
Water Resources & Issues in Central New Mexico

Bruce Thomson
University of New Mexico
(bthomson@unm.edu)



Introduction

- Many resources are vitally important to our culture & economy including energy, air, water, food, materials (metals, wood, chemical feedstocks, etc.)
- Water (& air) are unique – there are no alternatives
- Objectives of this presentation:
 - Present summary of water resources in central NM – where it comes from & how it's used
 - Discuss some of the constraints that complicate management of this resource

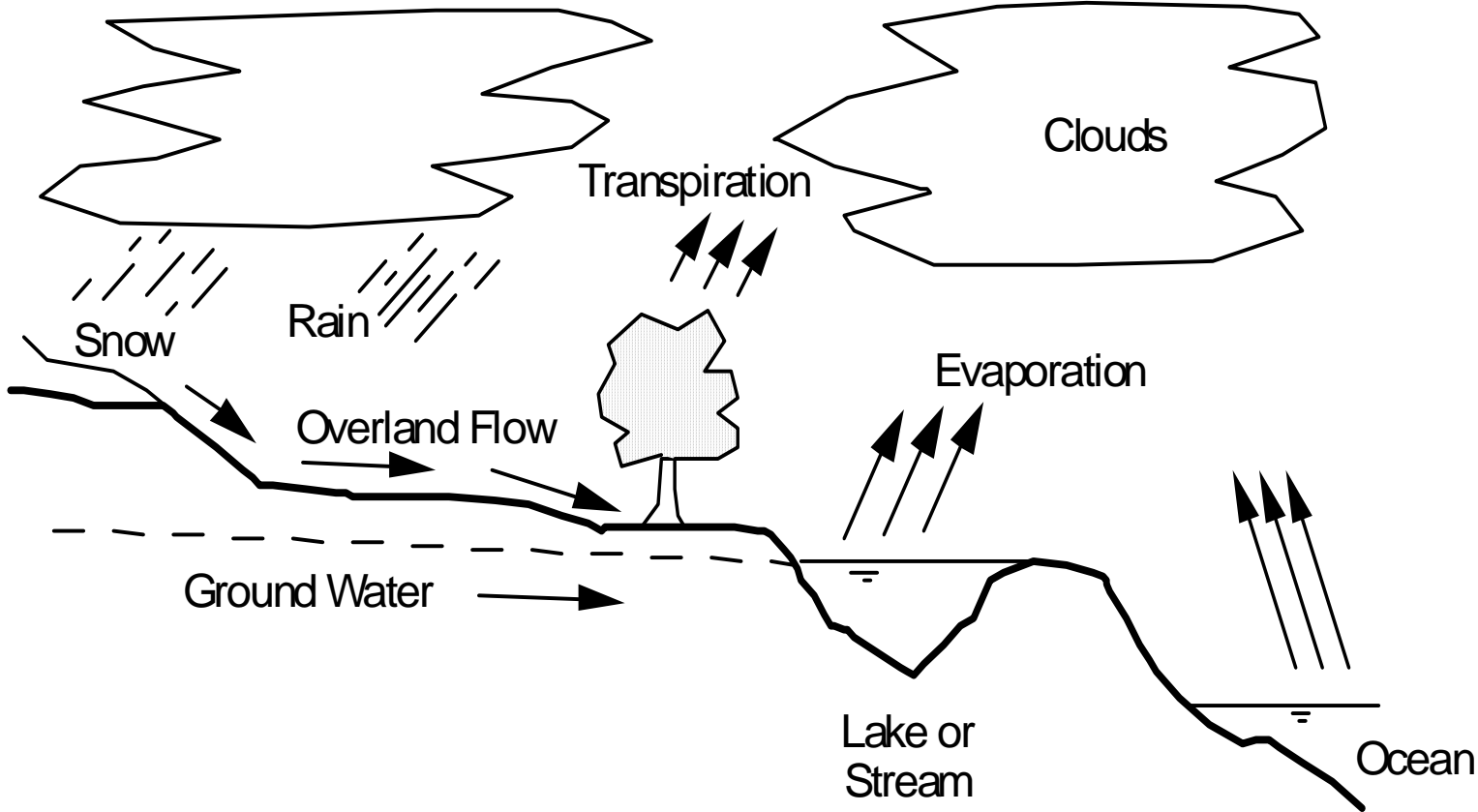


Organization

- Concepts & definitions
- Surface & ground water resources of
 - Pecos River Basin
 - Middle Rio Grande Basin
 - Estancia Basin
- Water law & administration
- Some current challenges

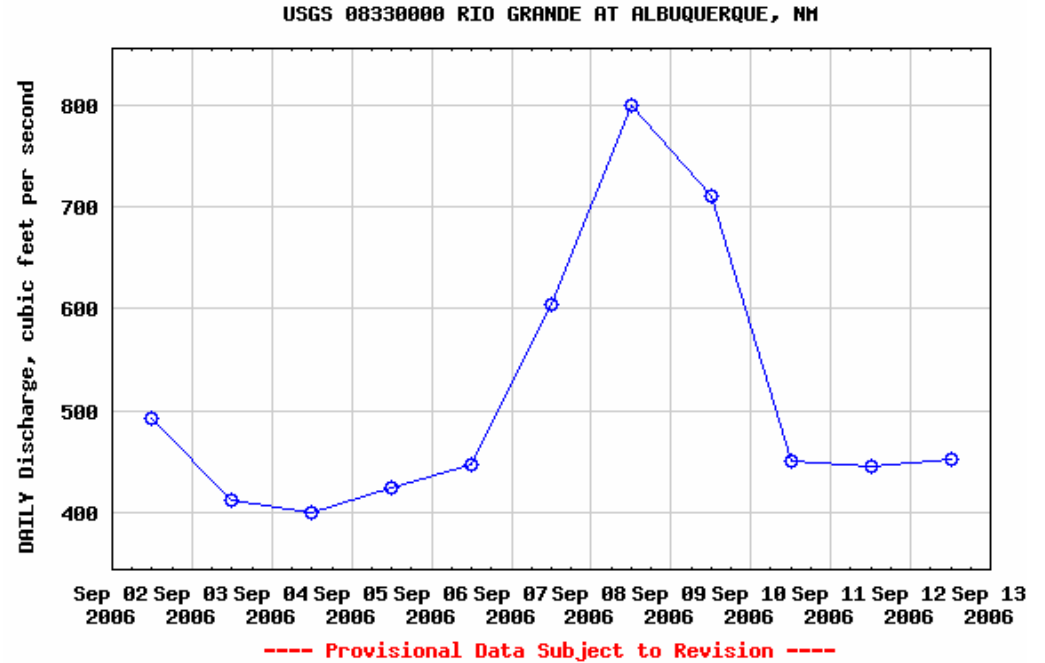


Concepts – Hydrologic Cycle



Definitions-1

- Hydrograph – plot of flow (Q) vs time
 - Storm hydrograph
 - Annual hydrograph



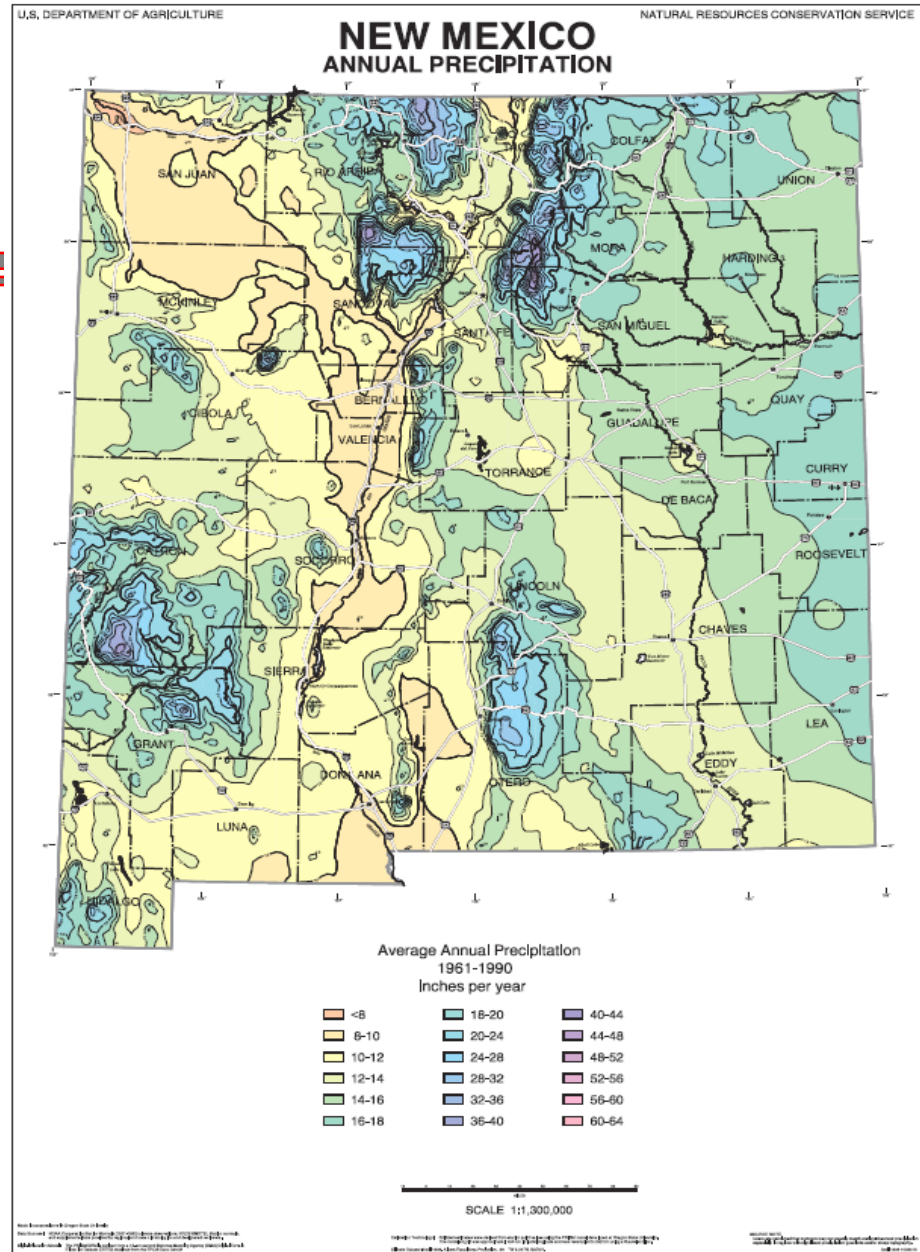
Definitions-2

- Withdrawal = Diversion – Amt. of water withdrawn from surface or ground water
- Consumptive use – water lost to atmosphere through ET
 - **Consumptive Use = Withdrawal – Return Flow**
- Depletion – Ambiguous
 - Surface water – Depletion = Consumptive Use
 - Ground Water – Depletion = Amt. pumped from wells
- Conjunctive management – Mgt. of surface & ground water as single, connected resource
- Sustainability – Actions taken today do not compromise needs of future generations

