

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

Peggy Barroll, Ph.D.

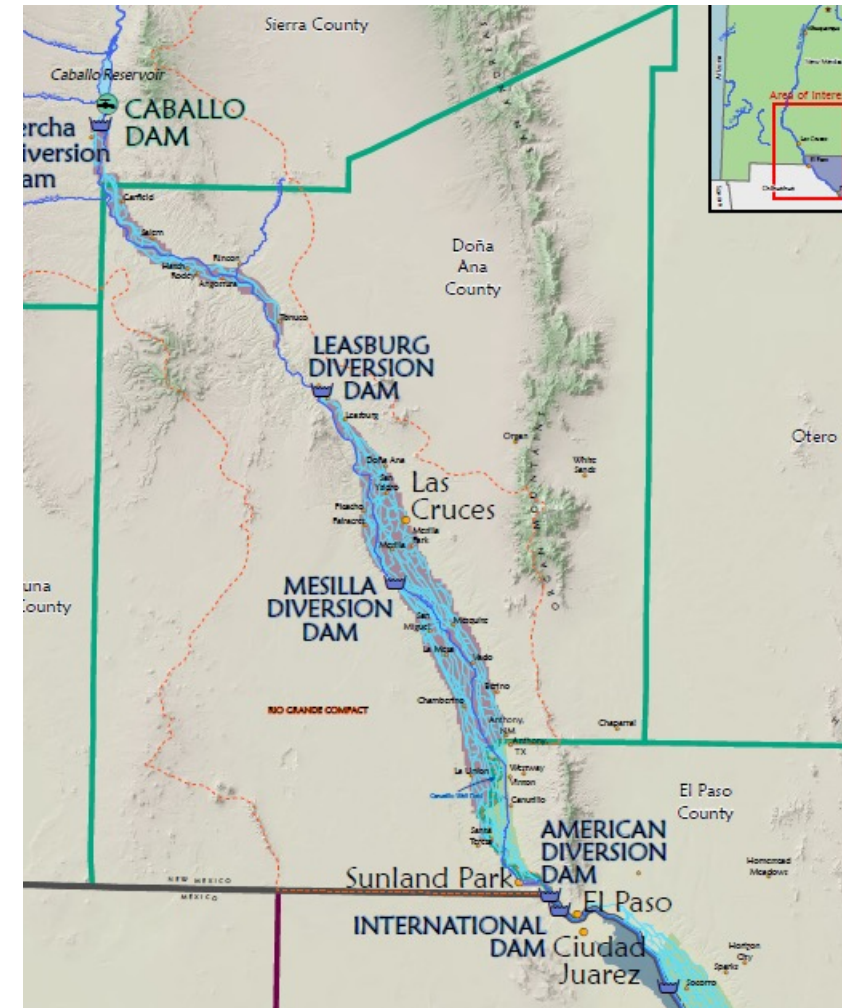
July 2024

# 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/>

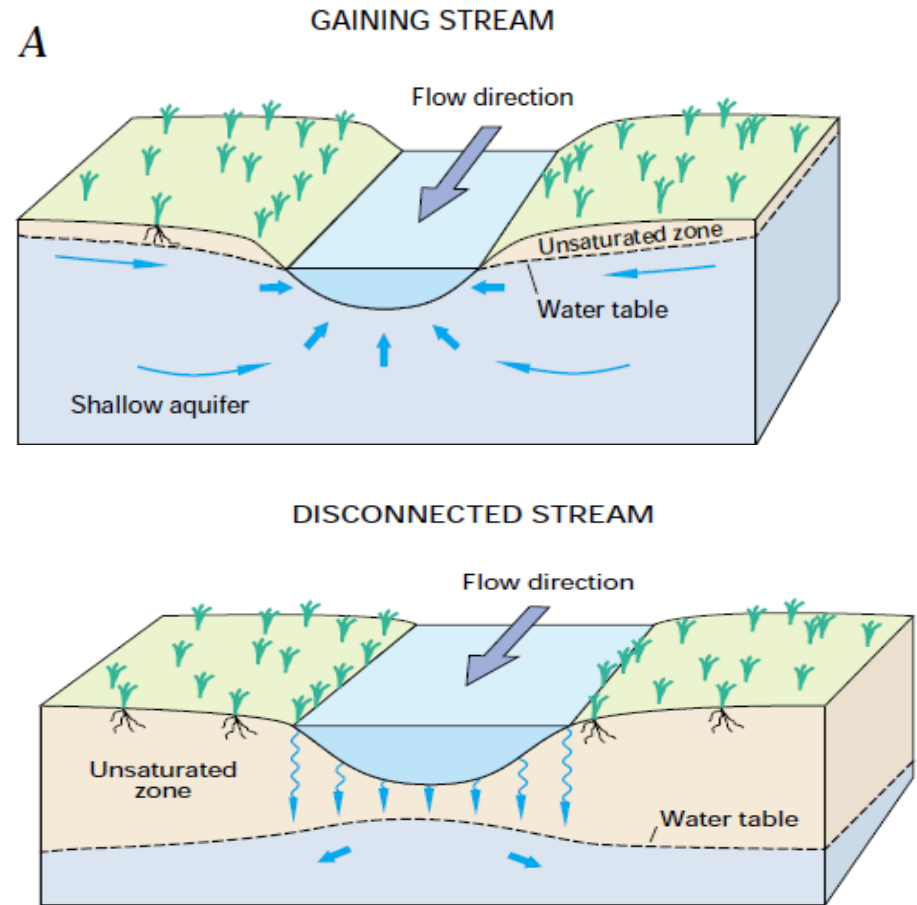
## Gaining Stream:

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

Active drains act like gaining streams.

## Losing Stream:

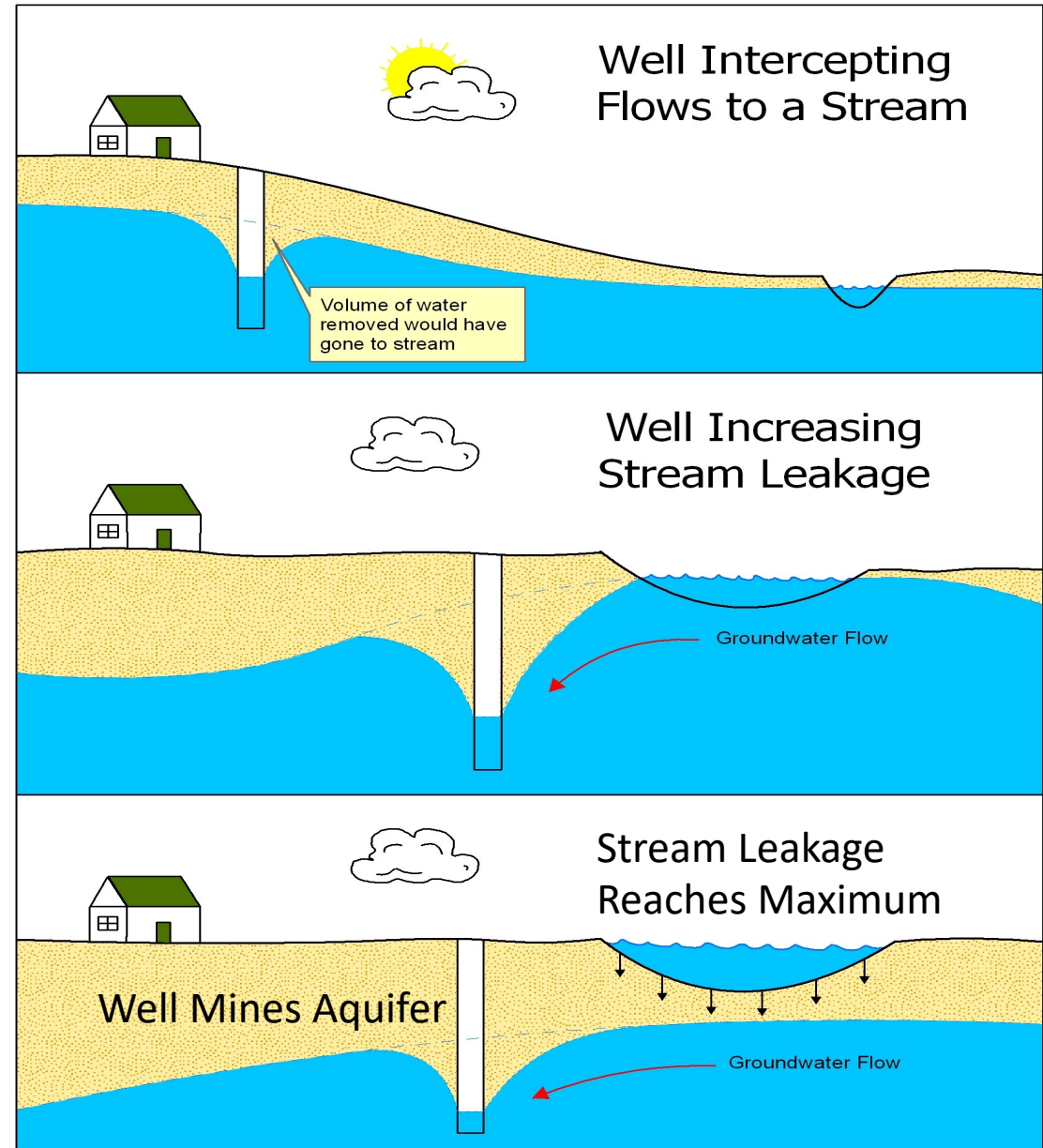
Surface water from stream seeps into (is “lost” to) aquifer



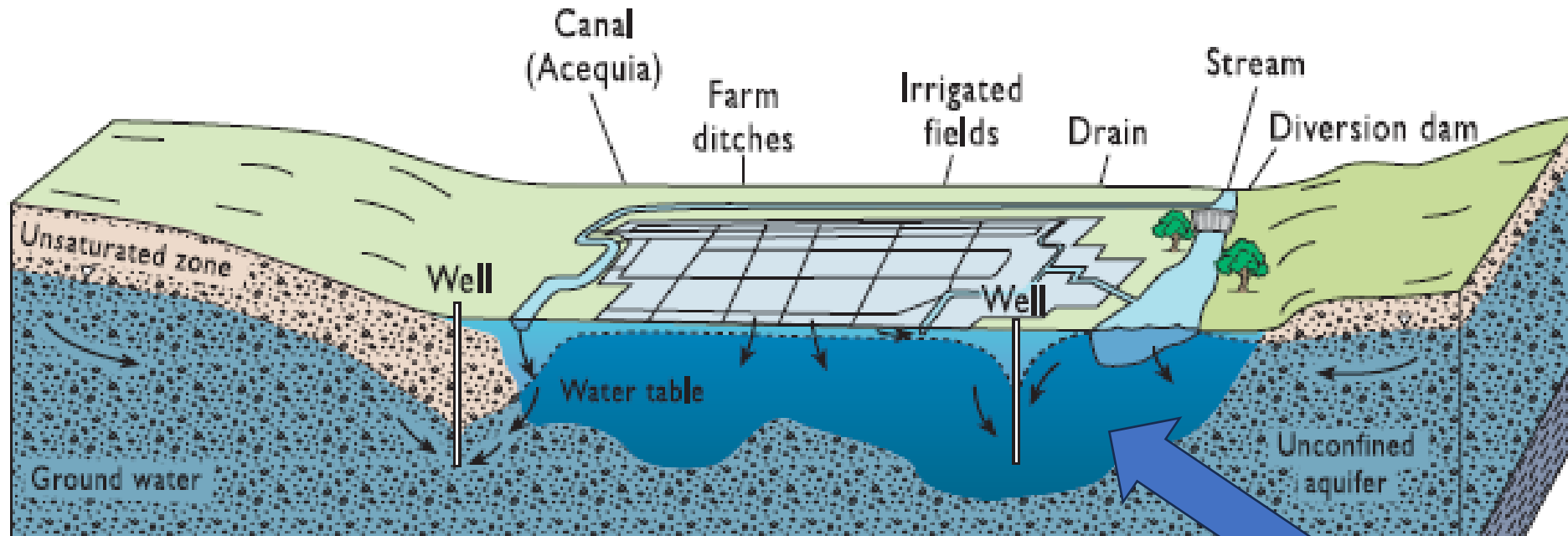
*Figure 10. Disconnected streams are separated from the ground-water system by an unsaturated zone.*

