

Groundwater Levels and Groundwater Pumping in the Lower Rio Grande Past, Present and Future

Peggy Barroll, Ph.D.

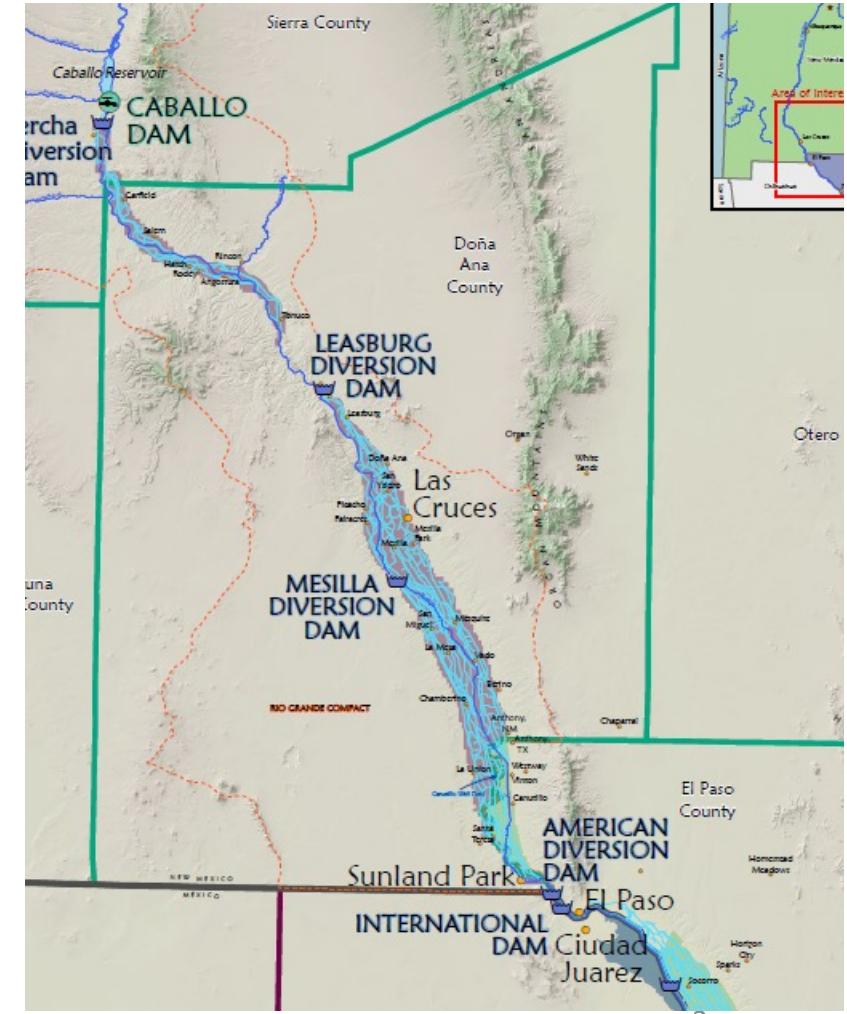
July 2024

Outline of Talk

- Introduction to Groundwater/Surface Water Systems
- Intro to LRG Aquifer System
- Surface Water Supply
- Groundwater Level Data
- Water Budget of Aquifer System
- What sectors are using how much water?
- Conclusions

Lower Rio Grande: Groundwater System Depends on Stream System

- LRG groundwater (aquifer) system historically dominated and sustained by the Rio Grande
- There is hydrologic interaction between the aquifer system and the stream system
- The stream system consists of
 - Rio Grande,
 - Rio Grande Project Canals
 - Rio Grande Project Drains



Stream- Aquifer Interaction:

USGS Reports: Groundwater and Surface Water, A Single Resource <https://pubs.usgs.gov/circ/circ1139/>
and
Sustainability of Ground-Water Resources <https://pubs.usgs.gov/circ/circ1186/>

Gaining Stream:

Groundwater seeps into the stream, either through springs or incremental gains along stream.

Active drains act like gaining streams.

Losing Stream:

Surface water from stream seeps into (is “lost” to) aquifer

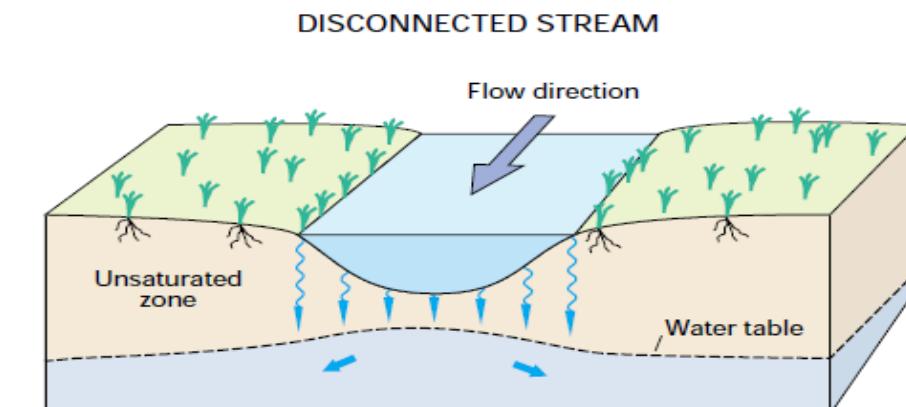
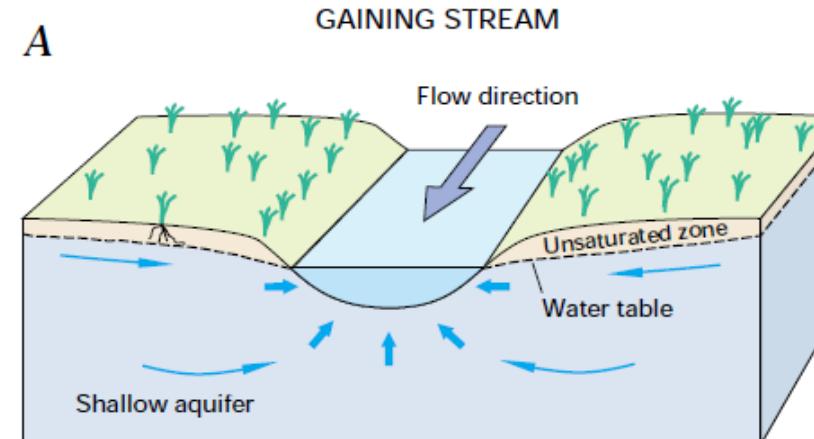
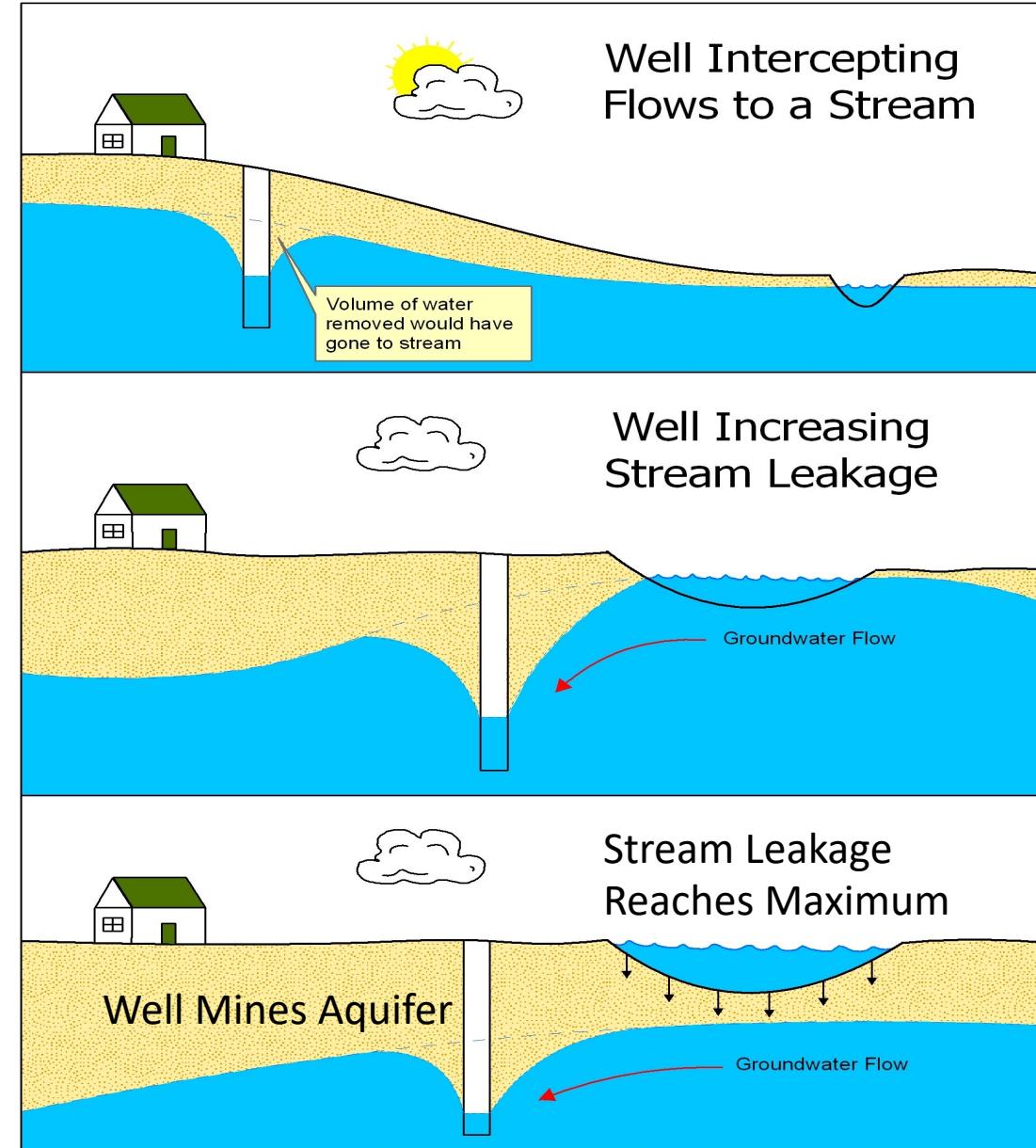


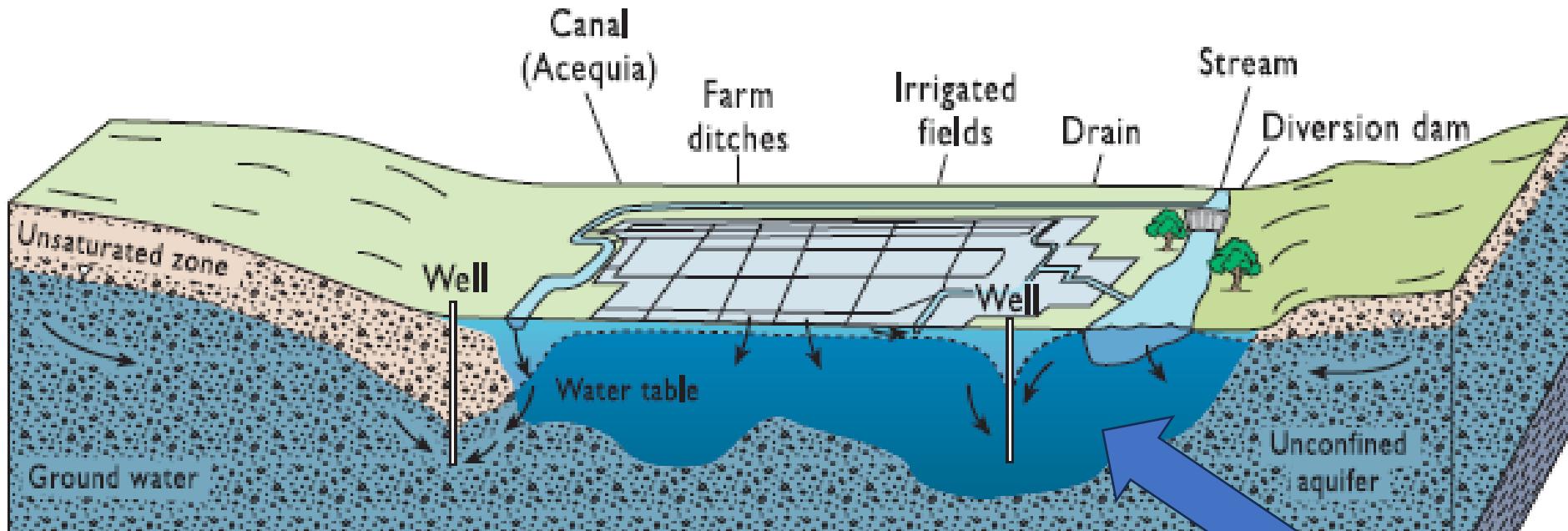
Figure 10. Disconnected streams are separated from the ground-water system by an unsaturated zone.

Generalized Cross-Sectional Diagrams showing well pumping effects

Groundwater pumping can intercept groundwater that had been heading for a stream, or actually pull water out of a stream



Lower Rio Grande Stream/Aquifer System looks more like this diagram...