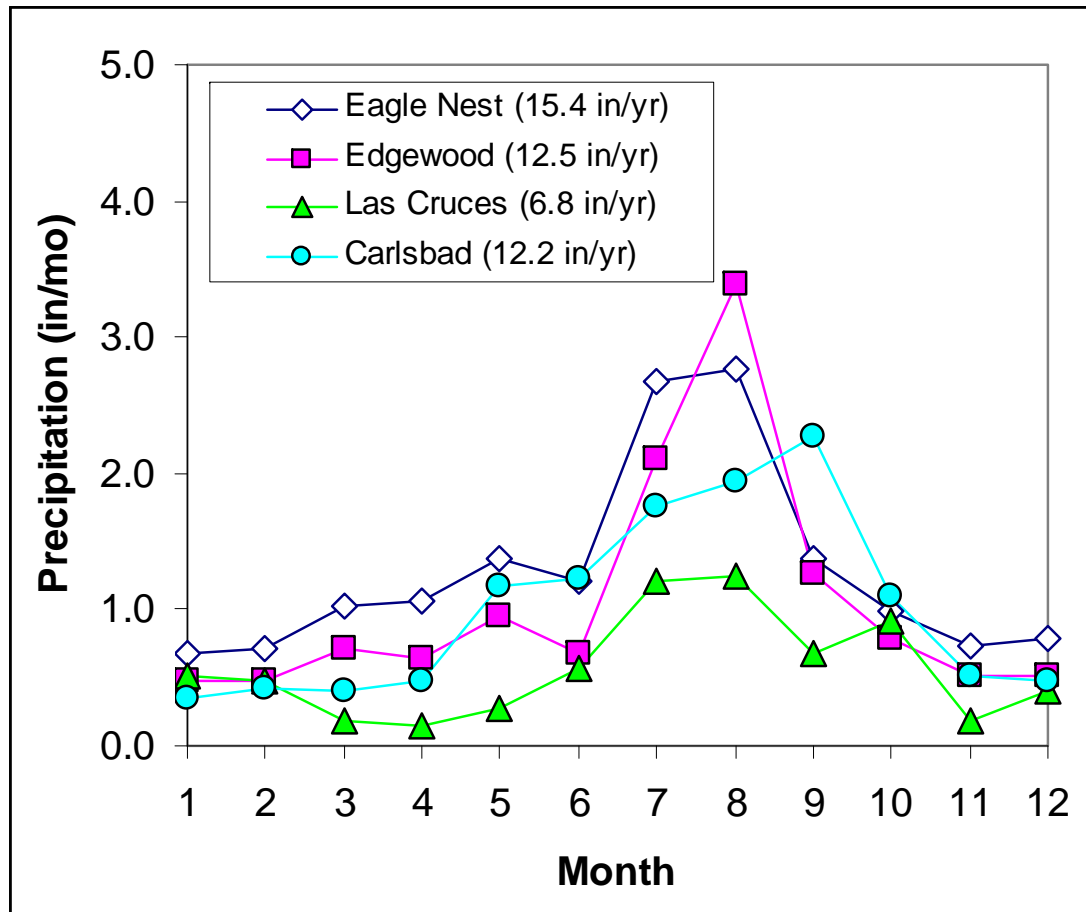


NM Precipitation Patterns

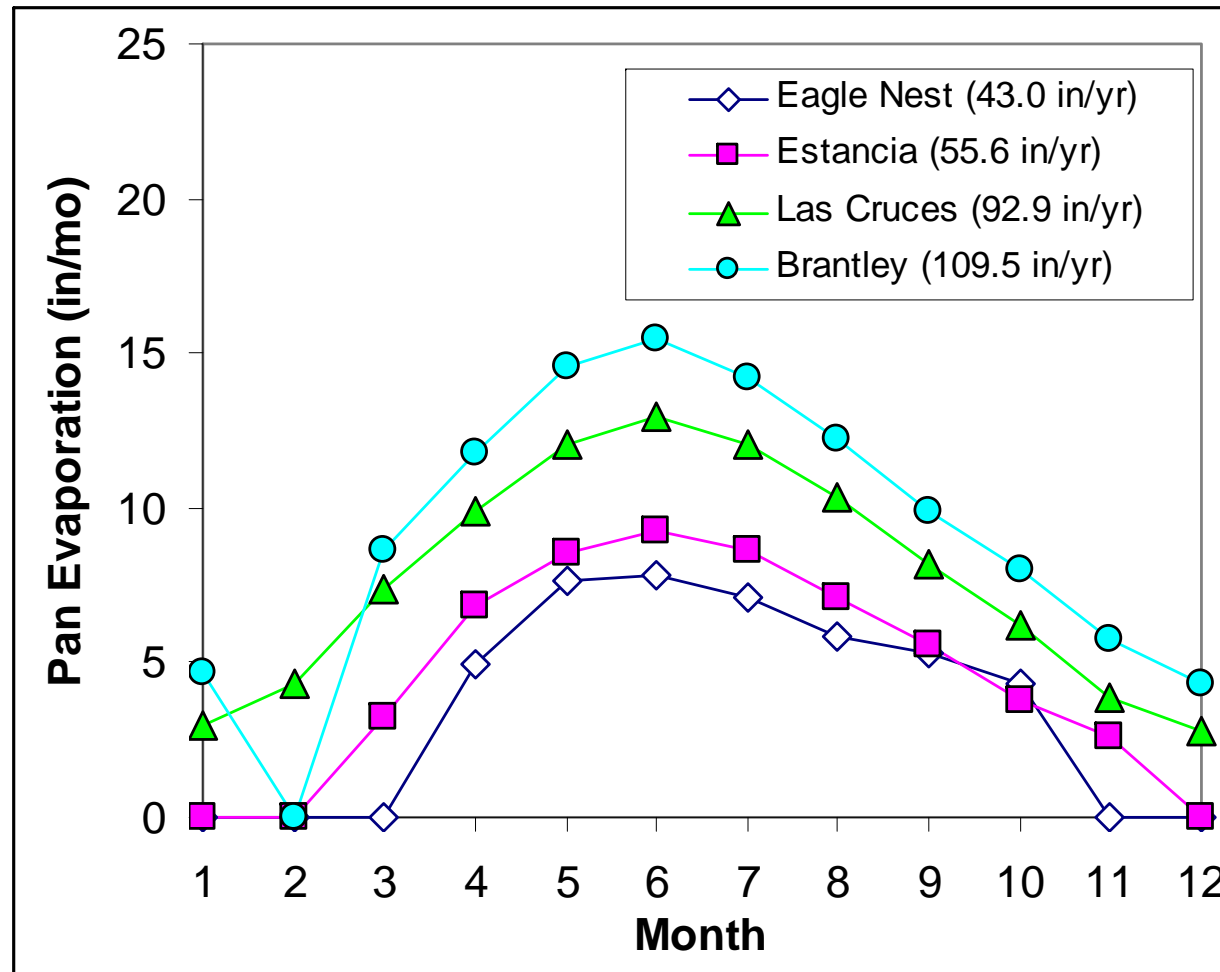
- NRCS Web Site – www.nrcs.usda.gov



Precipitation in NM



Pan Evaporation in NM



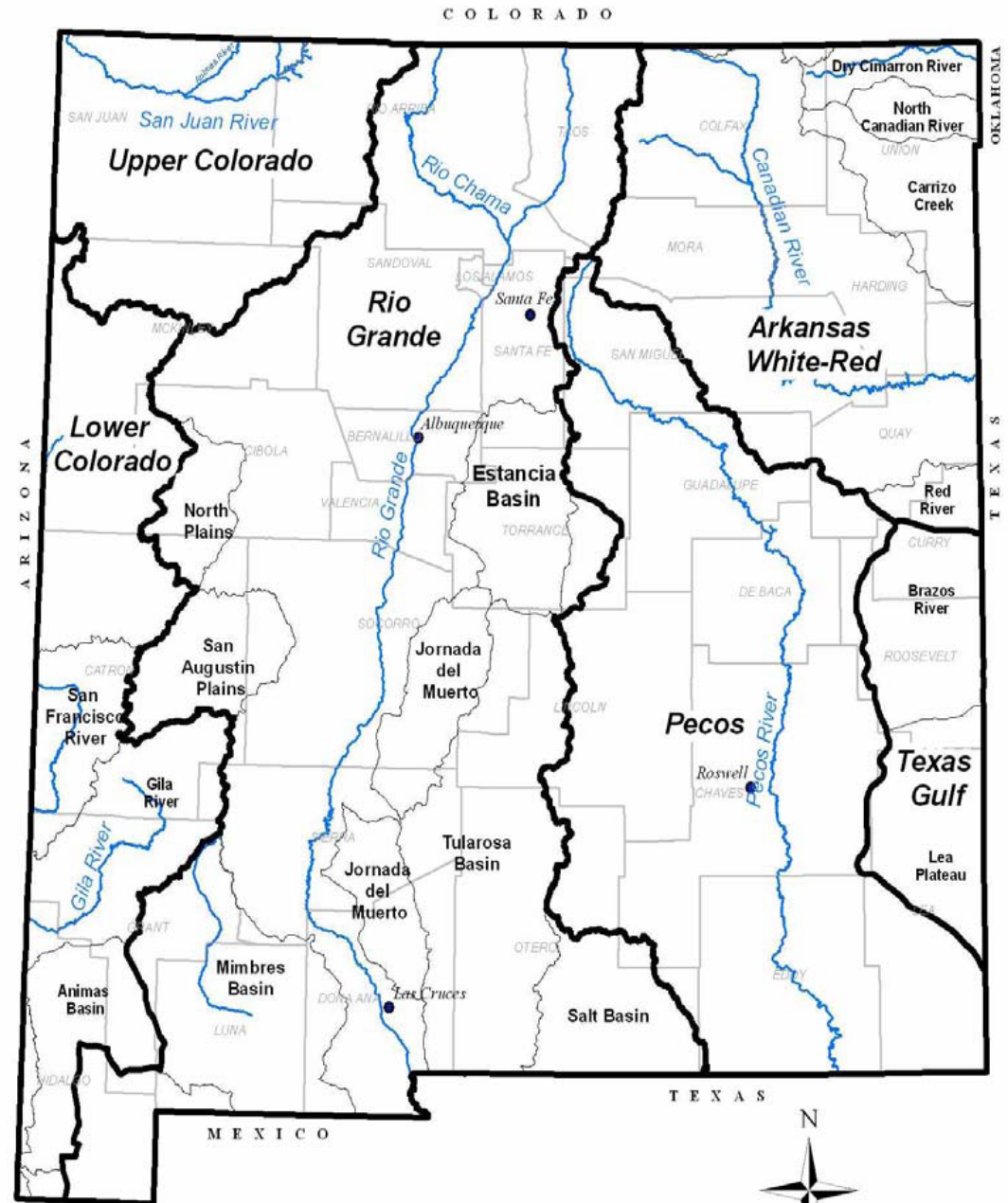
NM Climate Impacts on Water Resources

- Dependence on monsoons for annual precipitation
- Very large summer evaporation
- Most NM water resources primarily result of winter snow pack



River Basins of NM

(Longworth et al. 2008)



The University of New Mexico

Water

0 15 30 60
Miles

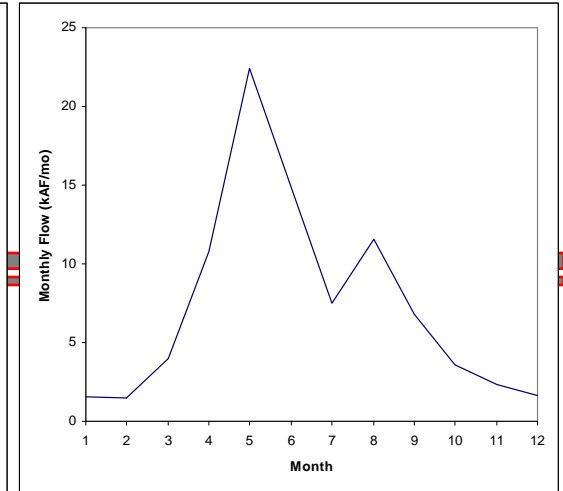
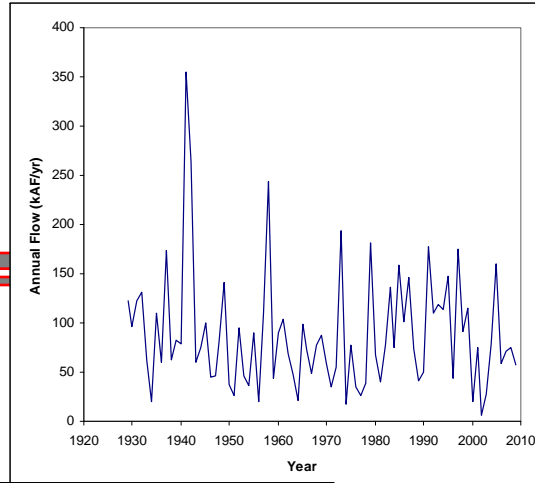
Map Projection:
UTM NAD83, Zone 13N

Pecos River Basin

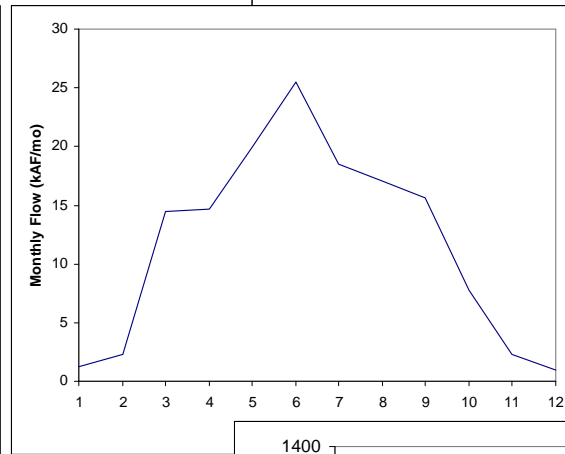
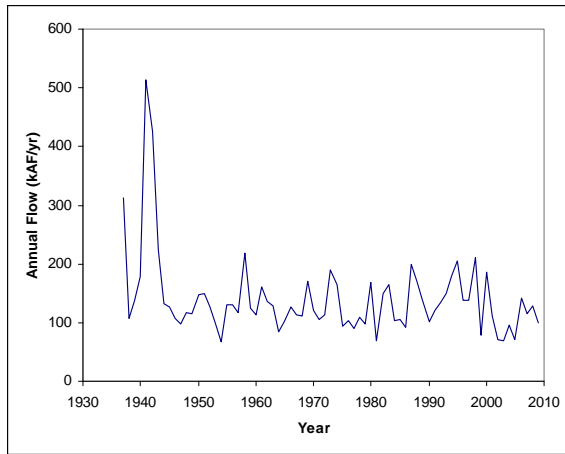
(Longworth & Carron, 2003)



