

Underground Storage Techniques

Present Projects and Future Possibilities

By James L. Jehn

“Whiskey is for drinking, Water is for Fighting” Mark Twain

“When you come to a fork in the road, take it.” Yogi Berra

Conjunctive Use

Can Be Defined As

In water resource planning, conjunctive use may be defined as managing surface water and ground water together to maximize yields and balance the natural cycles of wet and dry periods.

Important Elements Are

- Storage of Water in an aquifer during times when it is available.
- Water for aquifer storage can be obtained from renewable sources such as: surface water runoff or tributary water from streams when available, or from sources such as other aquifers and even treated effluent.
- Withdrawal of the water from storage in an aquifer is done when needed (i.e., during drought or to meet peak demands.)
- Less evaporation and fewer environmental impacts than surface storage

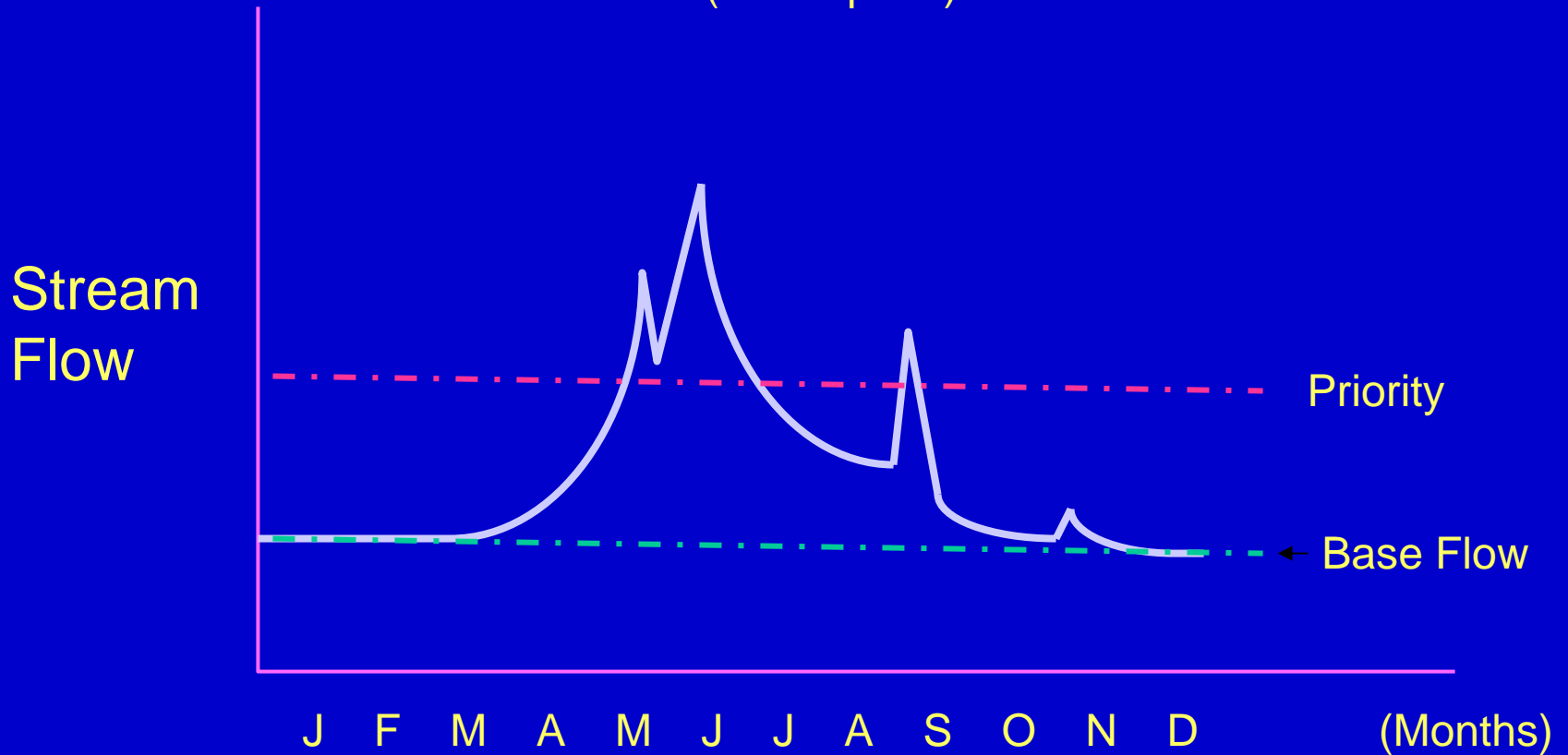
Conjunctive Use

Examples

- Injection Well and Withdrawal
 - Out of Same Well
 - Out of Other Well(s)
- Infiltration Basin/or Trenches - Withdrawal Out of Well(s)

Surface Water Sources In-Priority

(Conceptual)



Conjunctive Use

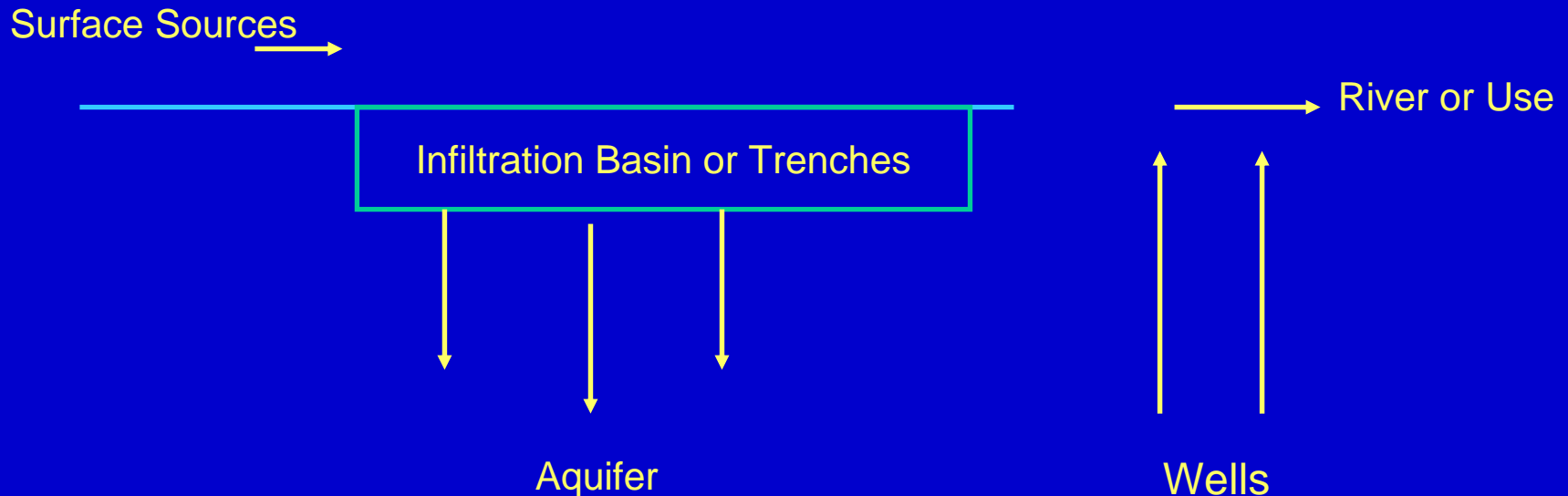
Three Projects

- Central Arizona Project (CAP)
- Centennial Water and Sanitation District Injection Wells and Withdrawal
- Castle Pines Metropolitan District Injection Well and Withdrawal