# 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

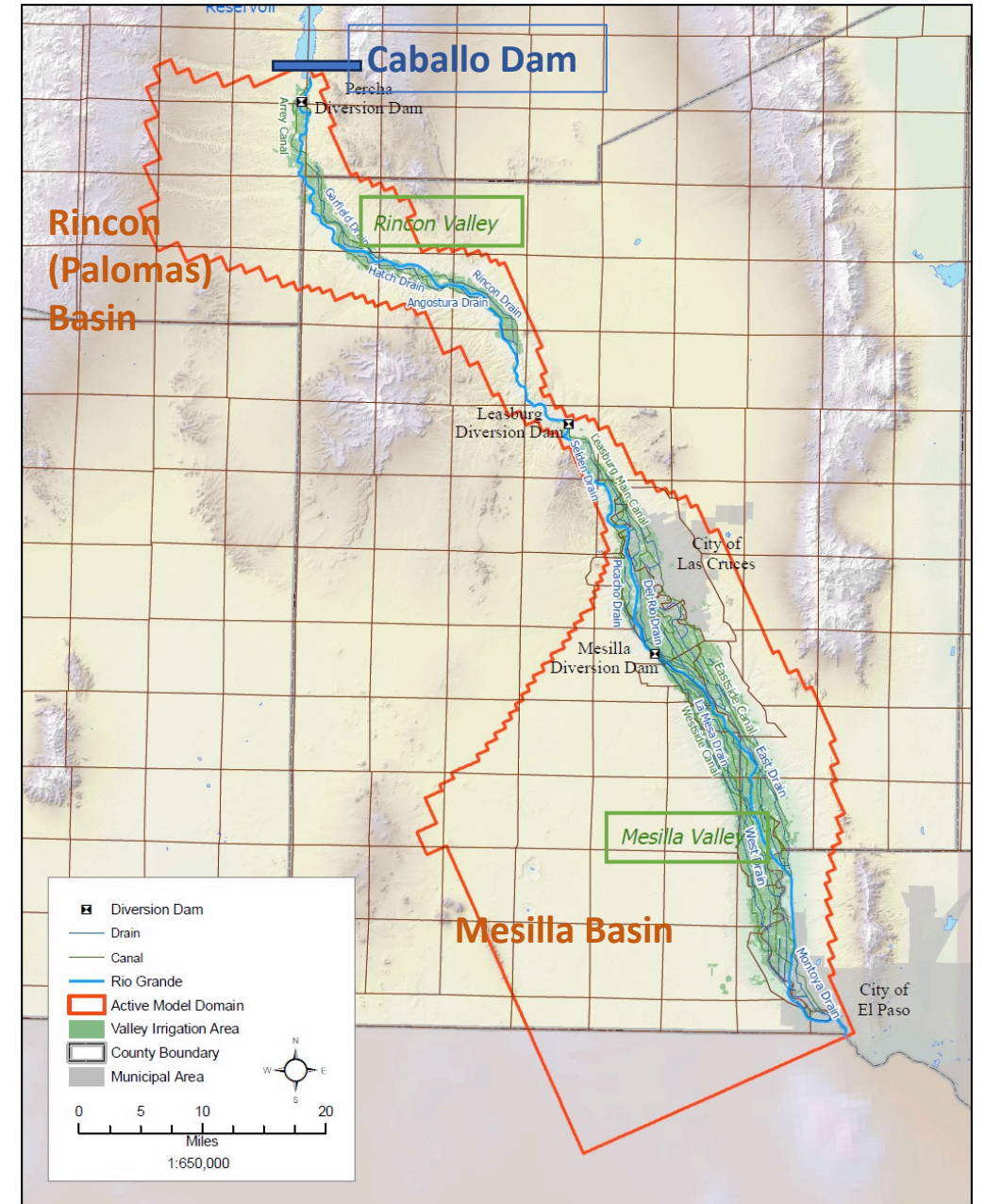
- Rincon (Palomas) Basin
- Mesilla Basin

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



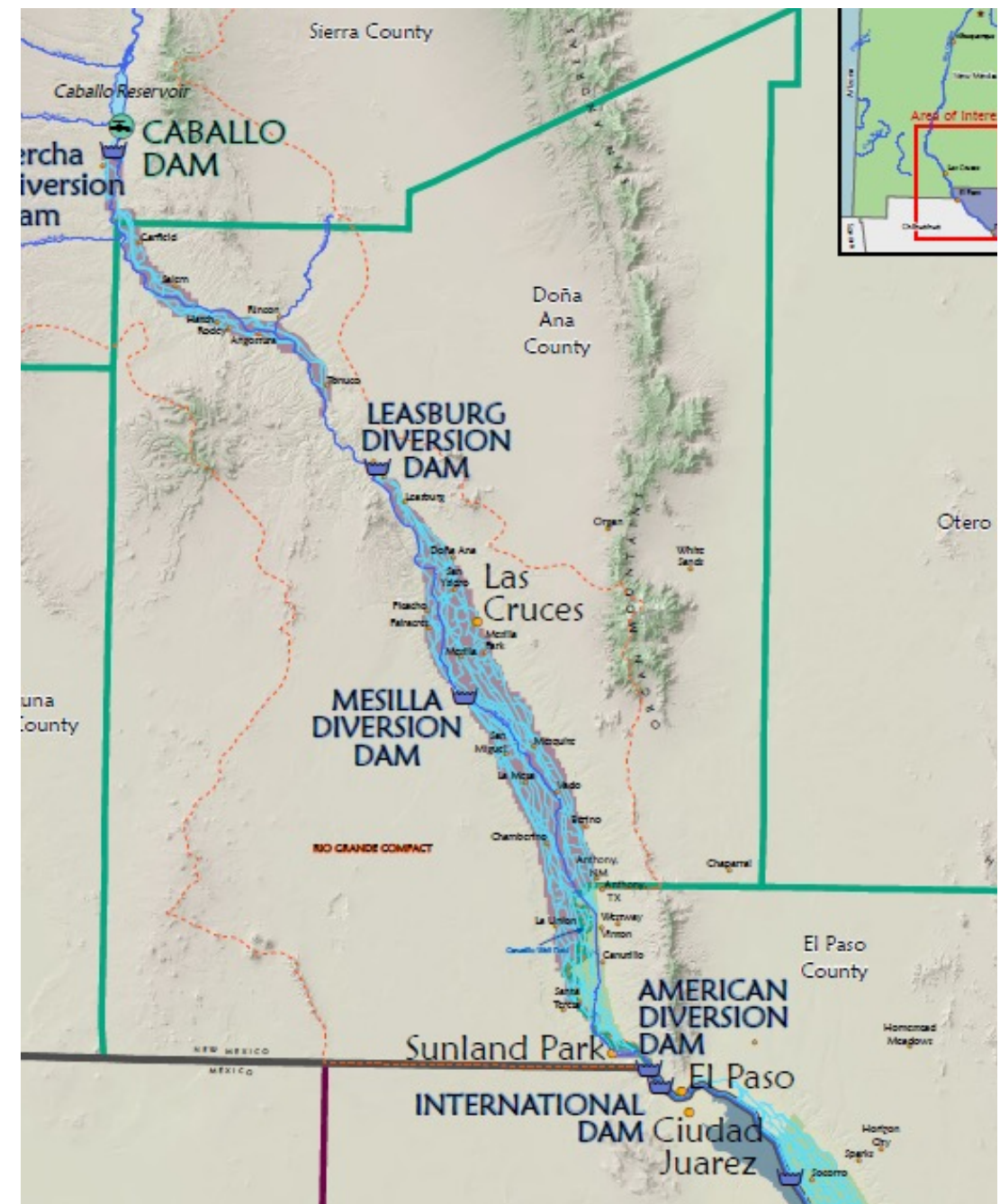
# LRG Surface Water System

Rio Grande

Rio Grande Project  
Diversions, Canal and Drains

## Source of Supply:

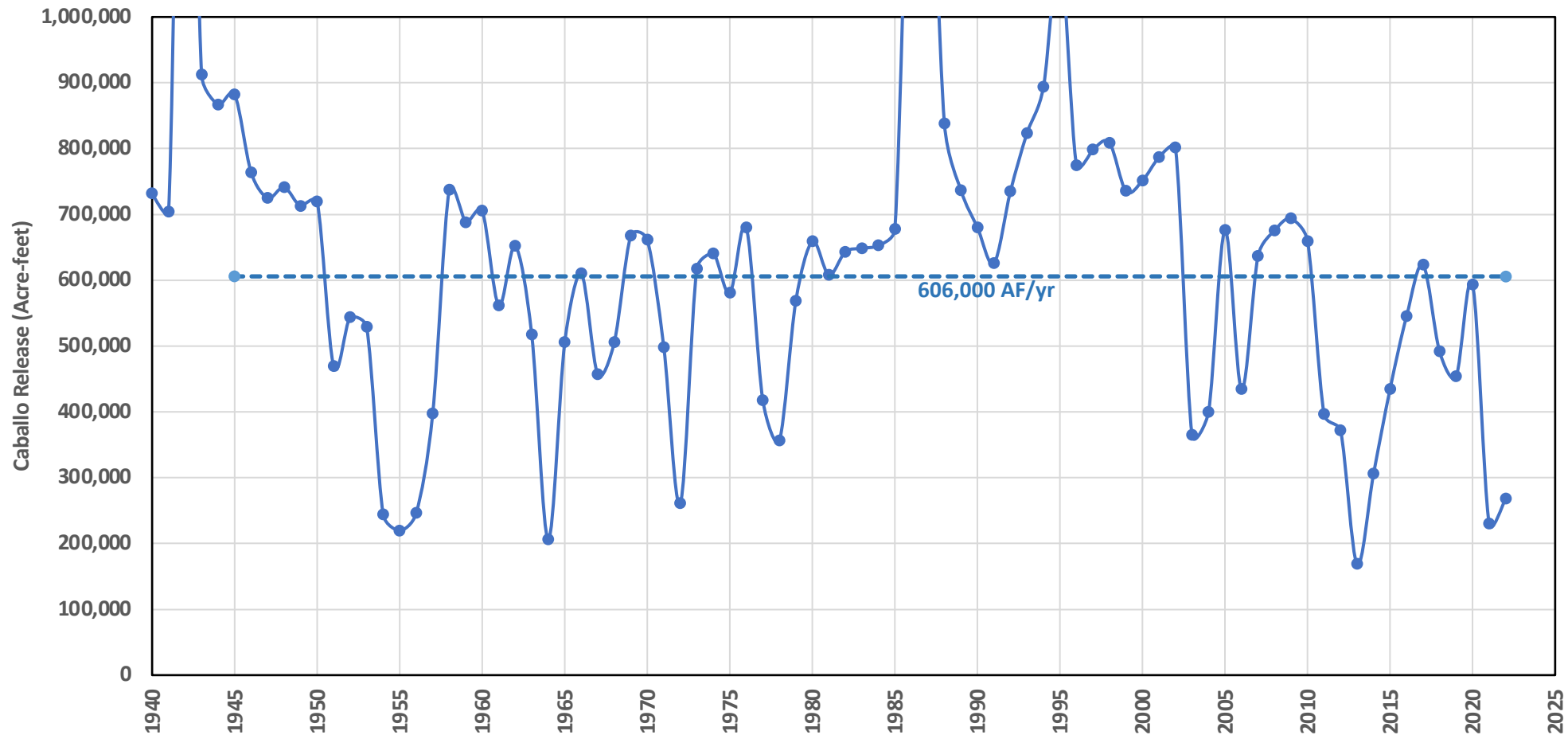
- Releases from Caballo Dam
- Small amounts of side flows from storms