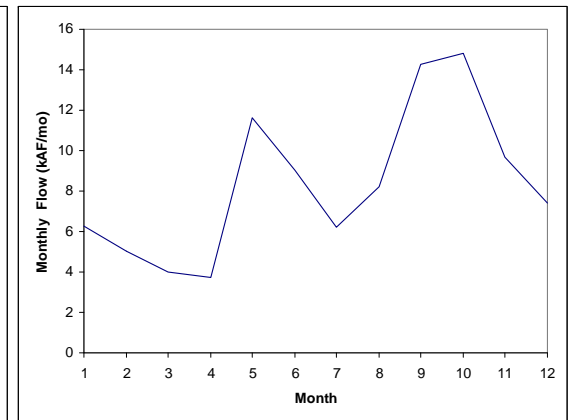
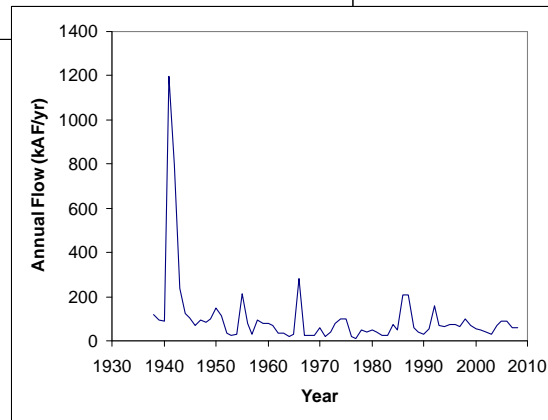
Pecos River Hydrographs



Anton Chico Gage



Lake Sumner Gage



Malaga Gage



Pecos River Basin Surface Water Resources

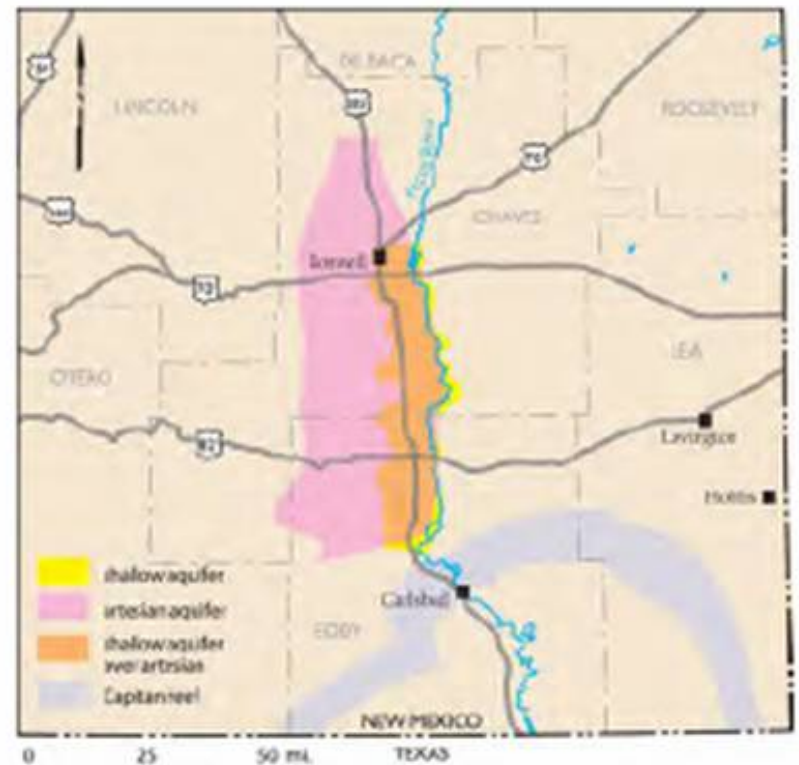
Gage Location	Period of Record ¹	Q _{avg} (kAF/yr)	Q ₁₀ (kAF/yr) ²	Q ₁₀ /Q _{avg}
Upper Pecos – Anton Chico gage	1929-	88.4	27.3	0.31
Middle Pecos – Below Sumner dam	1950-	127.5	84.8	0.67
Lower Pecos - Malaga	1950-	68.8	25.3	0.37

- Very high flow variability in upper reaches
- Less variability in lower reaches due in part to dams



Pecos River Ground Water Resources

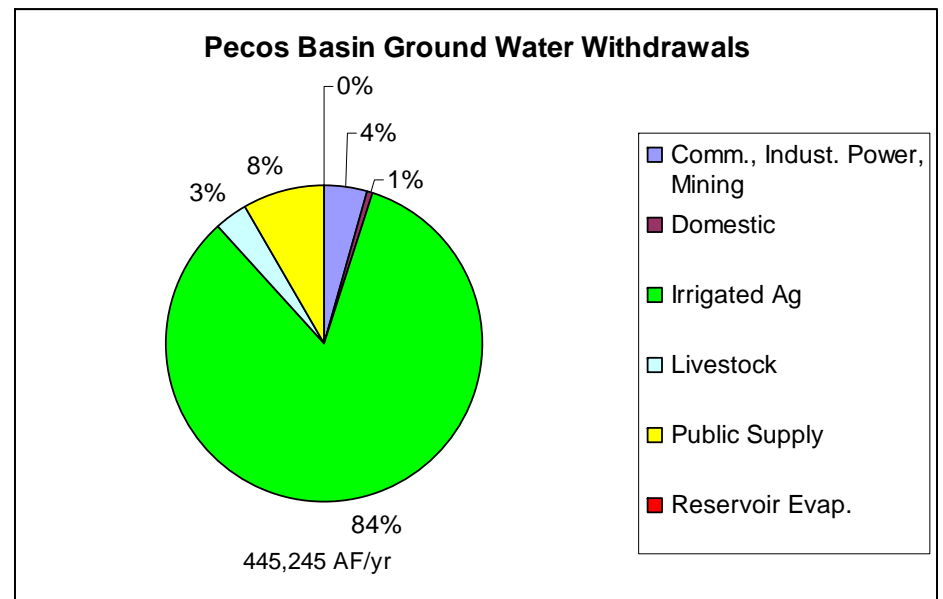
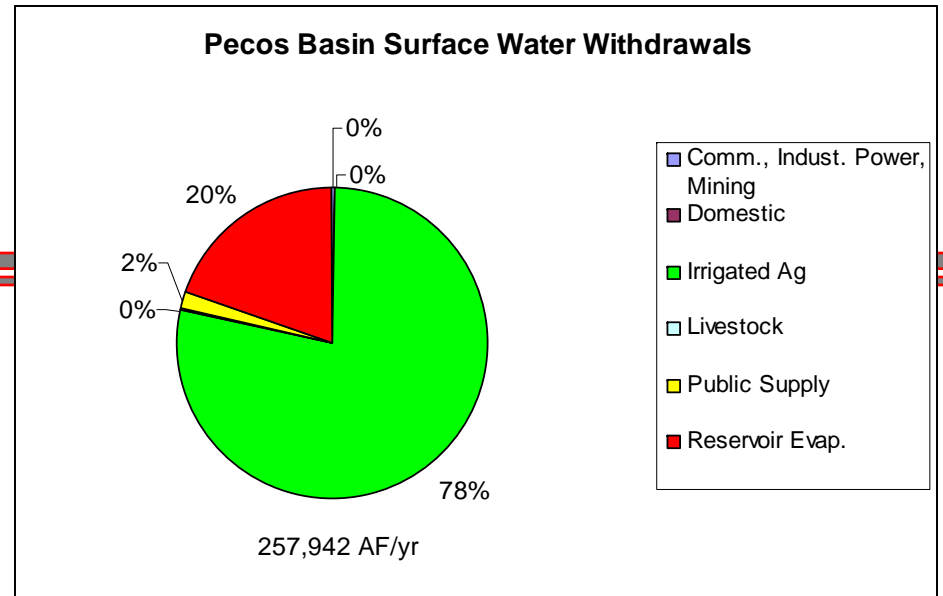
- Most ground water pumping is in Roswell Basin & south
- Extensive regional drawdown
- State is purchasing water rights to meet Pecos River Compact
- Salinity issues in lower basin



Pecos River Basin Withdrawals

(Longworth et al. 2008)

Category	Surface Water (AF/yr)	Ground Water (AF/yr)
Comm., Indust. Power, Mining	553	19,883
Domestic	0	2,822
Irrigated Ag	201,373	370,242
Livestock	804	15,517
Public Supply	4,635	36,781
Reservoir Evap.	50,577	0
Basin Totals	257,942	445,245

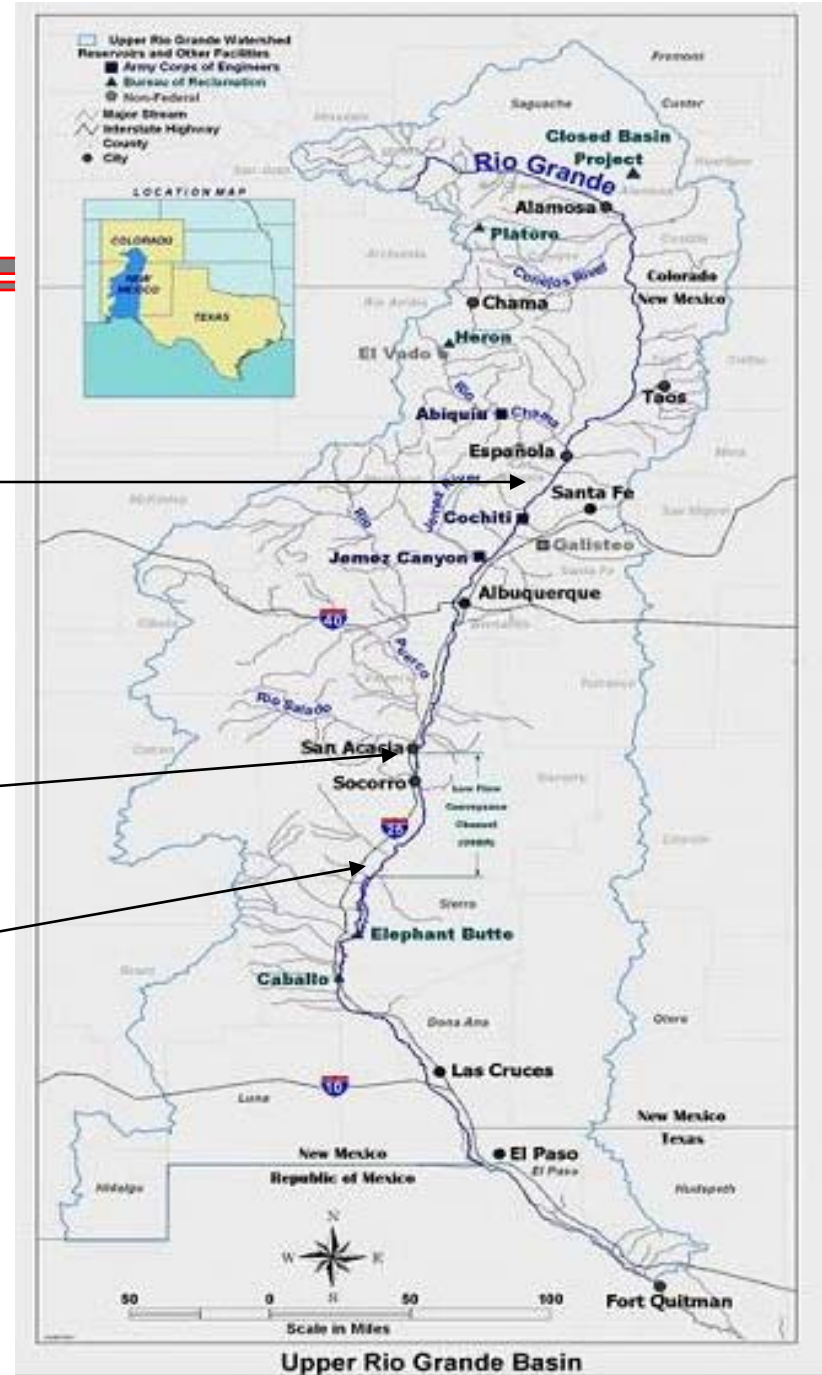


Rio Grande Basin (URGWOM)