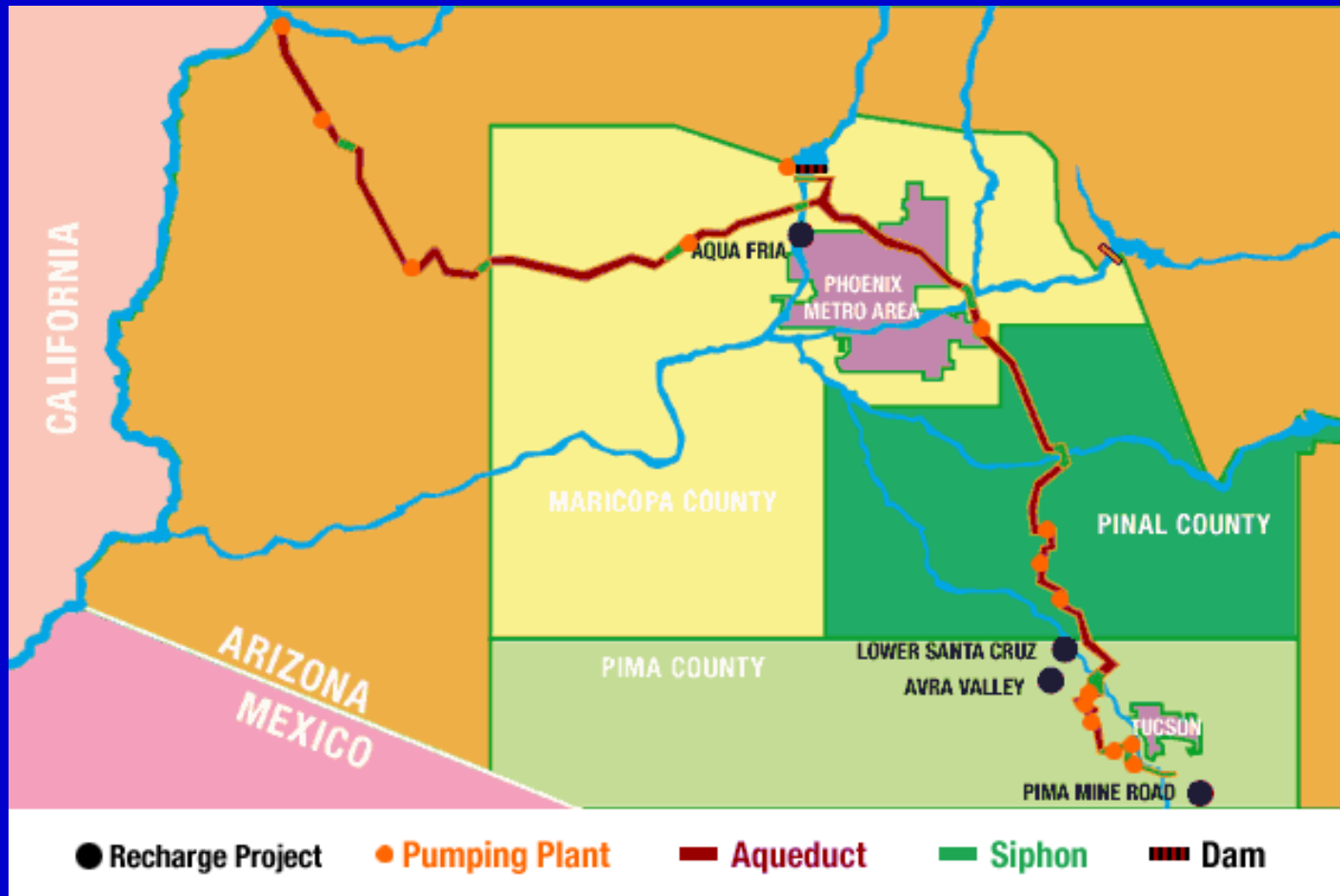
Central Arizona Project

- Surface Water Diversions from the Colorado River
- Diversions into Infiltration Basins, Recharge Trenches, and River Beds

