Understanding Water Conservation

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Water Conservation

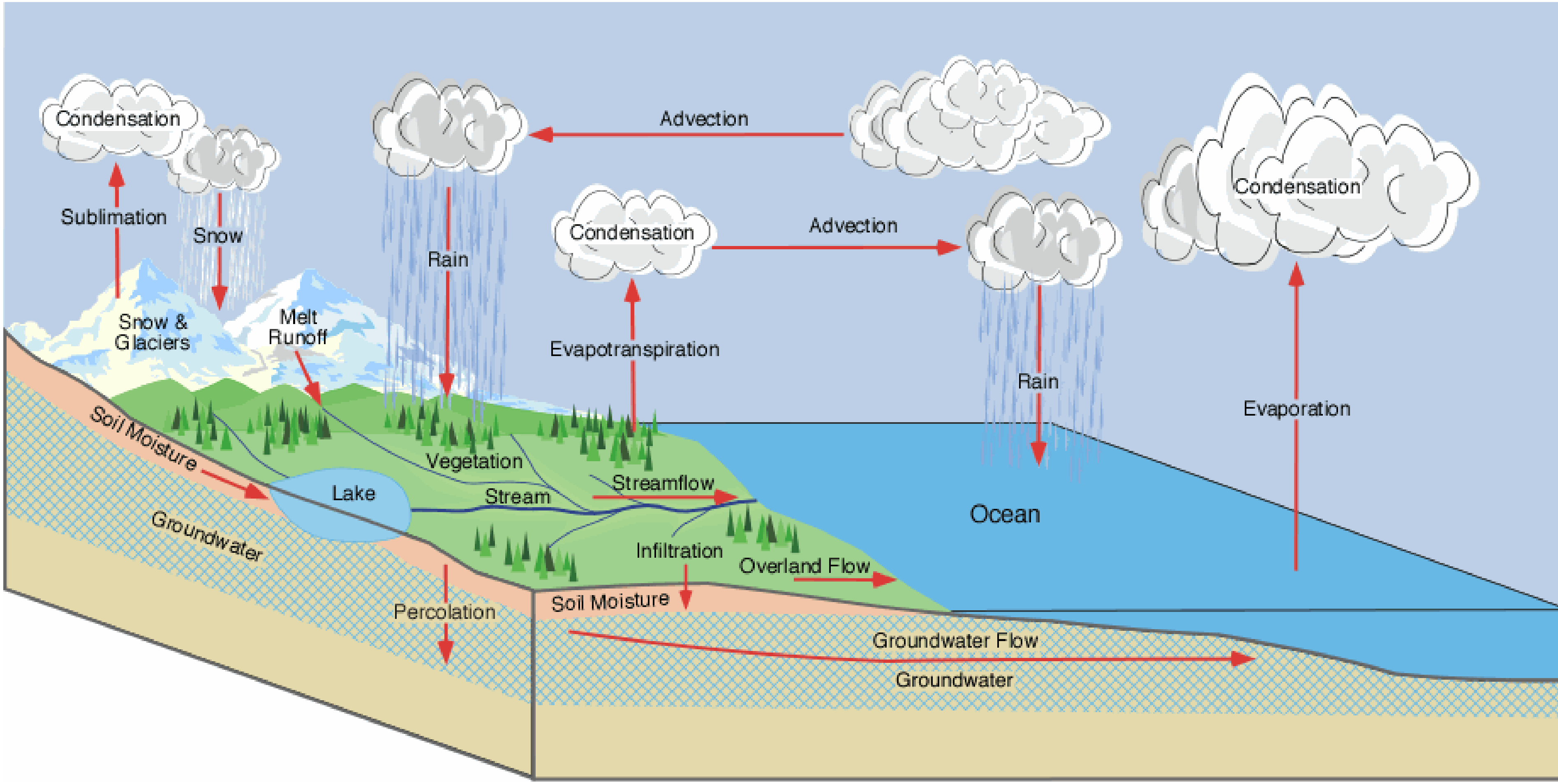
- Definitions
- Hydrologic cycles and terminology
- Water conservation complexities
- DROP – Wet Water Conservation
- Take-home messages

What is Water Conservation?

- Water conservation refers to the preservation, control and development of water resources, both surface and groundwater, and prevention of pollution.[1]
- Reduction in <u>Water Use</u>
- Reduction of <u>Applied Water</u>
- Reduction of <u>Depletion</u>
- Increase in production for a fixed application
- Increase in production for a fixed depletion
- Use of low quality water in lieu of high quality water

[1]Glossary of Environment Statistics, Studies in Methods, Series F, No. 67, United Nations, New York, 1997.