A Primer on Water: Ground Water, Surface Water and Its Development

Peggy Johnson, New Mexico Bureau of Geology and Mineral Resources

NM Bureau of Geology, 2003

This
groundwater has
been declining

LRG Aquifer System

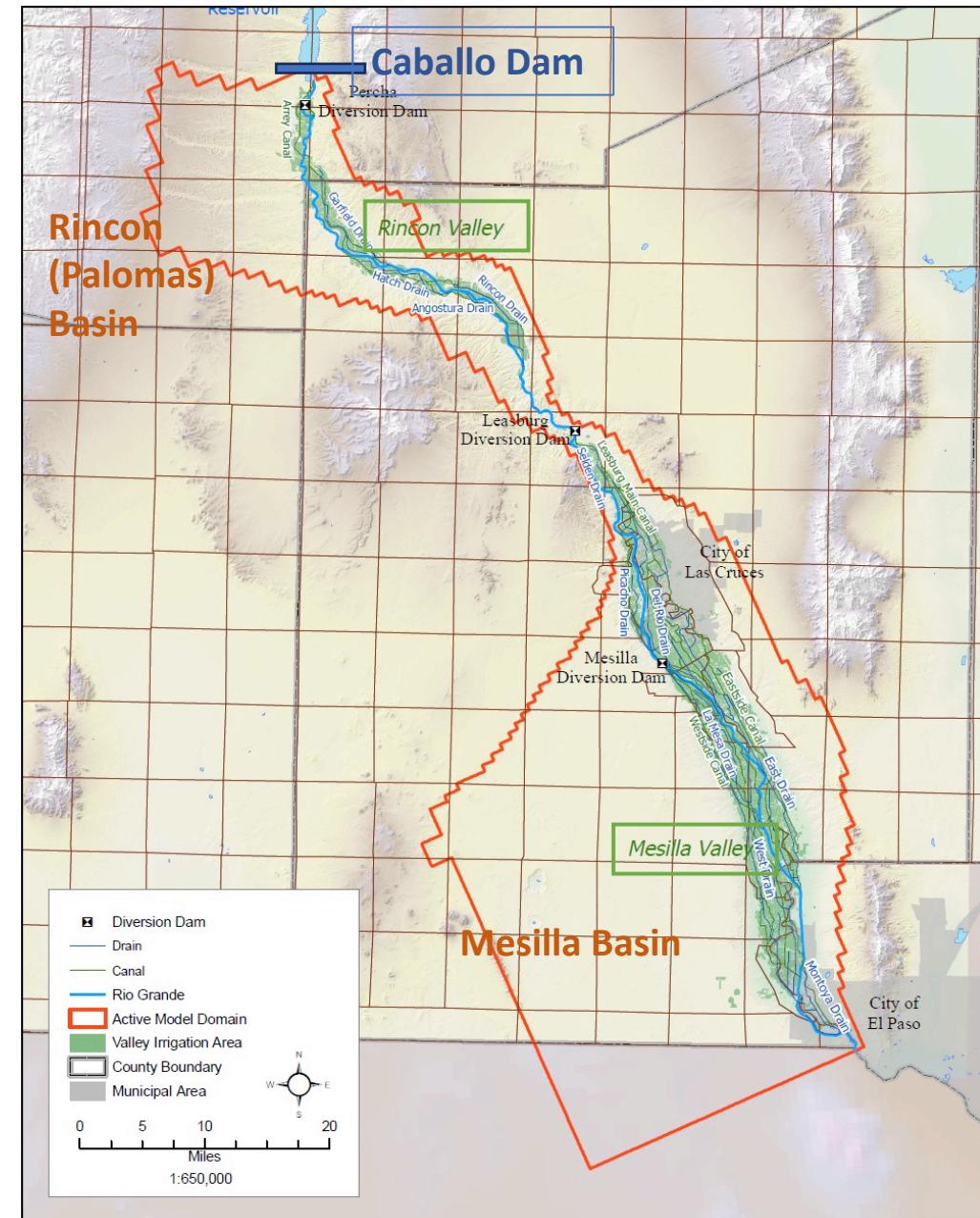
- 1) Large, deep groundwater basins
 - Rincon (Palomas) Basin
 - Mesilla Basin

On top of the deep basins, along the Rio Grande Valley:

- 2) Narrow Corridor of thin River Valley Alluvium (Shallow Alluvium)

Rio Grande Valley

- Rincon Valley
- Mesilla Valley

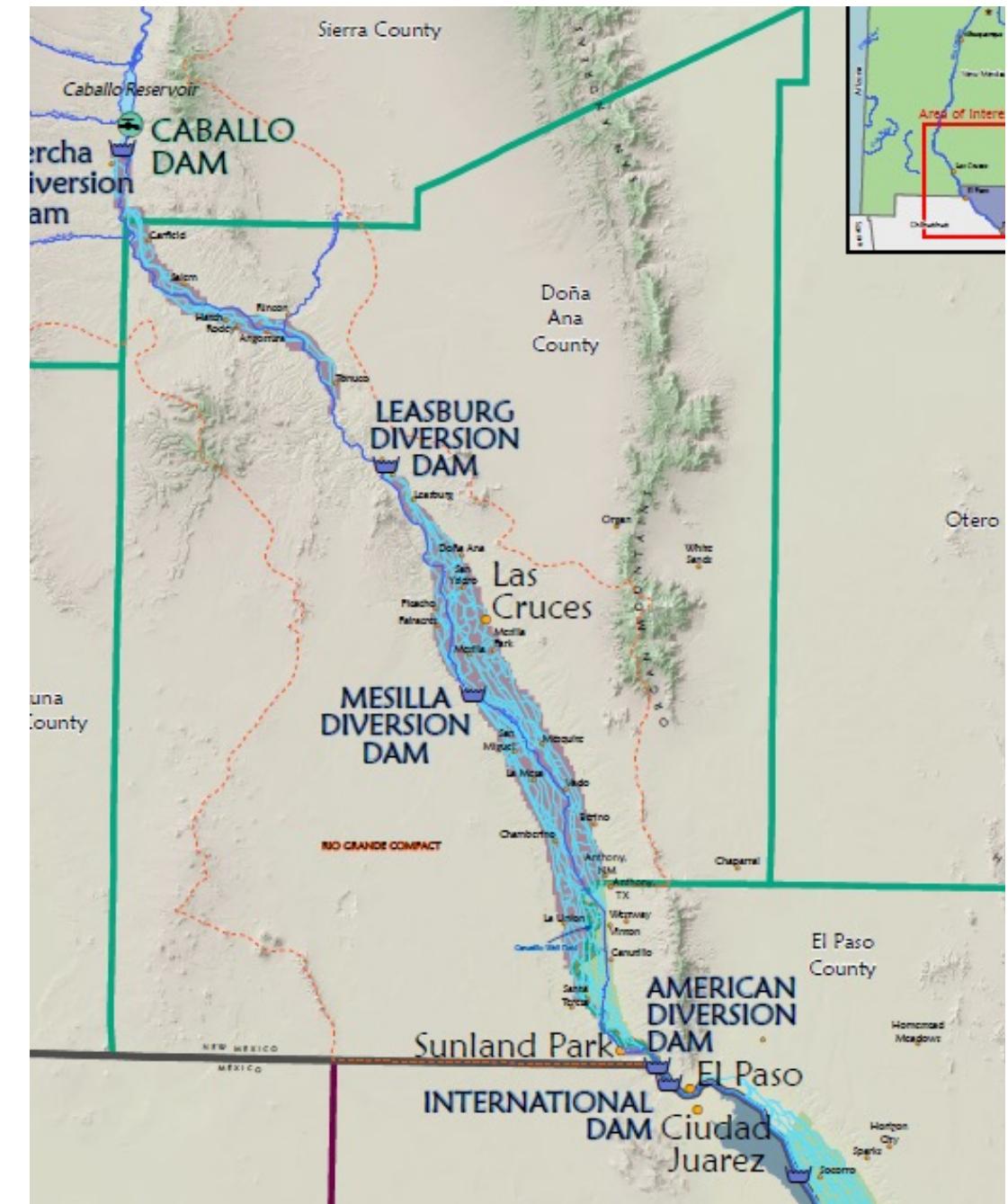


LRG Surface Water System

Rio Grande
Rio Grande Project
Diversions, Canal and Drains

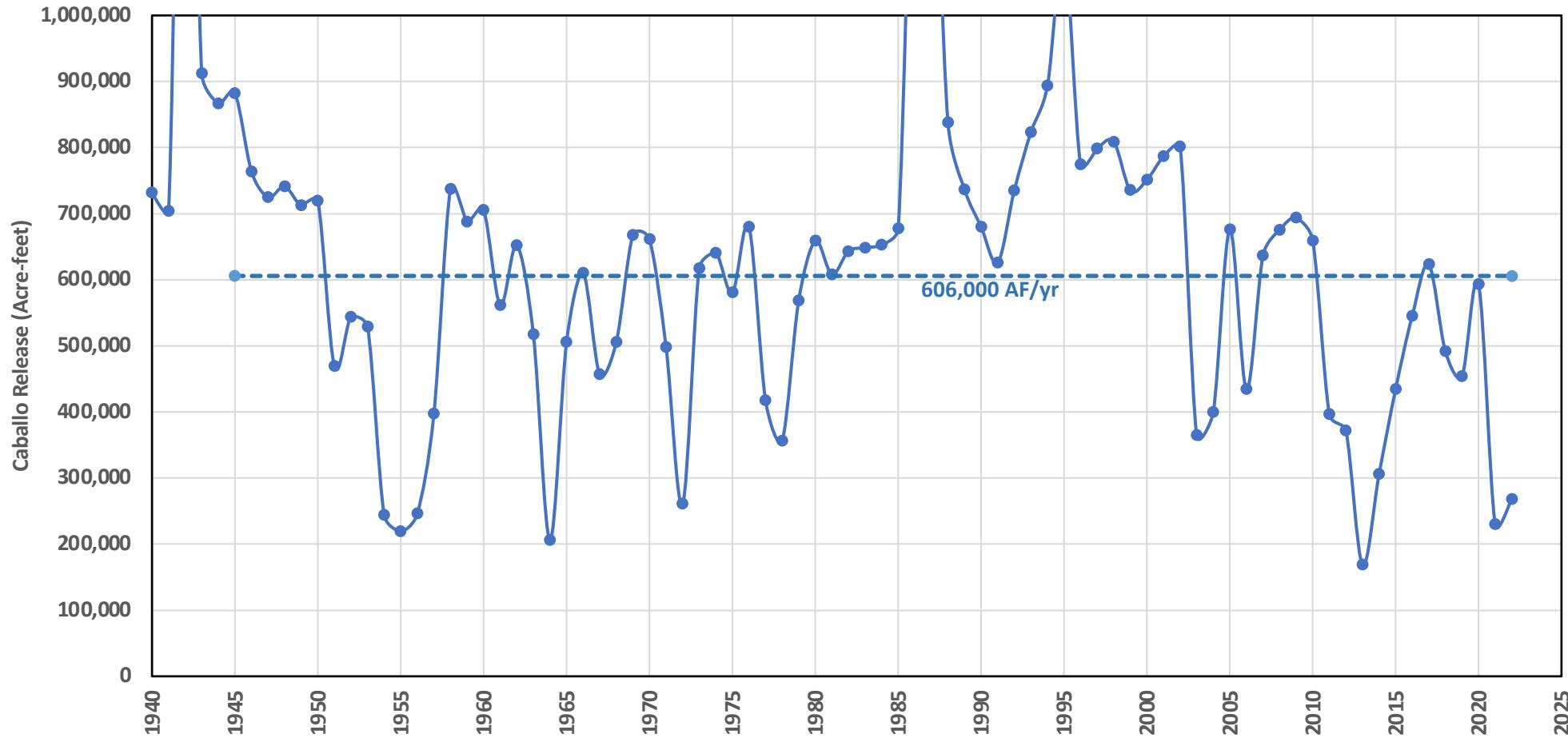
Source of Supply:

- Releases from Caballo Dam
- Small amounts of side flows from storms



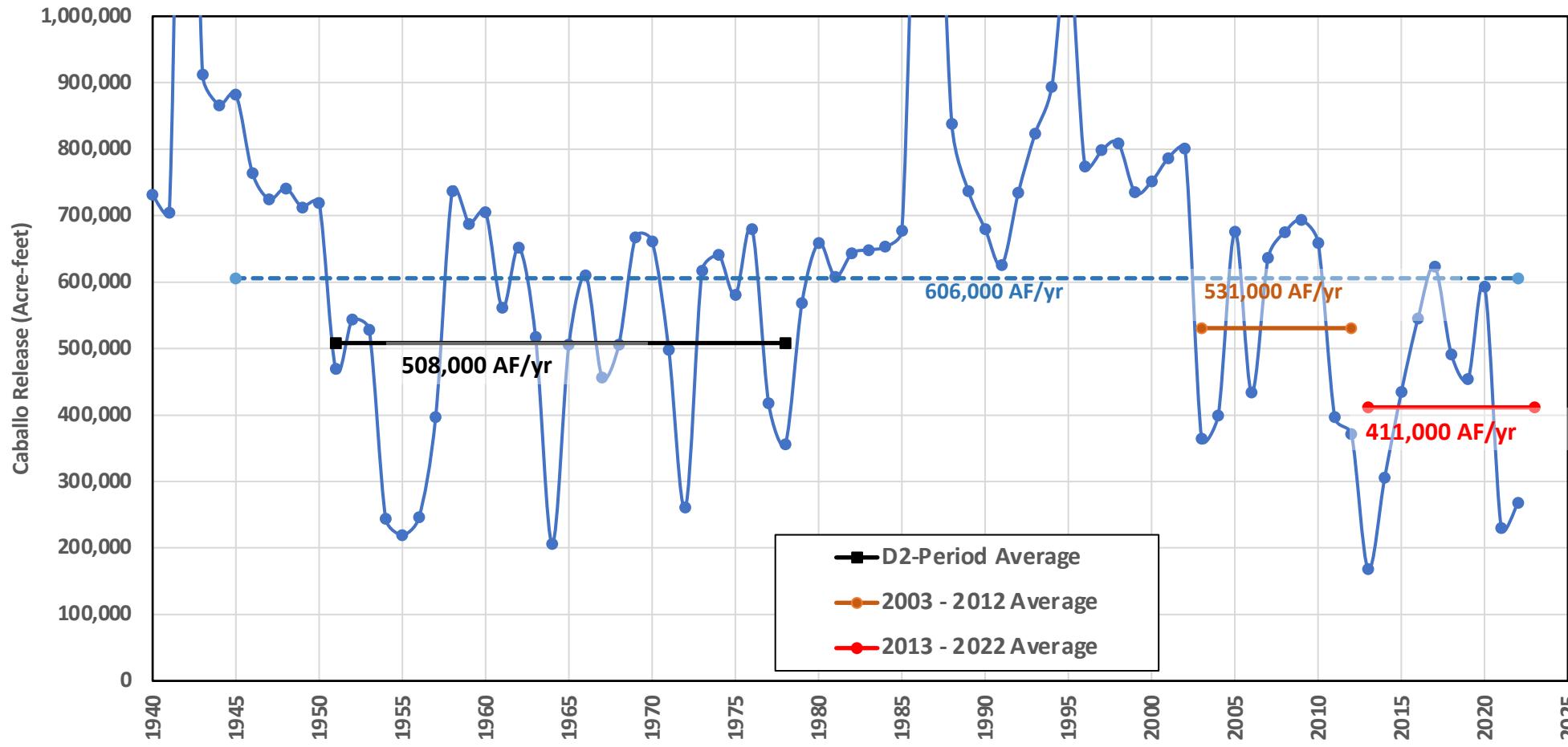
Historical Surface Water Supply: 1940 - 2022

Annual Release of Water from Caballo Reservoir



Historical Surface Water Supply: 1940 - 2022

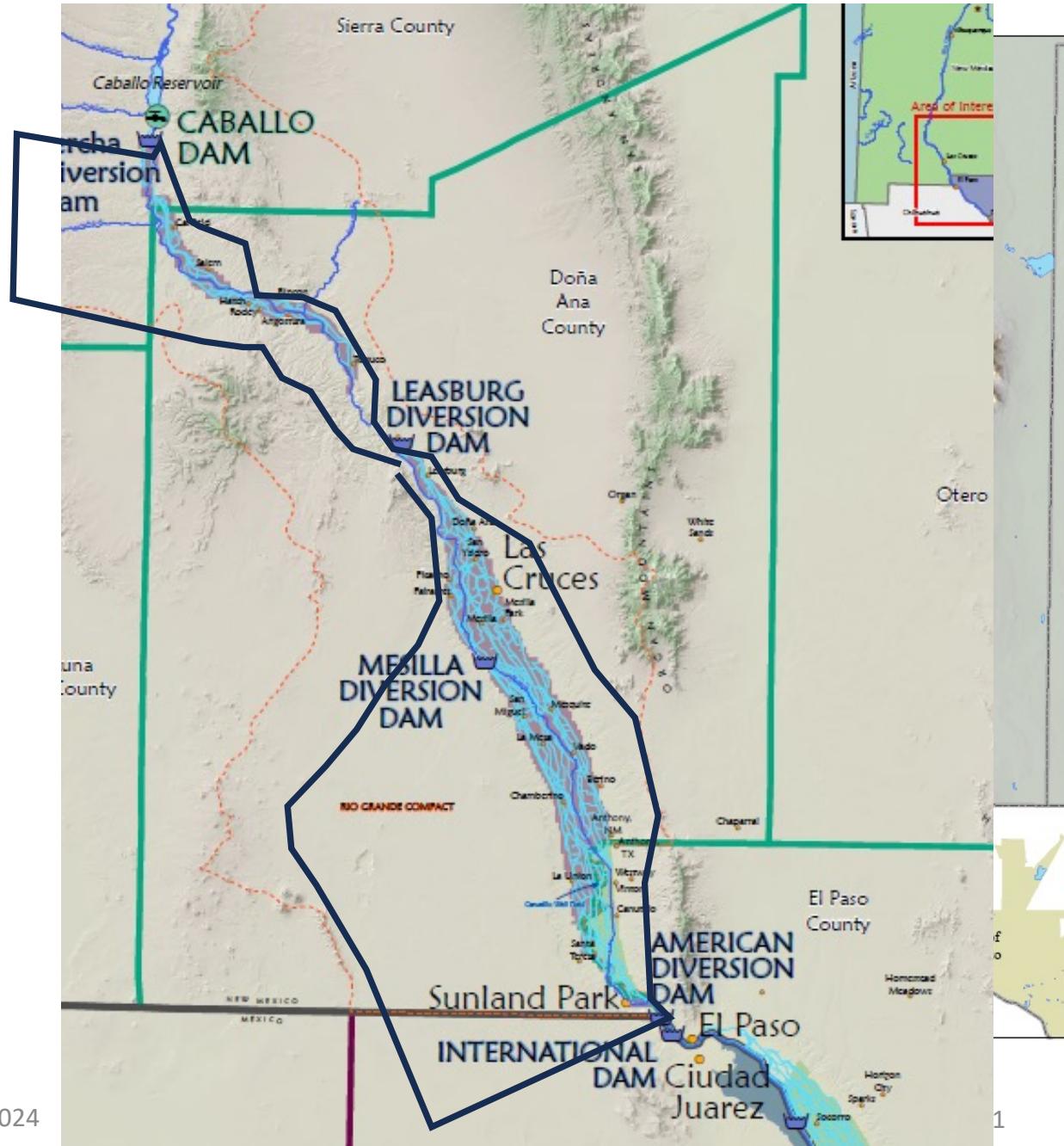
Annual Release of Water from Caballo Reservoir



LRG Surface-Water Groundwater Interaction:

- Surface water flow in Rio Grande, canals and laterals
- Seepage from river and canals into aquifer (recharge)
- Drain discharge from aquifer returned to Rio Grande
- Groundwater pumping

All of this happens predominantly in the Rio Grande Valley, within a few miles of the Rio Grande

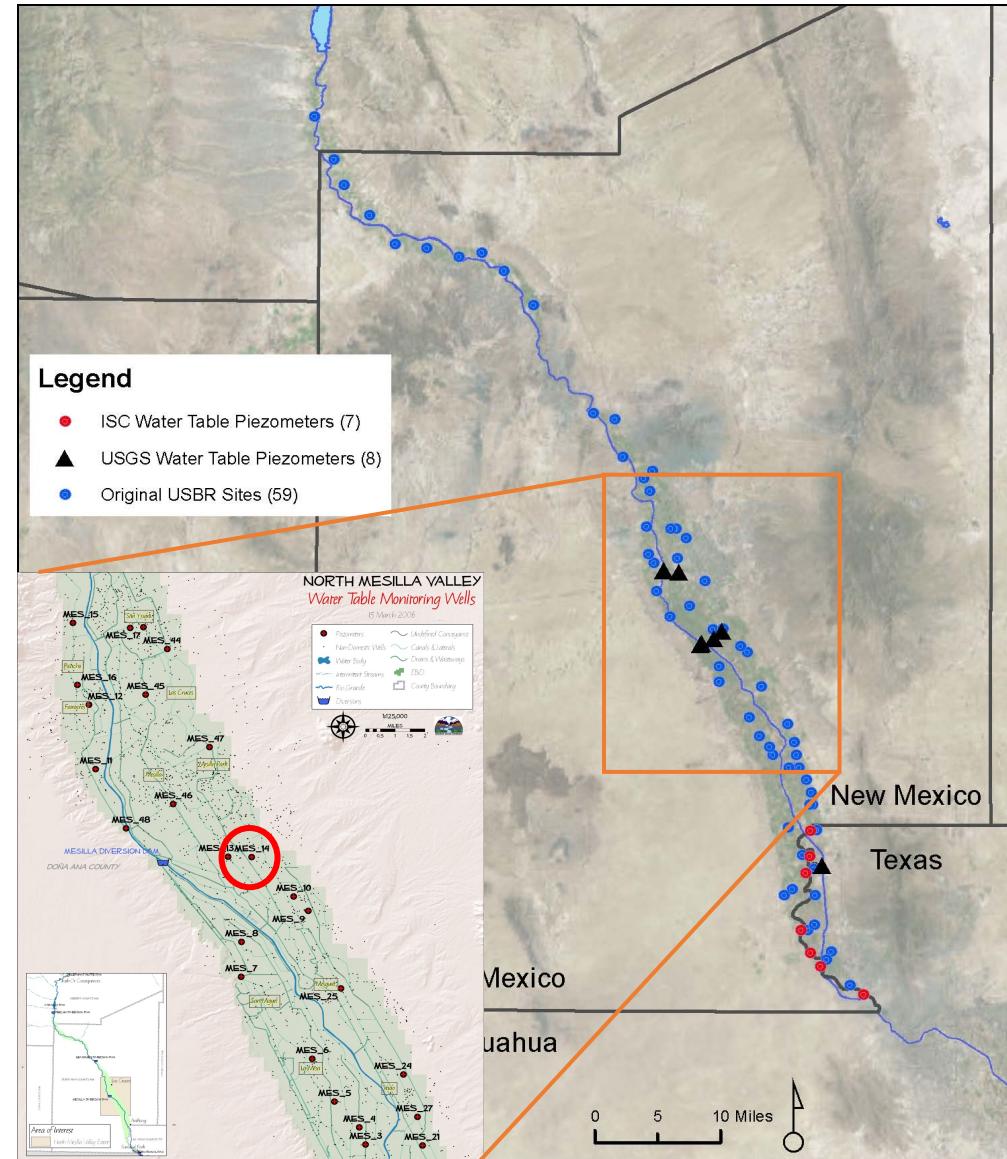


Rio Grande Valley Aquifer Conditions: Groundwater Levels

We have Numerous observation wells

- Original (1940's) USBR shallow monitor wells, and associated 2009 replacement wells
- USGS monitor well nests (1980's)
- ISC monitor well nests (2003)

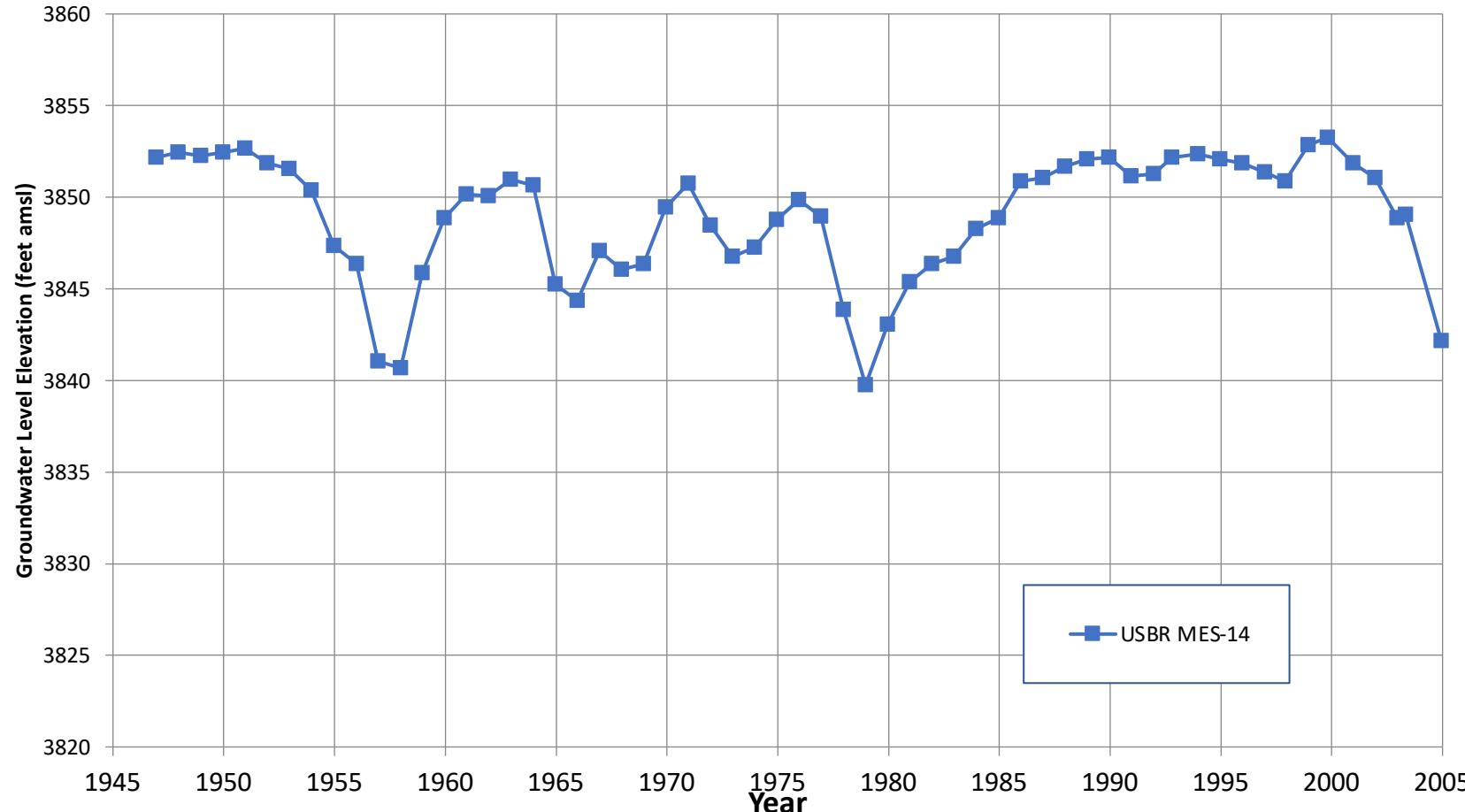
Drilled by US Bureau of Reclamation,
USGS and New Mexico OSE/ISC,
Maintained and monitored by EBID and
USGS