Surface Water Recharge Project



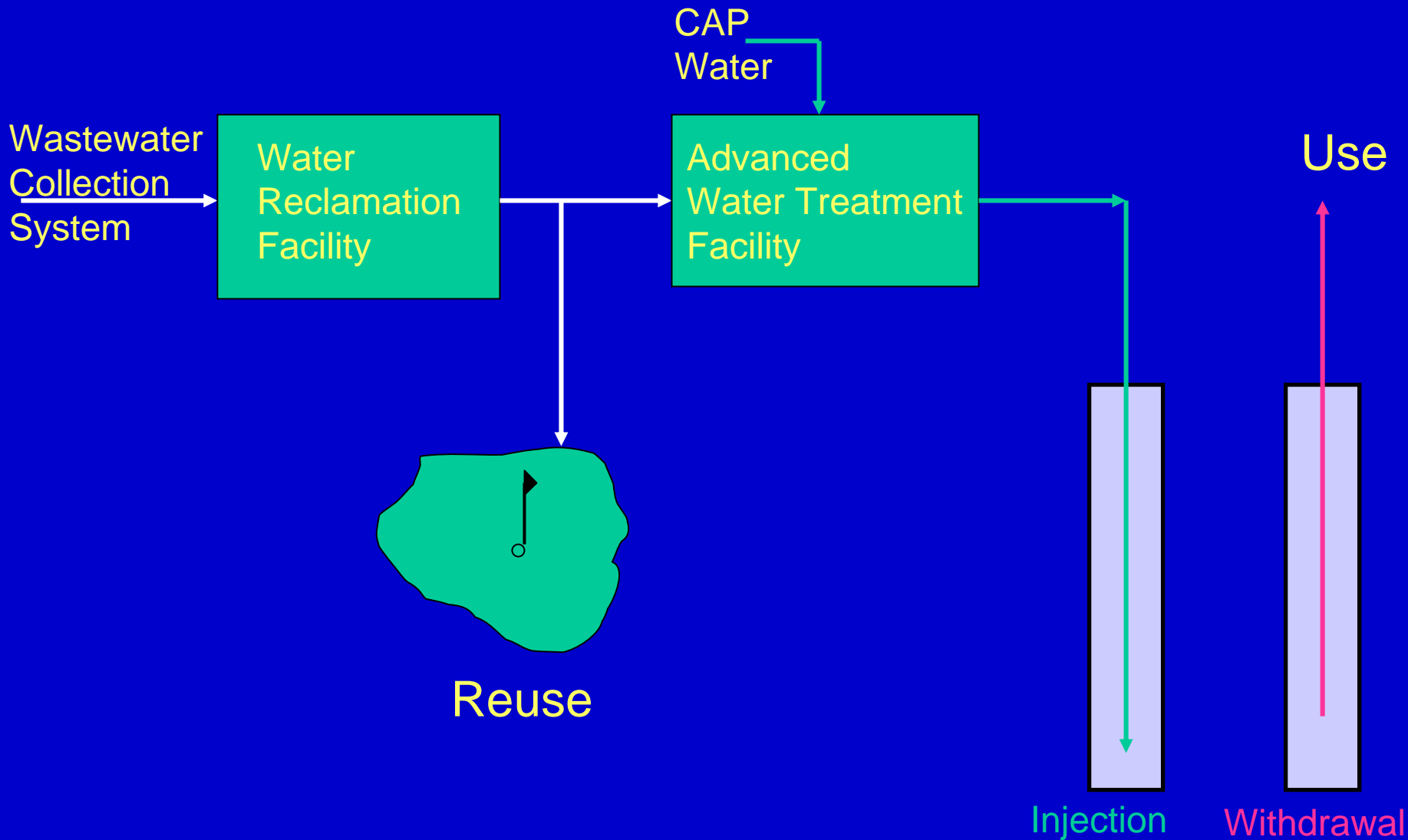
Central Arizona Project



Central Arizona Recharge Project

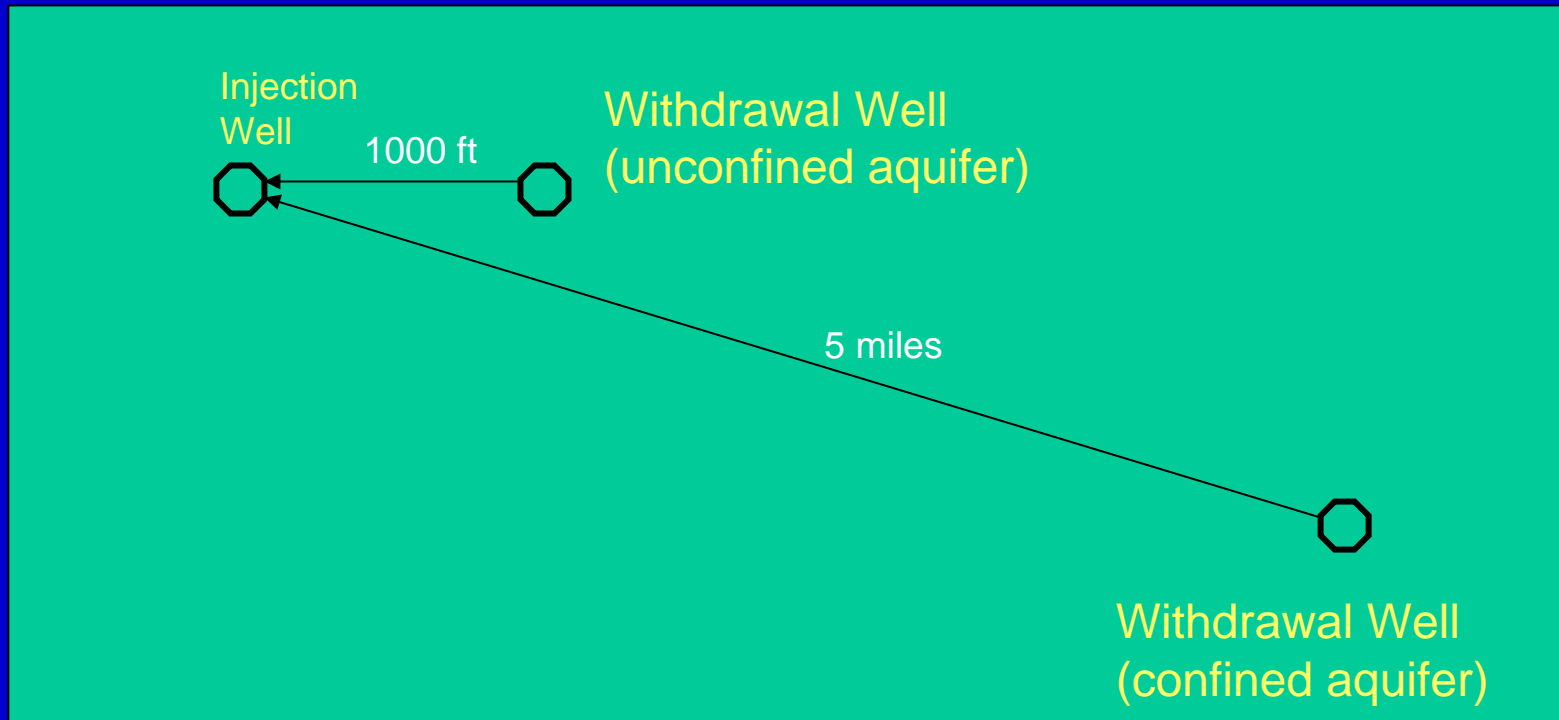


City of Scottsdale



Denver Basin Artificial Recharge Extraction Rules

Land Parcel



Centennial WSD and Castle Pines MD Conjunctive Use Projects

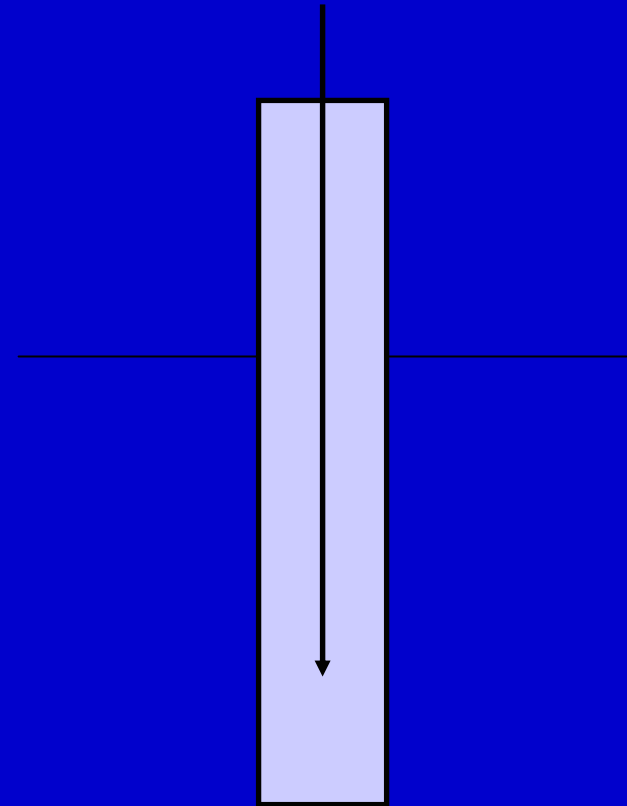
Aquifer Storage and Recovery

- Highest Demands Occur Yearly During Summer
- Diversion and Storage Occurs During Winter and Spring
- Water Available From a Variety of Sources
 - Surface Water Sources In-Priority
 - Other Aquifers