Hydrologic Cycle

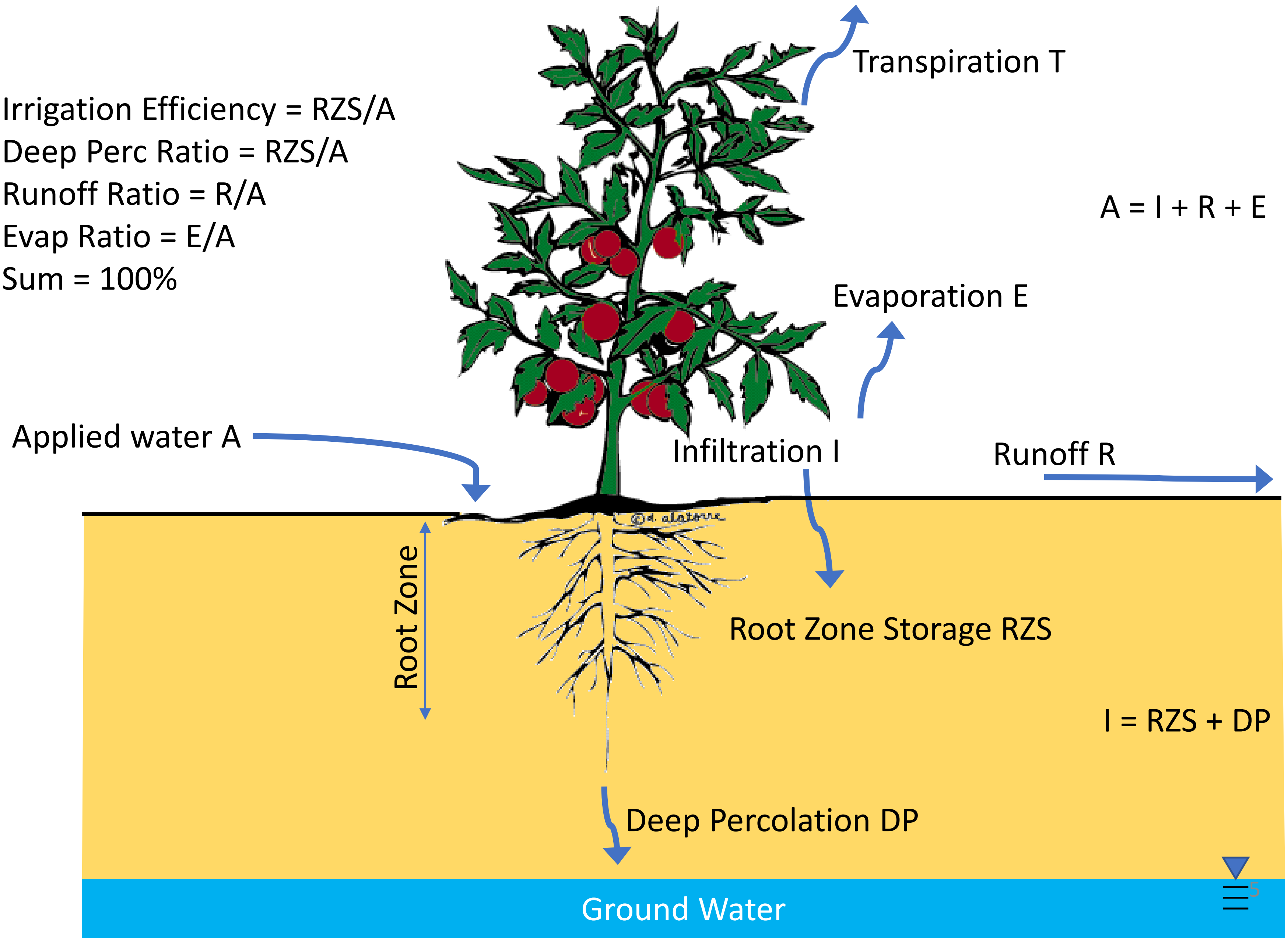


Inflow – Outflow = Change in Storage

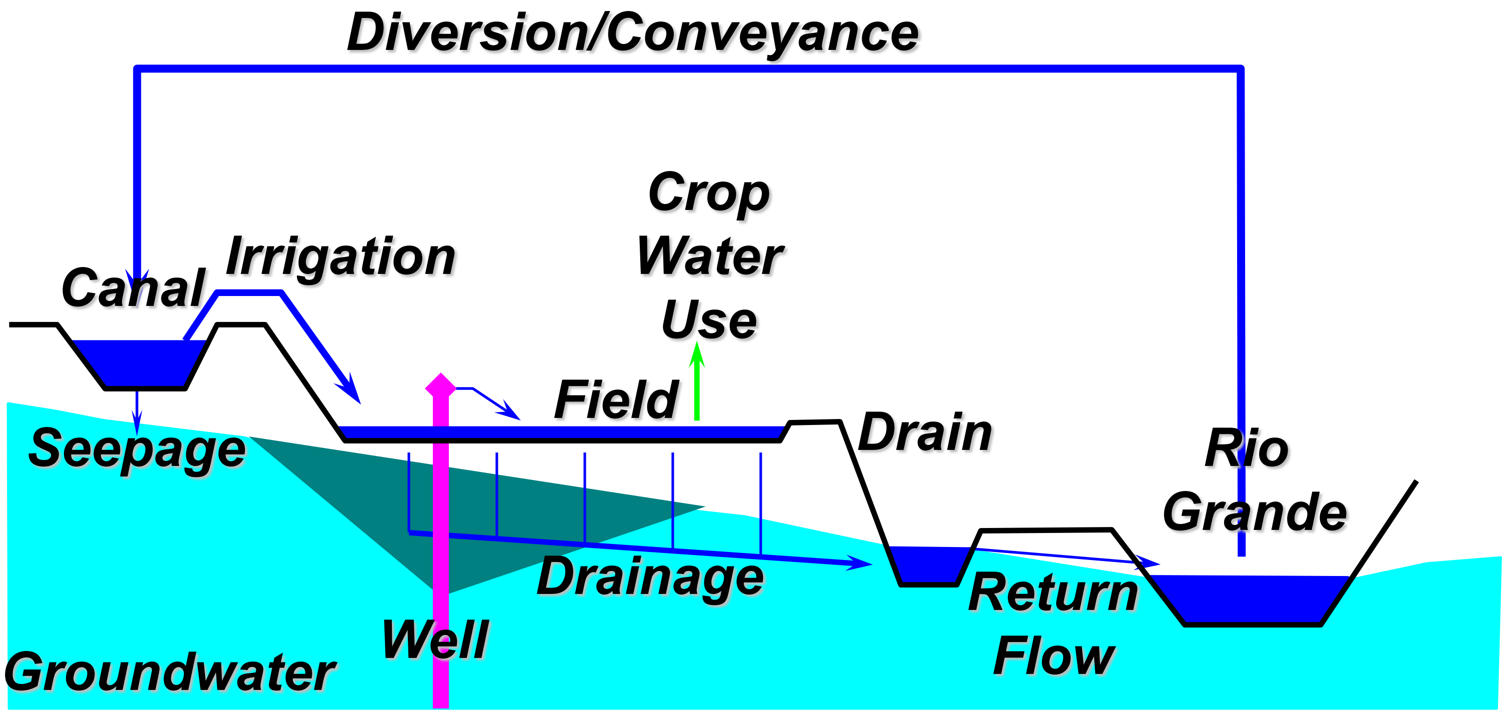
Thou shalt not create or destroy water.

On-Farm Irrigation Hydrology

Irrigation Efficiency = RZS/A
Deep Perc Ratio = RZS/A
Runoff Ratio = R/A
Evap Ratio = E/A
Sum = 100%



Irrigation System Hydrologic Cycle: Cross-section



Wet Water Conservation

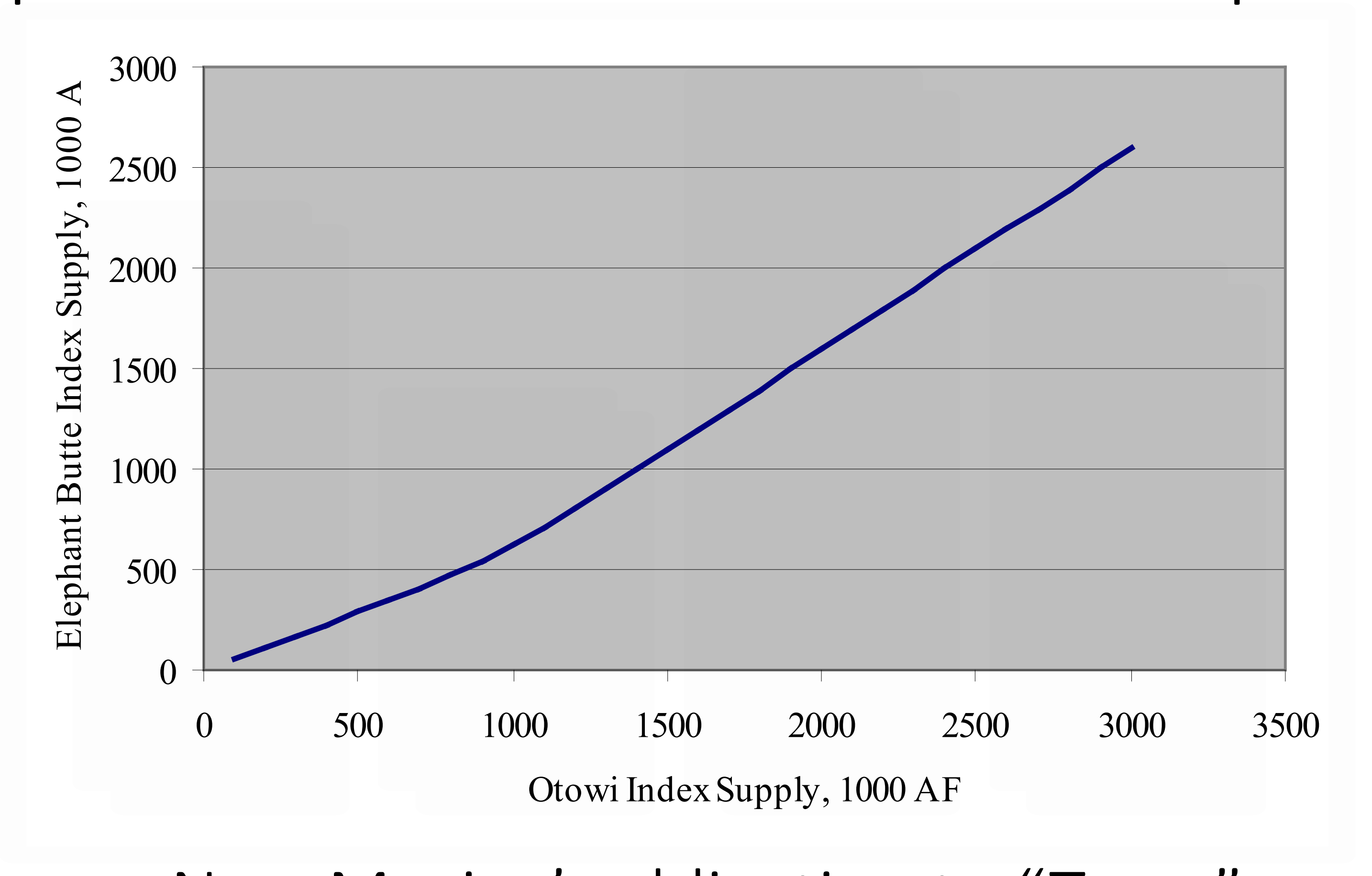
- Reduction of “irrecoverable losses”
- Reduction in depletion to local hydrologic system
- Make more water sustainably available for other uses