Historic Groundwater Levels from Monitor Well

1945 – 2005 Annual (winter) data

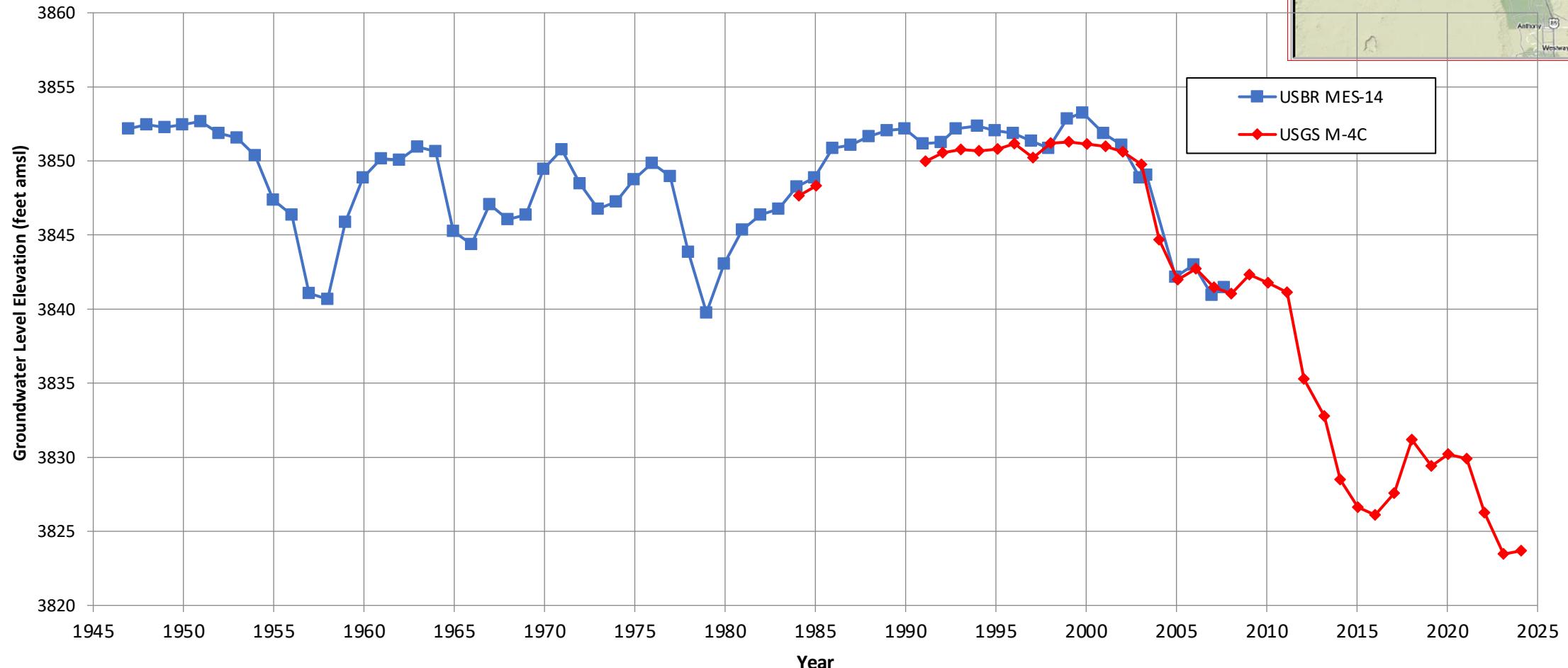
(Old USBR monitor well south of Las Cruces)



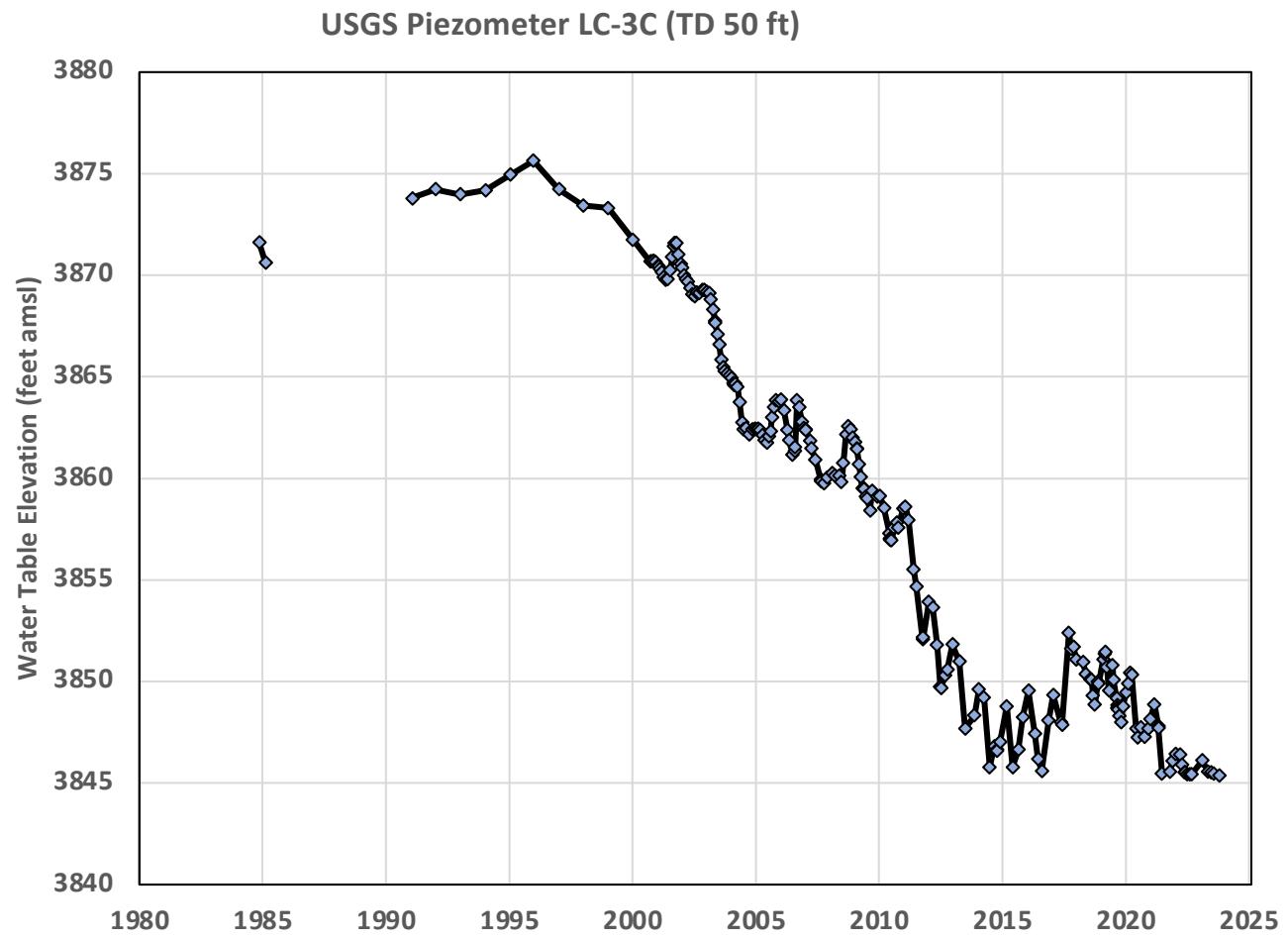
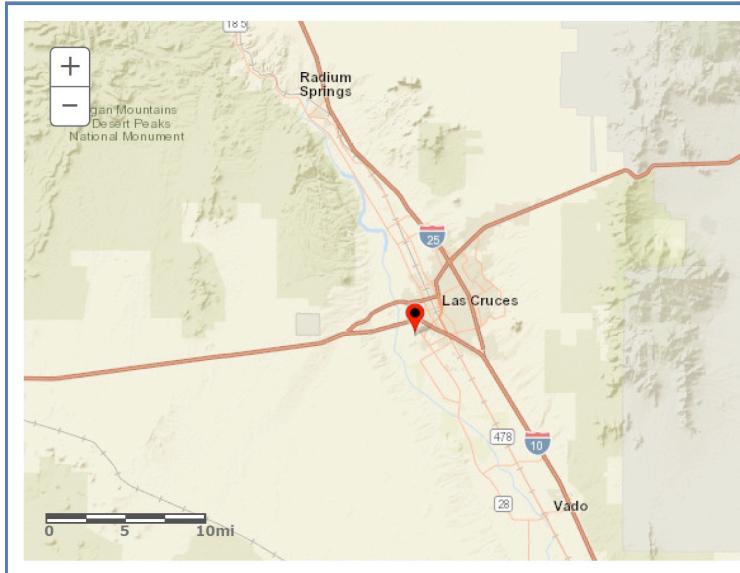
Up until about the year 2000, water levels fluctuated, declining during drought, recovering thereafter

Include More Recent Data from a near-by USGS well

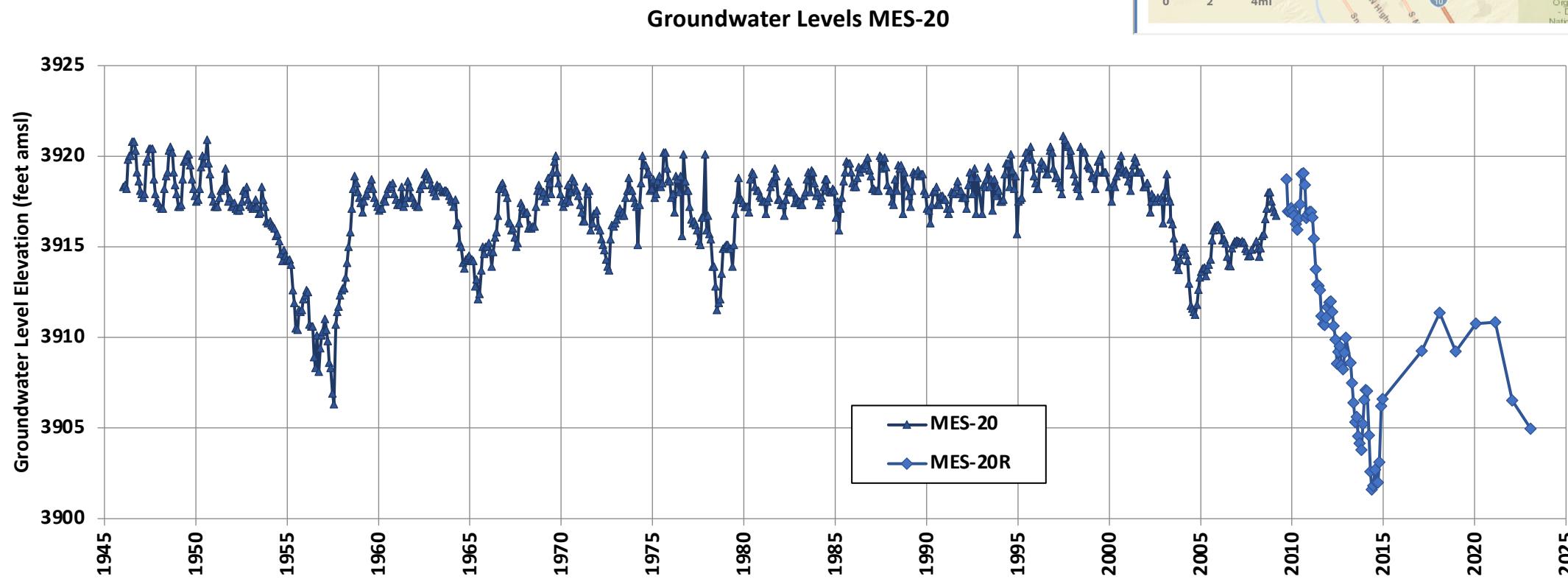
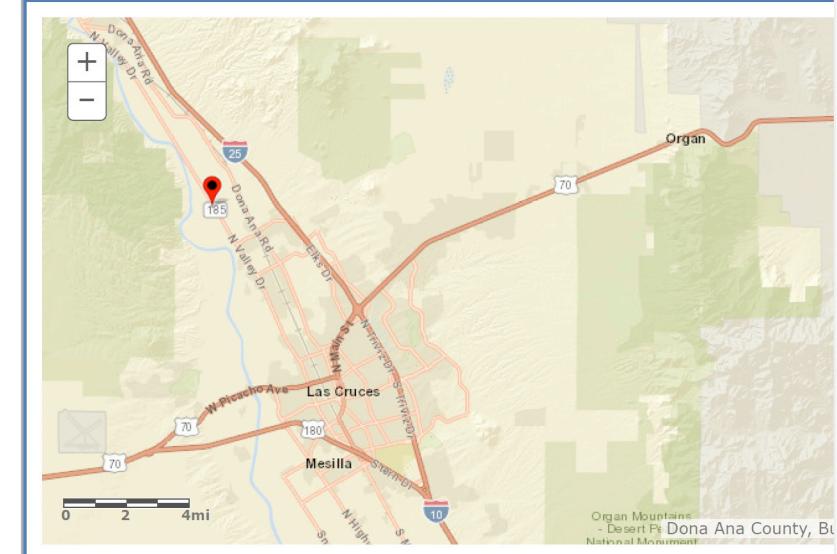
- Dropping, and not recovering
- Are we now in a mined-aquifer regime?