Injection and Withdrawal Well

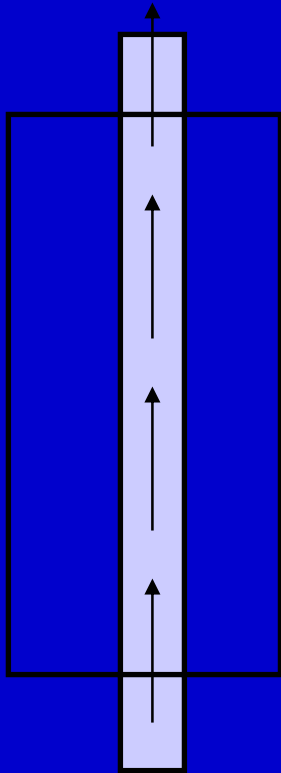
Methods

- Injection Tubes (orifice plate)
- Pump Impeller Adjustment
- Annulus Recharge
- Downhole Flow Control Valve

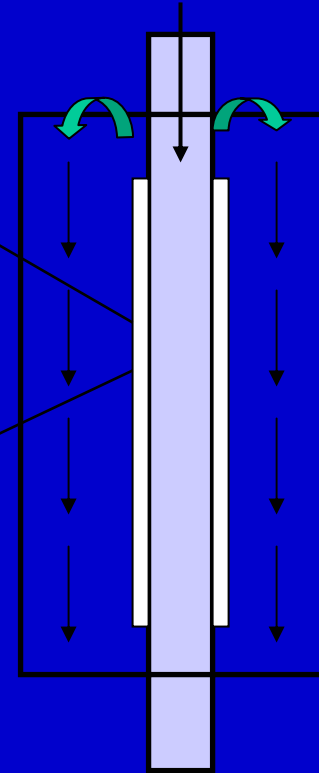
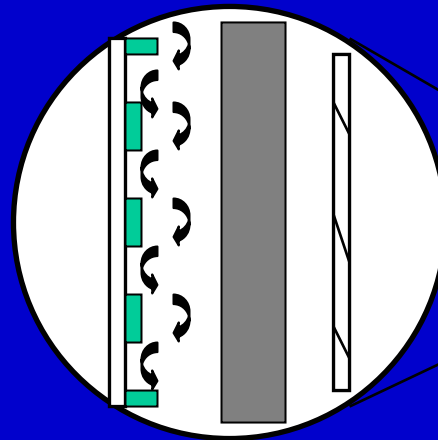


Downhole Flow Control Valve

(Conceptual)



Withdrawal
Check Valve Open



Injection
Check Valve Closed

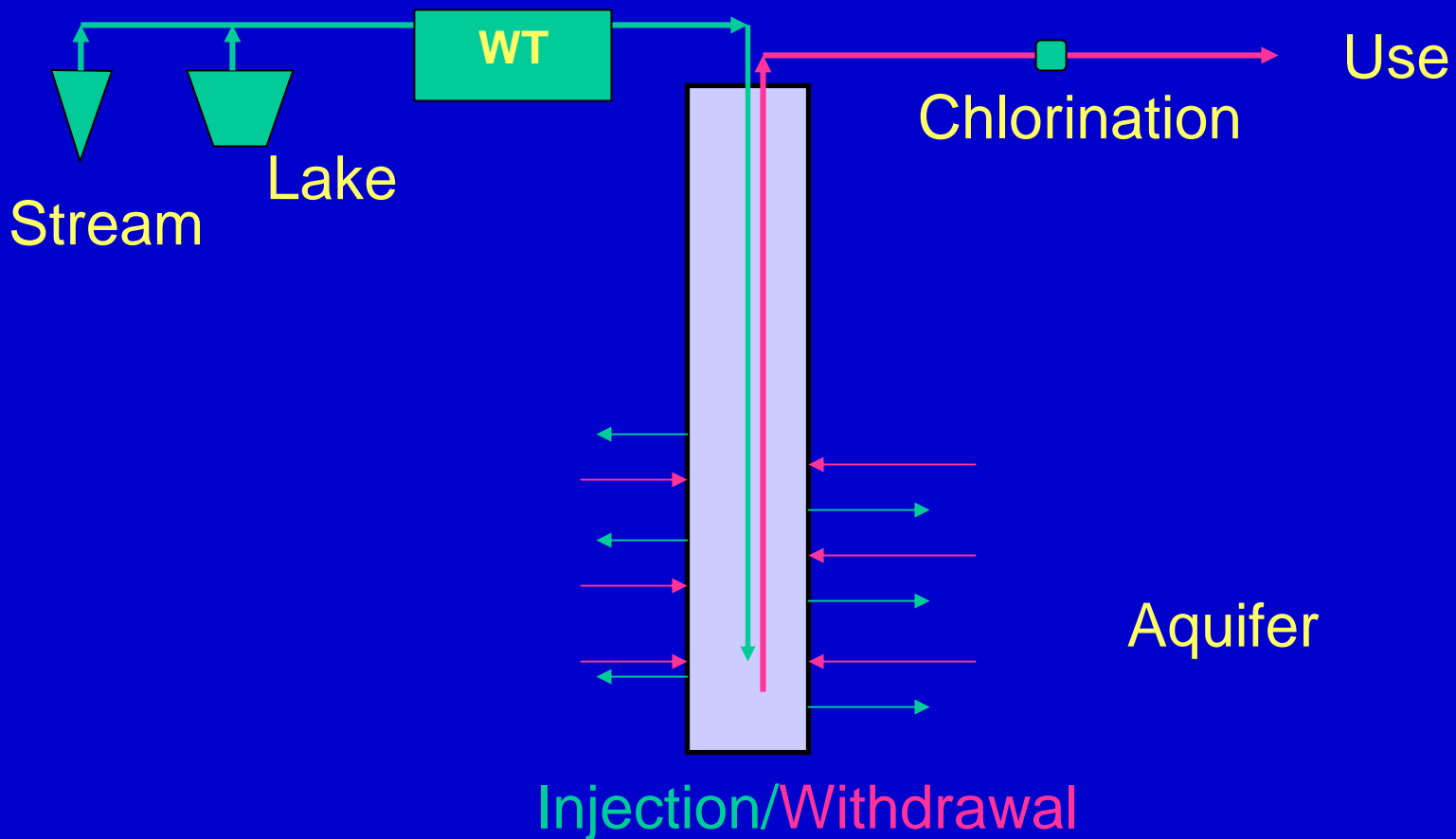
Downhole Flow Control Valve

(Actual)