Dry Water Conservation

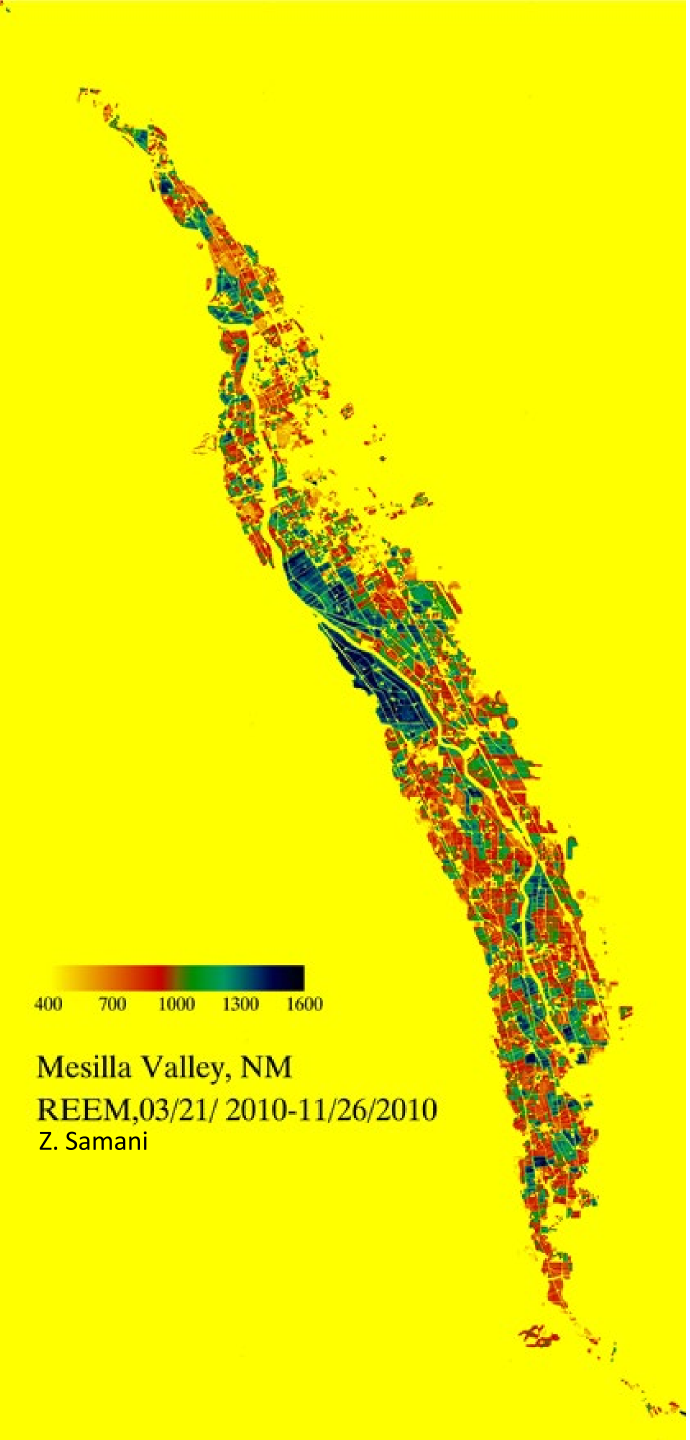
- Rearrangement of hydrologic components
- Net depletion on system unchanged (increased?)
- Saving in surface water may deplete groundwater
- Saving in groundwater may deplete surface water

Seckler, David, 1996. The New Era of Water Resources Management: From “Dry” to “Wet” Water Savings. Issues in Agriculture 8, CGIAR.

Depletions and the Rio Grande Compact



New Mexico's obligation to "Texas"



Depletion Reduction – A tough pill to take

- Lower water use crops – market driven
- Deficit Irrigation – reduced yield
- Fallowing – reduced production