Another site: Shallow Groundwater Levels in Las Cruces area



Another Site: Shallow Groundwater Levels North of Las Cruces



Aquifer Water Budget Components:

Inflow to the Aquifer (Recharge)

Most of the inflow to aquifer comes from

- Seepage of irrigation water from canals and farms (mostly Rio Grande water)
- Seepage directly from Rio Grande

Small amounts of recharge from local precipitation and side inflows



**Key
Anthropogenic
(Human)
Components**

Withdrawal of Water from LRG Aquifer System (Discharge)

Well pumping: irrigation and municipal users etc.

Discharge from drains

Other: Small amounts of groundwater are lost to evaporation from phreatophyte plants, and subsurface groundwater outflow

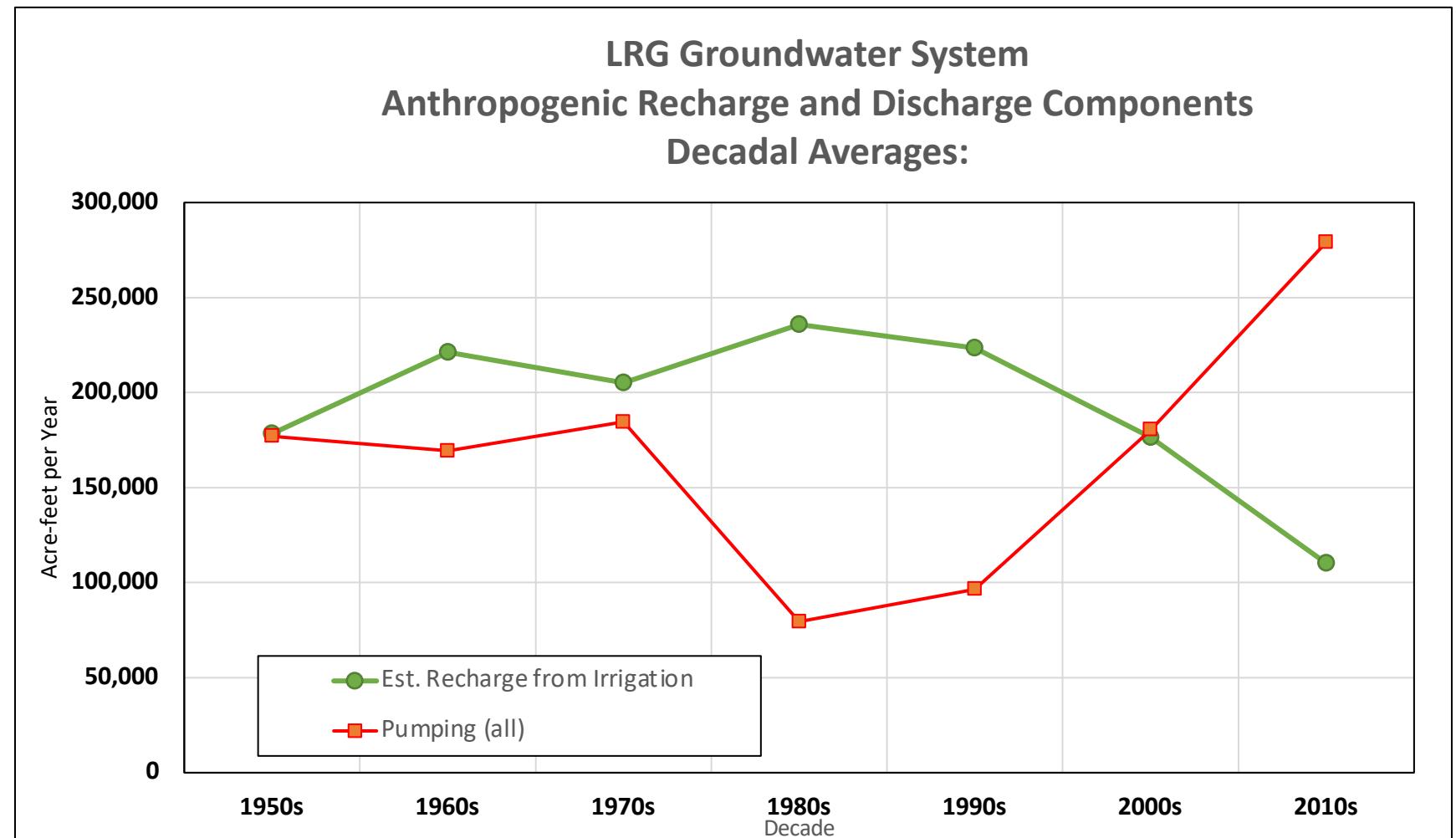
How Have Anthropogenic Water Budget Components of the LRG Groundwater System Changed with Time?

Key Recharge Component:
Recharge from Irrigation

- Canal Seepage
- On-Farm deep percolation

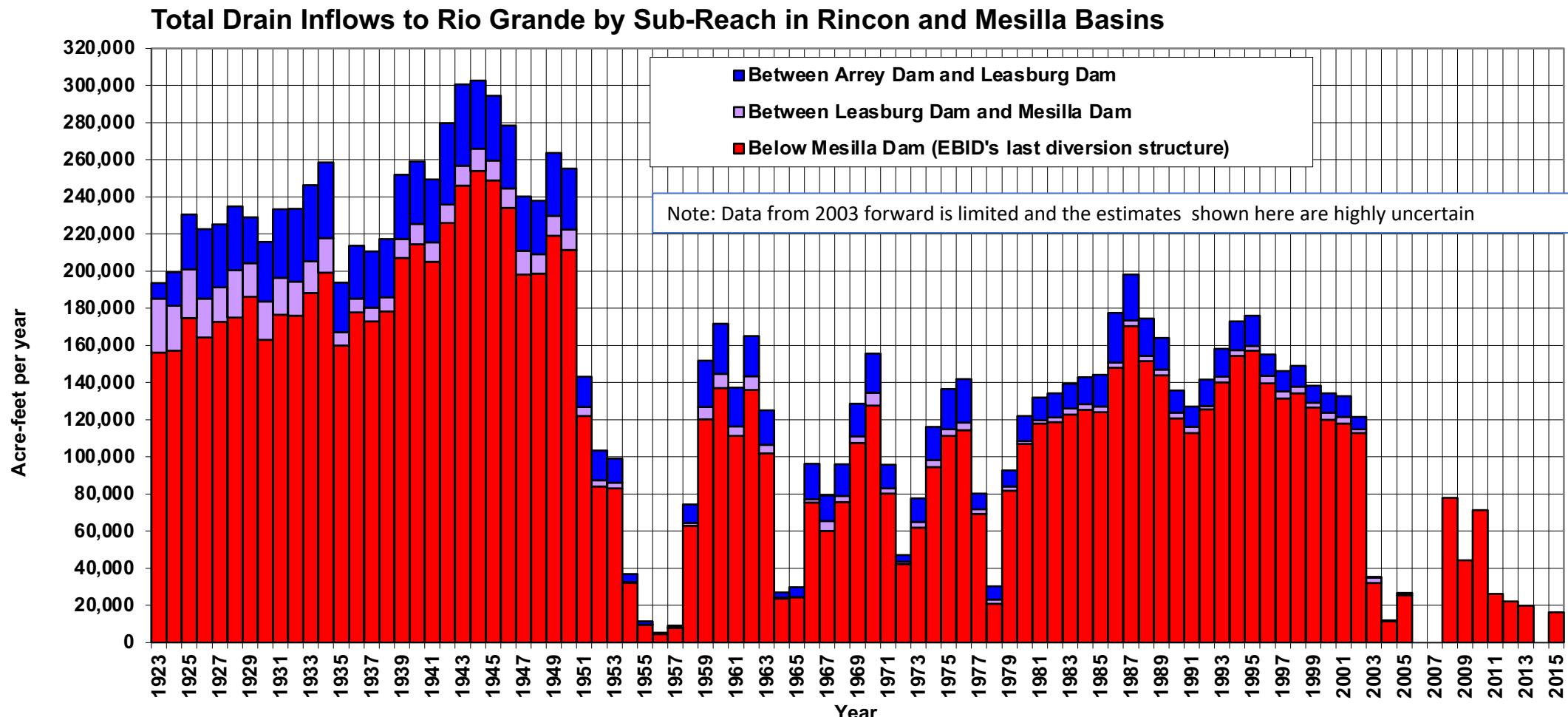
Key Discharge Component:
Groundwater Pumping

- Irrigation
- Municipal etc. (DCMI)



Drain Discharge into Rio Grande

- High in high-supply years,
- Low during drought, very low in recent years
- In recent, many drains are dry. The only flowing drains are in the southern-most Mesilla Valley

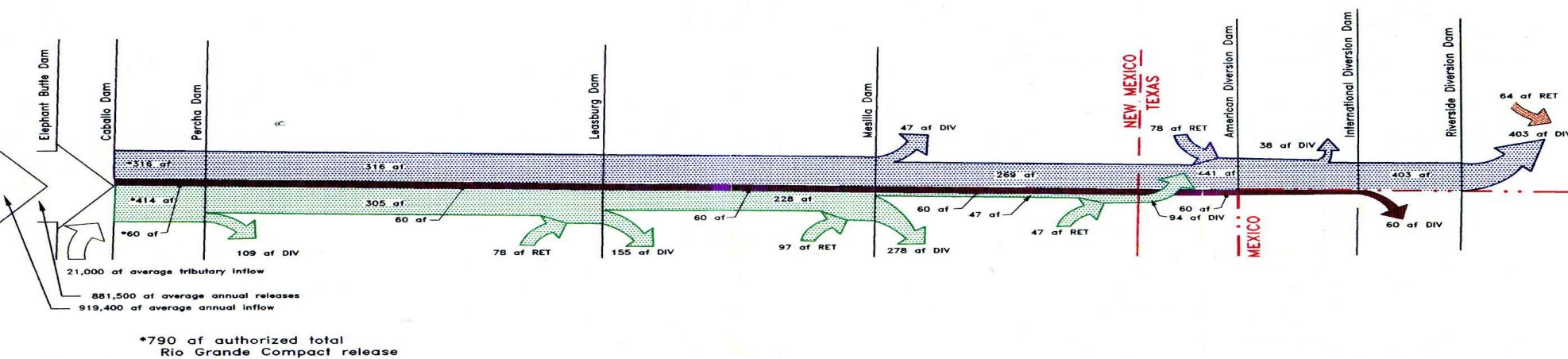


Importance of Drain Flows

Drain Flows are part of Project Supply

If drains don't flow:

- Project Supply is reduced
- Project efficiency is reduced

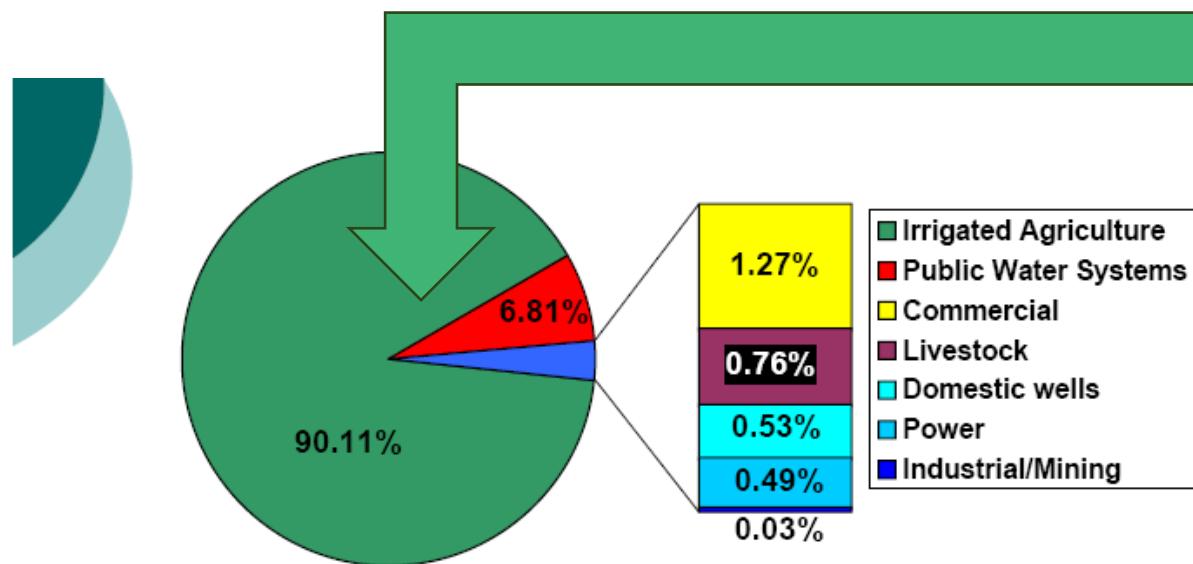


Drain Flows historically composed a significant part of flow at El Paso Gage

How is Water in the LRG being Used? By Whom? How has this use changed?