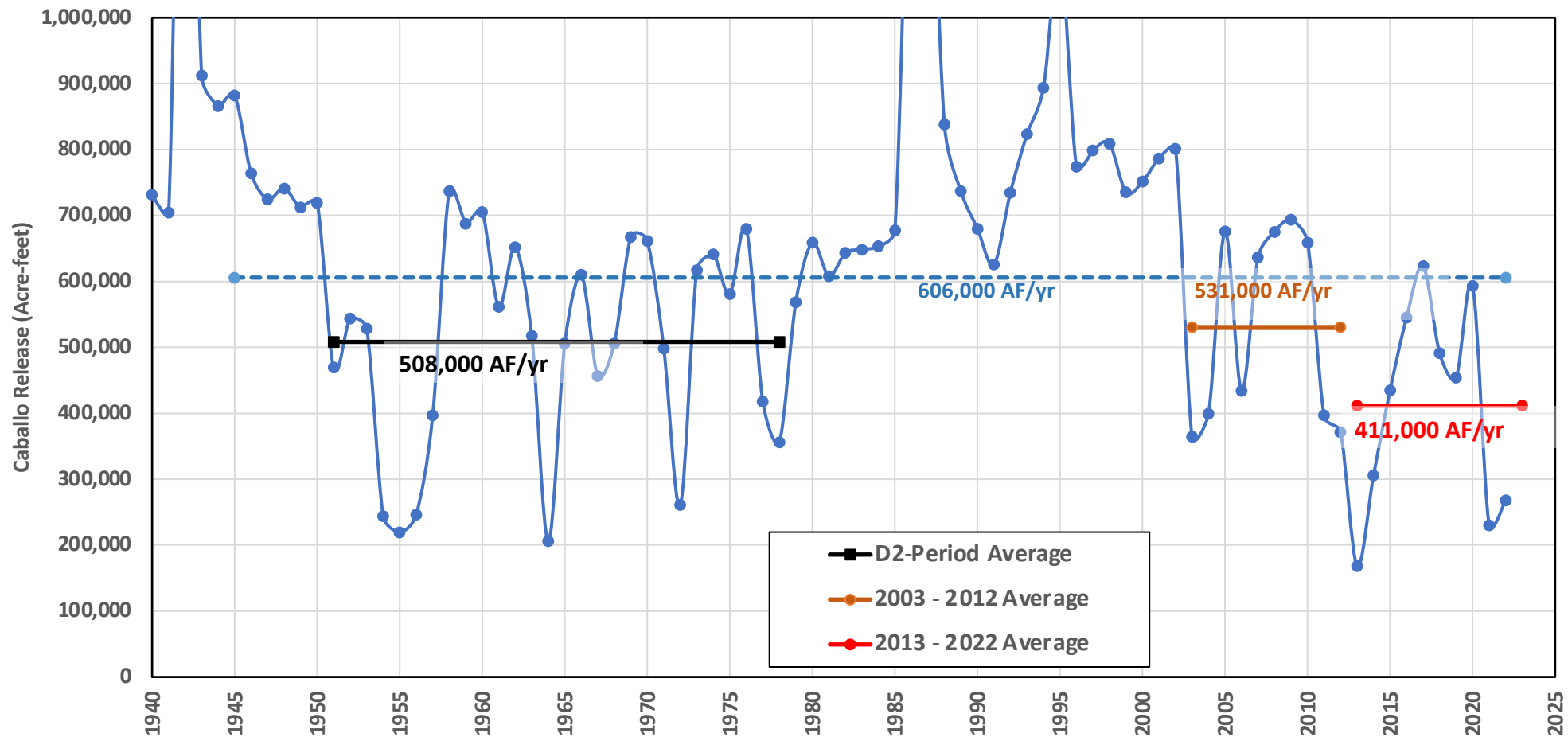
# Historical Surface Water Supply: 1940 - 2022

## Annual Release of Water from Caballo Reservoir



# Historical Surface Water Supply: 1940 - 2022

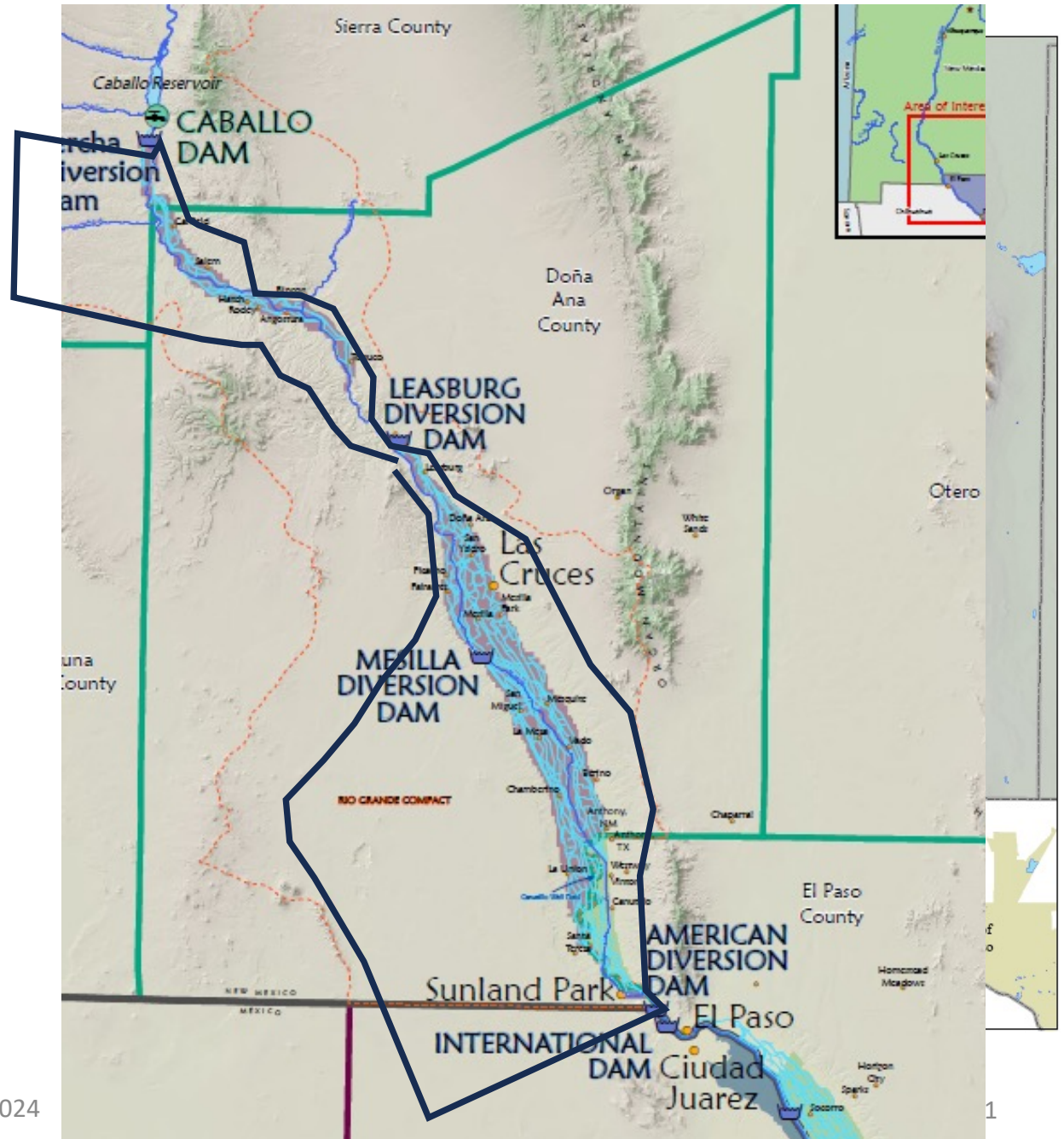
## Annual Release of Water from Caballo Reservoir



