Simulating How to Decrease Water Shortages in the Lower Republican River Basin Using New Management Options

Photo: Omaha World-Herald

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KU KANSAS GEOLOGICAL SURVEY
The University of Kansas

Kansas Water Office

Past Conflict

- Republican River Compact between Kansas, Nebraska, and Colorado signed December 31, 1942.
- Kansas filed suit in US Supreme Court against Nebraska in 1998 over Nebraska's overuse. Settled case in 2002, developing Final Settlement Stipulation.
- During subsequent dry periods Nebraska continued to overuse water and Kansas filed suit in the US Supreme Court again in 2010. Decided in favor of Kansas in 2015.
- August 24, 2016 signed 'Resolution approving long-term agreements related to the operation of Harlan County Lake for compact call years"

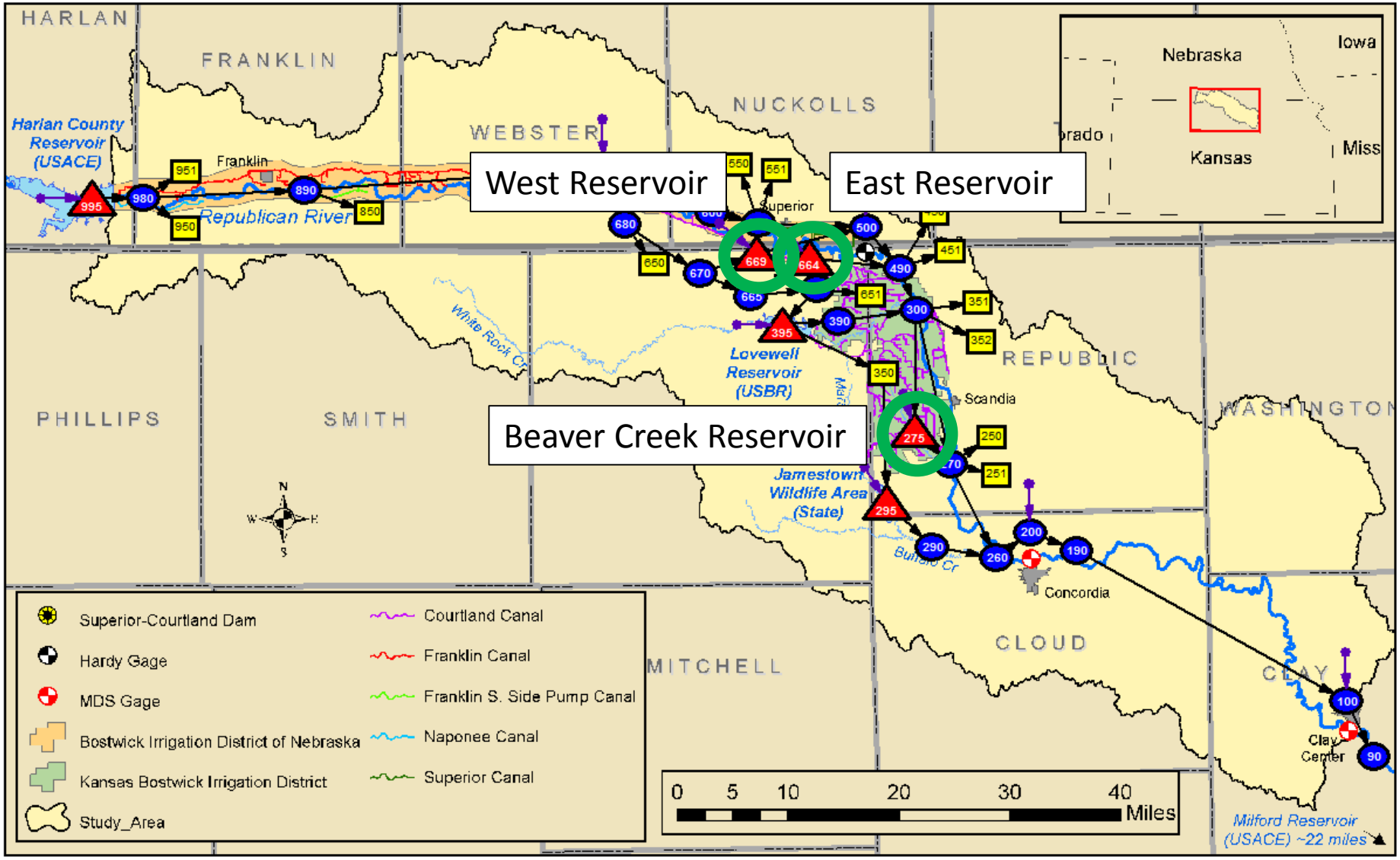
New Resolutions

- Established Remaining Compact Compliance Volume
  - Water stored ‘in the ground’ by NE for KS use
- Established Supplemental Account in Harlan County Lake (HCL)
  - Mechanism to store additional water for Kansas’ exclusive use in HCL, including for junior water rights downstream of HCL