Crop Water Production Functions

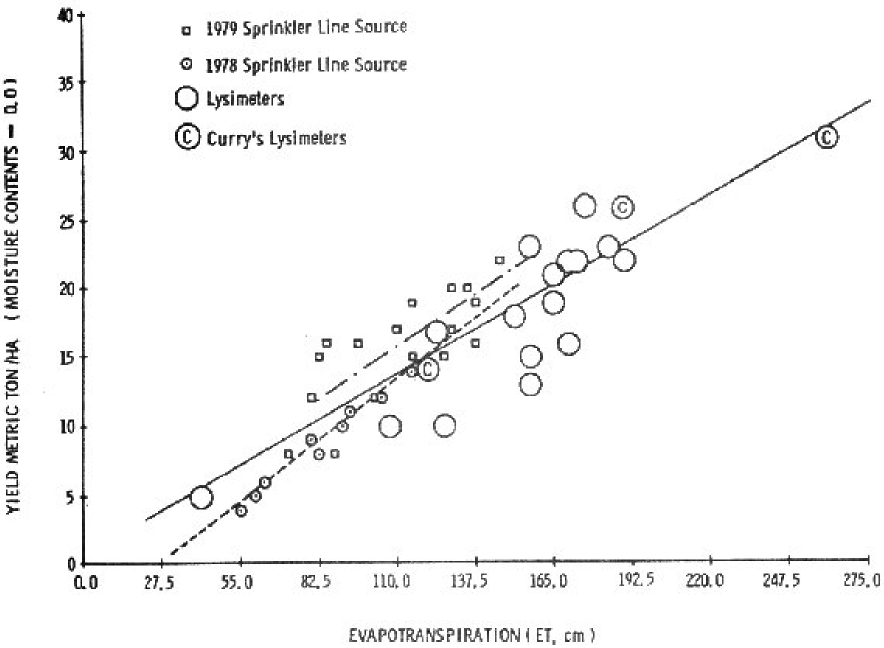
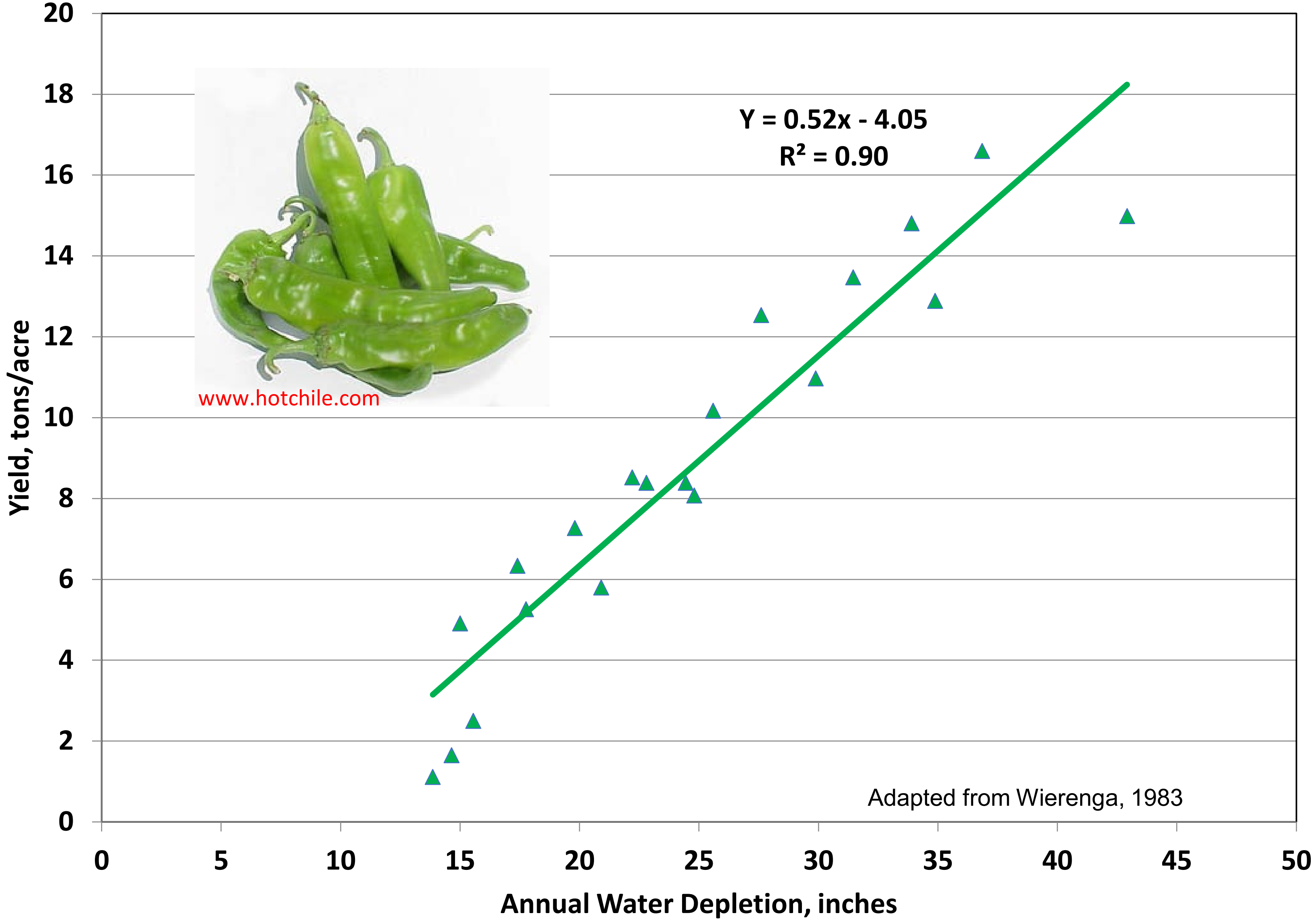


Fig. 1. Water-production function for alfalfa New Mexico.

From Sammis, 1983

- Relate crop yield to water consumption (ET)
- Developed at agricultural research stations
- Many other variables in play, but water is key

Hatch© Green Chile



Conversion from Traditional to High Efficiency Irrigation

Traditional Practice	
100	acres cultivated
36	inches applied water
300	acre-feet applied water
65%	Irrigation Efficiency
23.4	inches depletiom
195	acre-feet depletion
12.6	inches potetial return flow
105	acre-feet potential return flow
8.1	tons/acre yield
812	tons total production

Improved Practice	
100	acres cultivated
30	inches applied water
250	acre-feet applied water
95%	Irrigation Efficiency
28.5	inches depletiom
237.5	acre-feet depletion
1.5	inches potetial return flow
12.5	acre-feet potential return flow
10.8	tons/acre yield
1077	tons total production

Net Impact on System	
0.0	acre change in cultivated area
50.0	acre-feet reduction in applied water
42.5	acre-feet increase in depletion
265	tons increased production

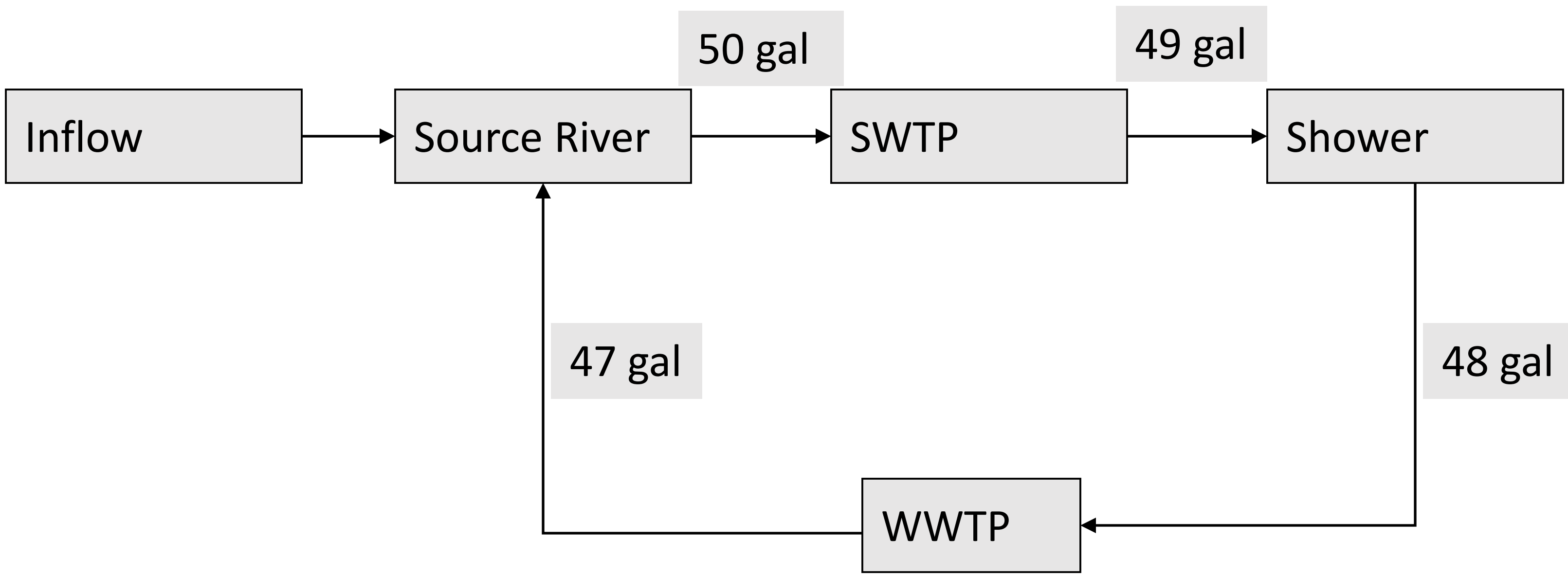
Conversion from Traditional to High Efficiency Irrigation – Balancing Depletion