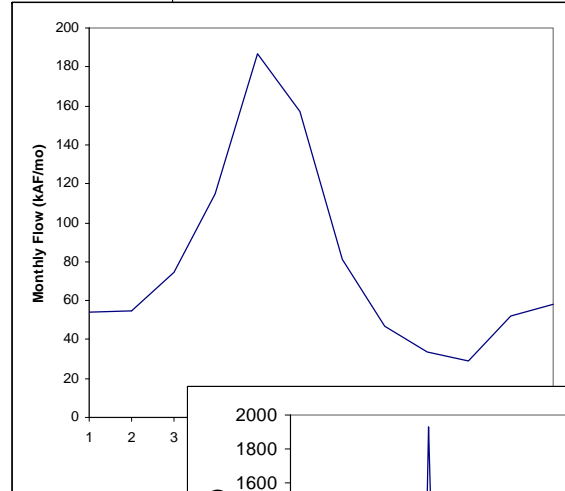
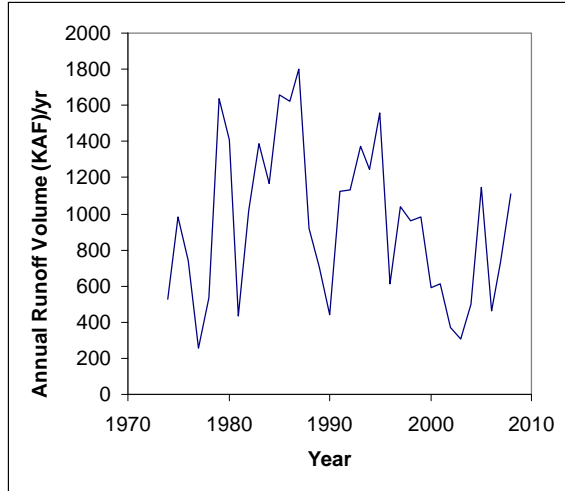
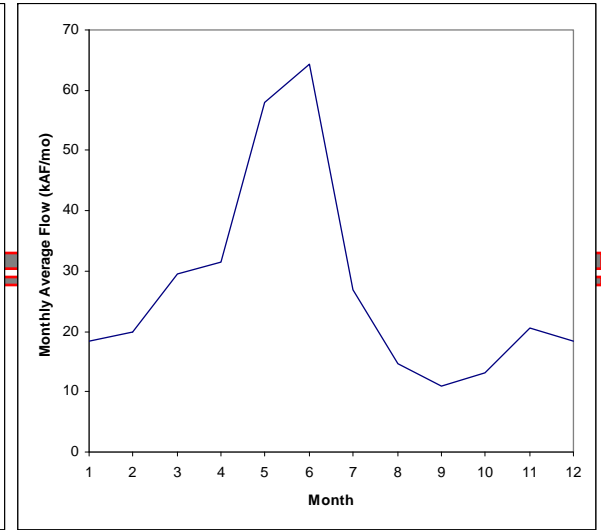
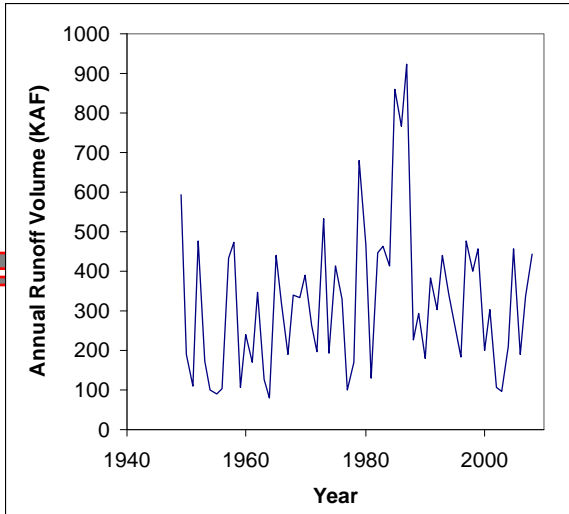
Otowi

San Acacia

San Marcial

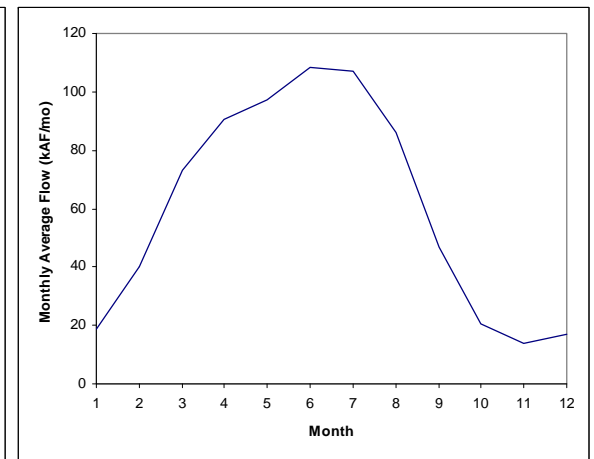
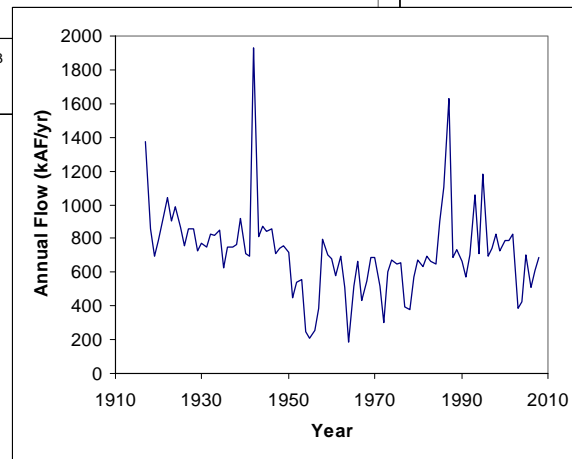


Rio Grande Hydrology



R.G. at Cerro

R.G. at Albuquerque



Rio Grande Basin Surface Water Resources

Location	Period of Record ¹	Average Annual Flow (kAF/yr)	Q_{10}^2 (kAF/yr)	Q_{10}/Q_{avg}
Rio Grande near Cerro, NM	1949-Present	325.4	106	0.33
Rio Chama near Chamita, NM	1971-Present	413.2	214	0.52
Rio Grande at Otowi Bridge, NM ³	1940-2008	962.5	407.2	0.43
Rio Grande at Albuquerque, NM	1974-Present	944.9	436.5	0.46
Rio Grande below Elephant Butte Dam, NM	1917-Present	718.5	422	0.59

- Strong influence of storage on river flows
- Flows dominated by spring runoff



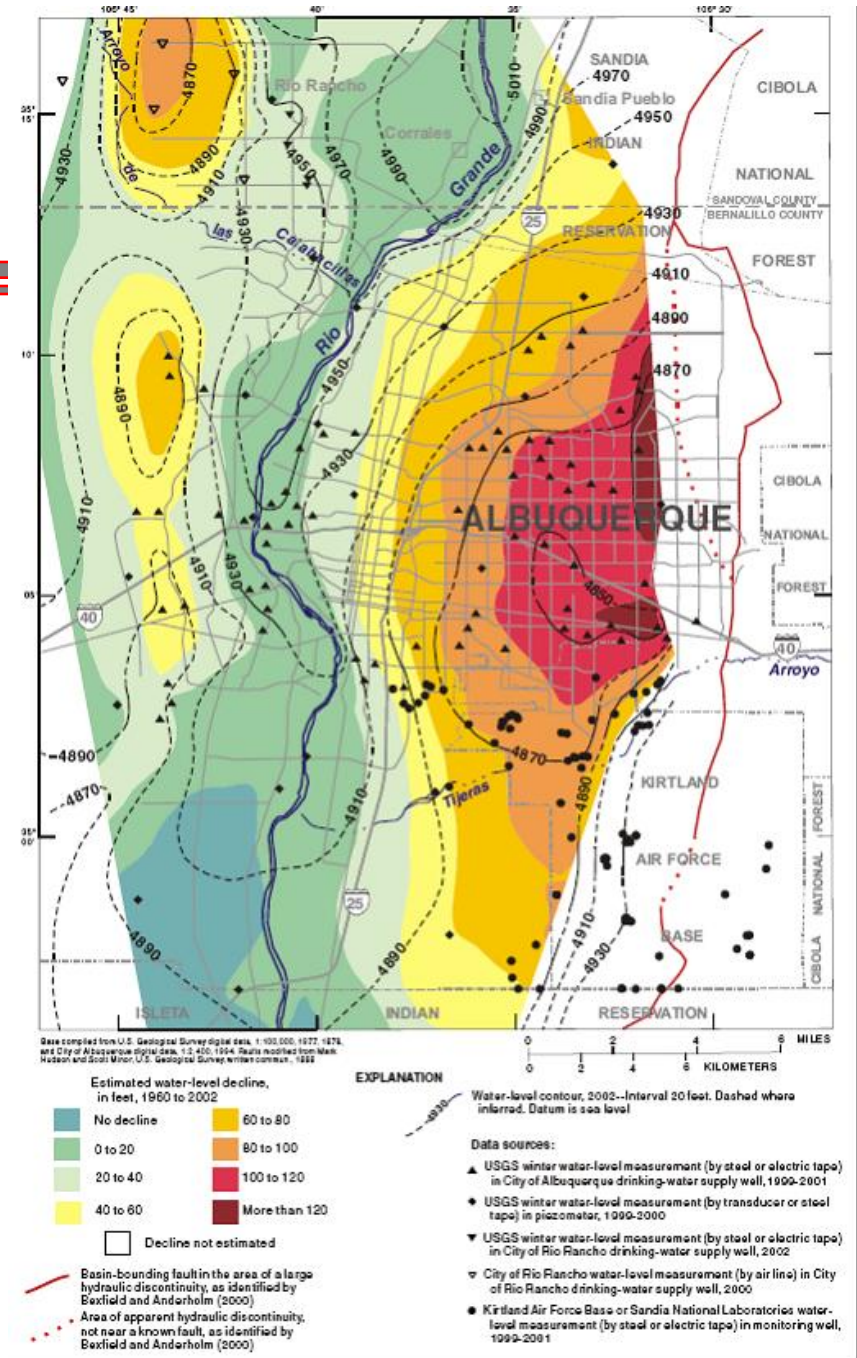
Major Tributaries to the Rio Grande



Tributary	Drainage Area (mi ²)	Q _{average} (kAF/yr)	Q ₁₀ (kAF/yr) ¹
Conejos River, CO	821	66.7	48
Costillo Creek, CO	200	11.2	0.4
Rio Chama, NM	3,159	413.2	214
Galisteo Creek, NM	670	7.4	2
Jemez River, NM	1,038	43.1	13.9
SWRP Discharge		62	
Rio Puerco, NM	6,057	28.9	8.5
Rio Salado, NM ¹	1,394	10	0.9



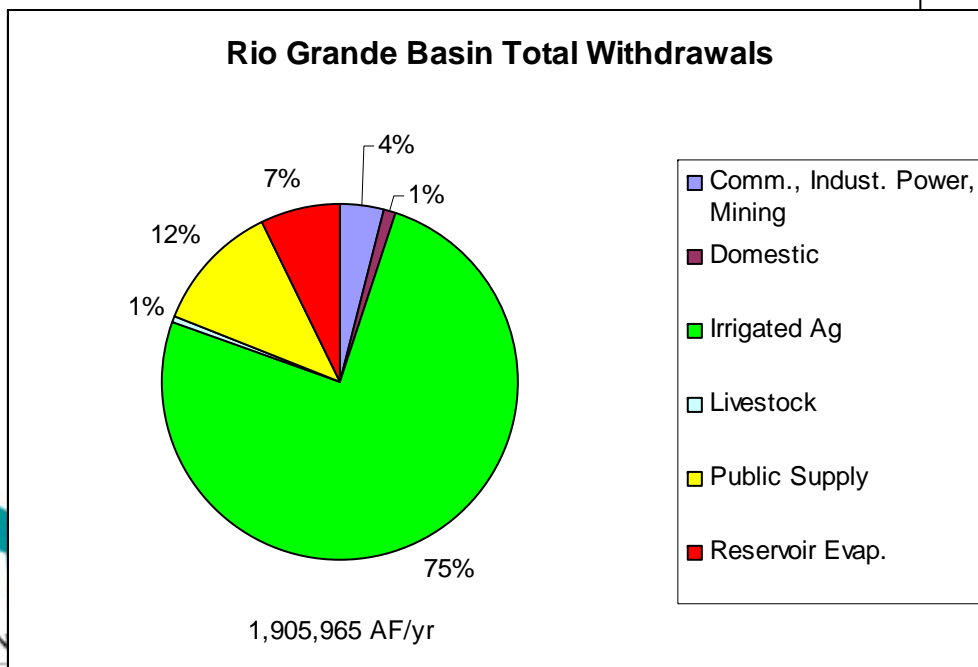
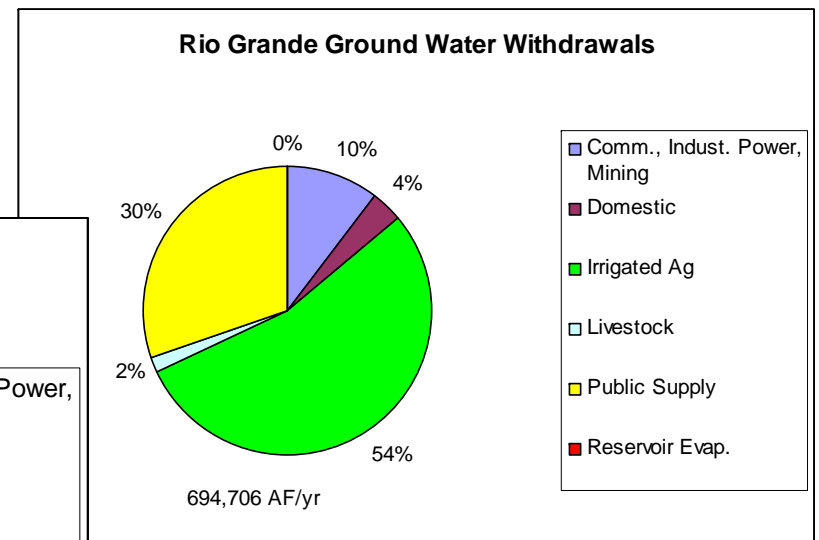
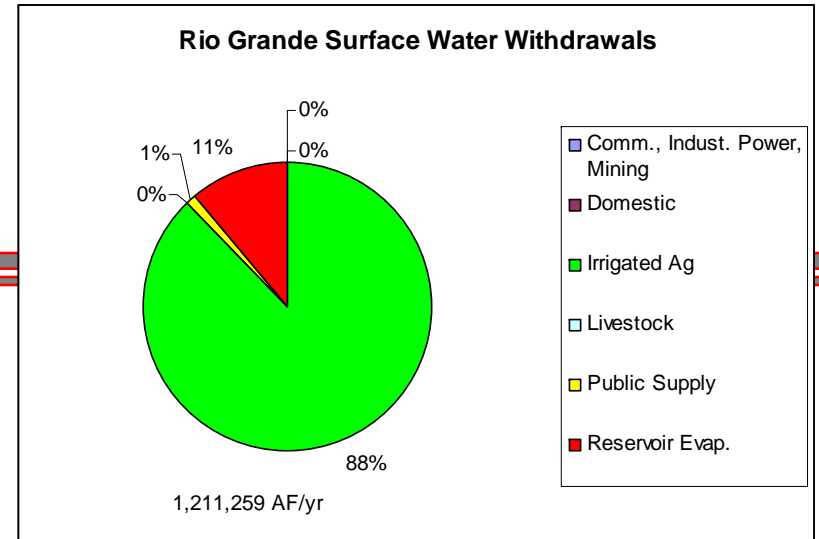
Middle Rio Grand Ground Water Declines (Bexfield & Anderholm, 2002)