Objectives

- **Using new management options, reduce water shortages in the Lower Republican River Basin (LRRB)**
  - Kansas Bostwick Irrigation District (KBID)
  - Junior water rights (forming an access district; AD)
- Simulate water management scenarios
  - Change operations of current reservoir
  - Construct new reservoirs
- Simulate climate scenarios
  - Baseline climate
  - Hot and dry climate

Lower Republican River Basin Model - OASIS



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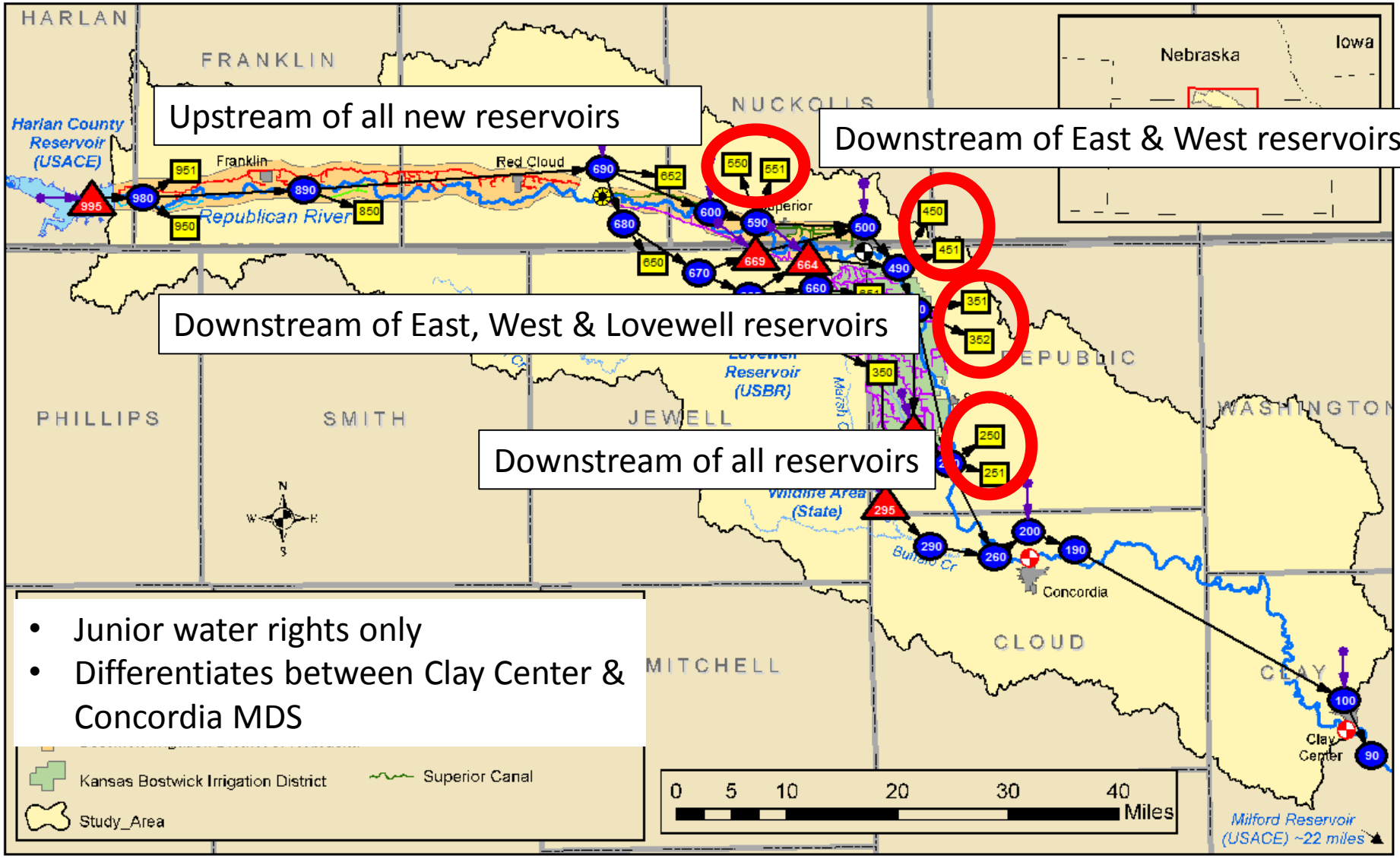
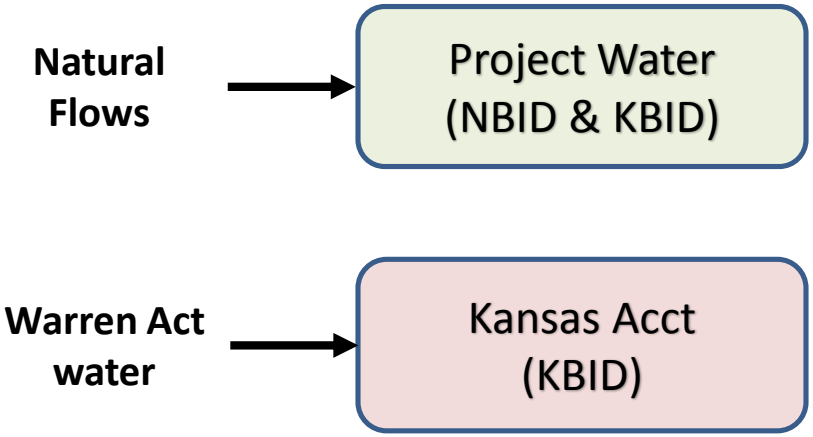