Traditional Practice	
100	acres cultivated
36	inches applied water
300	acre-feet applied water
65%	Irrigation Efficiency
23.4	inches depletiom
195	acre-feet depletion
12.6	inches potetial return flow
105	acre-feet potential return flow
8.1	tons/acre yield
812	tons total production

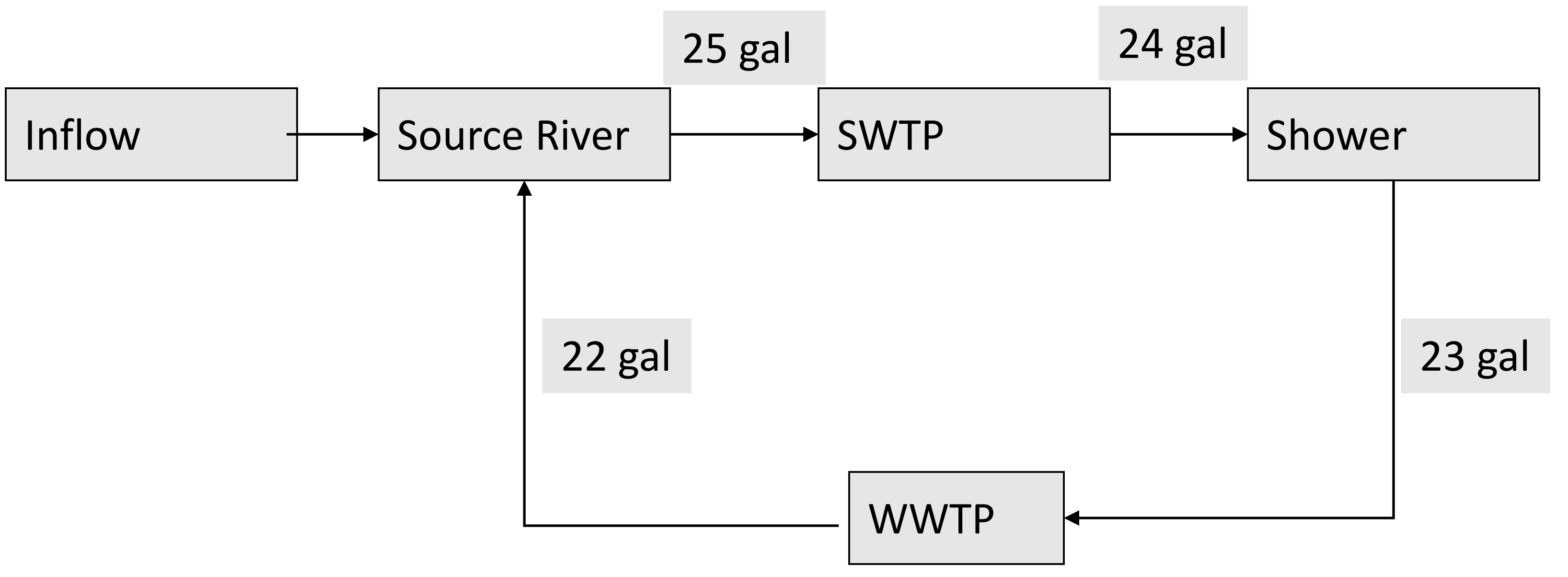
Balanced Depletion	
82.1	acres cultivated
30	inches applied water
205.3	acre-feet applied water
95%	Irrigation Efficiency
28.5	inches depletiom
195	acre-feet depletion
1.5	inches potetial return flow
10.3	acre-feet potential return flow
10.8	tons/acre yield
884	tons total production

Net Impact on System	
17.9	acre reduction in cultivated area
94.7	acre-feet reduction in applied water
0.0	acre-feet change in depletion
72	tons increased production

Shower Head Example
50 gal/shower



Shower Head Example
25 gal/shower



DROP:

Depletion Reduction and Offset Program

Elephant Butte Irrigation District

The core of the US Complaint in Supreme Court:

"New Mexico has allowed the diversion of surface water and pumping of groundwater that is hydrologically connected to the Rio Grande downstream of Elephant Butte Reservoir by water users who either do not have contracts with the Secretary of the Interior or are using water in excess of contractual amounts."

Motivation for DROP

- Municipal and Industrial (M&I) water users withdrawal of groundwater affects the surface water supply of the Rio Grande Project, and therefore EBID's surface water allotment.
- EBID is the only authorized user of Rio Grande Project water in New Mexico.
- M&I users cannot continue or expand the use of hydrologically connected groundwater without further impairing EBID's surface water supply.
- DROP provides a market-based means for M&I users to square up with the Rio Grande Project