Total water use (including surface water) by Sector:

90% agriculture, 7% municipal, 3% other



Agricultural Water Use:

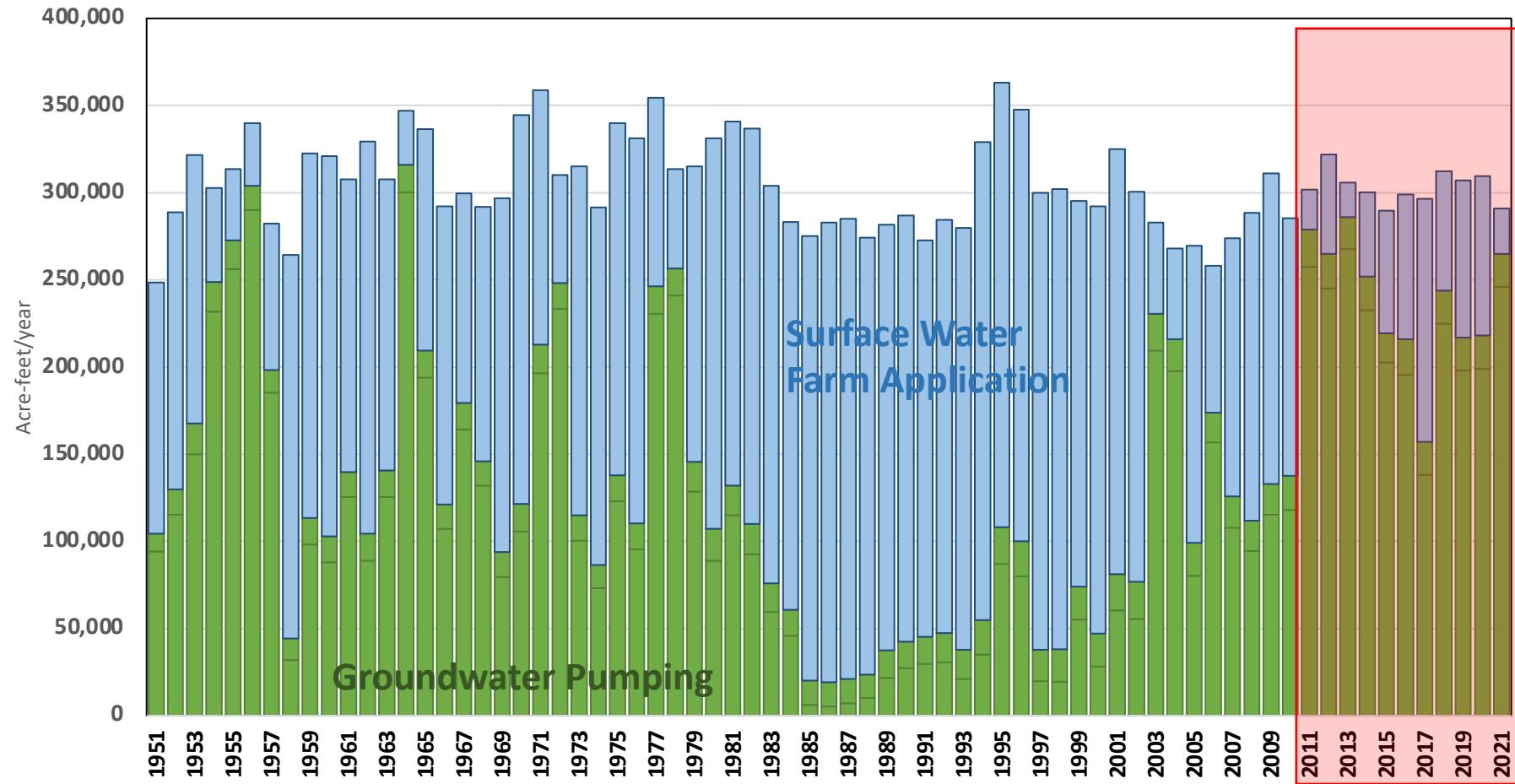
- Application of Irrigation Water
- Consumption of Irrigation Water

From LRGWUO
Regional Water
Plan 2003

97 percent of LRG water use is irrigation or public water systems



Irrigation Water Use: Surface Water and Groundwater delivered to farms



Total application of irrigation water is also pretty flat.

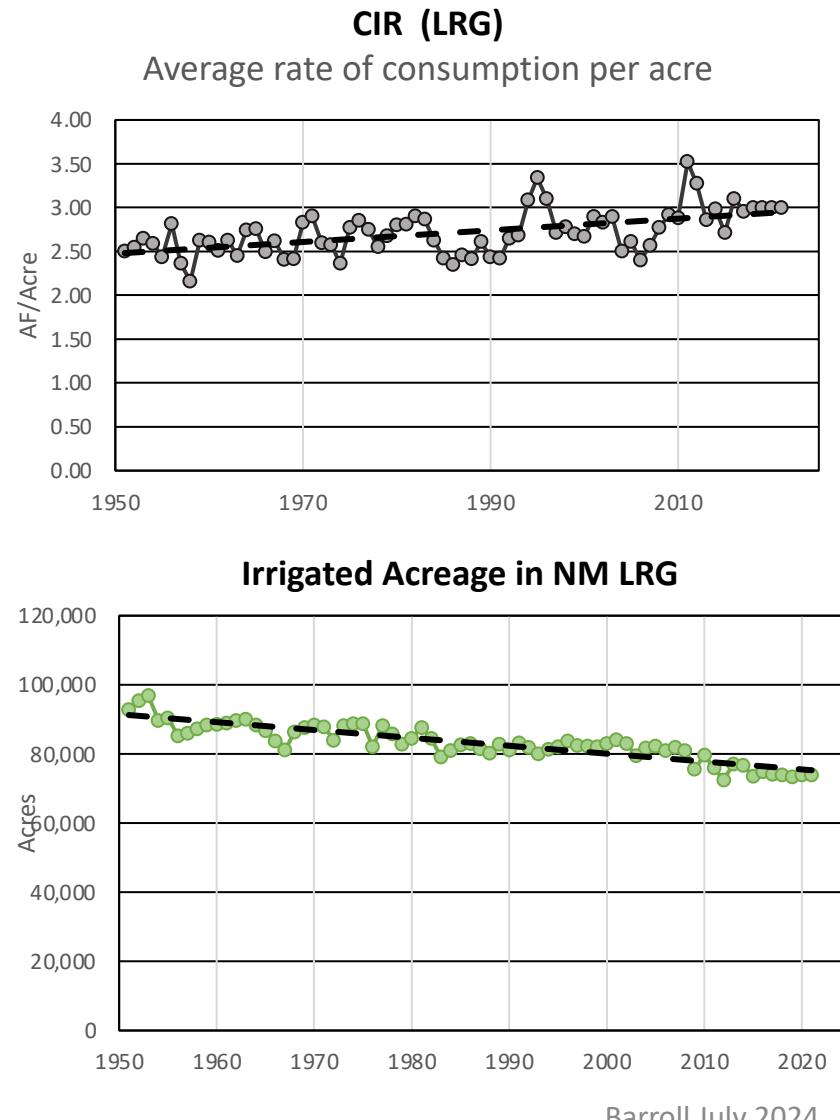
But: In recent years, very little surface water, so a large proportion of irrigation is from groundwater pumping

Irrigation Water Use: Consumption

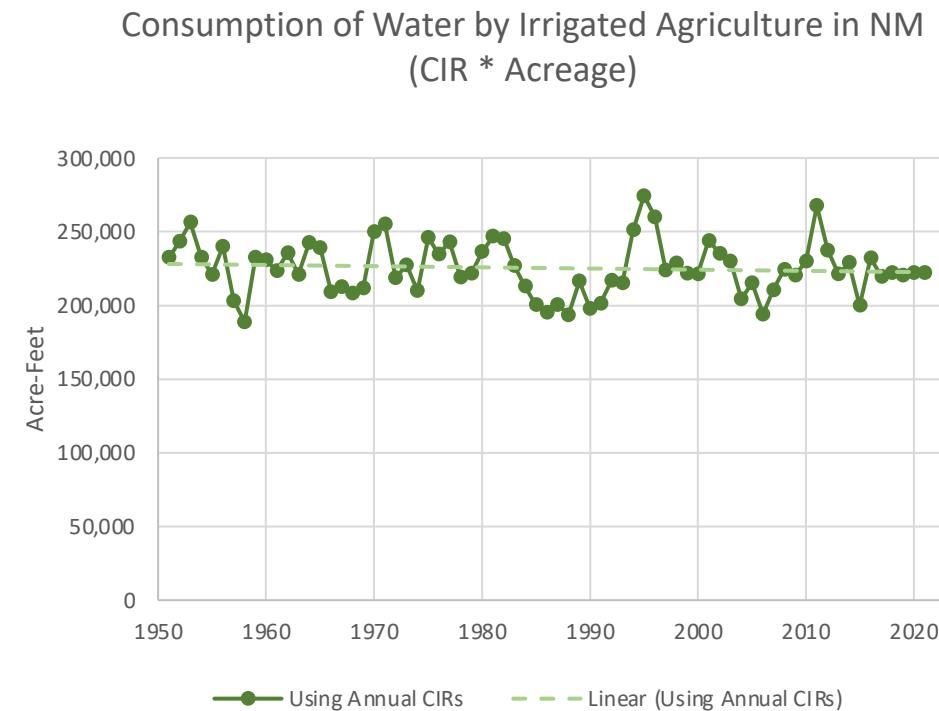
High consumptive use crops have increased in importance,

but

The total acreage irrigated has gone down.



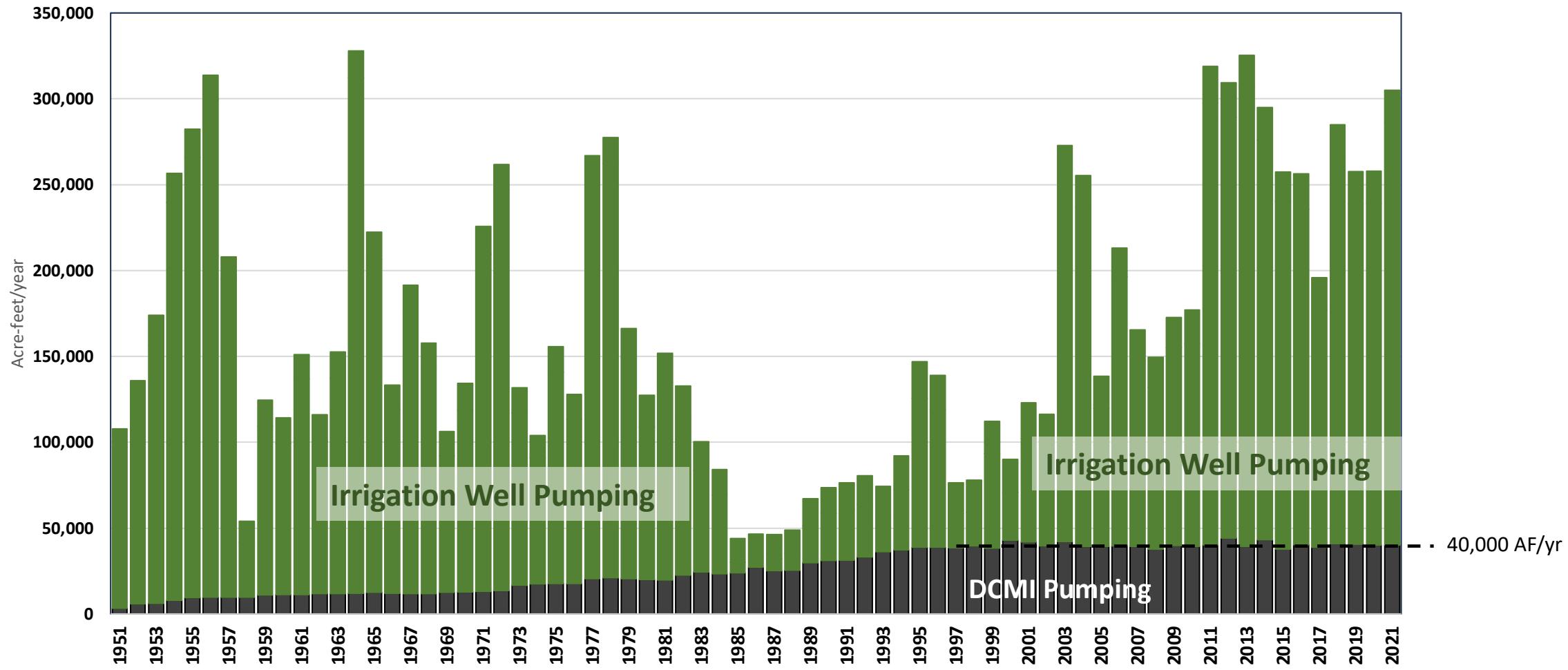
Total Consumption of water by irrigated agriculture is pretty flat (relatively constant)



Groundwater Pumping in the LRG: Historical Amounts and Breakdown

- Historical Trends in groundwater pumping
- Breakdown between:
 - Irrigated Agriculture and
 - DCMI (Domestic, Commercial, Municipal and Industrial pumping)
- Recent Meter Data from 2022 LRG Water Master Report