- Junior water rights only
- Differentiates between Clay Center & Concordia MDS

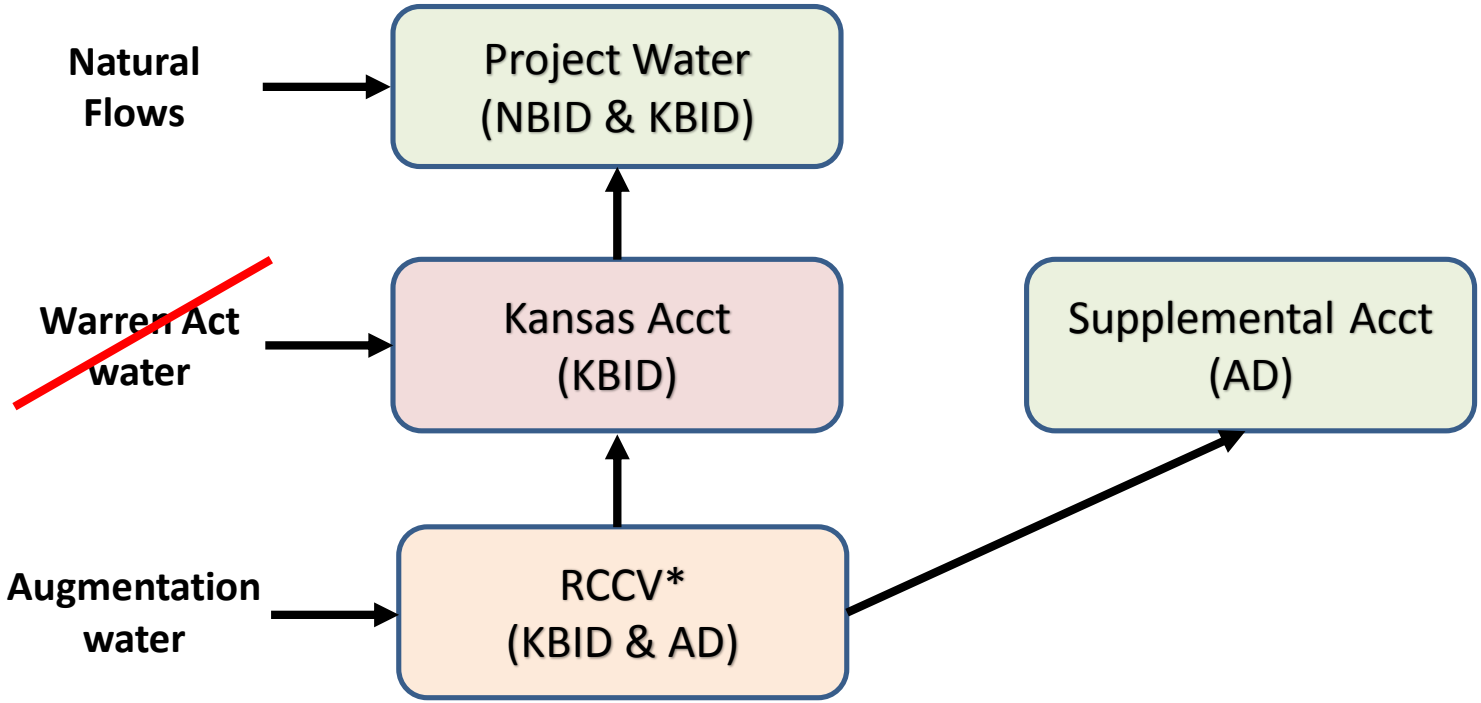
HCL Operations

- Original distribution of irrigation water in HCL:



HCL Operations

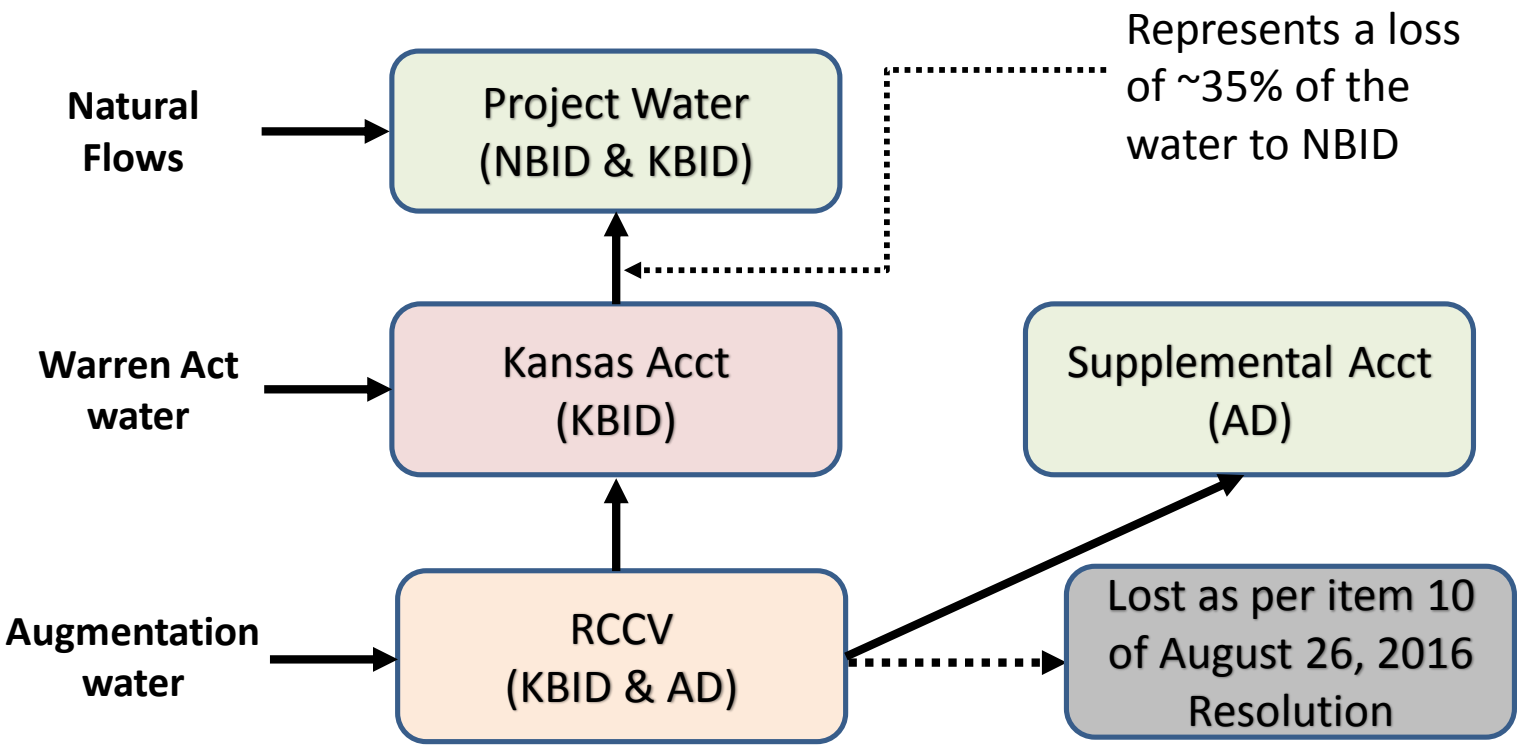
- New distribution of irrigation water in HCL:



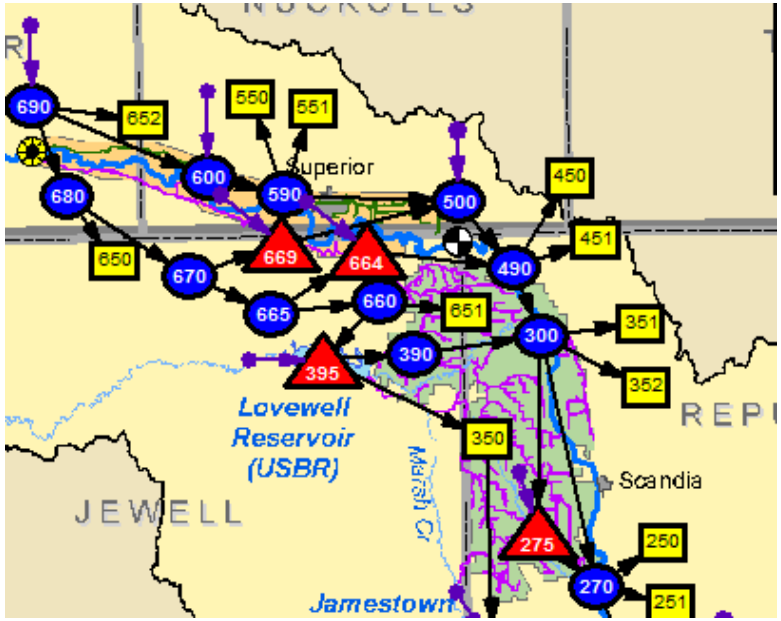
*Remaining Compact Compliance Volume

Optimize Kansas' Use

- Minimize system losses and water shortages



New Reservoir Management



Inflows:

- Runoff
- Republican River

Outflows:

- Evaporation
- AD demands

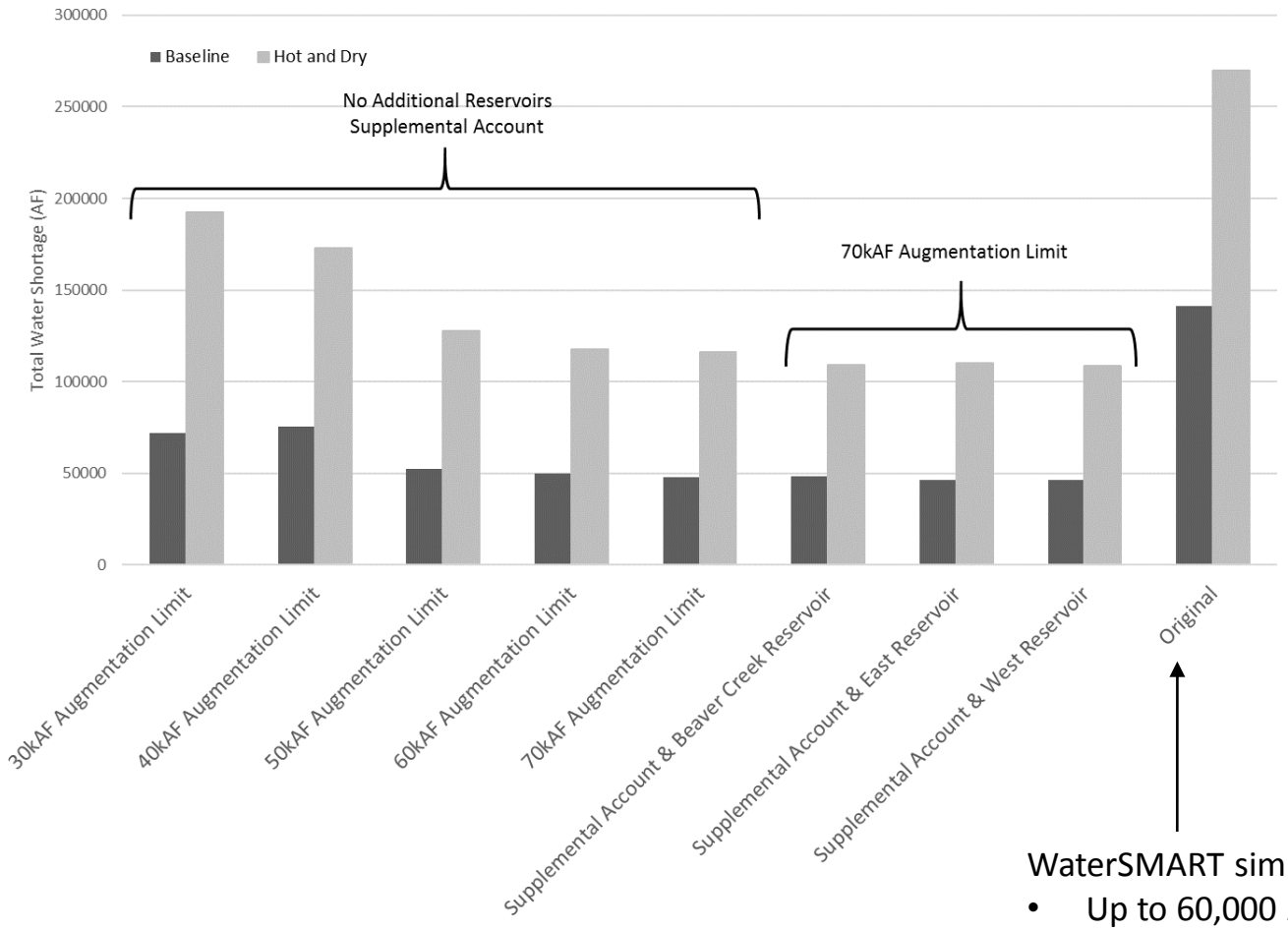
MDS Administration:

- Operate junior to MDS
- During MDS administration all inflows pass through to rivers