# 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

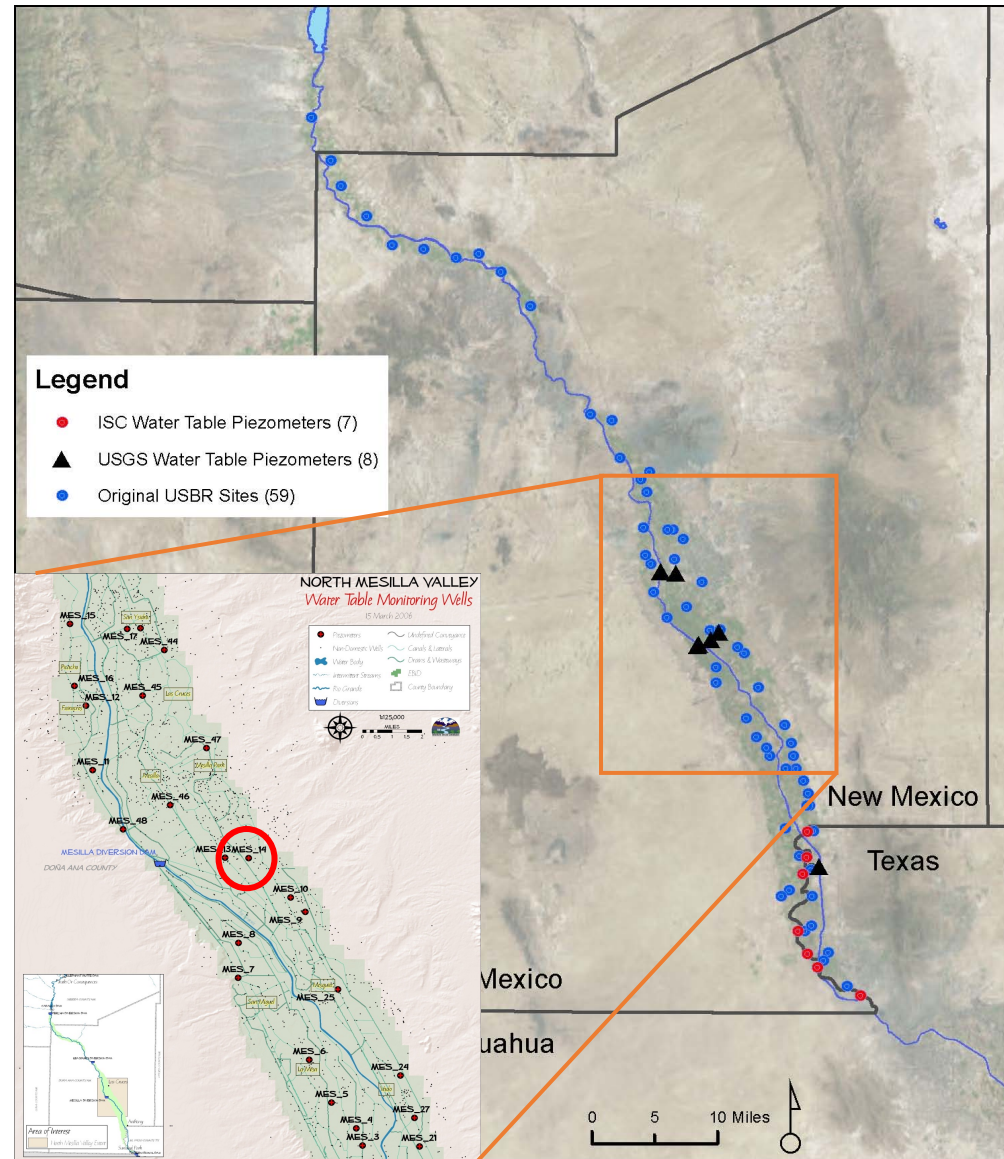


# Rio Grande Valley Aquifer Conditions: Groundwater Levels

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

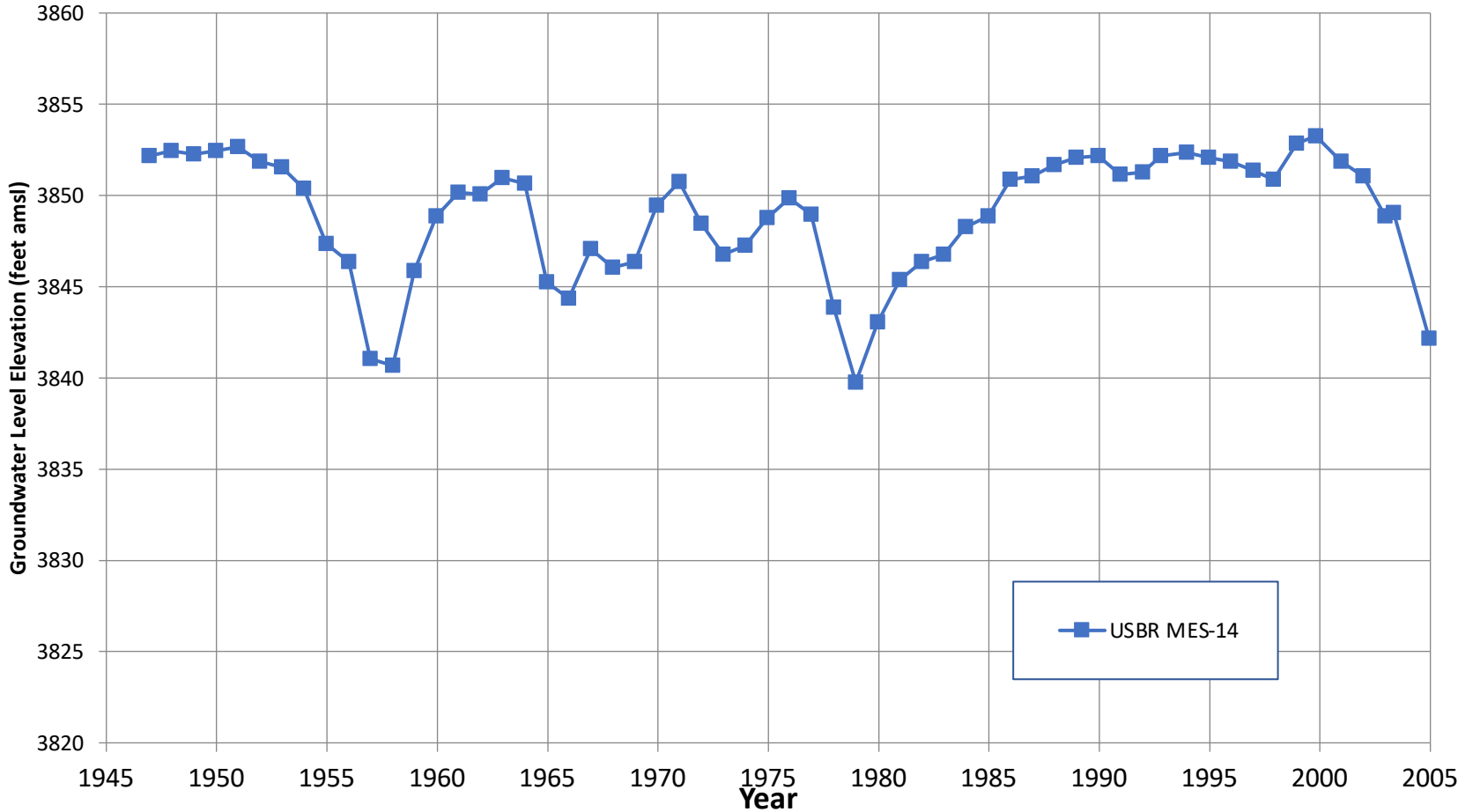
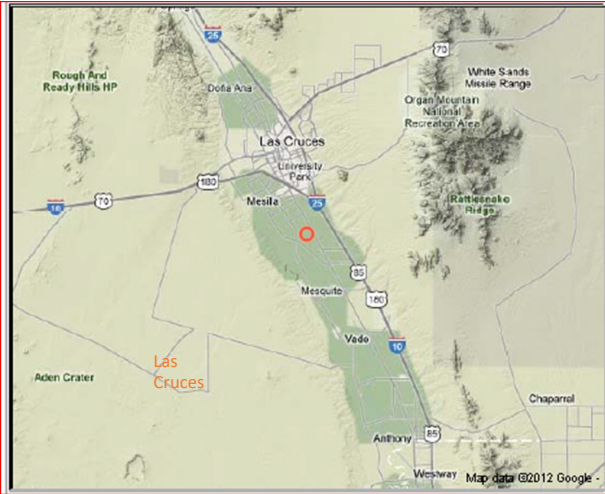




# Historic Groundwater Levels from Monitor Well

## 1945 – 2005 Annual (winter) data

(Old USBR monitor well south of Las Cruces)

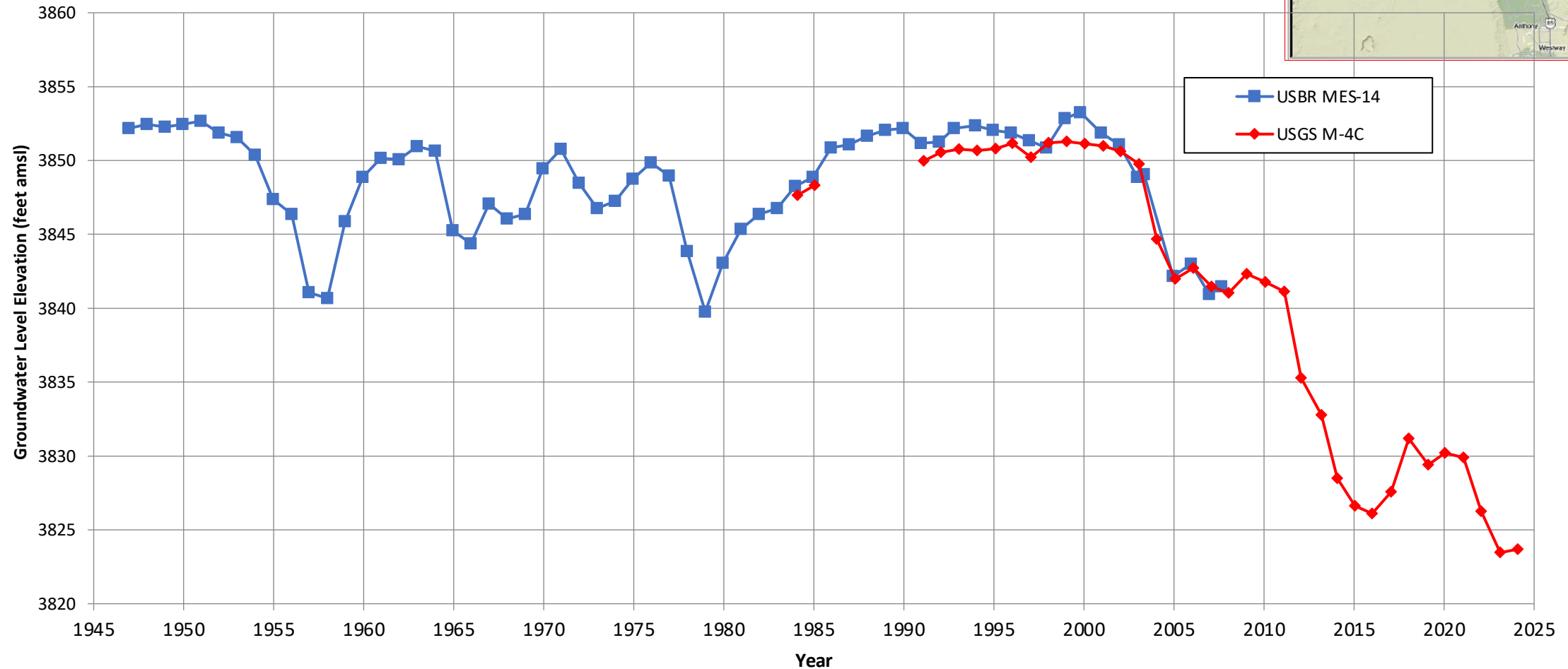


Up until about the year 2000, water levels fluctuated, declining during drought, recovering thereafter

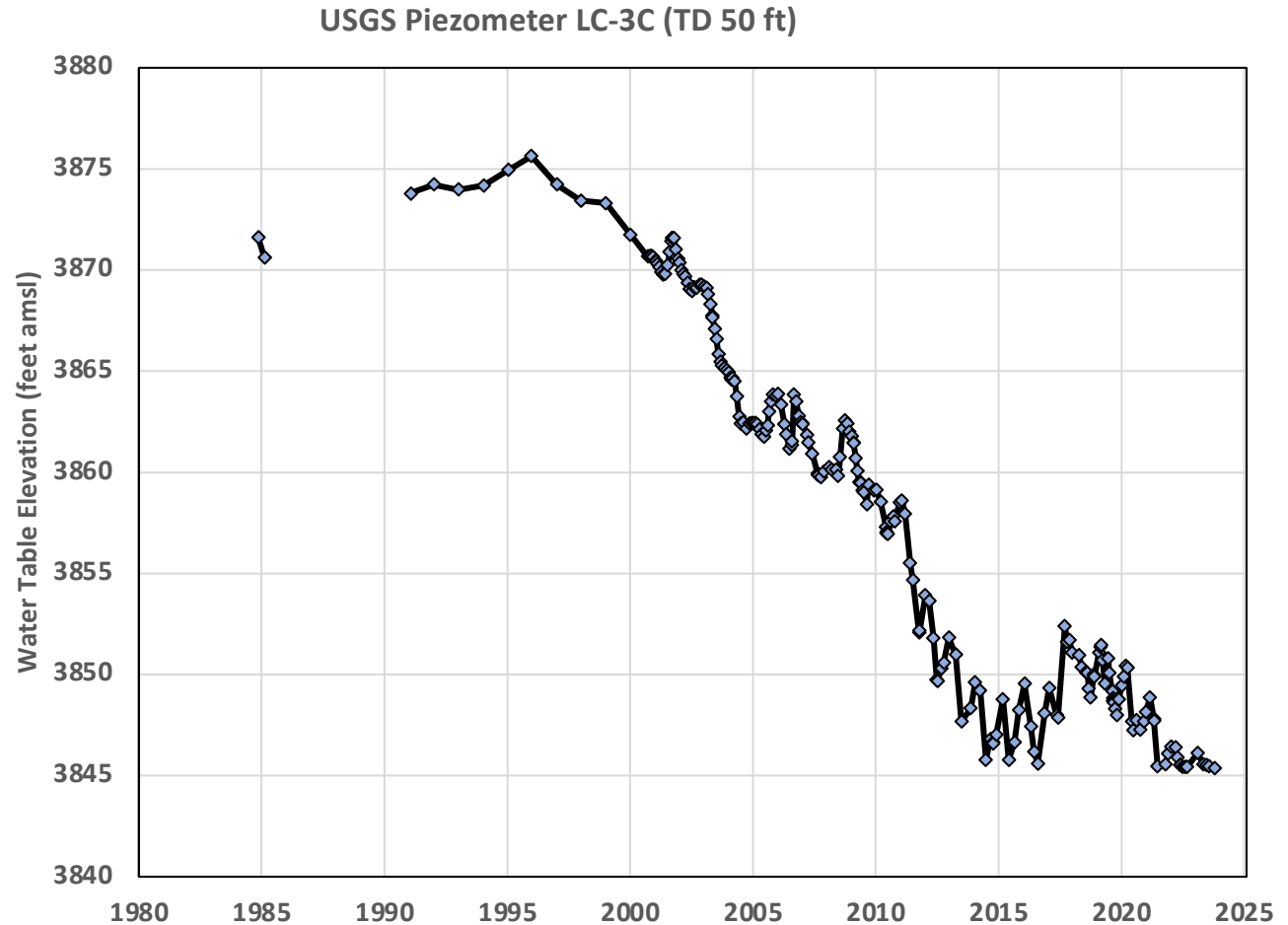


# Include More Recent Data from a near-by USGS well

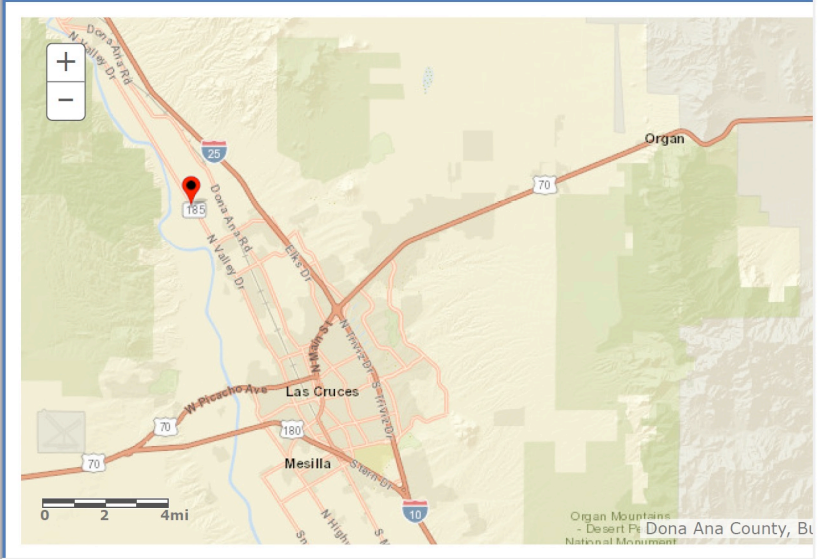
- Dropping, and not recovering
- Are we now in a mined-aquifer regime?