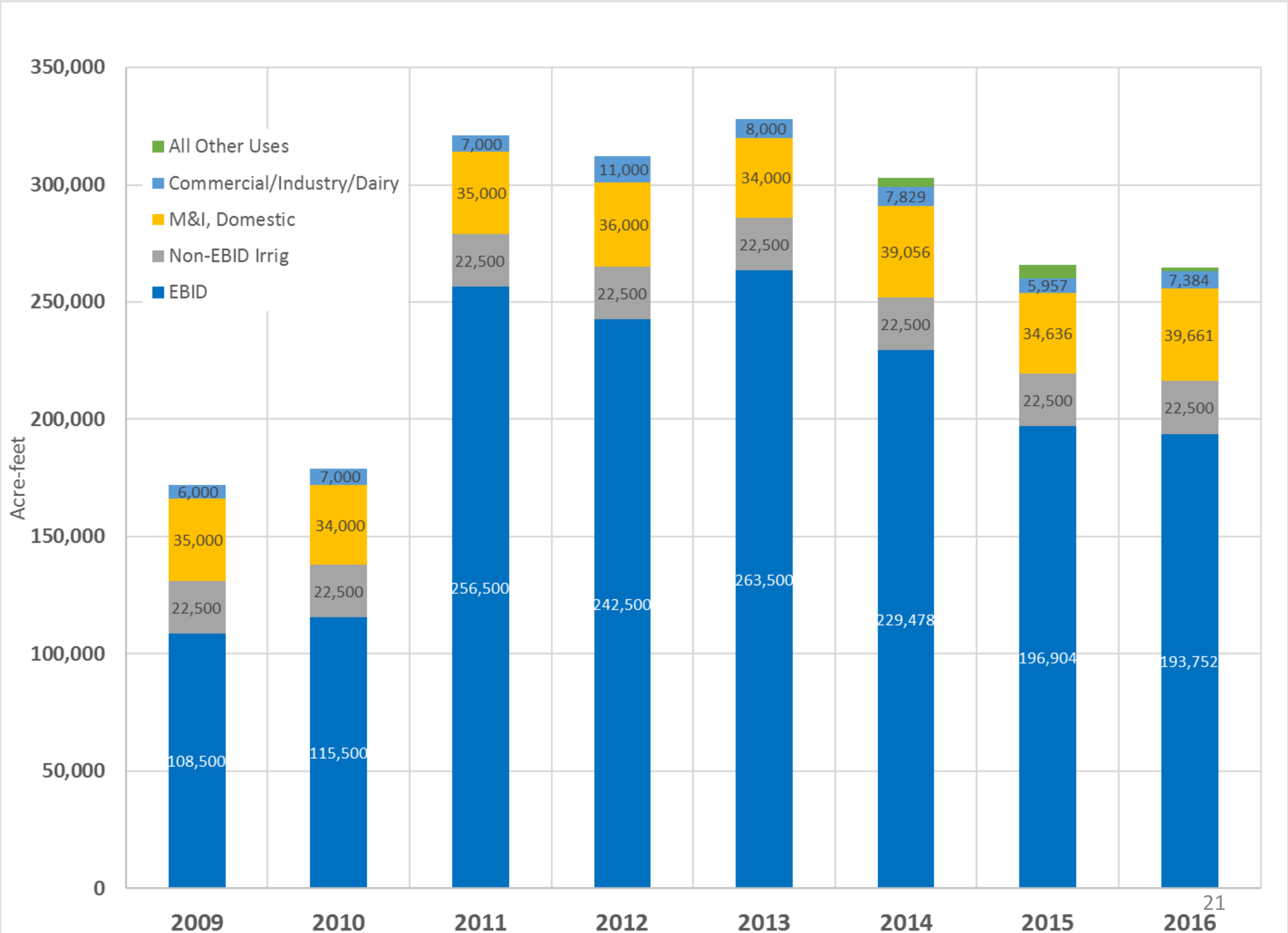
DROP in a Nutshell

- M&I users motivated to offset the impact of their groundwater use on the surface water supply of the Rio Grande Project enter into forbearance agreements with farmers.
- Farmers would be paid by the M&I user through EBID to fallow land, eliminating the local hydrologic depletion that would have occurred on that land, taken to be 2.6 acre-feet per acre of fallowed land.
- M&I users continue to use their groundwater wells (or expand groundwater use), having offset their effect on the local hydrologic system and the Rio Grande Project.

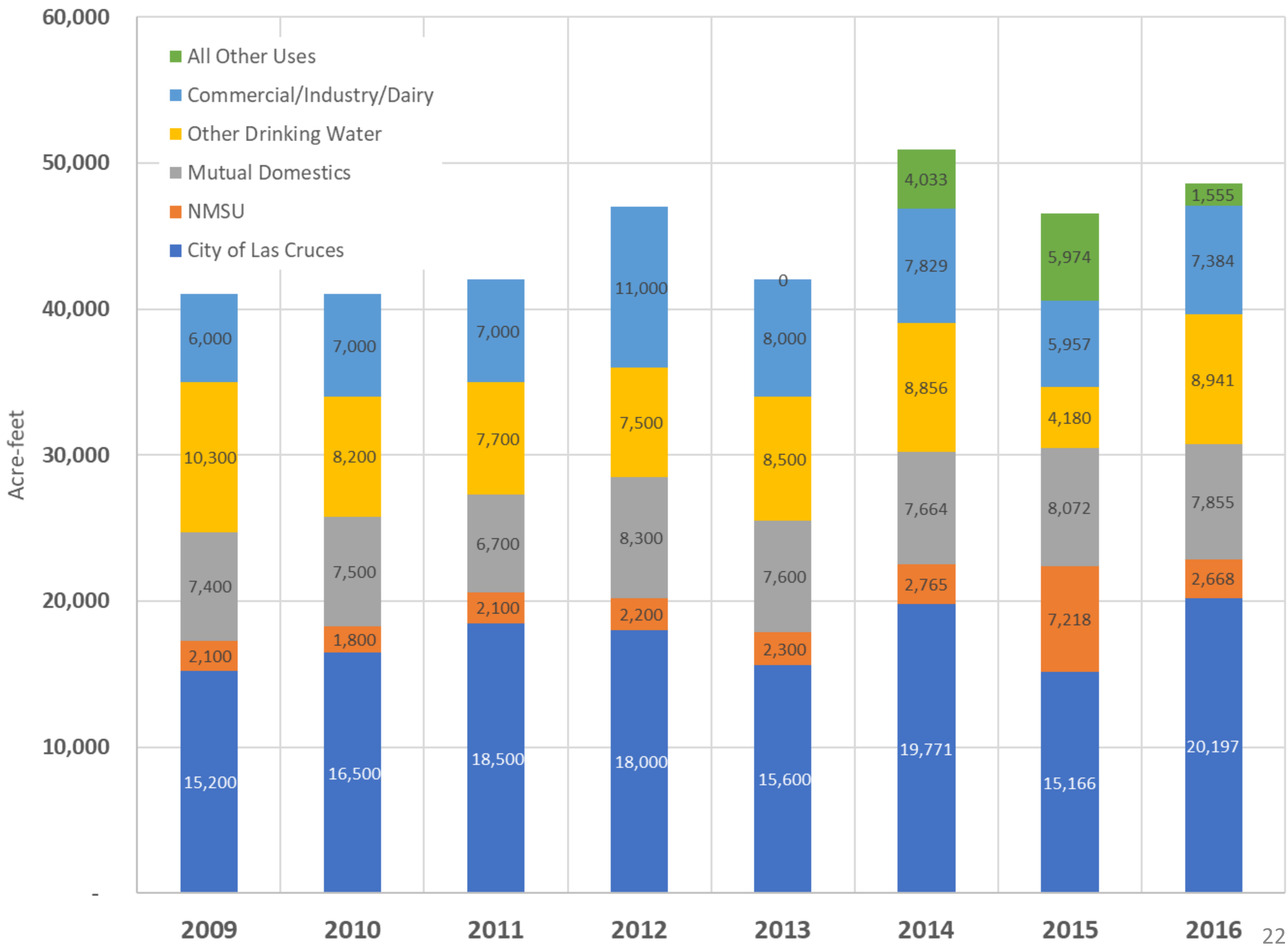
Considerations

- Plaintiffs in Texas v. New Mexico seek to protect the Rio Grande Project water supply from depletions by "non-Project contractors."
- DROP will allow M&I users to become Project contractors.
- Depletion reduction directly addresses effect on interactive surface water-groundwater system and reduces stress on aquifer systems.
- Excessive or poorly planned fallowing can threaten the viability of agriculture.

Groundwater withdrawals in the LRG



M&I Groundwater Withdrawals in the LRG



Contingencies

- Entry by farmers into DROP forbearance agreements is voluntary.
- Land entering program must have been irrigated four of the past five years, and must have surface water and groundwater rights.
- Farmers may enroll up to 20 percent of their land into forbearance agreements, though the EBID board has the ability to waive this limit.
- Lands under forbearance agreements are fallow, and not irrigated with surface water or groundwater.
- Surface water allotted to land under forbearance agreement will stay with the farmer who entered into the program for use on his cultivated land or transfer to other EBID lands.
- Farmers rotate land in the program through entire acreage, with a given parcel being fallowed for no more than three consecutive years.
- Land in the program must be maintained according to a land management plan.
- DROP will last for up to the term of the 2008 Operating Agreement.

DROP Example: 50 acre farm, 12” surface water allotment

20% = 10 acres in DROP forbearance agreement

- No surface water or groundwater use on 10 acres
- Depletion reduction (offset) = 2.6 ft CIR x 10 acres = 26 AF

50 acre account
40 acres in production

- Surface water allotment: 12” to 50 acres (50 AF)
- 15” surface water on 40 acres in production (50 AF)
- 15” – 12” = 3” reduced groundwater use on 40 acres in production (10 AF)

The Bottom Line

- Change of Purpose of Project Water requires compliance with the Sale of Water for Miscellaneous Purposes Act, 43 USC §521.
- Price range to be determined in that process.
- Must be high enough to attract participating farmers – this is a voluntary program.
- Cost borne by M&I users participating in the program.