Water Use in the Rio Grande Basin

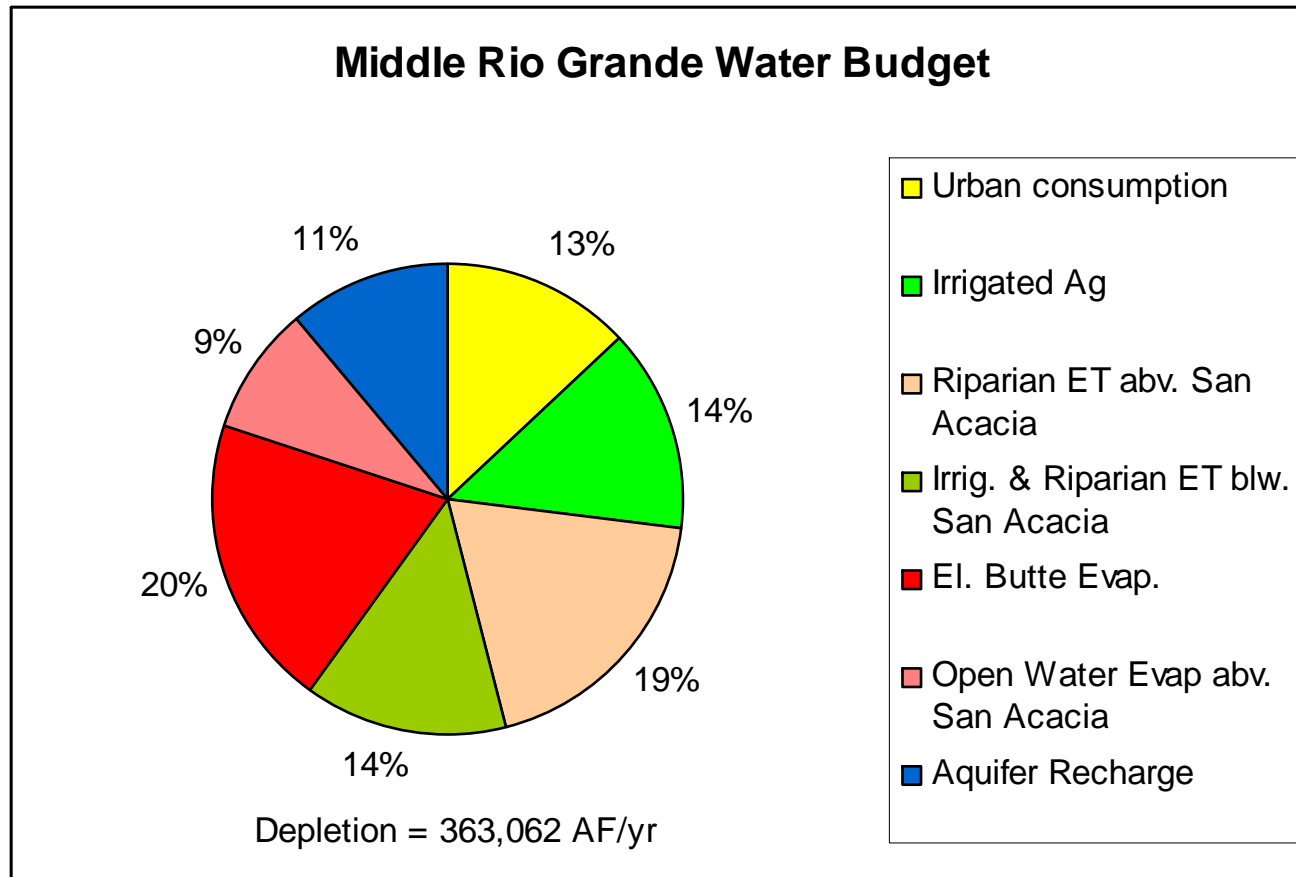
(Longworth et al. 2008)

Category	Surface Water (AF/yr)	Gound Water (AF/yr)	Total Withdrawals (AF/yr)
Comm., Indust. Power, Mining	1,517	71,526	73,043
Domestic	0	24,556	24,556
Irrigated Ag	1,061,896	375,887	1,437,783
Livestock	910	12,260	13,170
Public Supply	11,338	210,477	221,815
Reservoir Evap.	135,598	0	135,598
Basin Totals	1,211,259	694,706	1,905,965

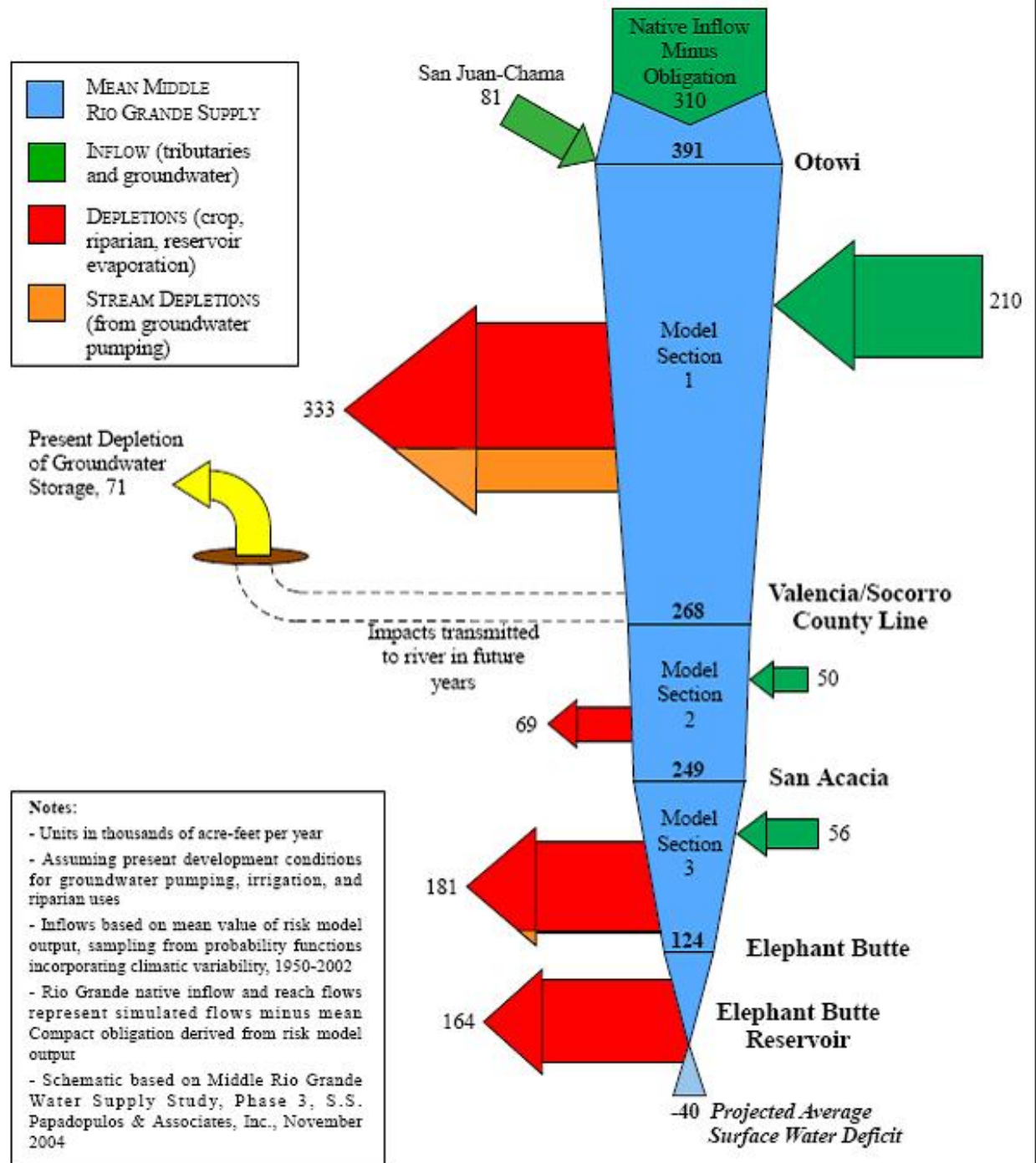


Middle Rio Grande Water Budget - Average

(MRGWA, 1999)

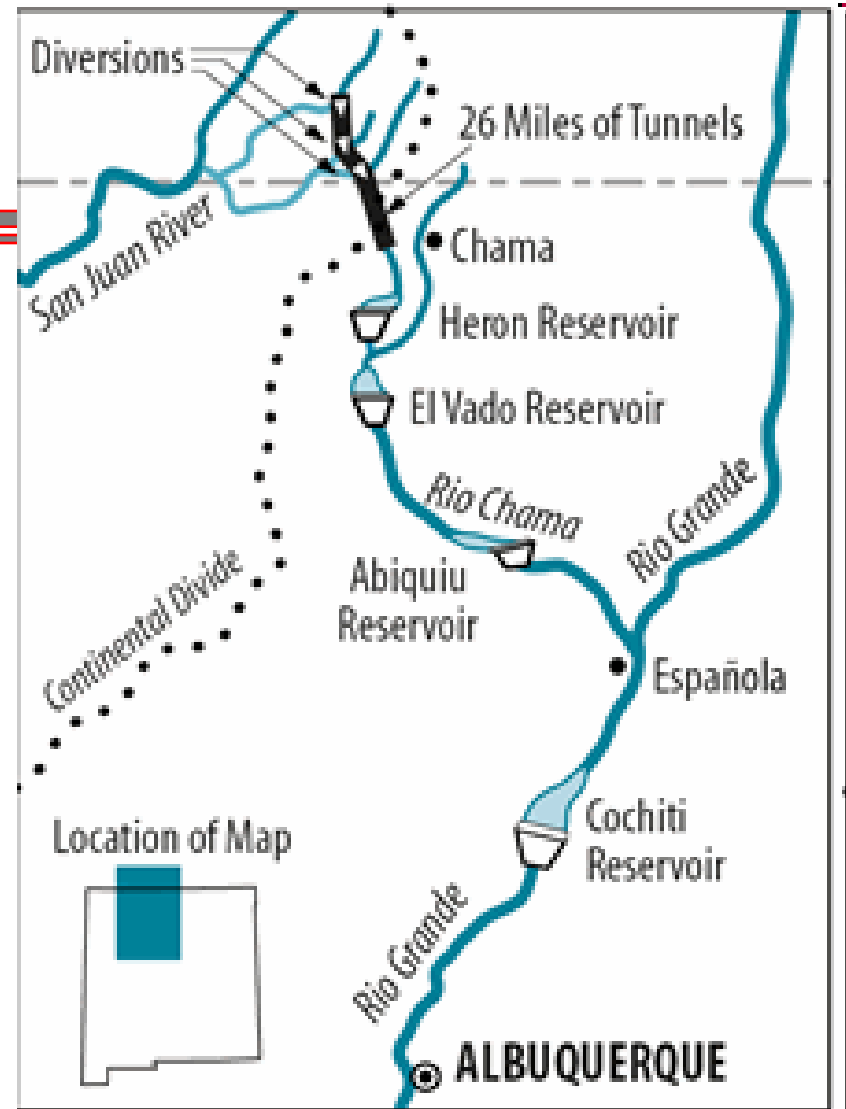


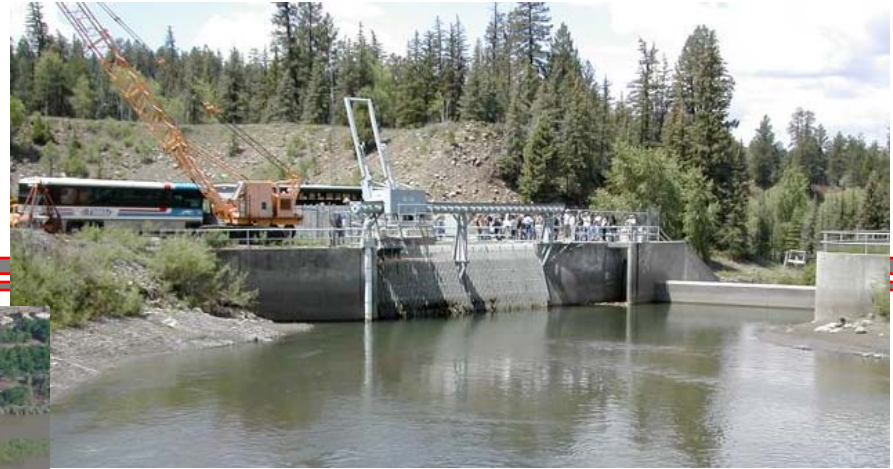
Middle Rio Grande Water Budget – Flows (SSPA, 2006)