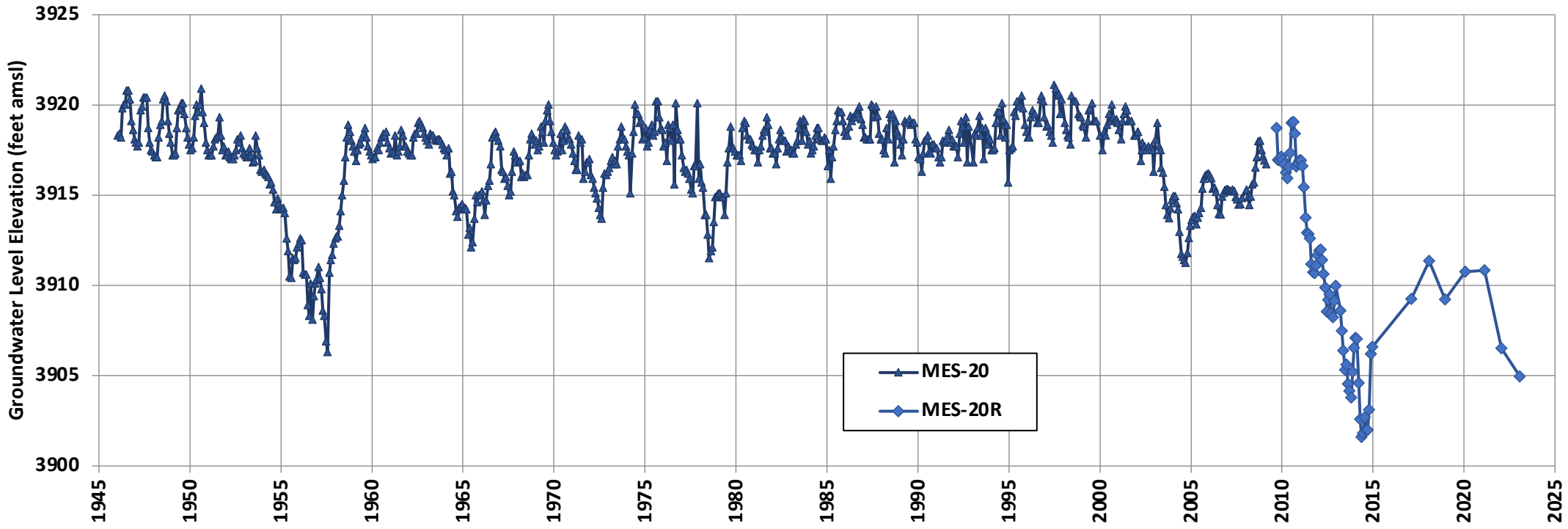
# Another site: Shallow Groundwater Levels in Las Cruces area



# Another Site: Shallow Groundwater Levels North of Las Cruces



Groundwater Levels MES-20



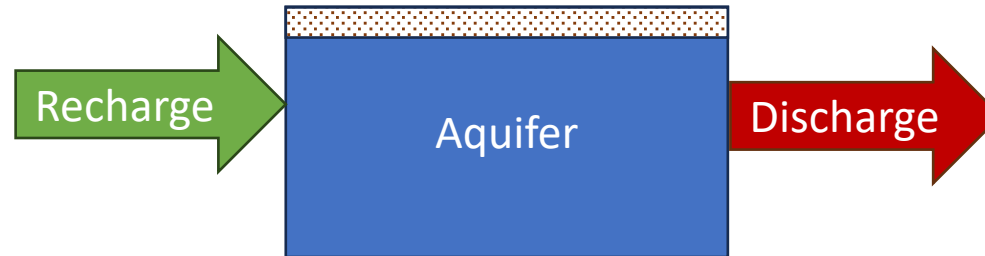
# Aquifer Water Budget Components:

## 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

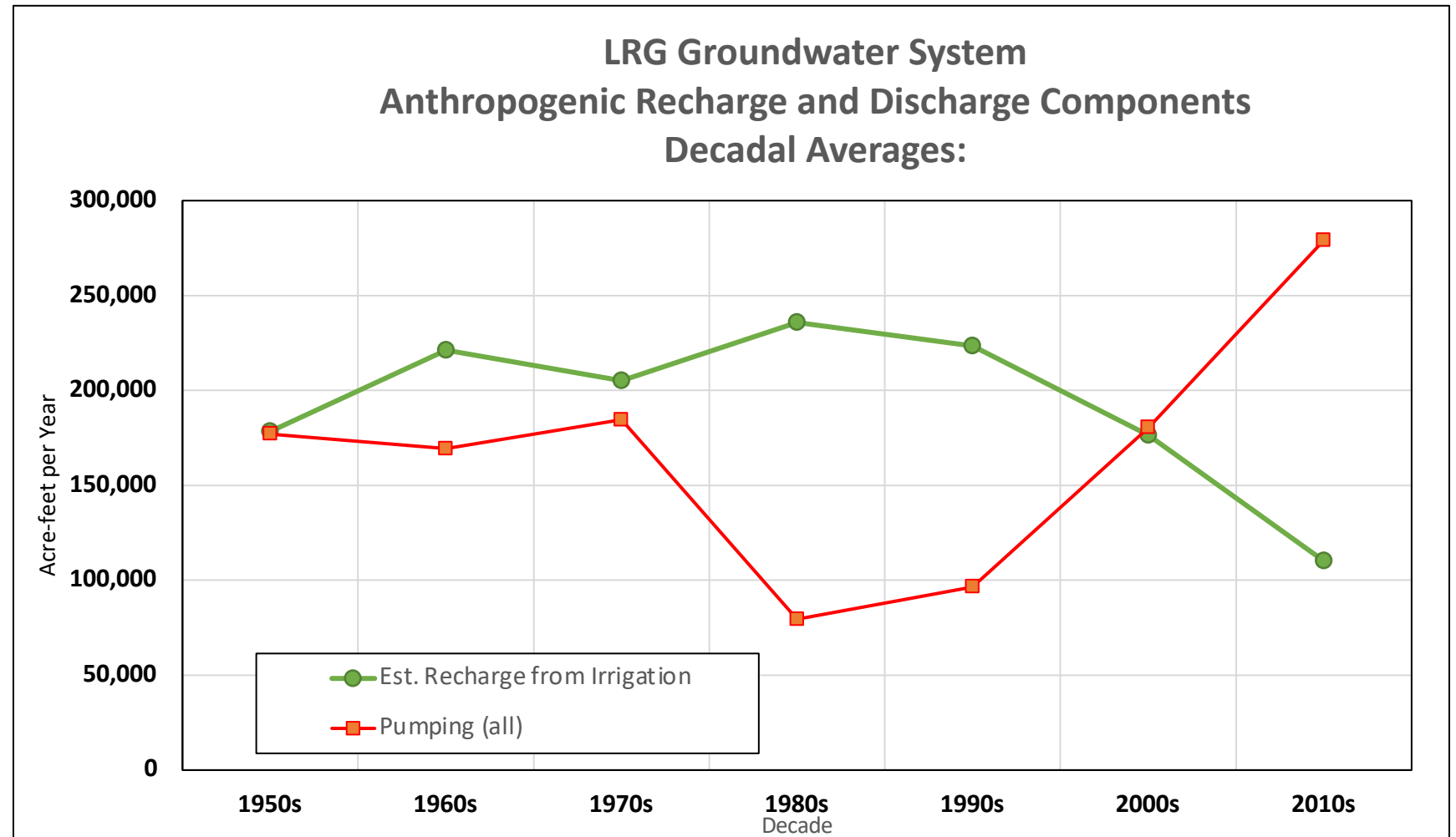
# How Have Anthropogenic Water Budget Components of the LRG Groundwater System Changed with Time?

## Key Recharge Component: Recharge from Irrigation

- Canal Seepage
- On-Farm deep percolation

## Key Discharge Component: Groundwater Pumping

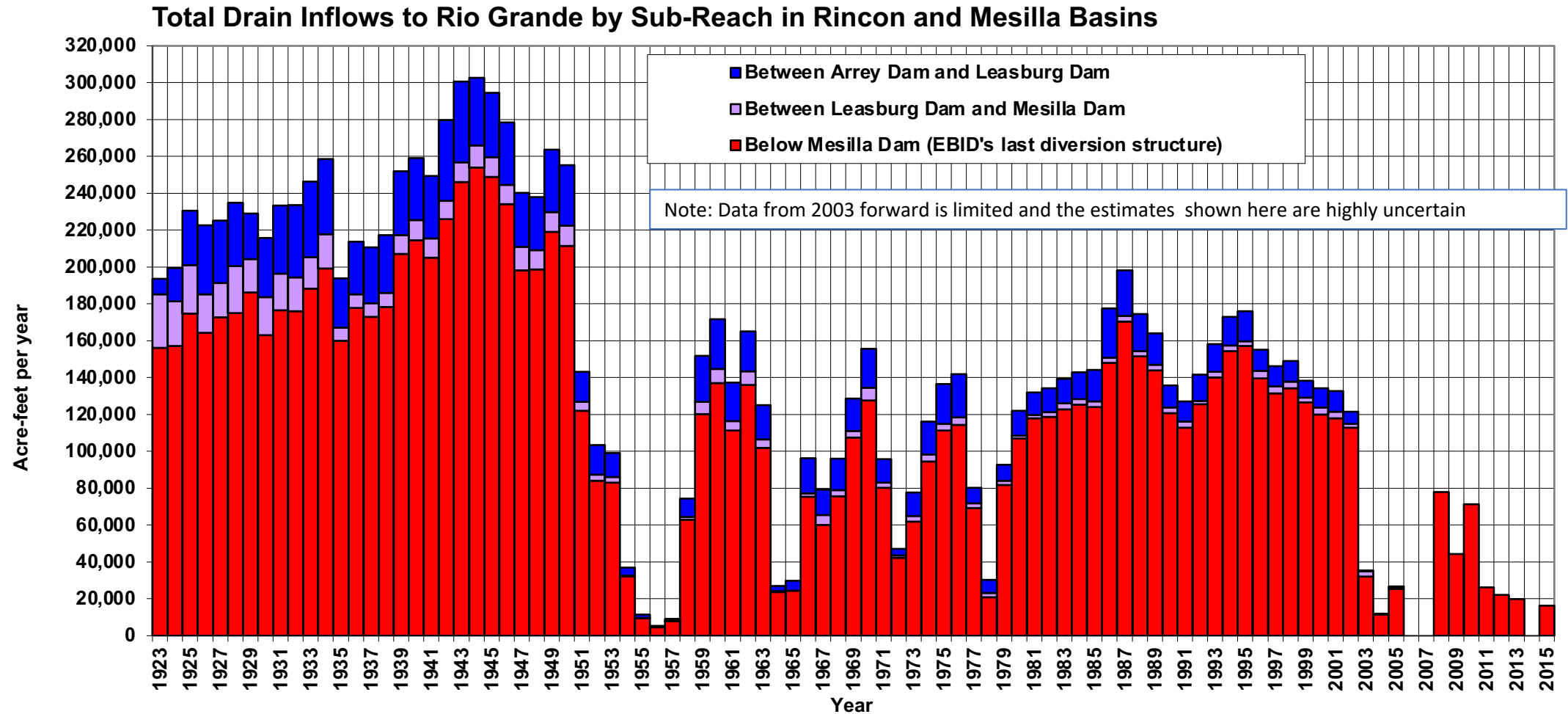
- Irrigation
- Municipal etc. (DCMI)