Alternative Sources of Water

- Storm water capture
- Imported water
- Re-use
- Direct use of Surface Water for Municipal and Industrial use
- Desalination of brackish groundwater

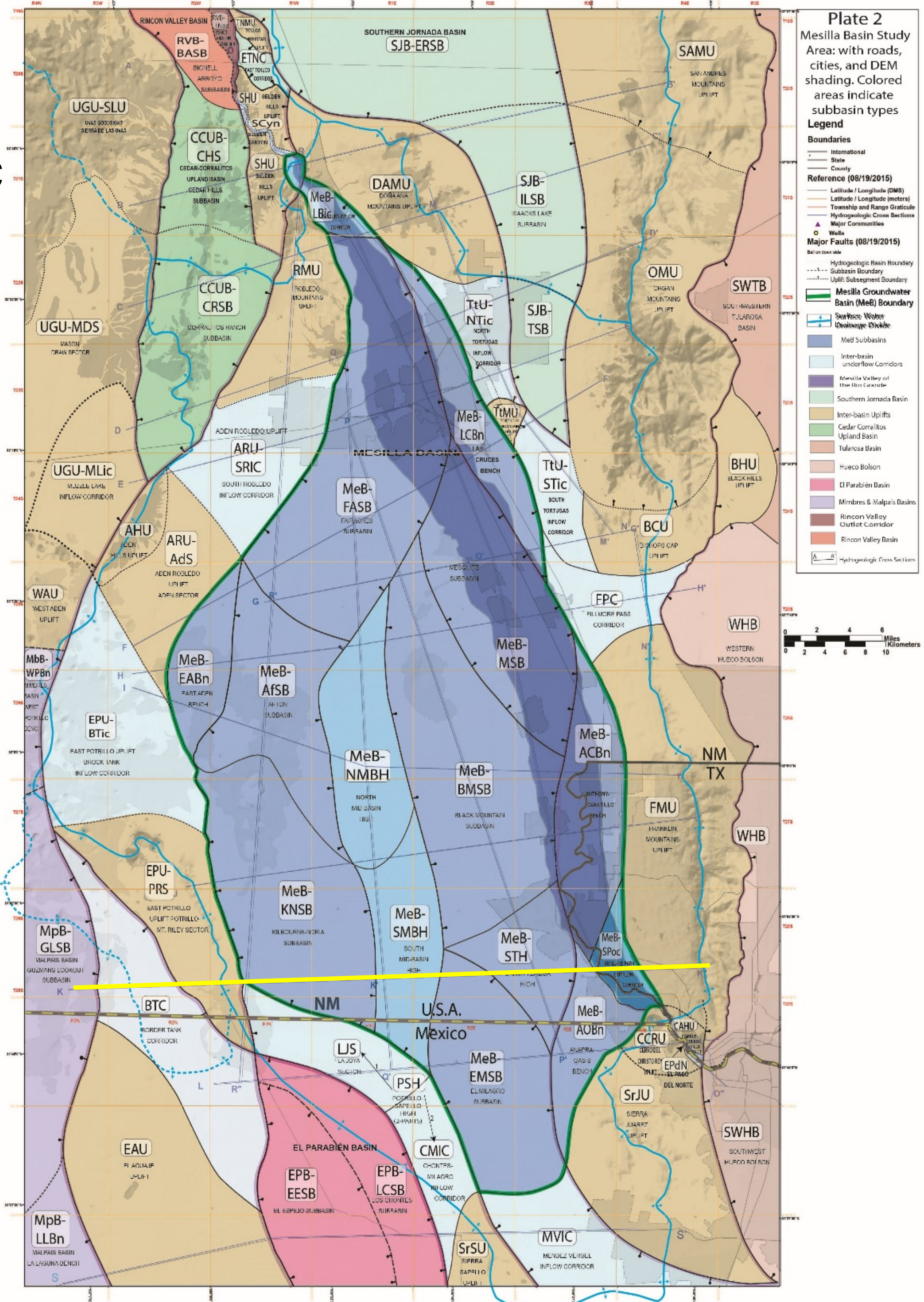
Desalination of Brackish Water

- US Bureau of Reclamation funding $400k + $478k cost share (NMWRRI), Jan 2019 – Dec 2020
- Co-PIs: Dr. Pei Xu, Dr. Sam Fernald, Dr. KC Carroll
- Geohydrology: Dr. John Hawley, PG
- Consultant: Ed Archuleta, PE

Project Objectives:

- Assess potential for brackish water desalination in the Santa Teresa area;
- Characterize source water and geohydrology, treatment technologies, and disposal alternatives;
- Integrate with prior and ongoing planning efforts;
- Explore binational potential for water supply to San Jeronimo in Mexico;
- Produce a Preliminary Engineering report and plan path forward.