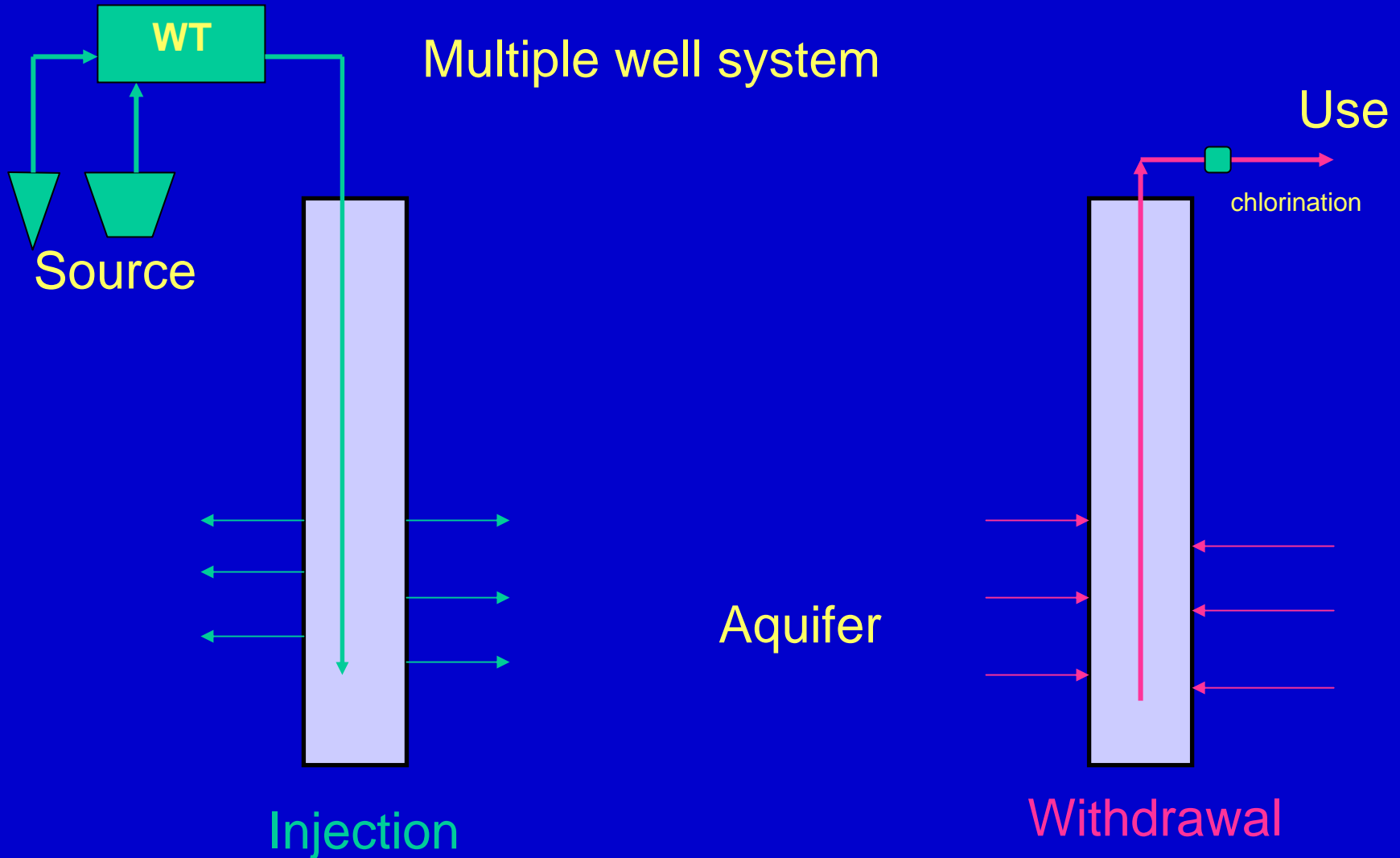


Surface Water Sources

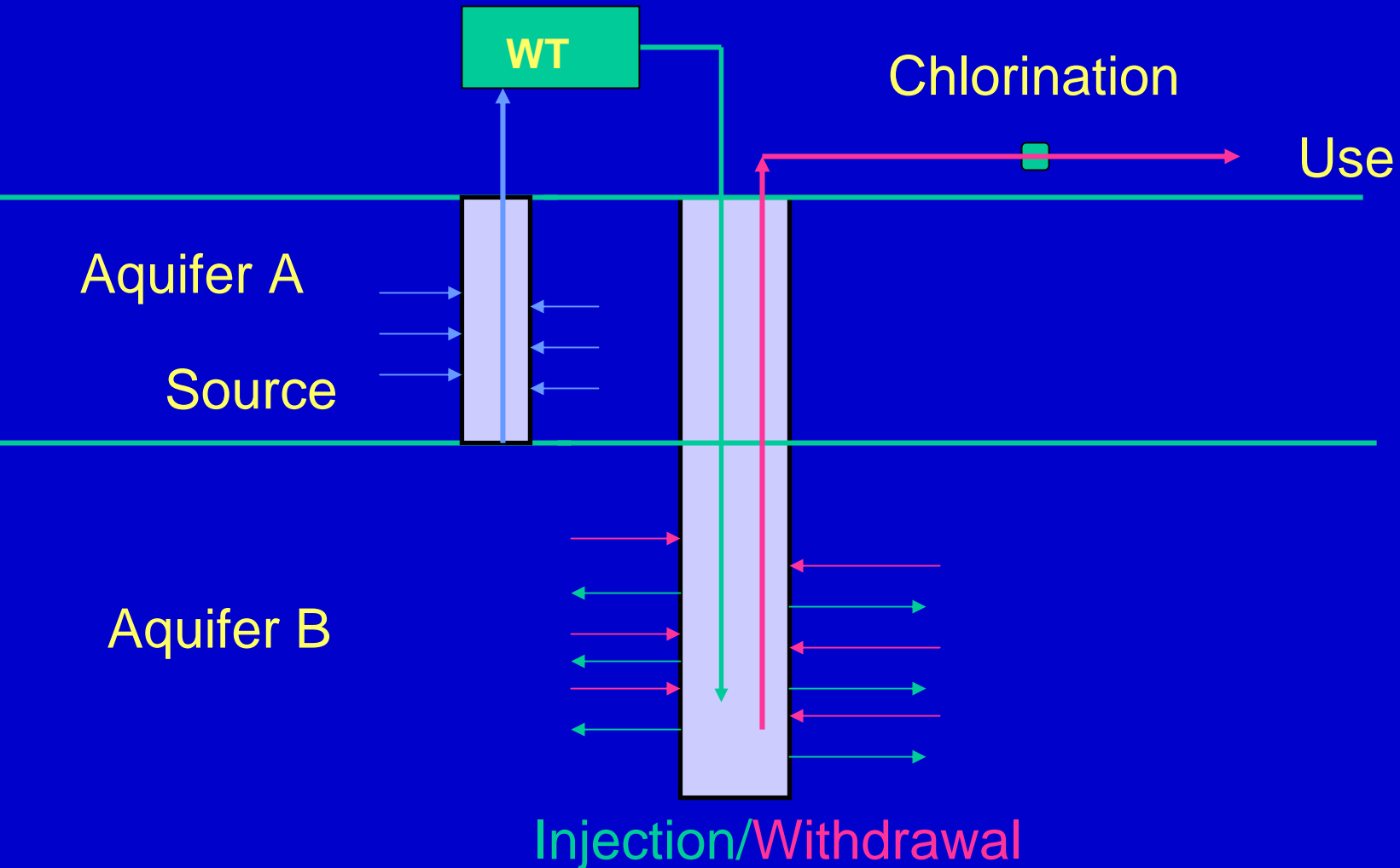
Single Well System



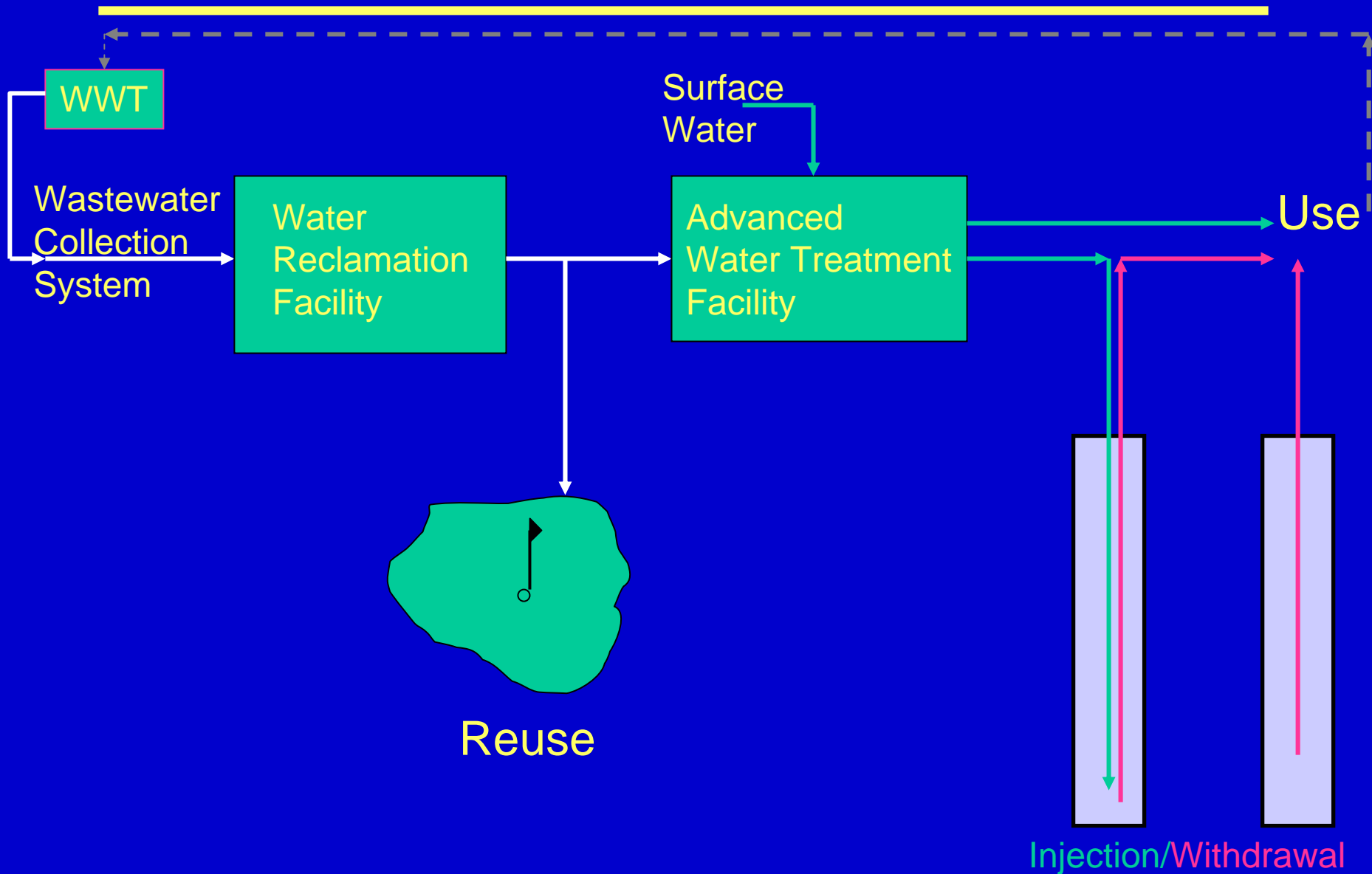
Surface Water Sources



Ground Water Source



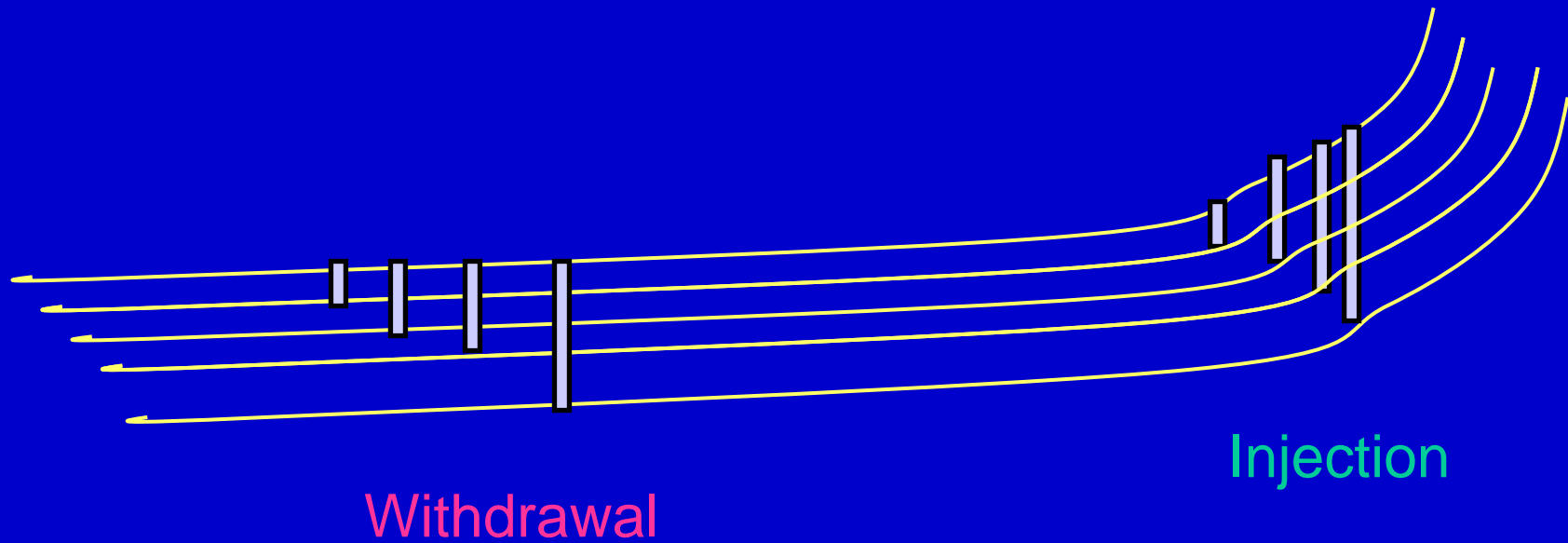
Future Conjunctive Use System



Future Conjunctive Use System

East

West



A recent Supreme Court decision (01SA56) The Board of County Commissioners of Park County et al v. Park County Sportsmen's Ranch, upheld Water Court Ruling that:

“(1) artificial recharge activities involving the movement of underground water into, from, or through aquifers underlying surface lands of Landowners would not constitute a trespass; and (2) the proposed project would not require the Landowner's consent or condemnation and the payment of just compensation . . .”