# 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

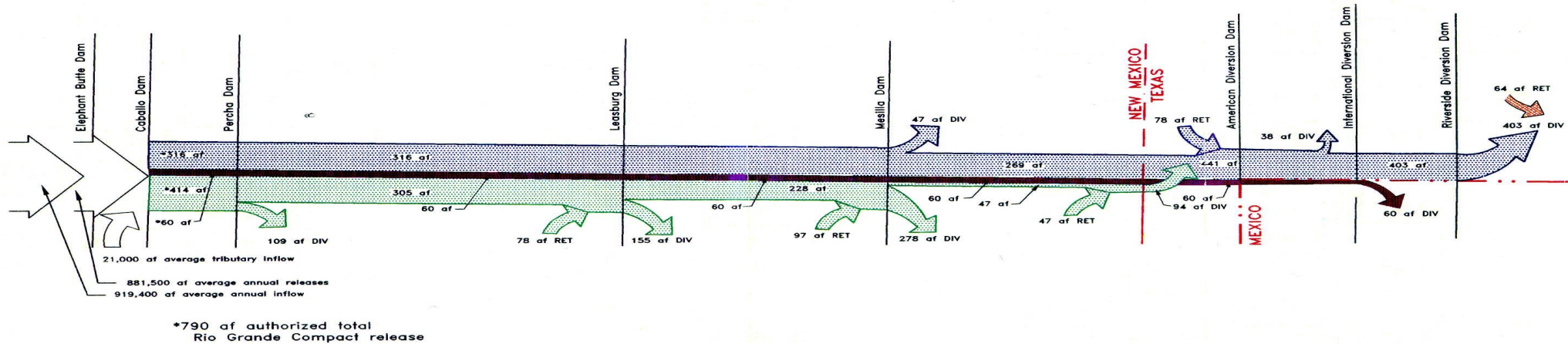


# Importance of Drain Flows

## Drain Flows are part of Project Supply

If drains don't flow:

- Project Supply is reduced
- Project efficiency is reduced

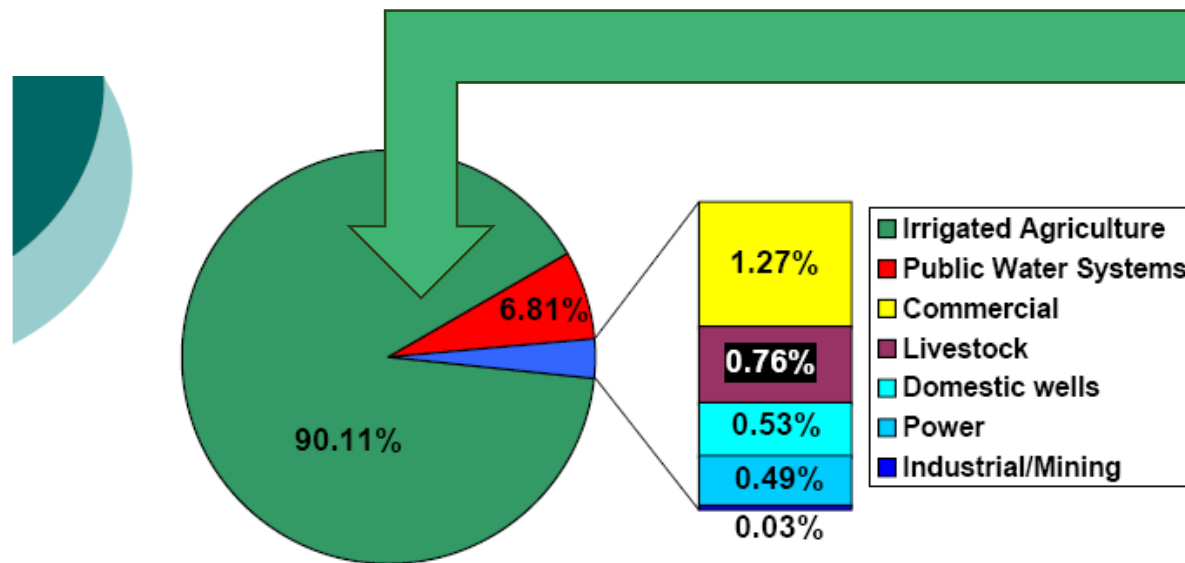


Drain Flows historically composed a significant part of flow at El Paso Gage

# 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:

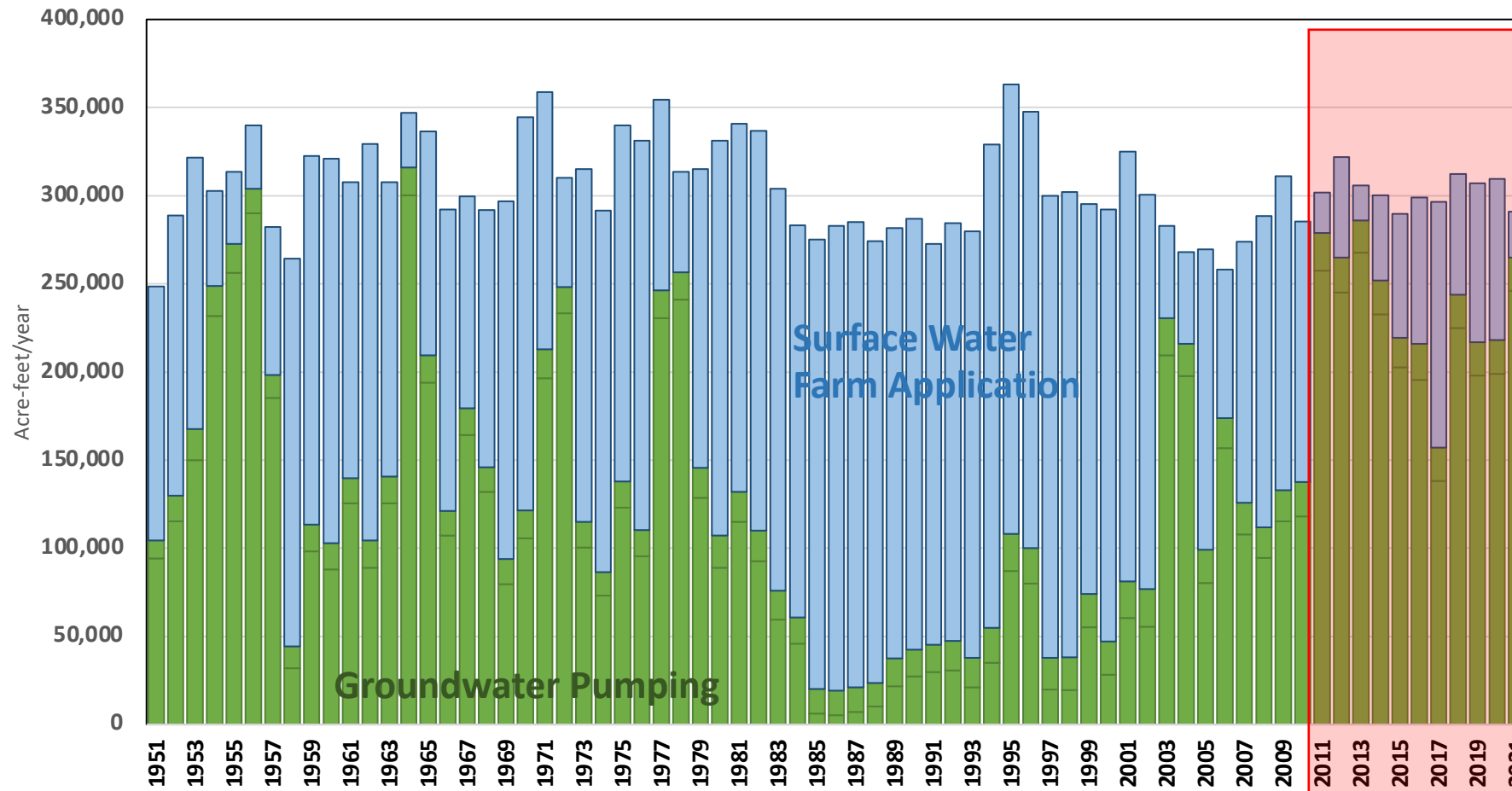
- Application of Irrigation Water
- Consumption of Irrigation Water

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.

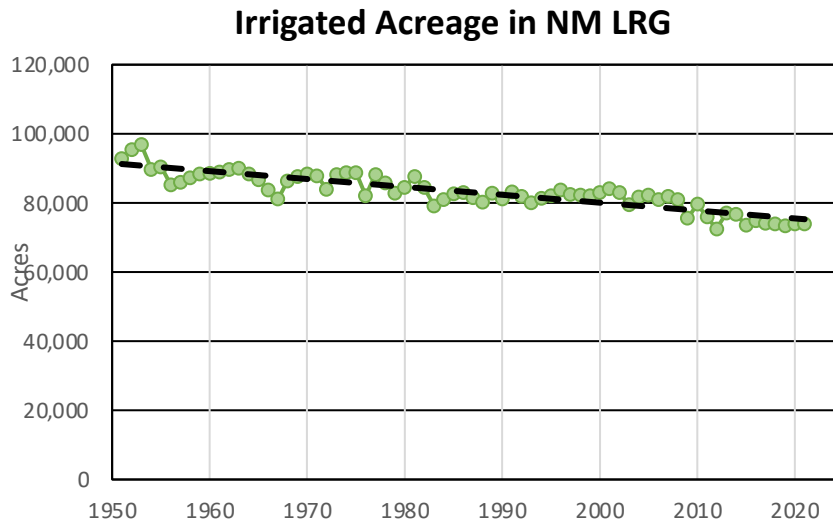
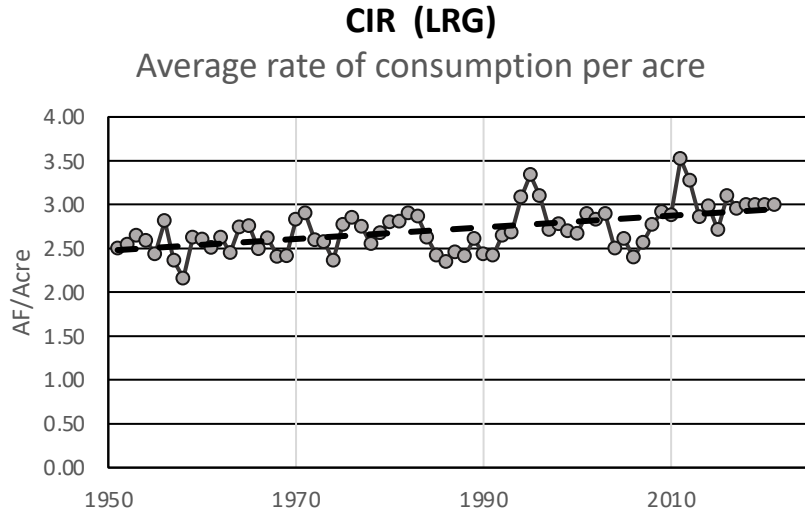
But: In recent years, very little surface water, so a large proportion of irrigation is from groundwater pumping