All Groundwater Pumping Mesilla and Rincon Basins in New Mexico



Recent LRG Water Master District Meter Data Summary

2022 LRG Water Master Report by Ryan Serrano

<https://www.ose.nm.gov/WM/WMdistrict4.php>



Three (3) Year Comparison and Summary of Metered Groundwater Withdrawals in the Lower Rio Grande Basin (Acre-Feet)



Category	2020		2021		2022		3-Year Total	
Irrigation	218,231	82.11%	264,430	84.77%	239,098	84.53%	721,759	83.87%
Drinking Water: Municipal, Mutual Domestic, and individual Domestic Supply <i>(includes 2,400 AF of estimated unmetered domestic)</i>	40,164	15.11%	39,234	12.58%	37,234	13.16%	116,632	13.55%
City of Las Cruces	21,401		21,049		20,845			
New Mexico State University	3,087		3,080		1,964			
Mutual Domestic	12,204		11,665		10,860			
Other Drinking Water	3,472		3,440		3,565			
Commercial/Industrial/Dairy	6,662	2.51%	7,879	2.53%	6,027	2.13%	20,568	2.39%
All Other Uses	738	0.28%	400	0.13%	491	0.17%	1,629	0.19%
TOTALS	265,794		311,943		282,850		860,588	100%

(Note: This data set includes approx. 7,000 AF/yr of DCMI pumping from the Jornada del Muerto, which is not part of the Rincon/Mesilla aquifer system)

Conclusions

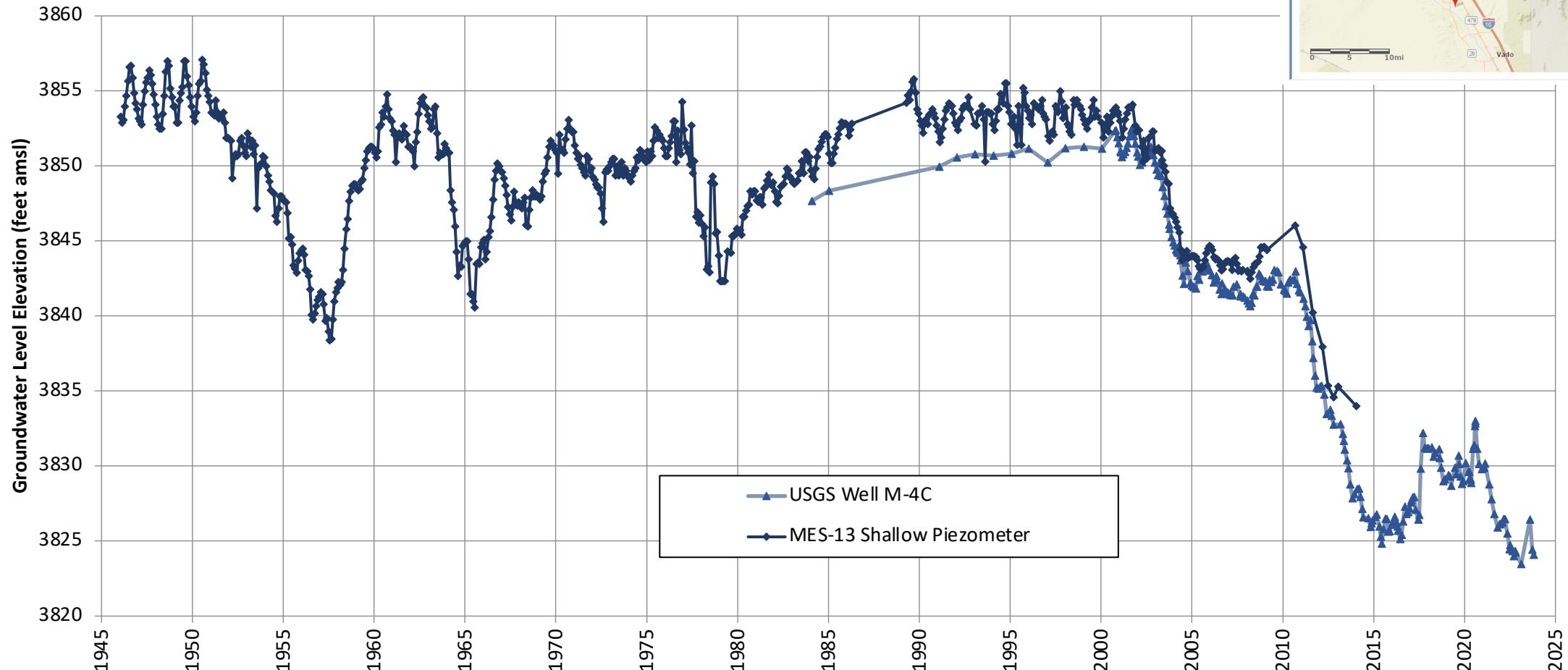
- Supply of surface water to the LRG has been relatively low for past 20 years
 - Low recharge to aquifer
 - High irrigation well pumping
- Groundwater levels have fallen, without much recovery, since about 2000
- Drain flows are low to non-existent
 - Low efficiency for Project and for delivery of water to El Paso Gage
- Recent groundwater use and depletions are incompatible with low surface water supplies and low aquifer recharge
 - Total irrigation depletions have been stable over time, but low surface water supplies have led to large amounts of irrigation well pumping in recent years
 - DCMI water use has increased over time; but has been stable since about 1995.

The End

- Questions?

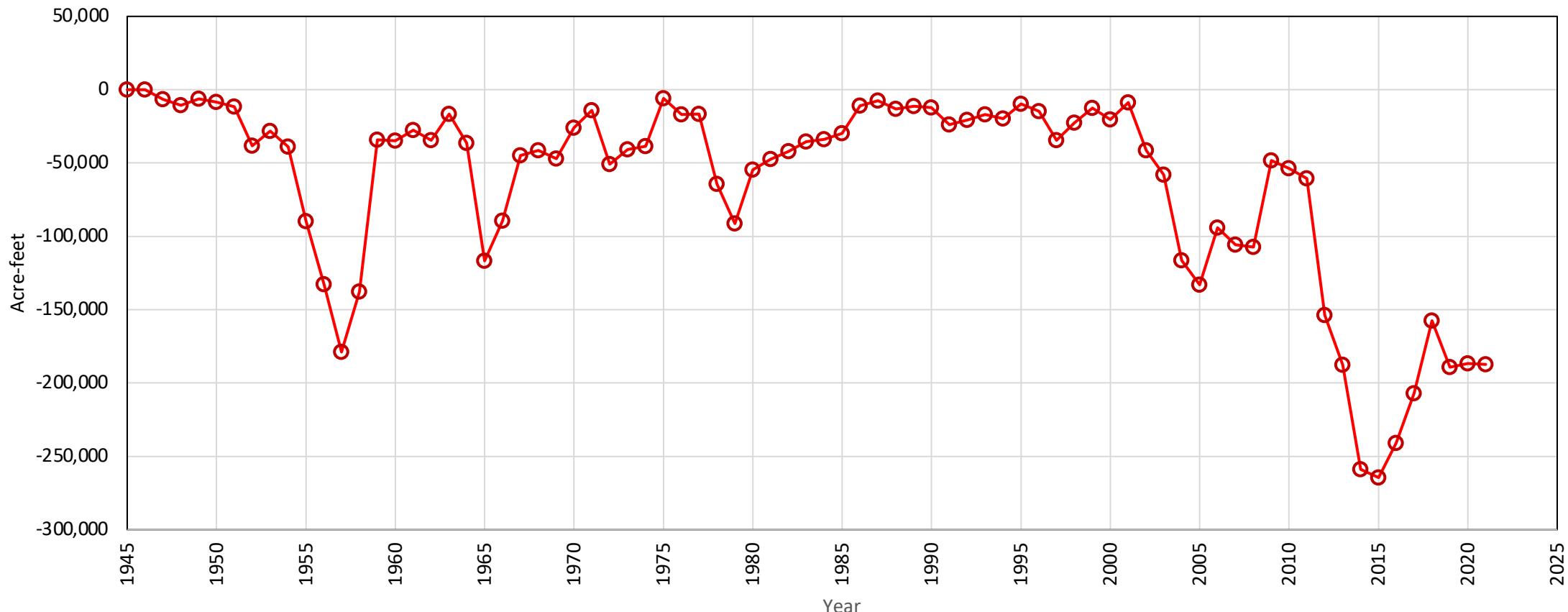


Latest Data (from same location)



Aquifer Storage: Reduction of the Amount of Groundwater Stored in the Shallow Aquifer

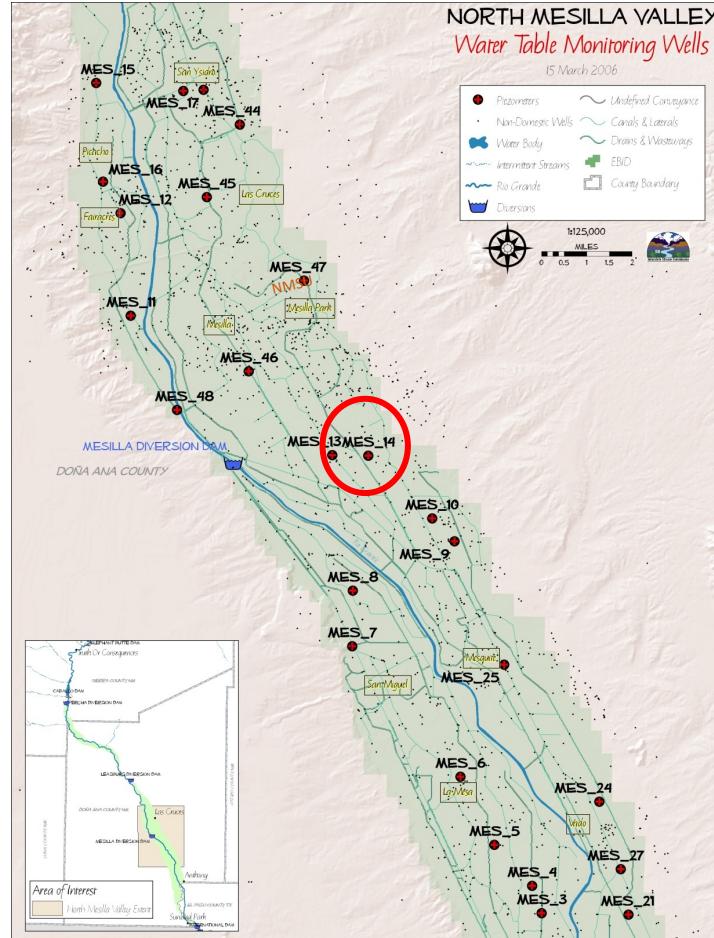
Balleau Groundwater and Dr. Erek Fuchs from measured groundwater level data.
Calculated relative to 1945 baseline condition.