Interlinked Hydro-geologic Basins and Subbasins of the Mesilla Basin Region

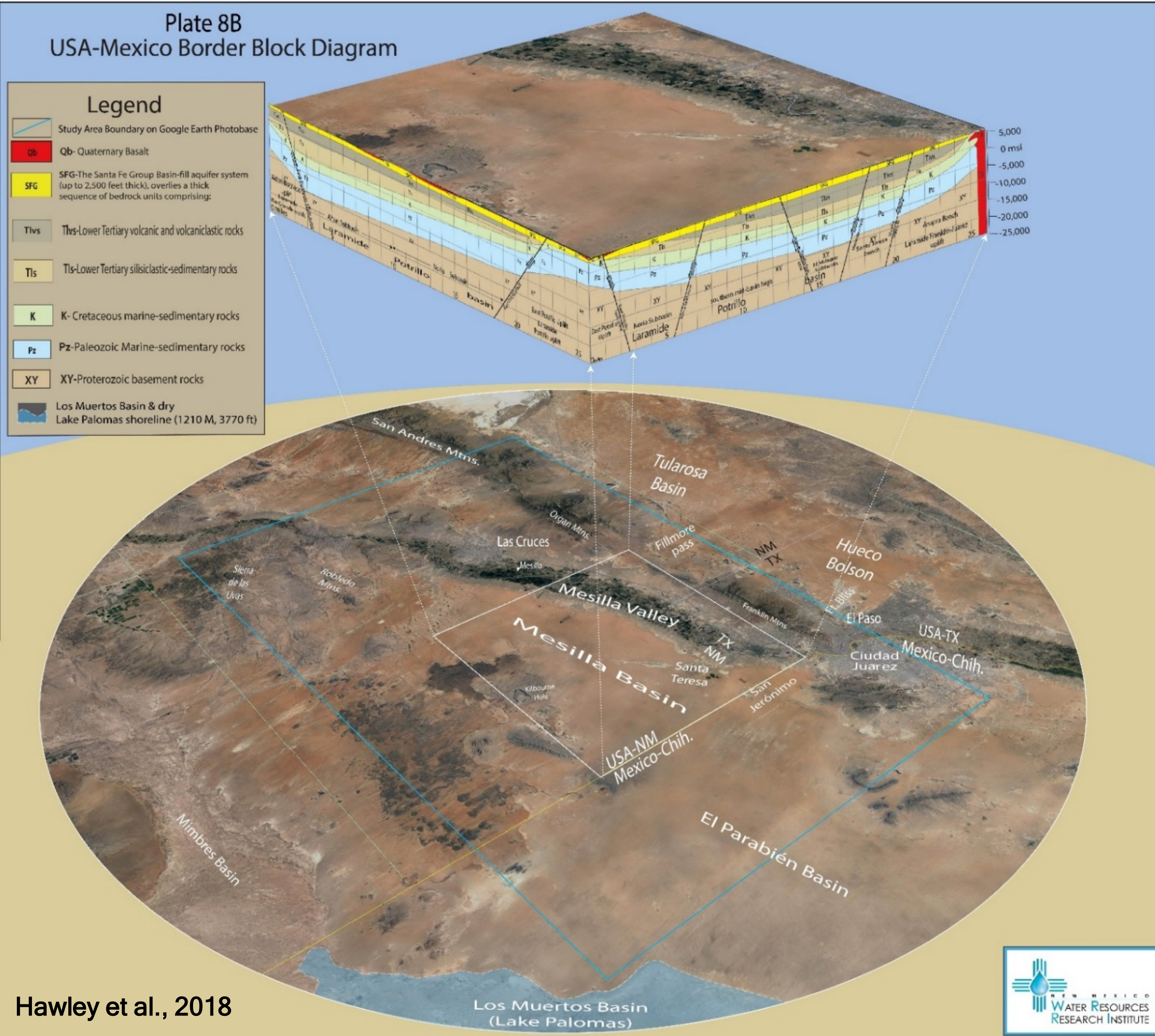


Rincon (beige), Southern Jornada (light green), Cedar-Corralitos (green), Tularosa (brown), Hueco (light brown), Malpais (purple), El Parabien (violet), Bedrock Highlands (tan), and Inter-basin Underflow Corridors (light blue)

Mesilla Basin-Subbasin Area with thick zones of saturated Santa Fe Group Basin Fill (blues).

Rio Grande Valley floor (dark blue)

Hawley et al., 2018



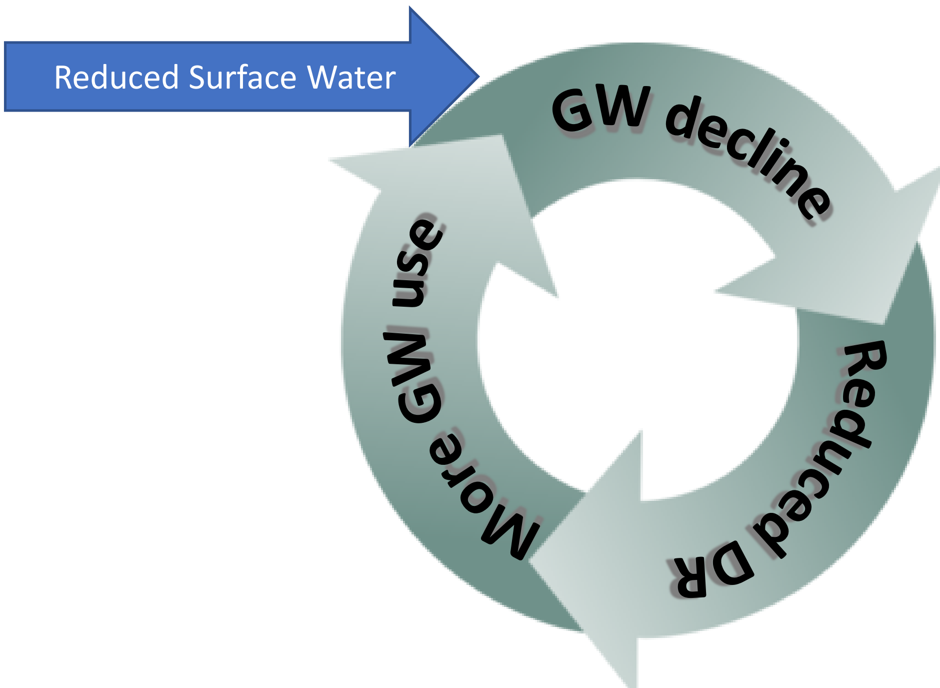
Hawley et al., 2018

Current Efforts:

- Stakeholders meetings
- Public presentations, media outlets
- Well access coordination: CRRUA, USGS, private land
- Focus on supply for Industrial Park area
- Pilot testing, demonstration of concept
- Student Capstone treatment plant design projects – RO, ED
- Binational potential: USIBWC, Mexican partners

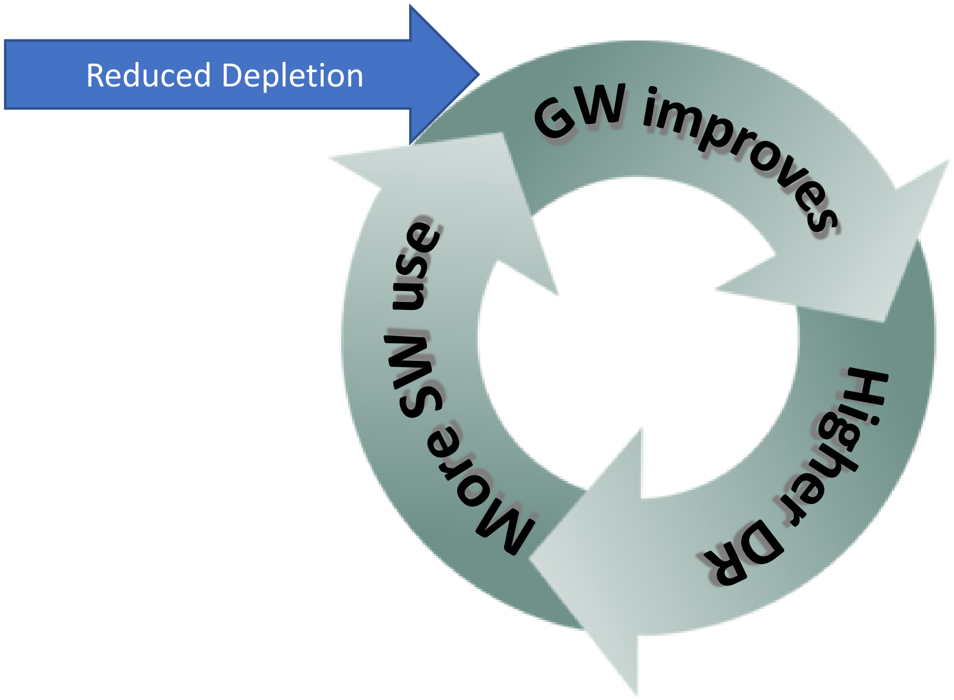
Reference:
Hawley, J.W., B.H. Swanson, J.S. Walker, S.H. Glaze, 2018. Hydrologic Framework of the Mesilla Basin Region of New Mexico, Texas, and Chihuahua (Mexico) – Advances in Conceptual and Digital Model Development. NM Water Resources Research Institute Technical Completion Report 363. Publication pending.

The Curse of Positive Feedback (AKA Death Spiral):



DR = Diversion Ratio = Project Diversions/Caballo Release

Using Positive Feedback:



Take-home messages

- New sources offer a valuable strategic alternative to traditional reliance on use of naturally potable, river-connected groundwater
- Buffering drought impacts through aquifer storage is a good short-term strategy – climate change requires longer term solutions
- "Dry Water" conservation has many benefits, and is an important part of efficient and productive water management in an increasingly arid climate
- Depletions are paramount, and hardest to reduce – "Wet Water" conservation
- For large-scale decrease in depletions, difficult choices must be made
- Interaction between depletion management and maintaining viability of irrigated agriculture is a delicate balance requiring clear understanding of hydrologic science, agro-economics, and culture