# Irrigation Water Use: Consumption

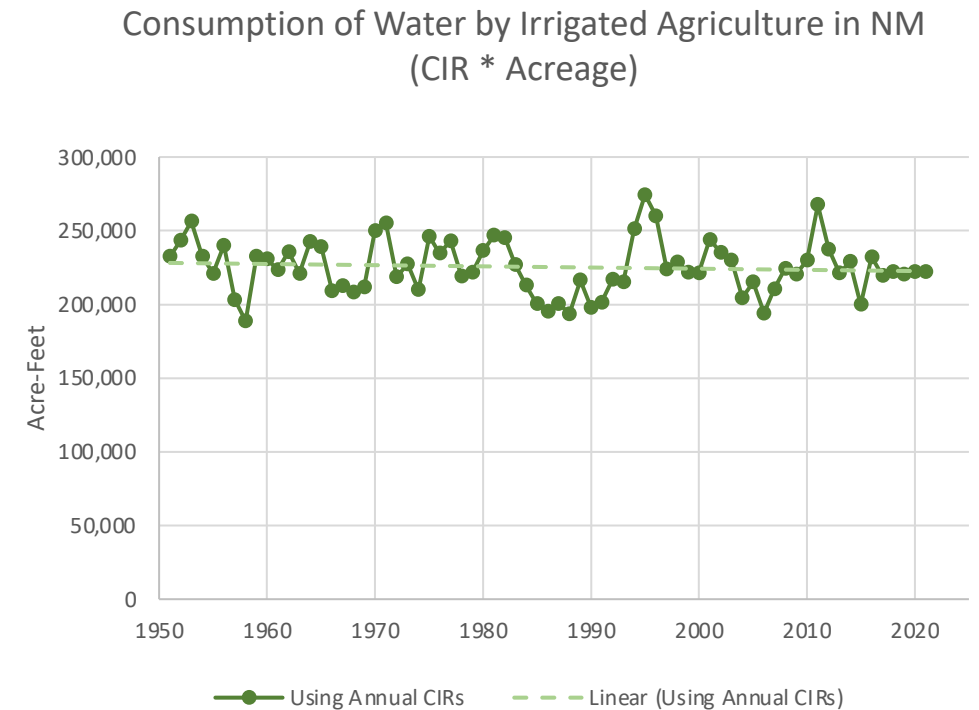
High consumptive use crops have increased in importance,

but

The total acreage irrigated has gone down.



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

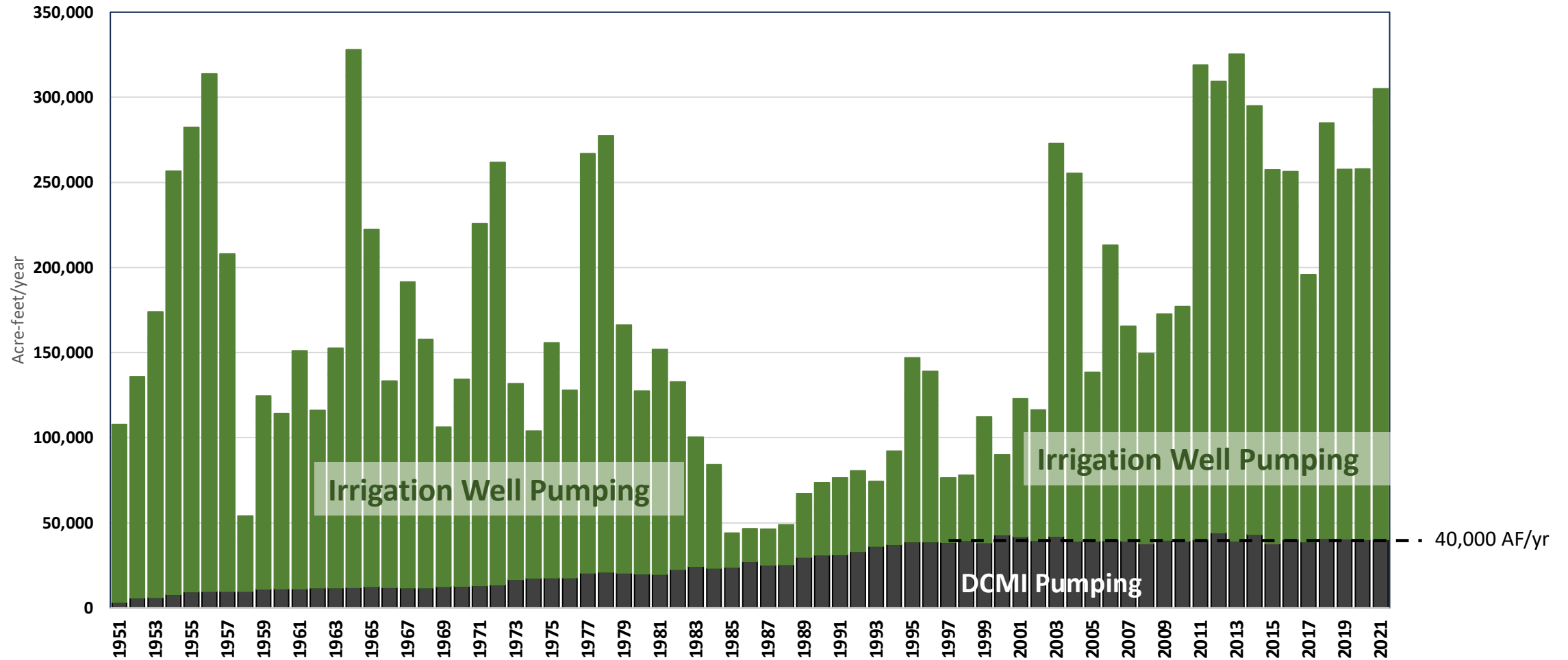




# Groundwater Pumping in the LRG: Historical Amounts and Breakdown

- 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>

		<b>Three (3) Year Comparison and Summary of Metered Groundwater Withdrawals in the Lower Rio Grande Basin (Acre-Feet)</b>							
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%
<b>TOTALS</b>		<b>265,794</b>		<b>311,943</b>		<b>282,850</b>		<b>860,588</b>	<b>100%</b>

(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

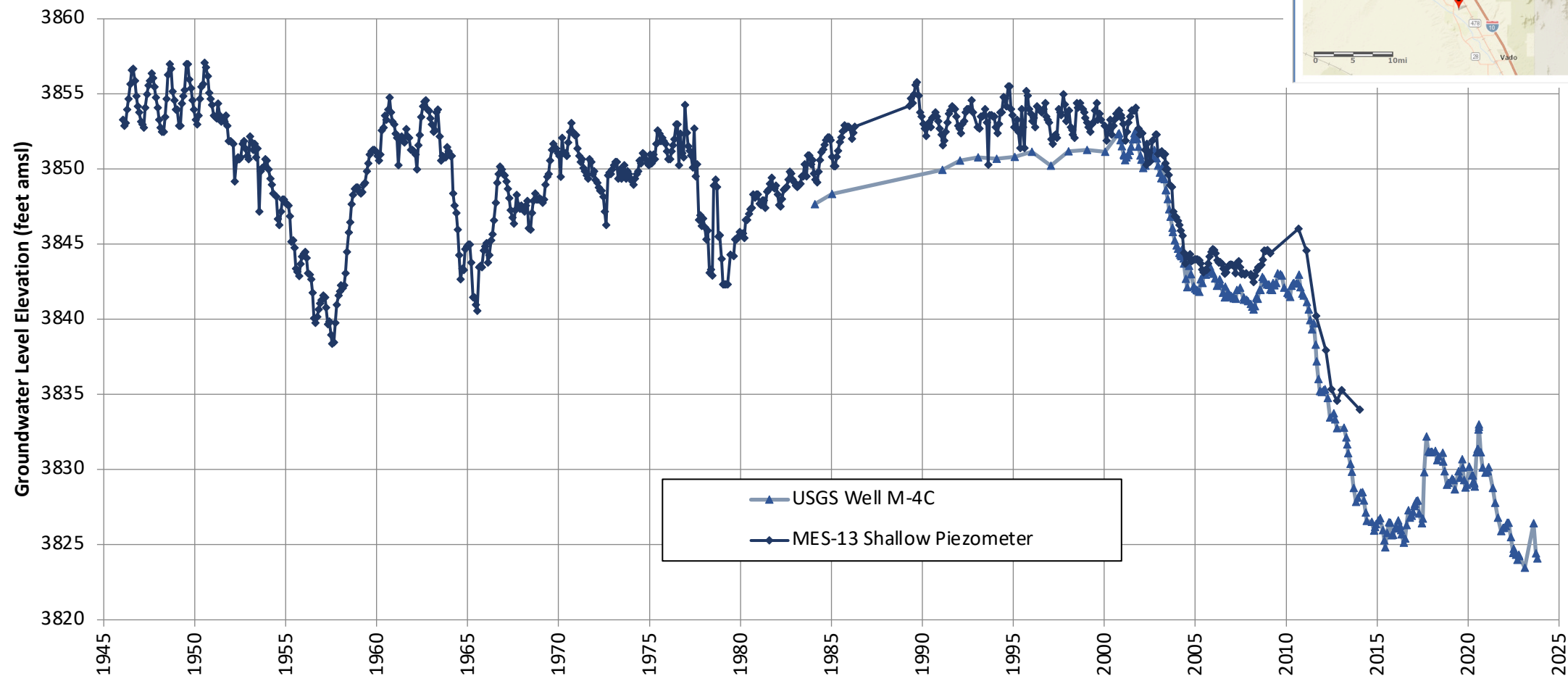
- Supply of surface water to the LRG has been relatively low for past 20 years
  - Low recharge to aquifer
  - High irrigation well pumping
- Groundwater levels have fallen, without much recovery, since about 2000
- Drain flows are low to non-existent
  - Low efficiency for Project and for delivery of 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?