San Juan Chama Project

- First surveys in 1933
- Authorized in 1962
- Azotea tunnel completed in 1970
- Diversions began in 1971
- ABC WUA diversion dam, treatment plant & pipeline project completed in 2008





Azotea Tunnel Entrance



Diversion Dam & Pump Station



Treatment Plant

Partners in the SJC Project

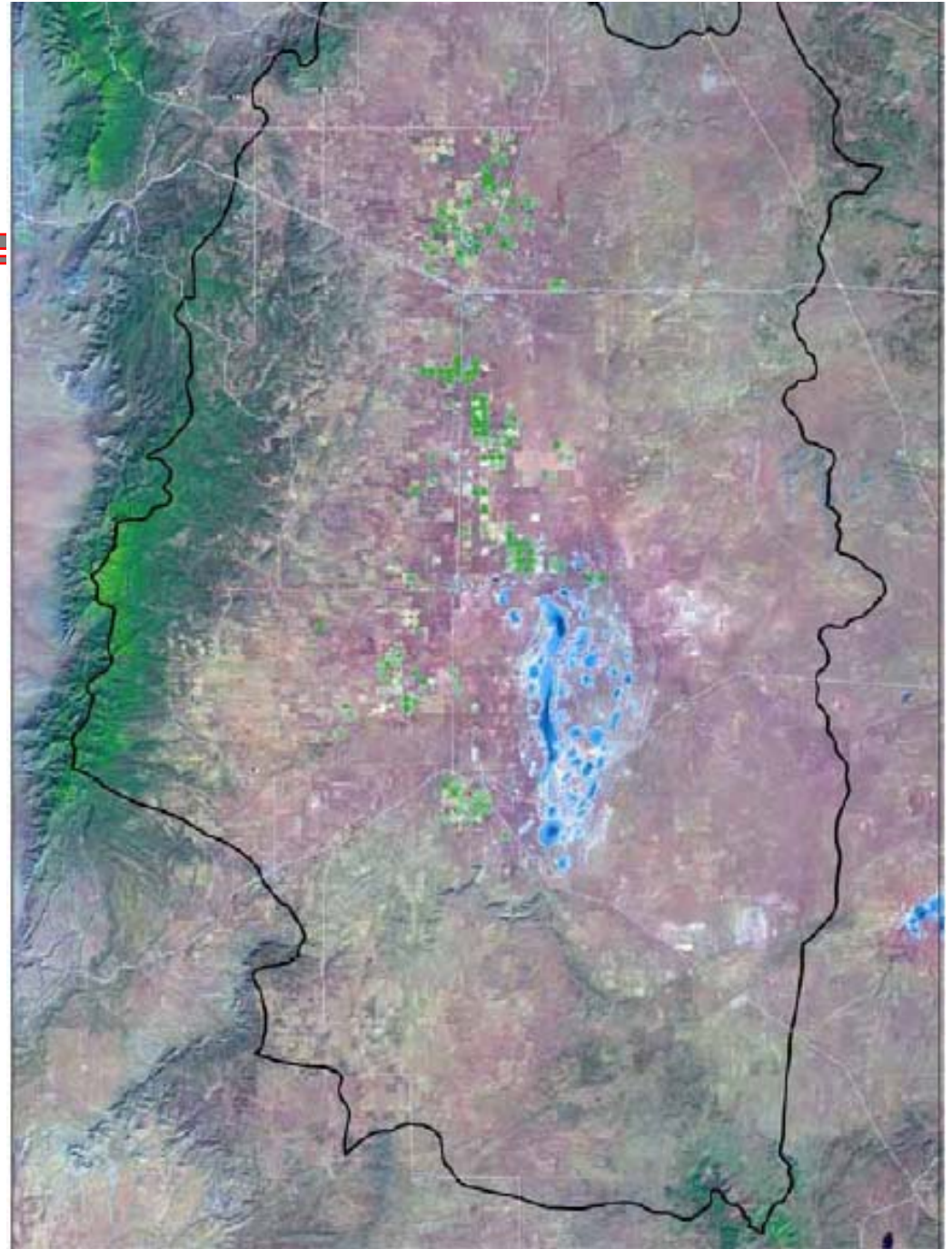
Partners in the San Juan Chama Project	Annual Supply (AF/yr)
Municipal, Domestic & Industrial Supplies	
City of Albuquerque	48,200
Jicarilla Apache	6,500
City and County of Santa Fe	5,605
County of Los Alamos	1,200
City of Espanola	1,000
Town of Belen	500
Village of Los Lunas	400
Village of Taos	400
Town of Bernalillo	400
Town of Red River	60
Twining Water & Sanitation District	15
Irrigation Supplies	
Middle Rio Grande Conservancy District	20,900
Pojoaque Valley Irrigation District	1,030
Other	
USACE – Cochiti Fish, Wildlife & Recreation	5,000
.Allocated but uncontracted	4,990
Total Annual Supply	96,200



Estancia Basin

- Closed basin
- No surface water diversions

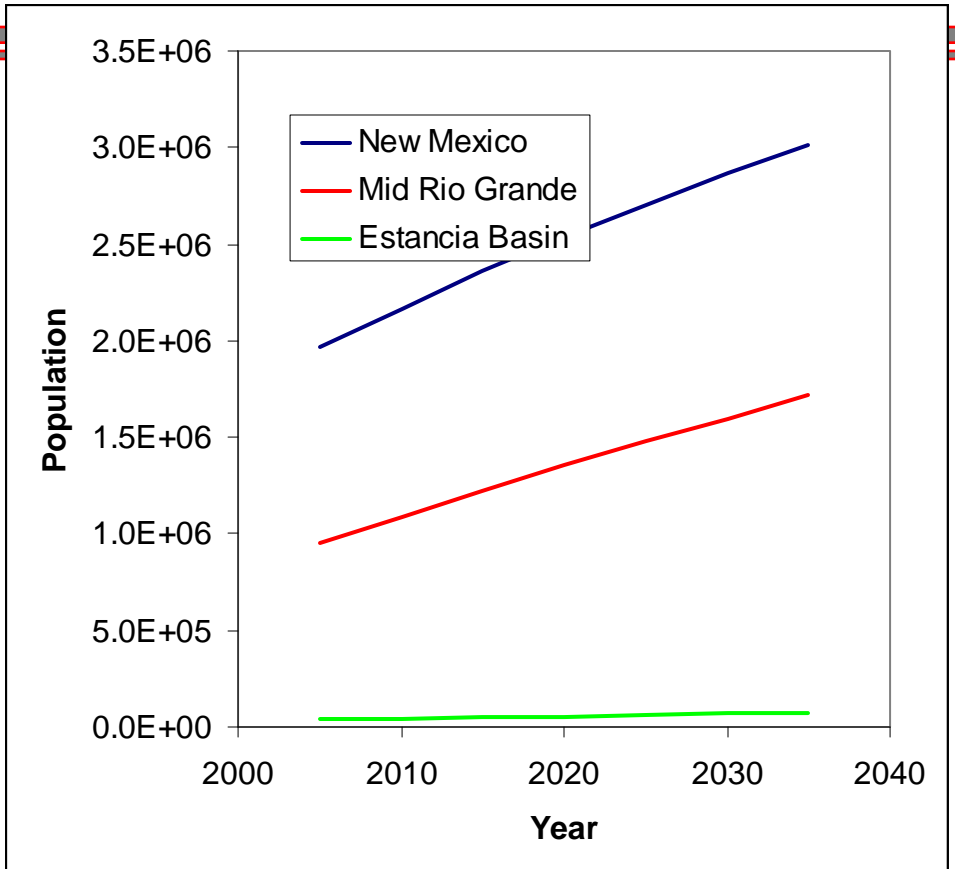
From Estancia Basin Water Plan



NM Population Projections

(BBER, 2007)

- Steady growth
- Estancia basin pop is small relative to ABQ & SAF



Annual Depletion



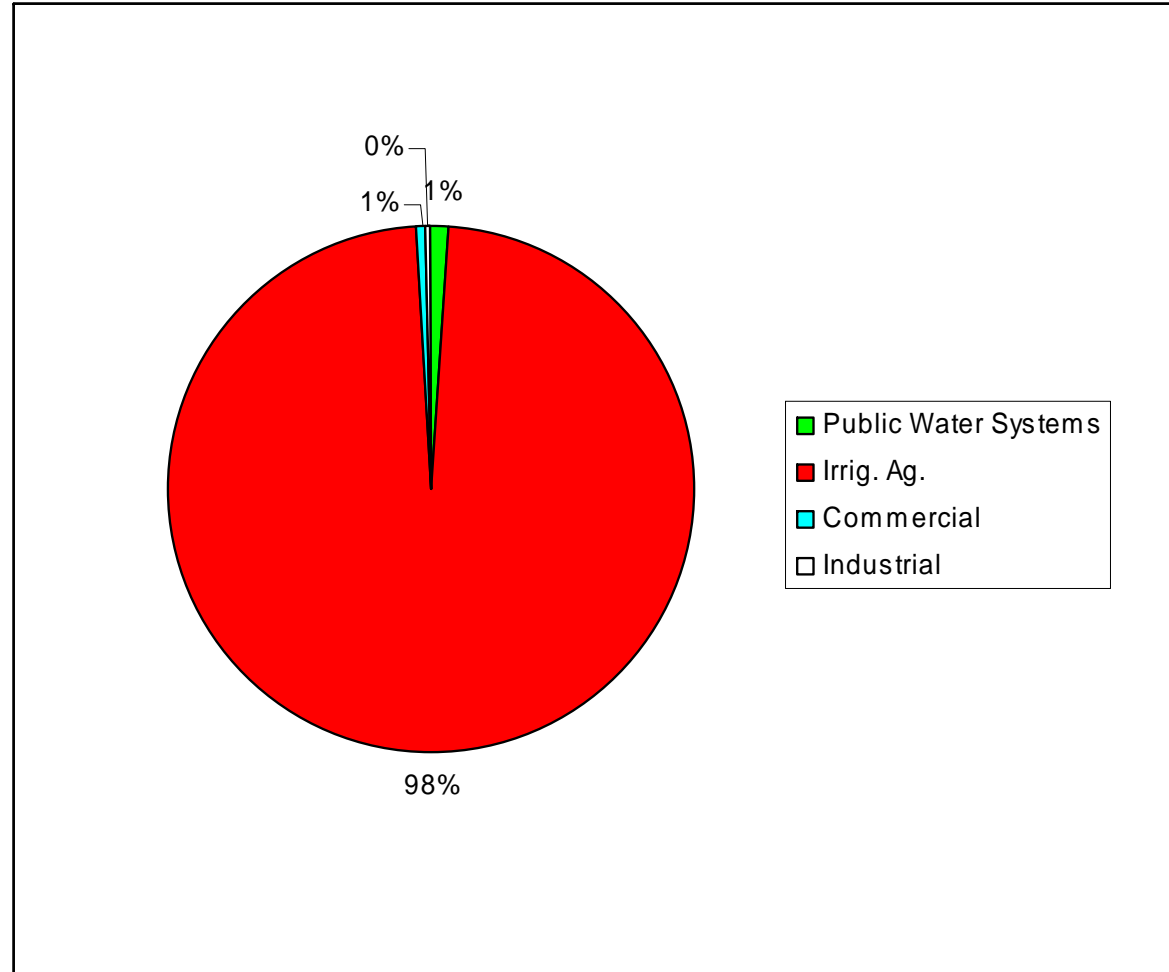
- Current GW depletion ~110 KAF/yr
- Basin plan calls for reduction to 20 KAF/yr by 2040 in valley fill
- Model predicts > 60 ft drawdown in pumping centers