Scenarios

- 8 scenarios for both baseline and hot and dry climates
  - RCCV only (no reservoirs) with variable maximum yearly augmentation volume
    - 70,000 AF
    - 60,000 AF
    - 50,000 AF
    - 40,000 AF
    - 30,000 AF
  - RCCV with maximum of 70,000 AF of augmentation volume with:
    - East Reservoir
    - West Reservoir
    - Beaver Creak Reservoir

Results: KBID Water Shortages

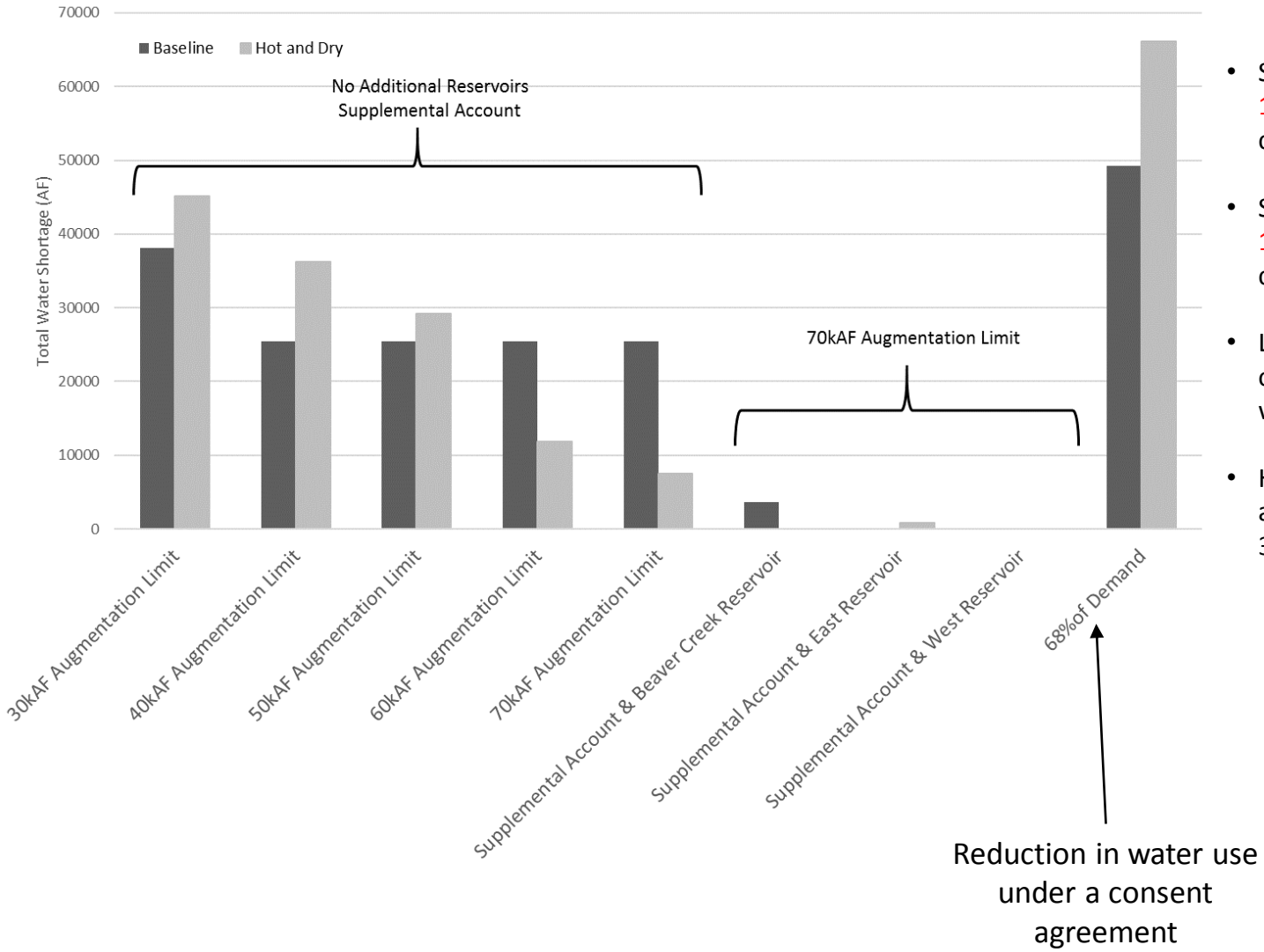


- Shortages reduced by between 71% and 47% for baseline climate.
- Shortages reduced by between 58% and 29% for hot and dry climate.
- Largest reduction under operation of any reservoir with supplemental account.
- Highest shortages when augmentation is limited to 40,000 AF/yr or lower.