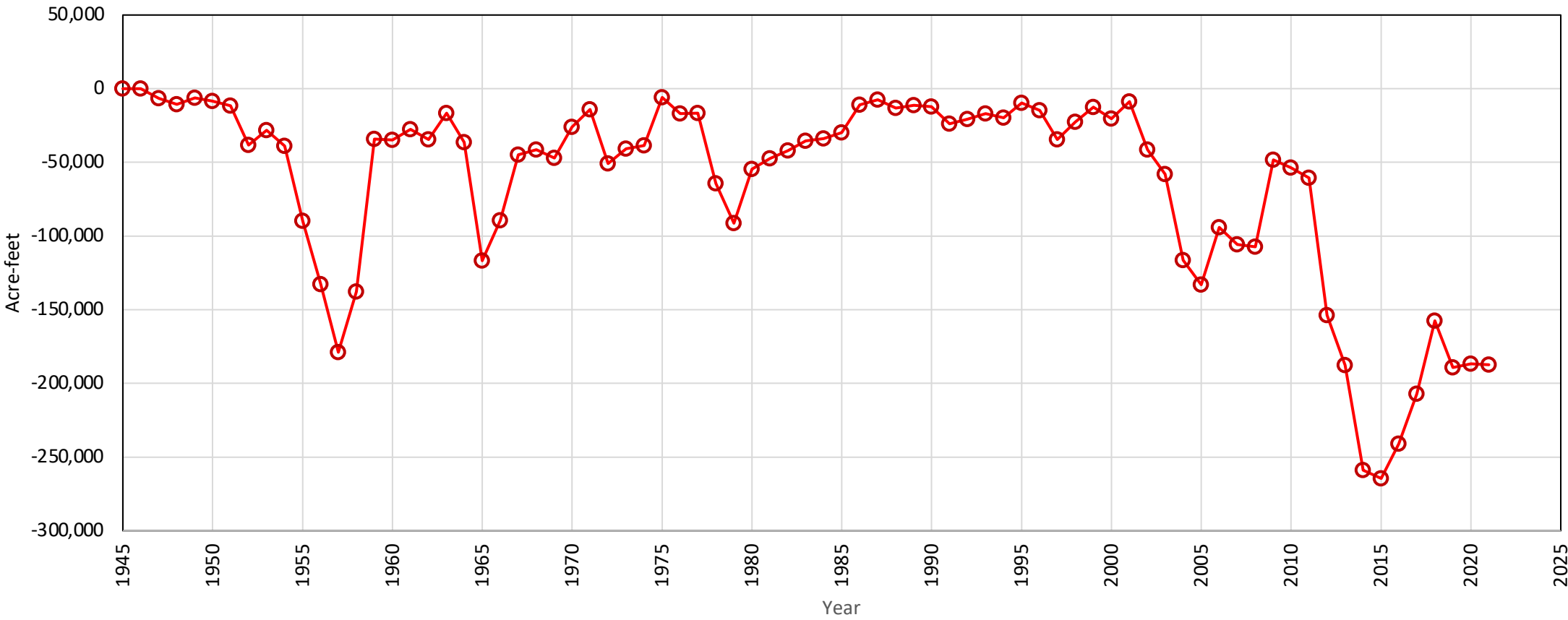


# Latest Data (from same location)



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

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





# LRG Aquifer System in Cross-section from the works of Dr. John Hawley Hawley and Kennedy (2004)

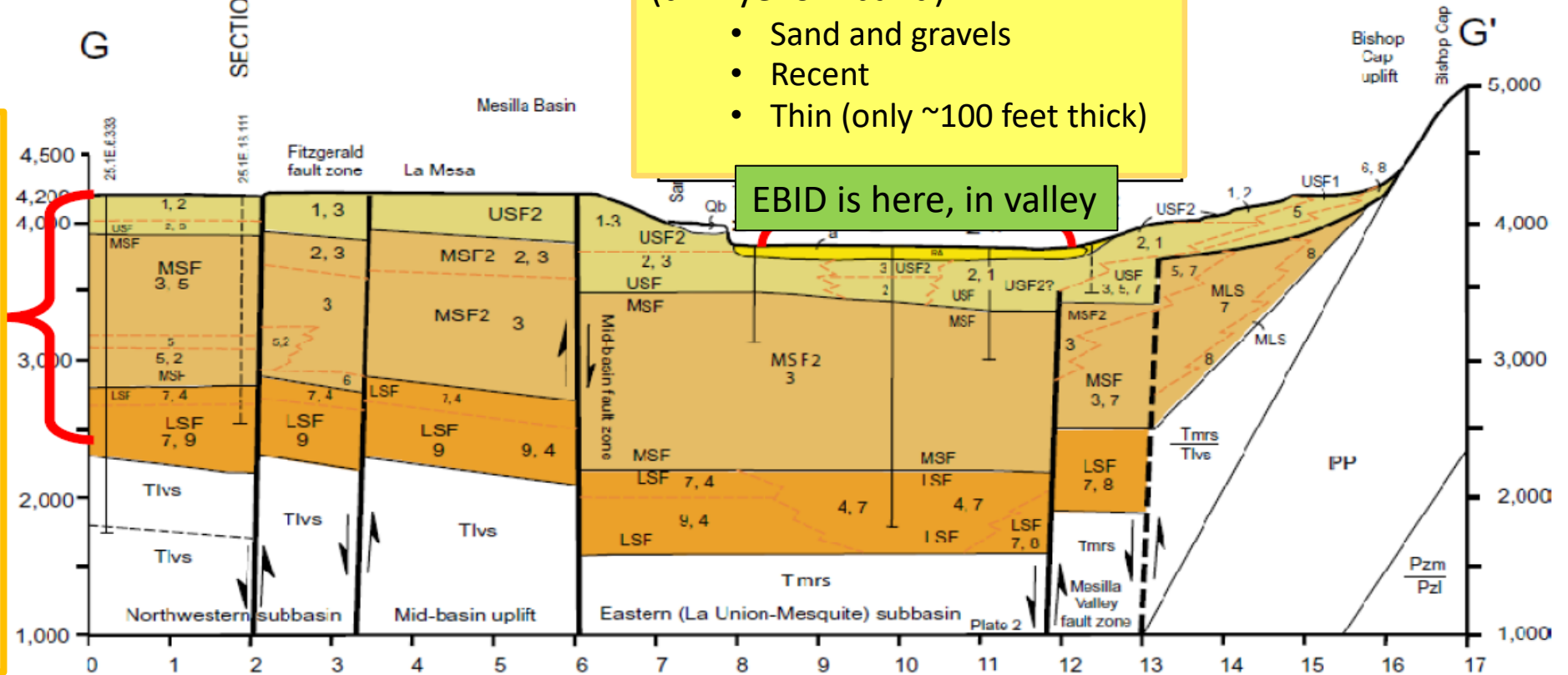
## Santa Fe Group (various shades of orange)

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

## River Valley Alluvium (thin yellow band)

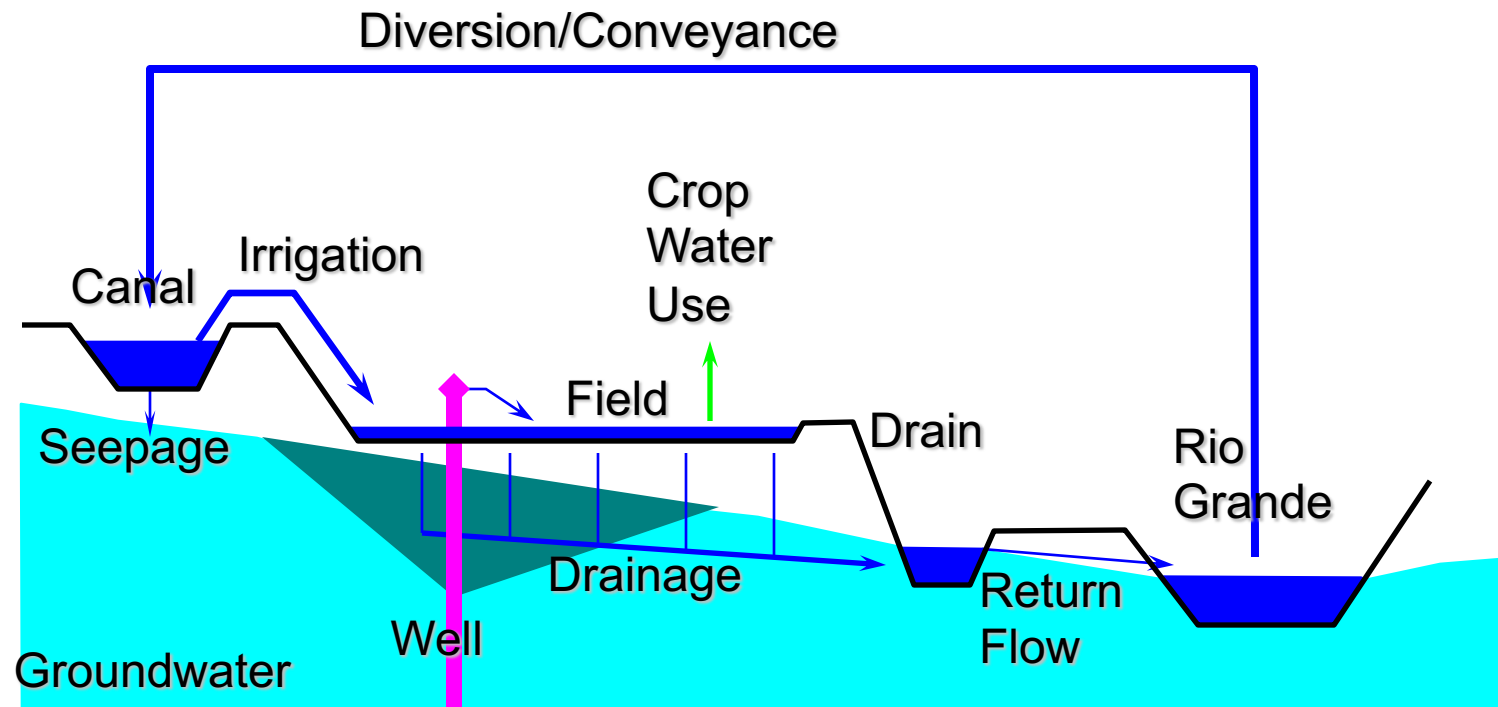
- Sand and gravels
- Recent
- Thin (only ~100 feet thick)

EBID is here, in valley



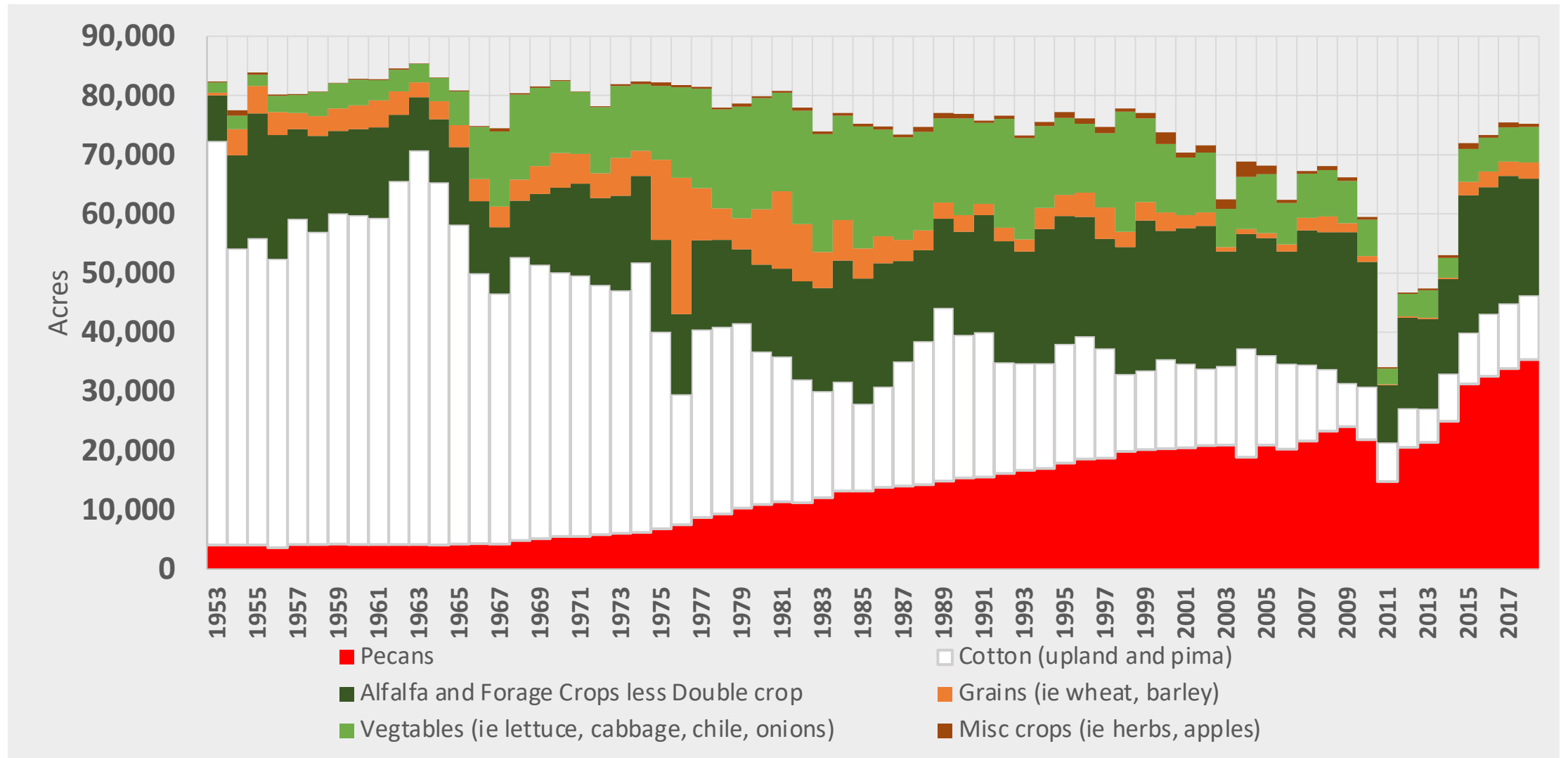
Underneath: "Bedrock" that does not contain  
much useful groundwater

# 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)