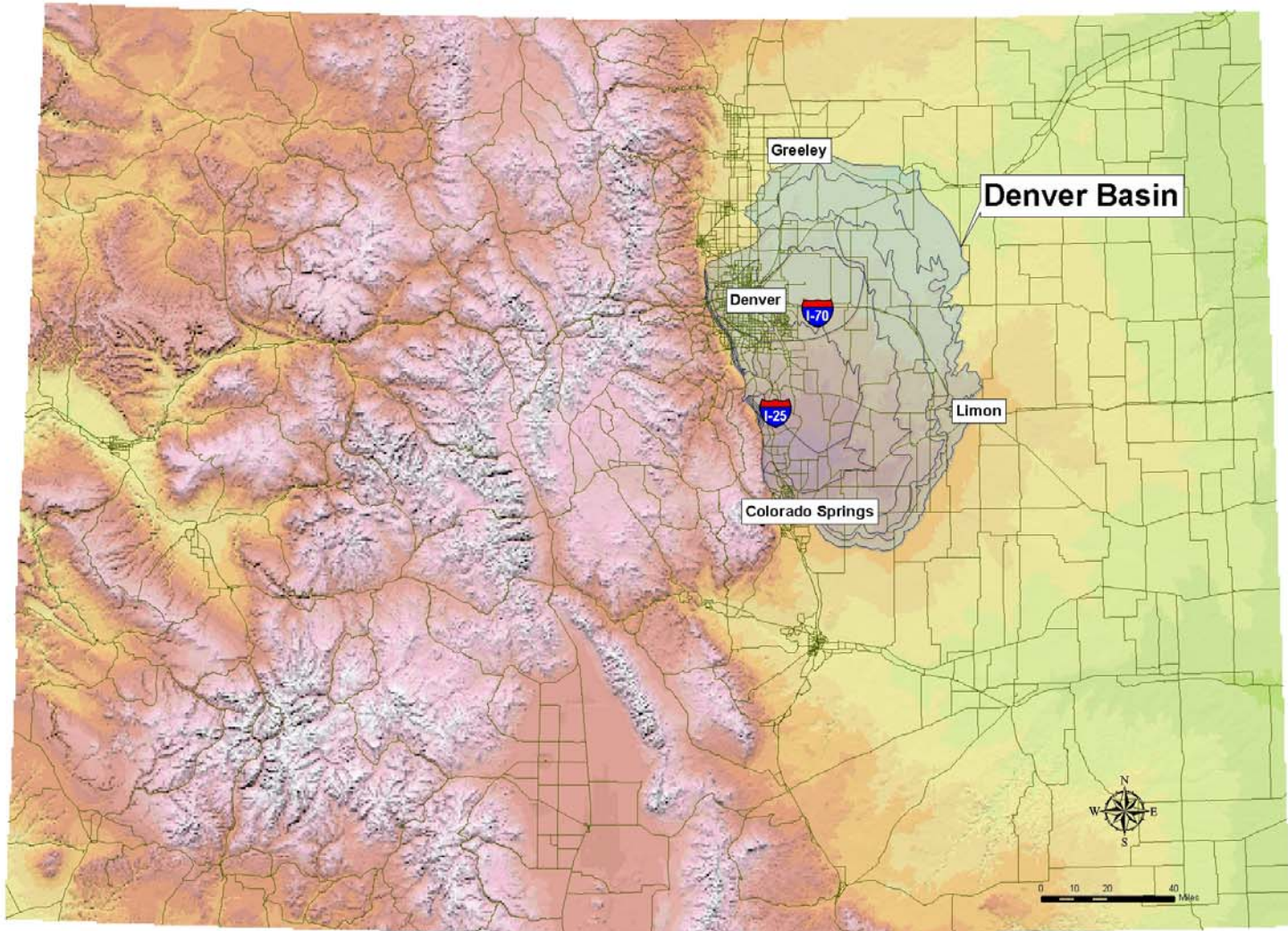
COSTS OF STORAGE

Surface Water: \$2500 to \$10,000 per acre-foot

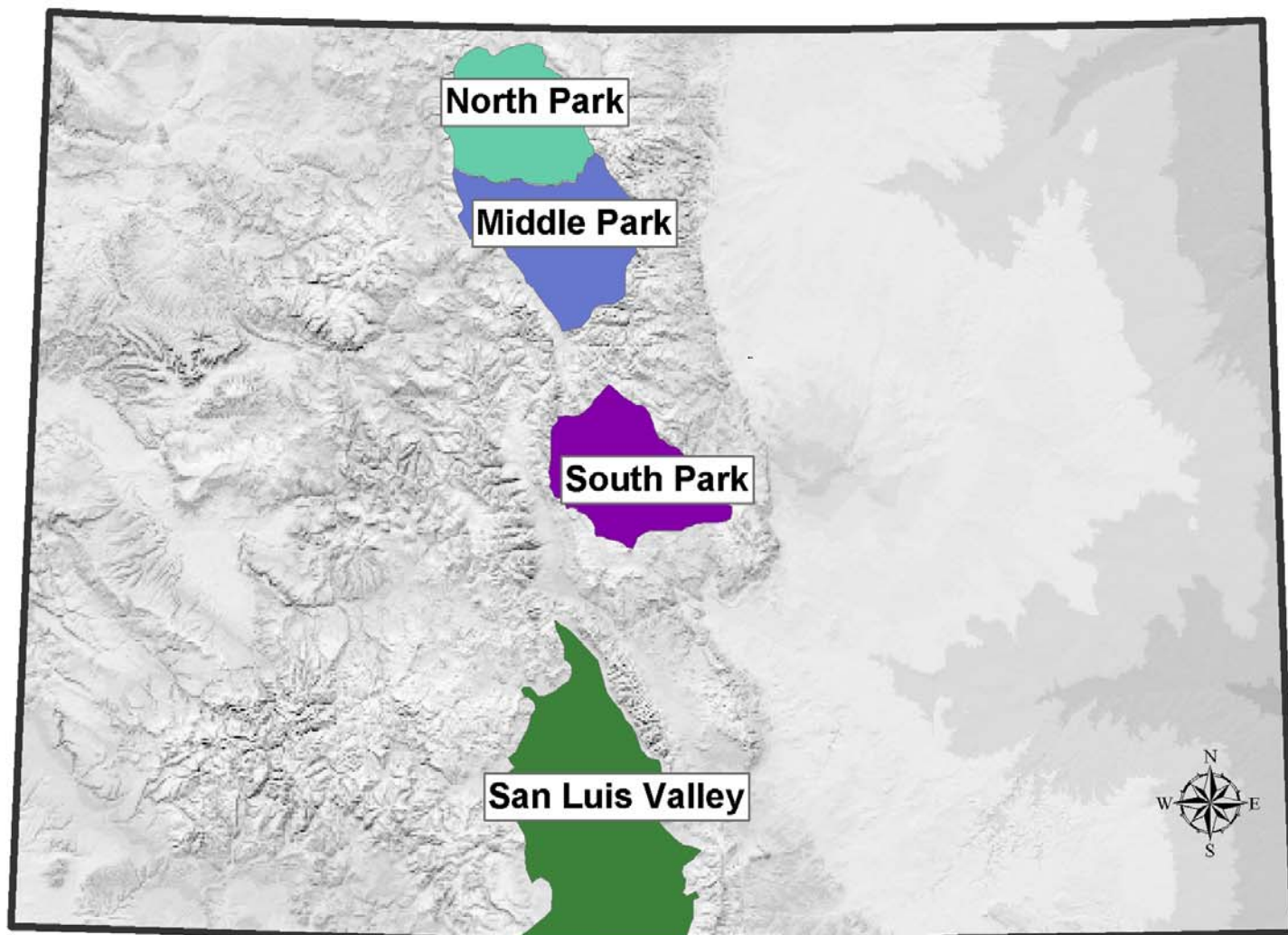
Ground Water (ASR):

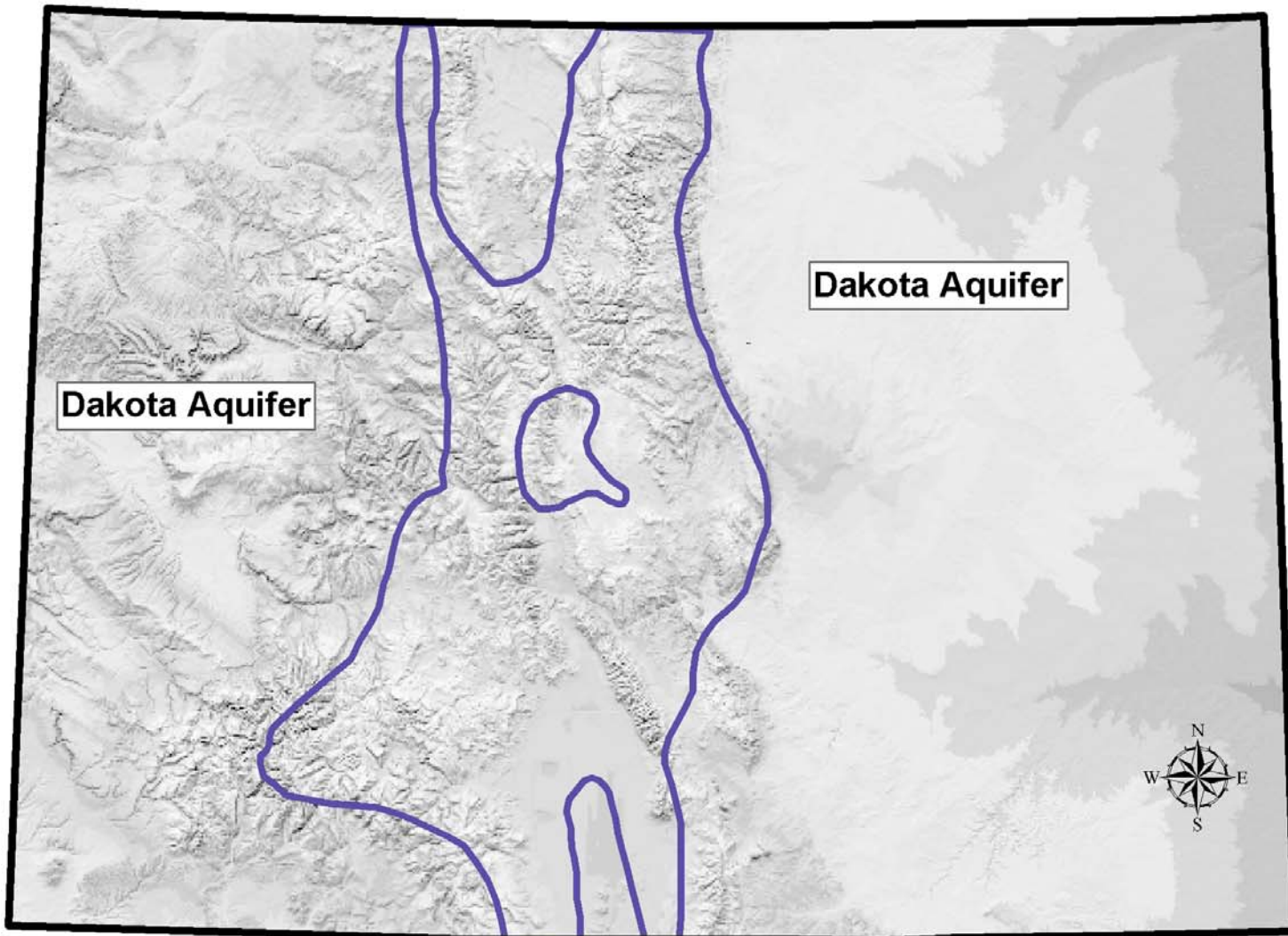
\$1500 per acre-foot for new wells dedicated to recharge and recovery

\$500 per acre-foot for existing water supply wells retrofitted for recharge and recovery



Denver Basin





Dakota Aquifer

Dakota Aquifer



CONCLUSIONS

- Colorado is not taking advantage of opportunities to use underground storage
- Existing wells in the Denver Basin could be retrofitted at minimal costs
- New wells could be added to allow ASR
- Other aquifers throughout the State could be used for underground storage
- **WE ARE AT THE FORK IN THE ROAD
- LETS TAKE IT!**