Surface Water-Groundwater Connectivity Under Dam Operations and Potential Trajectories Under Drought

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+ Research Group
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Hydropeaking

USGS 08158000 Colorado Rv at Austin, TX

Gage height, feet


--- Provisional Data Subject to Revision ---

- Gage height
- Measured gage height
Flushing and filling of an island

River stage (m.a.s.l)

1:00 PM

Contour interval = 0.1 m

Water table elevation (m.a.s.l)

Scale: 50 m
How much water went in and out?
Bed-to-bank studies
Water table and head fluctuations
Dynamic thermal regime in the bed

7/7/09 4:00 PM

Elevation (m)

Distance From Bank (m)

Temperature (°C):
- 30.0°C
- 29.5°C
- 29.0°C
- 28.5°C
- 28.0°C
- 27.5°C
- 27.0°C
- 26.5°C
- 26.0°C
- 25.5°C
- 25.0°C
Dynamic thermal regime of riverbed sediment
Electrical Resistivity Tomography
Mixing of groundwater and river water in the riverbed
Delineation of Mixing Zones

GW res = 8.25 Ωm
The LCR is naturally groundwater (base) flow fed.

Larkin and Sharp, 1992
Exchanges fluxes between the river and aquifer across the bank.

Water levels of river (black) and near-stream wells:

↑ Flow out of the river

↓ Flow into of the river
The STREAM is not a PIPE — Ken Bencala (USGS)
Revising the prevailing model

- Larger pressure gradients (up to 3 orders of magnitude larger)
- Shorter time-scales but larger length-scales
- Interfacial exchange is less patchy (no scattered upwelling/downwelling areas)

Potential Biogeochemical and Ecological Consequences

- Thermal perturbation of near-stream zones and buffering of the river
- Diurnal cycles are altered in the stream, riparian zone and hyporheic zone
- No well-established redox ladder in the near-stream zone
- Less contact time for non-equilibrium processes
Long-term and seasonal variation in water releases
No change yet in release regimes with last year’s drought
Under a drought regime, there will be adaptive management of water releases

Therefore, we need to think about the following processes or effects on them:

1) Downstream thermal regime: habitat quality, temperature dependent uses
2) Increase/decreases in baseflow contribution to rivers, and changes in coupling of rivers and aquifers
3) Surface and subsurface flow regimes in riparian zones
4) Flow regimes in hyporheic zones
5) Intelligent and holistic methods in modeling and management of the river-aquifer continuum