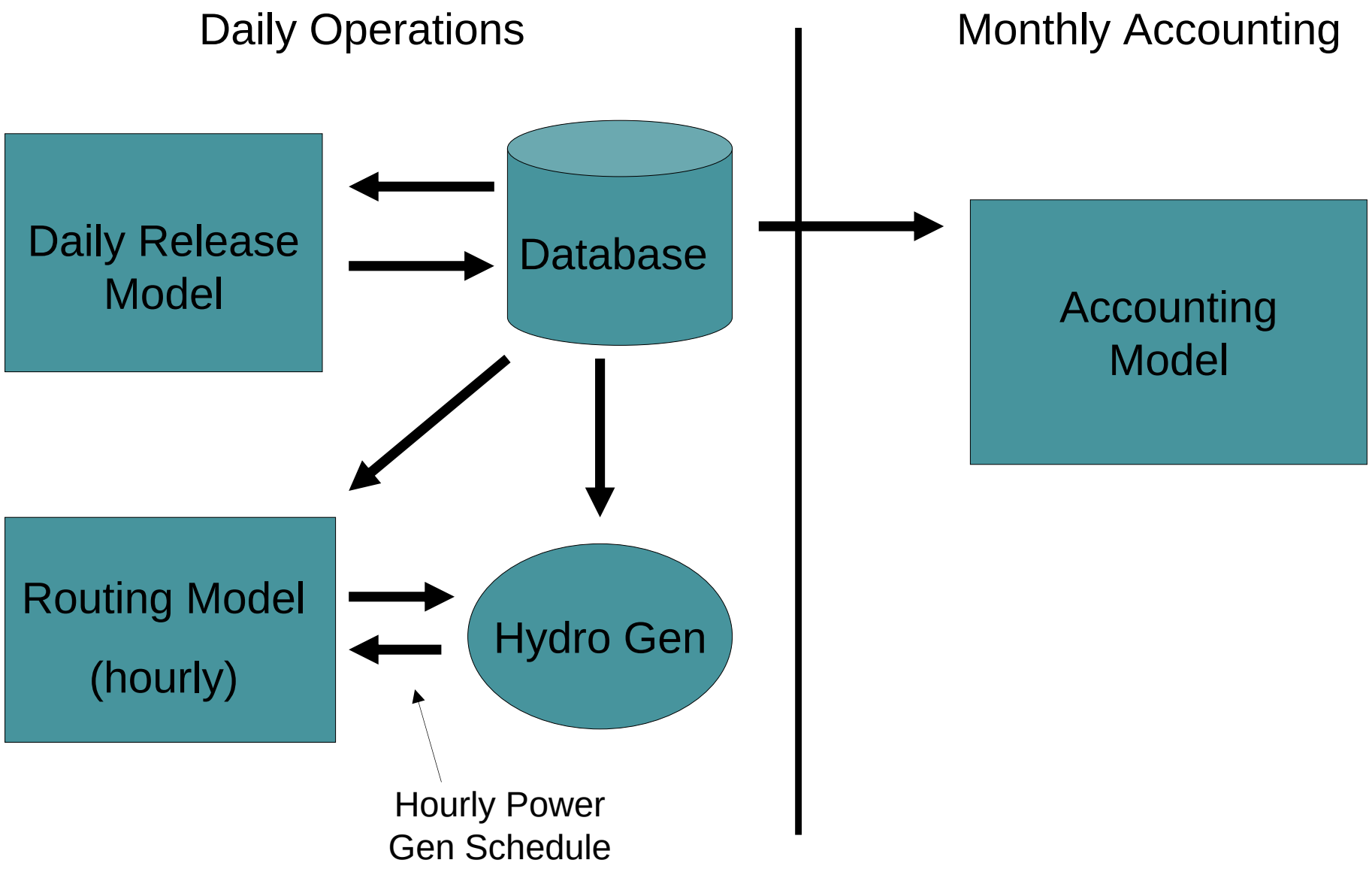
Daily Accounting Model

- Mode 1 – Customer Use
  - Inputs: actual inflows to highland lakes and lower river, actual reservoir releases and levels, actual diversions
  - Outputs: breakdown of run-of-river vs. stored water diversions for each customer/diversion point
- Mode 2 – Intent of Release
  - Inputs: actual inflows to highland lakes, actual reservoir releases and levels, *forecasted* lower river inflows, *orders* at diversion locations
  - Output: breakdown of reservoir releases by intent of release – stored water vs. run of river
    - For each, breakdown into municipal, irrigation, environmental, etc…

Model Interaction – Daily Release and Routing Model

1. Run daily release model to determine minimum daily release volumes
2. Send results to hydropower generation desk
3. Shape daily volume to hourly release schedule
4. Run routing model to verify hourly release schedule
5. Repeat steps 2-4 if necessary (without violating min flow in step 1)

DROM Schematic



Summary

- RiverWare used for all three DROM models
- All models use same schematic (routing model begins at Tom Miller)

- For Daily Release and Accounting Model…

- Same accounting system
- Same "core policy logic" – same core RiverWare rules for daily release and monthly/annual accounting – Water Rights Solver
- Consistent platform and logic for all three models. Benefits…
  - Consistent comparisons
  - Evaluate system and operating efficiency by comparing daily release and accounting models
  - Consistent platforms and logic allow for "apples to apples" comparison
  - Performance studies

Questions?