Water Bearing Unit	Ground Water in Storage (MAF)	Assumed Basin Wide Water Level Decline (1995-2005)	Depletion (AF) (1995-2005)	Depletion Rate (AF/yr)
Valley Fill	6.58	10.4	520,520	52,052
San Andres Limestone	0.67	N/A	N/A	N/A
Glorieta Sandstone	5.85	N/A	N/A	N/A
Yeso Formation	23.8	N/A	N/A	N/A
Abo Formation	44.9	N/A	N/A	N/A
Madera Group	11.1	50	612,000	61,200



Estancia Basin Water Use by Category

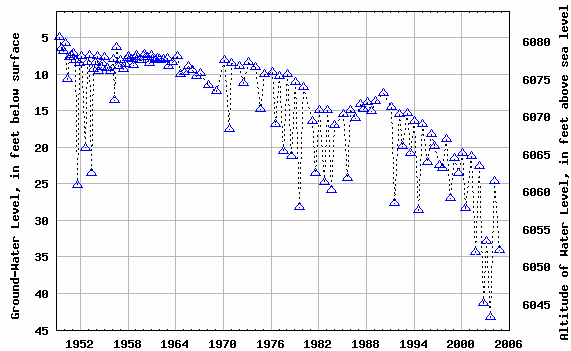
(Basin Plan, 2008)



Ground Water Declines



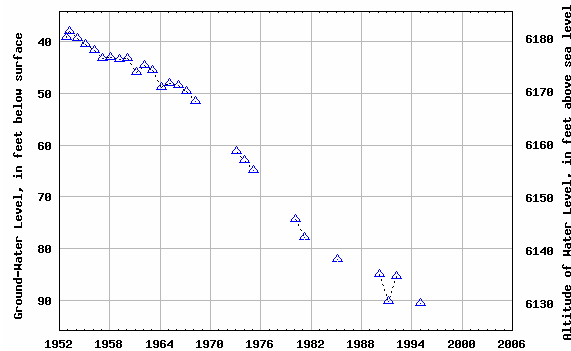
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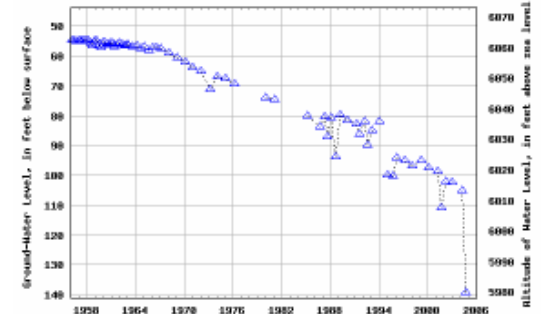
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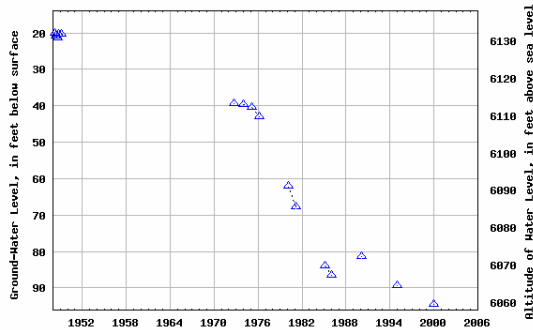
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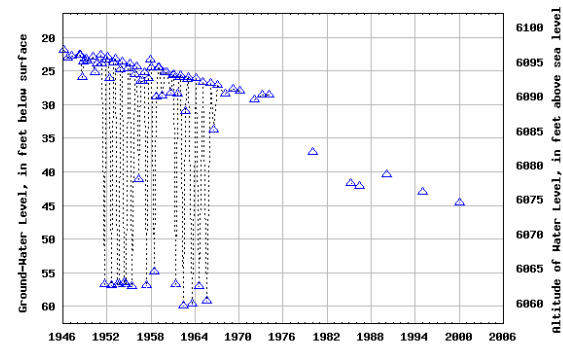
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Provisional Data Subject to Revision



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Provisional Data Subject to Revision



Summary of Brackish Water Export Proposal

- Construct wells in eastern side of basin
- Extract 7200 AF/yr
- Construct desalination plant & pipeline to Santa Fe (~75 miles)
- Estimated project cost = \$100 M (\$14/KAF)
 - \$120 M profit at \$30/KAF for water



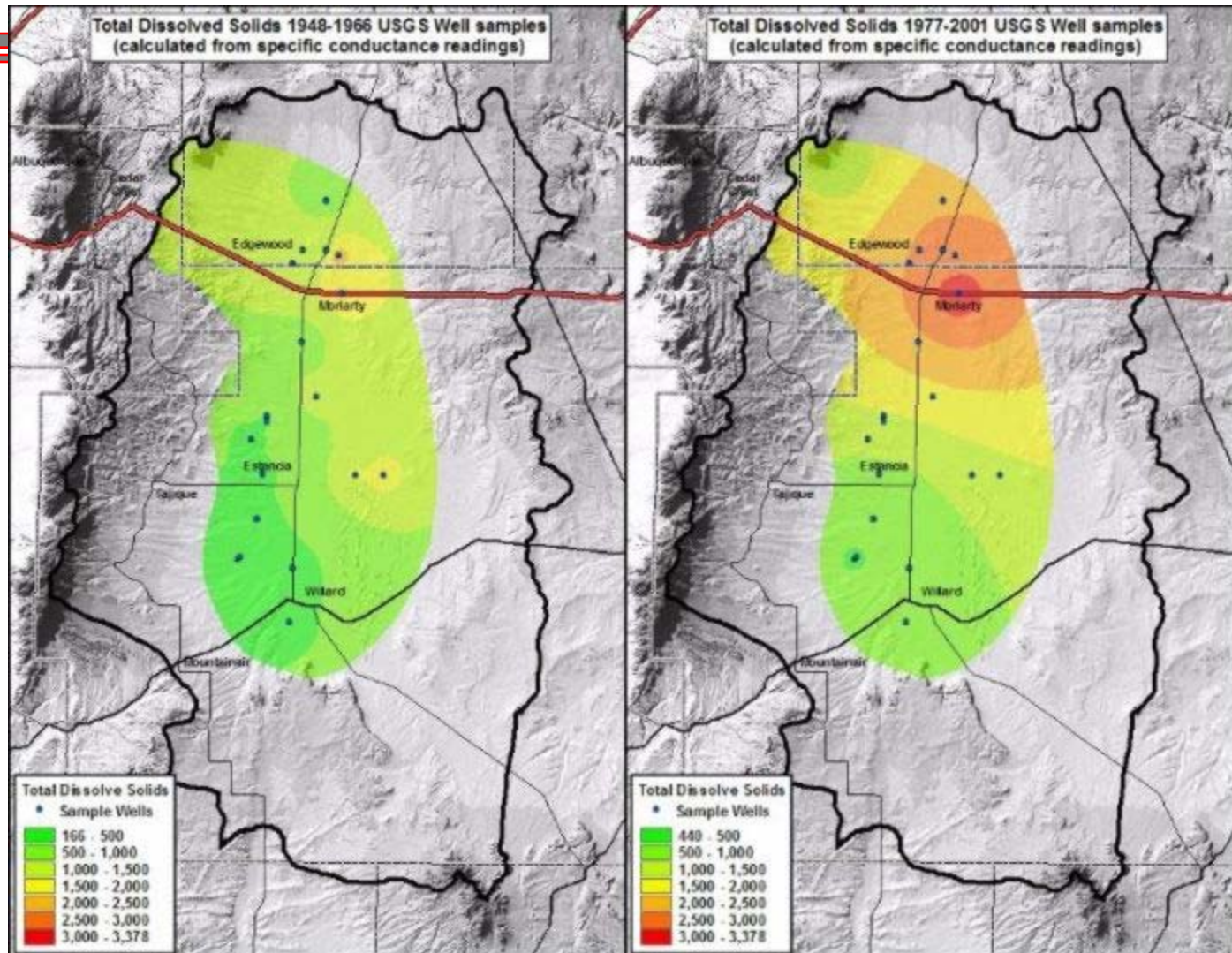
Recharge & Salinity

(Shafike & Flannigan, 1999)

- Virtually all recharge is from mountain front on west
- Salinity principally due to concentration by evaporation
 - Confirms little recharge from east
 - No recharge studies in east



Drawdown Is Increasing Salinity of Existing Wells



Desalination Issues

- Recovery of 75% will require ground water depletion of 9,600 AF/yr to produce 7,200 AF/yr of potable water
- Energy consumption - ~16,000 Kwh/d
- CO₂ footprint - 20,000 lbs CO₂/d
- Cost - \$6 - \$8/10³ gal
- Brine disposal options for 2,400 AF/yr
 - Deep well injection
 - Playa lakes



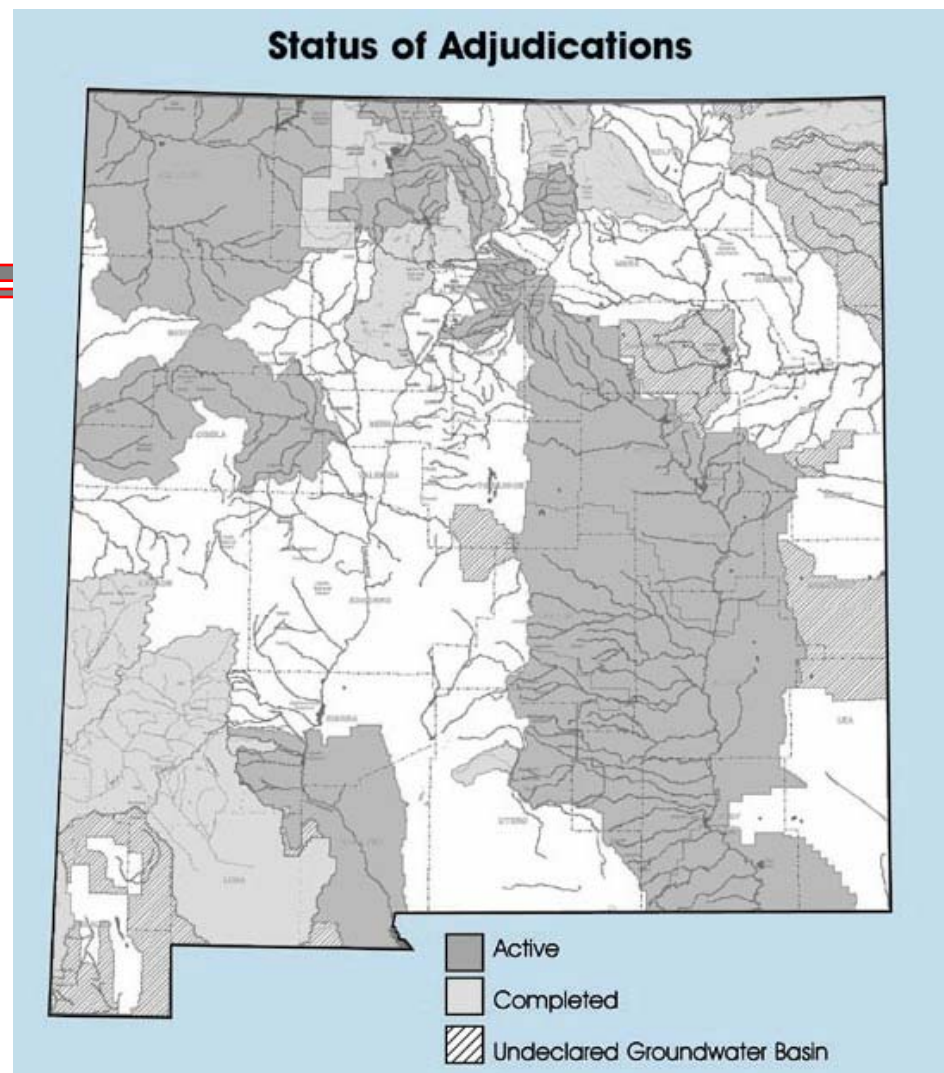
Water Law & Administration

- 1907 NM Territorial Code of Water Law
 - Requires permit from the State Engineer for new appropriation of surface water
- 1931 Legislation declared ground water to be public.
 - Permits required in “Declared Basins”
 - 33 declared basins covering 92% of state
 - Conjunctive management – if surface & ground water connected
- Priority Administration – Water rights priority based on appropriation date
 - First in time = first in right
 - Do not share shortages in times of drought