WaterSMART simulation:

- Up to 60,000 AF Warren Act purchase
- No Augmentation Water

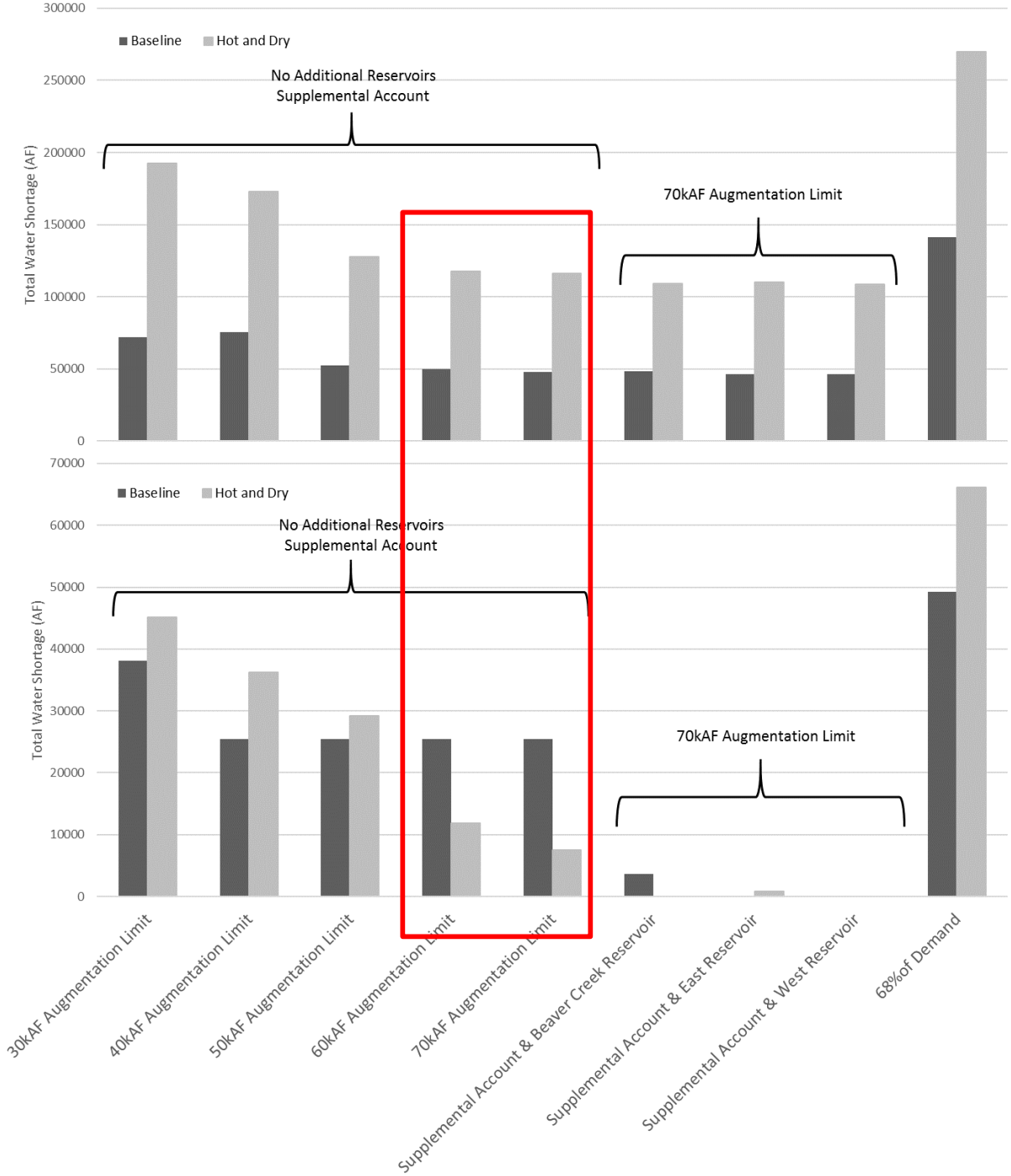
Results: AD Water Shortages



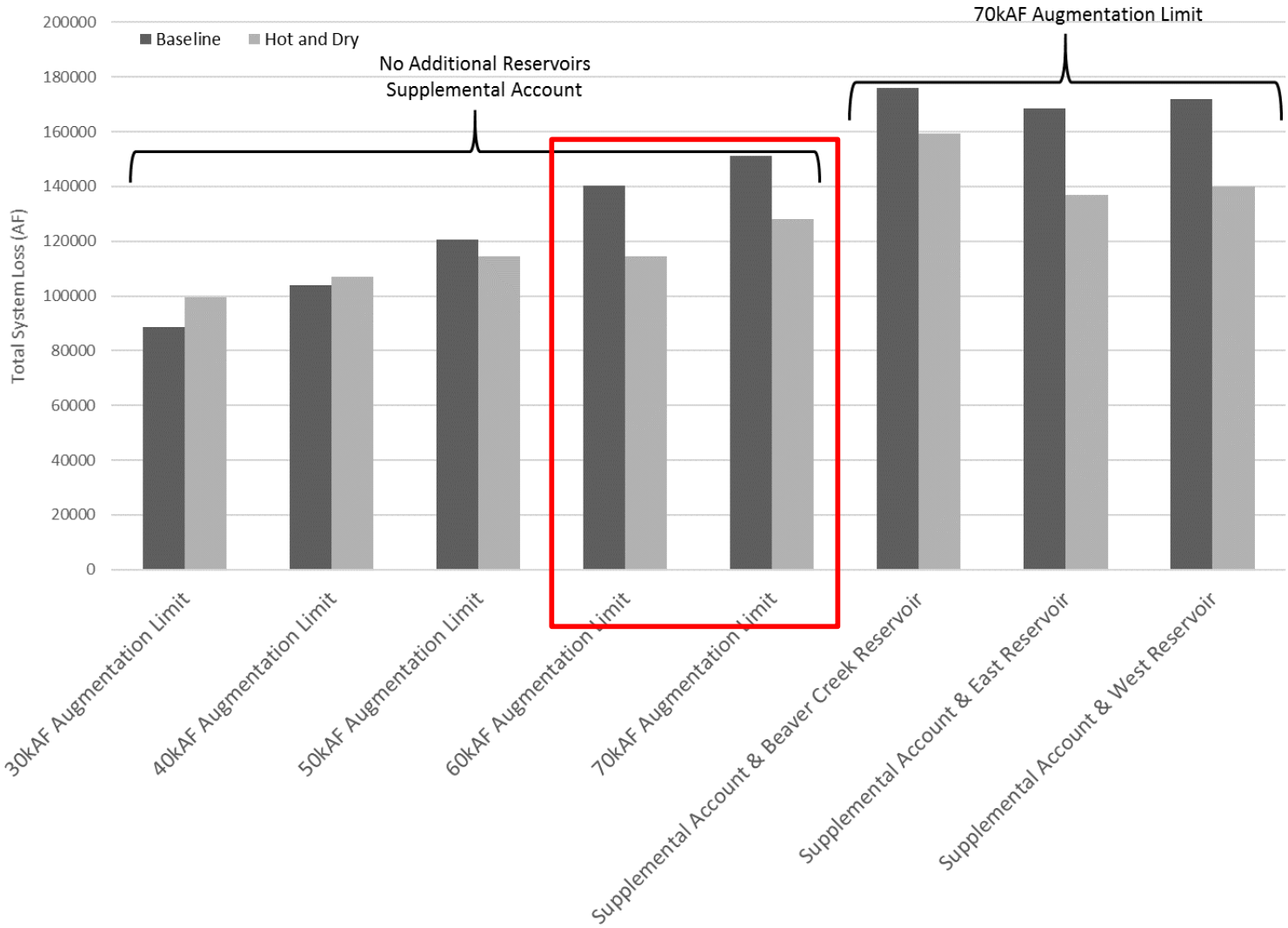
- Shortages reduced by between 100% and 23% for baseline climate.
- Shortages reduced by between 100% and 20% for hot and dry climate.
- Largest reductions under operation of a new reservoir with a supplemental account.
- Highest shortages when augmentation is limited to 30,000 AF/yr.

KBID

AD


Baseline
Hot and Dry
No Additional Reservoirs
Supplemental Account
70kAF Augmentation Limit
Total Water Shortage (AF)
300000
250000
200000
150000
100000
50000
0
70000
60000
50000
40000
30000
20000
10000
0
30kAF Augmentation Limit
40kAF Augmentation Limit
50kAF Augmentation Limit
60kAF Augmentation Limit
70kAF Augmentation Limit
Supplemental Account & Beaver Creek Reservoir
Supplemental Account & East Reservoir
Supplemental Account & West Reservoir
68%of Demand

Results: Total System Loss



Conclusions

- All management options reduce water shortages
- Need a better idea of augmentation volumes to understand effectiveness of AD
  - So far volumes have been at or less than ~40 kAF
- Reservoirs reduce shortages, West and Beaver Creek more than East.
  - Dependent on reliability of inflow data
- Lots of parameter uncertainty that makes it difficult to assess the results.

Future Work

- Assess uncertainty of environmental and management factors
  - Inflow to Harlan Reservoir
  - Augmentation volumes
  - Climate conditions & their effect on reservoir inflows
- How to optimize distribution of water from RCCV
  - When to allow AD to transfer to supplemental account
- Revisit option to expand Lovewell reservoir
  - By 16 kAF or 25 kAF

Thank you!

Photo: Kansas Wildlife, Parks & Tourism