NORTH MESILLA VALLEY
Water Table Monitoring Wells

15 March 2006

- Piezometers
- Non-Domestic Wells
- Water Body
- Intermittent Streams
- Rio Grande
- Diversions
- ~~~~ Undefined Conveyance
- Canals & laterals
- Drains & Westways
- EBID
- County Boundary

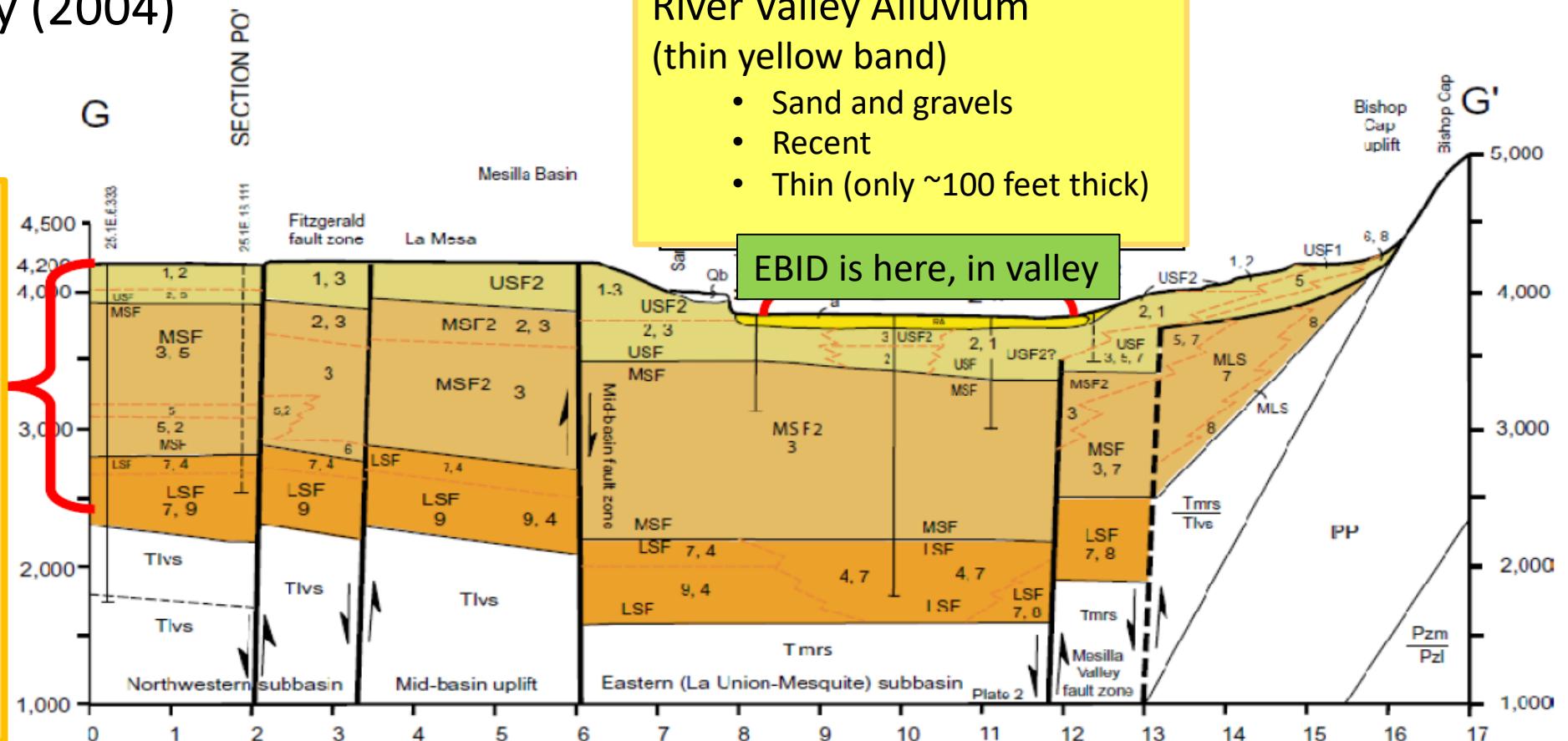


LRG Aquifer System in Cross-section

from the works of Dr. John Hawley
Hawley and Kennedy (2004)

**Santa Fe Group
(various shades of orange)**

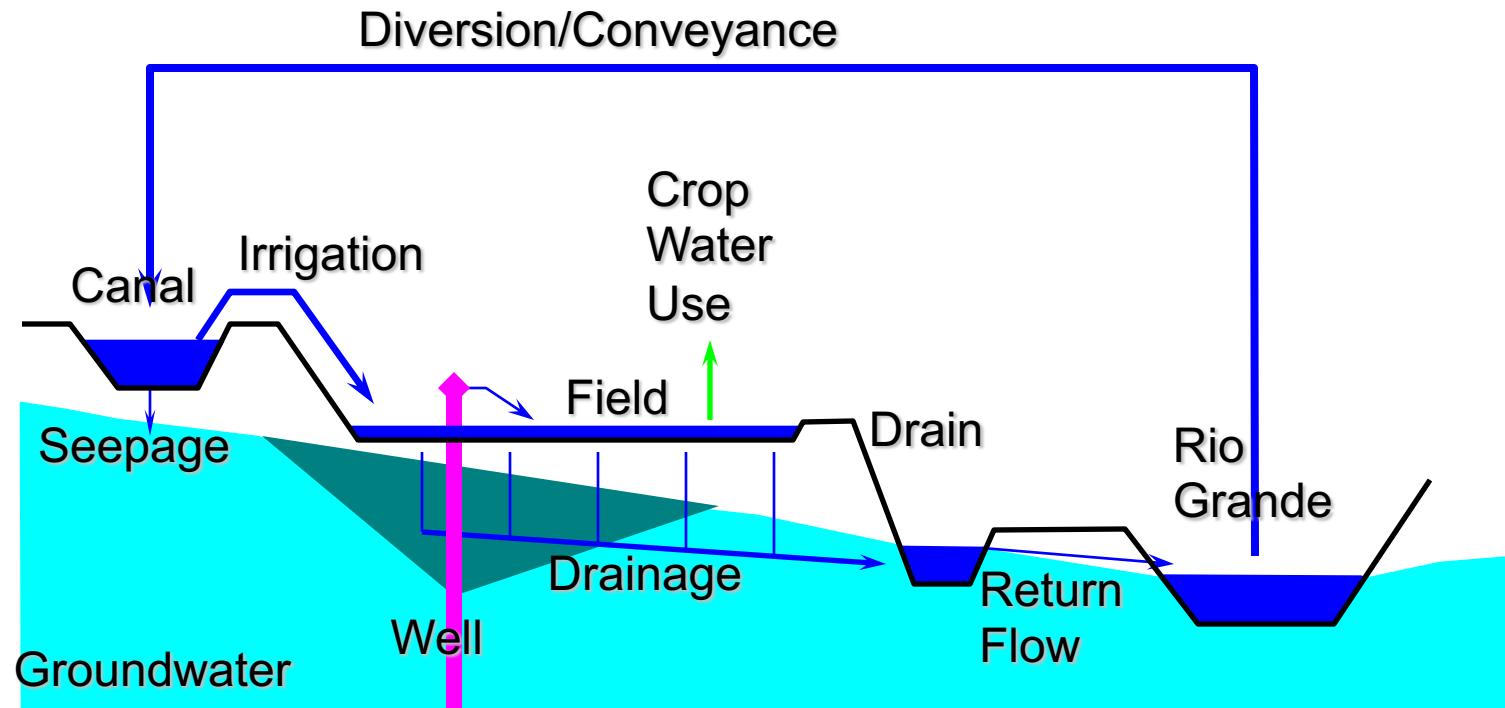
- Clay and silt, some sands and gravels (highly variable)
- Older
- Thick (thousands of feet thick)



Underneath: “Bedrock” that does not contain
much useful groundwater

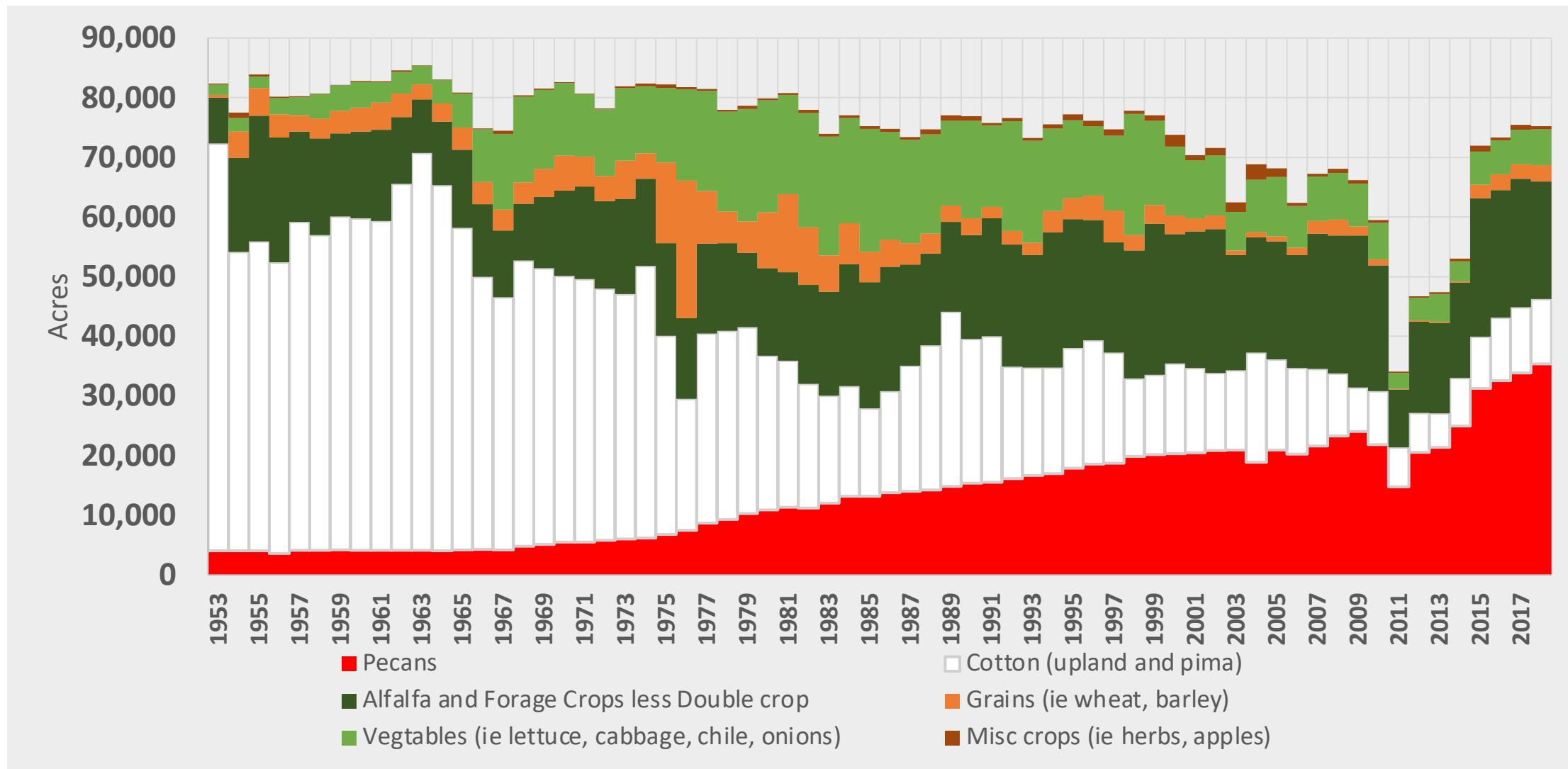
4a. Section G-G'
Santo

Hydrologic Cycle



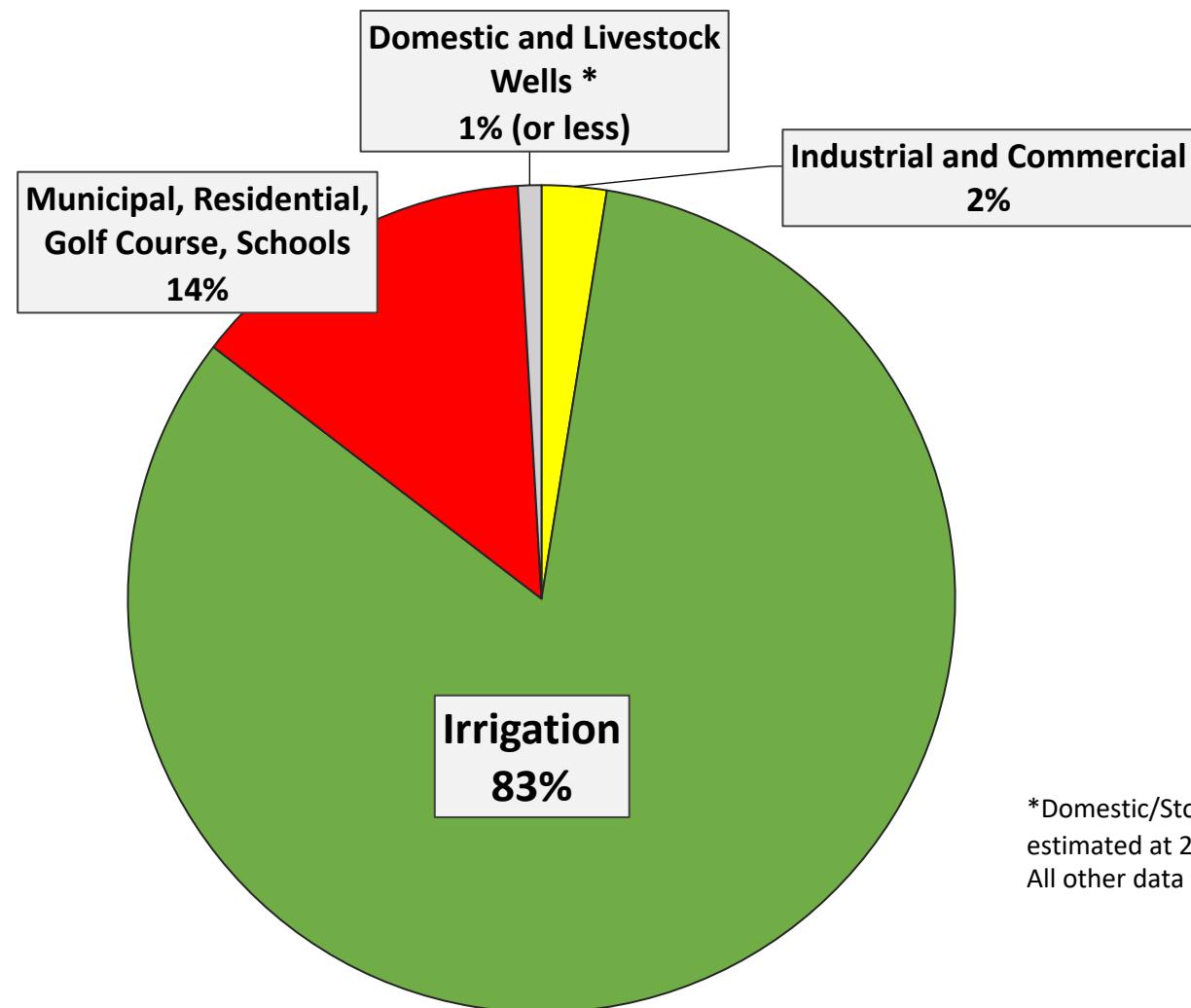
EBID Reported Crop Distribution

(Acreages undercounted in some low-supply years such as 2003-2004 & 2011-2014)



2020 Groundwater Withdrawals in the Rincon/Mesilla basins

(Not including pumping from the Jornada del Muerto)



*Domestic/Stock diversions
estimated at 2,400 AF/yr.
All other data from meters.