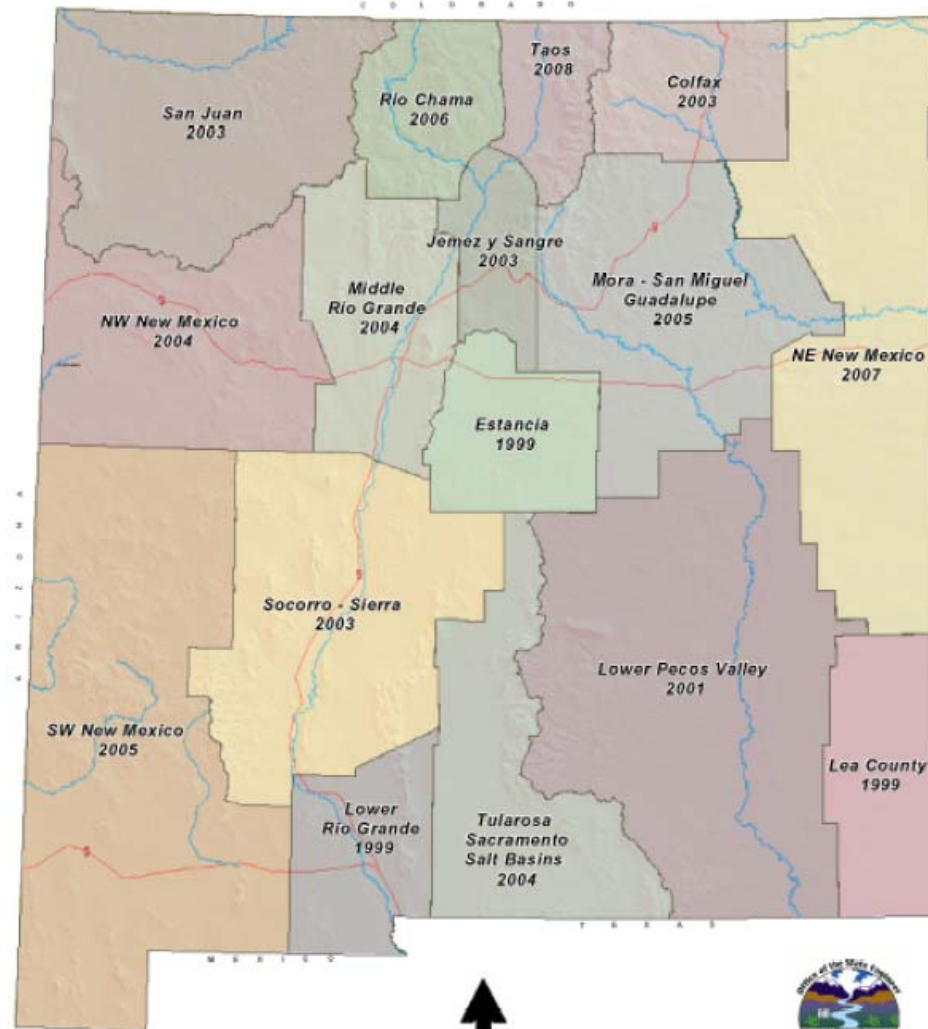


Office of the State Engineer & Interstate Stream Commission

- OSE Administers water in NM
 - ISC responsible for compliance with compacts
- Adjudication – Court proceeding that formally identifies who owns how much water & priority date
- Most basins are fully appropriated – no new permits granted, except domestic wells

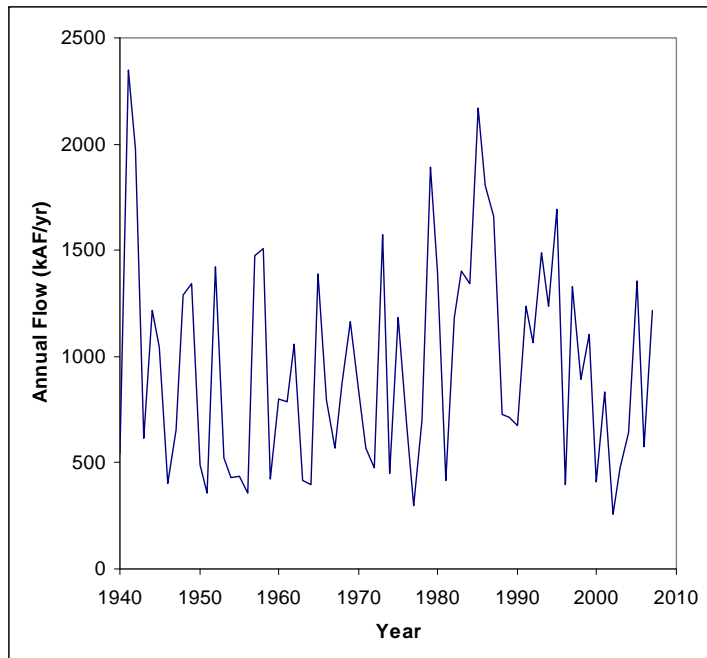


ISC Sponsors State & Regional Water Planning

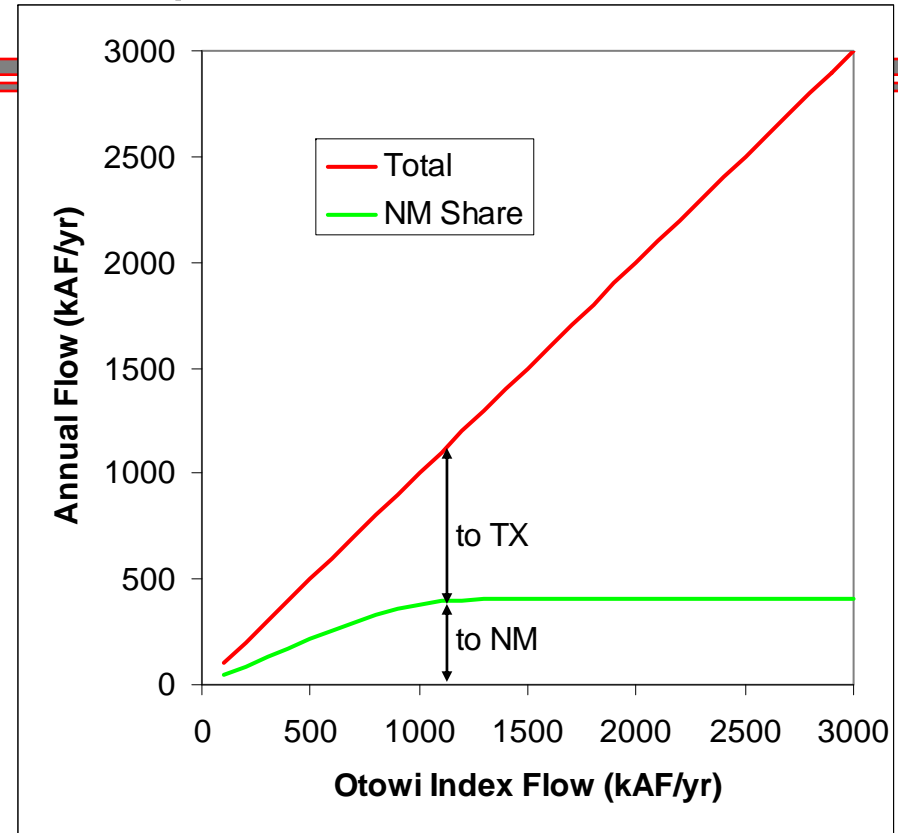


Rio Grande Compact

- Requires delivery of water to TX based on flows at Otowi gage



Otowi Index Flows



Issues – Domestic Wells

- Domestic well statute (NMSA 72-12-1) - OSE automatically grants well permits for domestic wells (1 AF/yr), generally without regard to impact on water resources
- 137,000 domestic wells state wide
 - OSE issues ~7,000 domestic well permits/yr
 - Ultimate impact on Rio Grande ~36,000 AF/yr
- Legal status
 - Bounds decision (2008) – Declared statute unconstitutional
 - If upheld - May mean existing domestic wells subject to priority administration
 - If reversed – May mean domestic well permit is not water right, not transferable, not protected from impairment



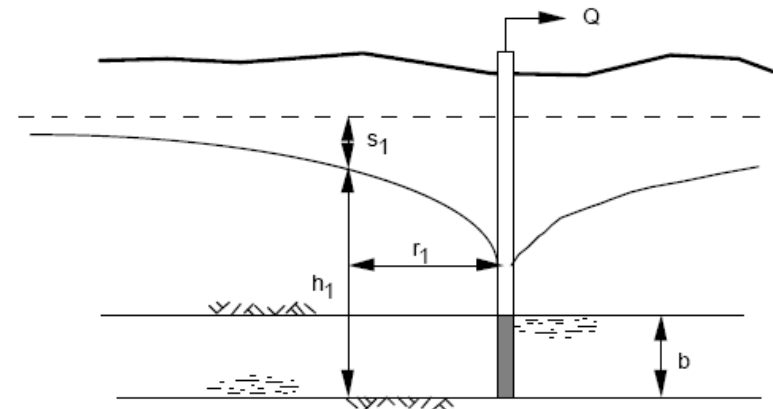
Issues – Indian Water Rights

- Winters Doctrine (1908) – Reserved rights
 - Oldest priority
 - PIA – practicably irrigable acreage
- Pueblo Water Rights
 - Pueblos hold aboriginal rights under Spanish & Mexican land grant status
 - Not clear if Winters Doctrine applies
 - Aamodt case
- Much uncertainty
 - Increasing willingness by Pueblos, State & local communities to work together.



Issues – Permits to Pump vs. Water Rights

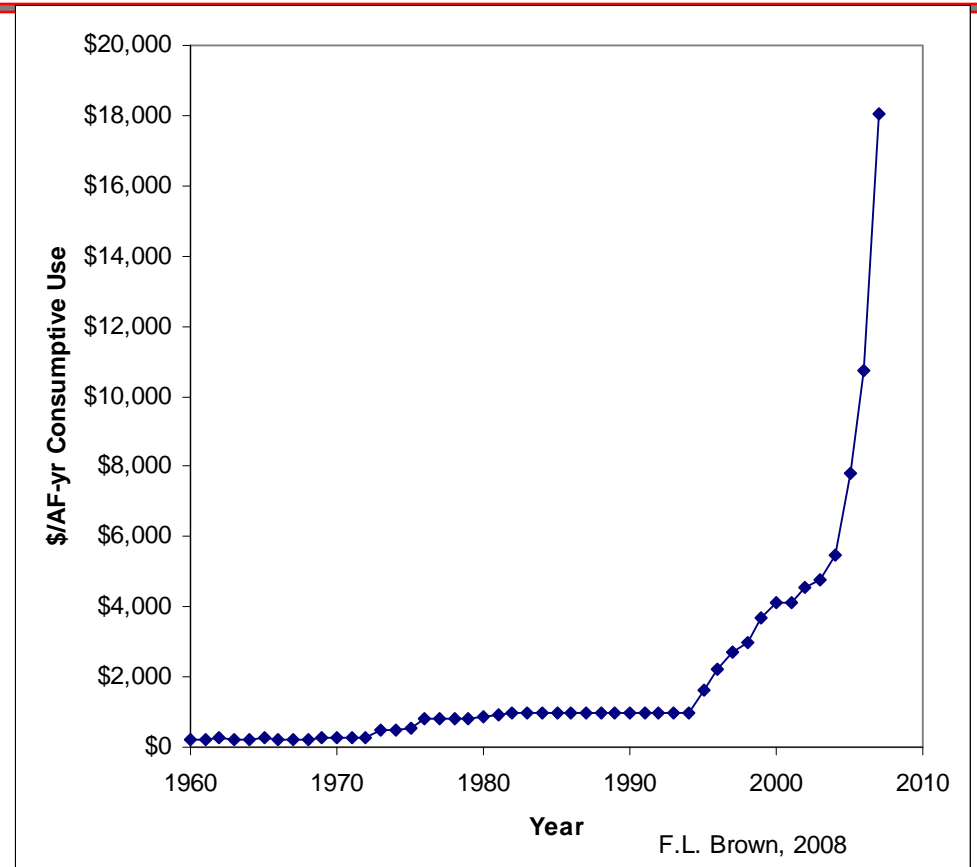
- OSE has issued permits to pump to communities which must acquire water rights before pumping impacts surface water (sometimes called “Dedications”)
- Rio Rancho must purchase rights for 24,000 AF/yr
- Others:
 - Hunning Ranch
 - Intel (owns 741 AF, must acquire 3,200 AF)
- ISC calculates that ALL irrigation water (including Pueblos) must be re-allocated to public supply to satisfy existing permits



Price of Water

(Brown, 2008)

- Price depends on many factors, primarily priority date
 - Household use ~ 1/3 AF/yr
 - At \$30 K/AF, cost to purchase water for new house is \$10 K
- Much discussion of water markets as way to equitably allocate water

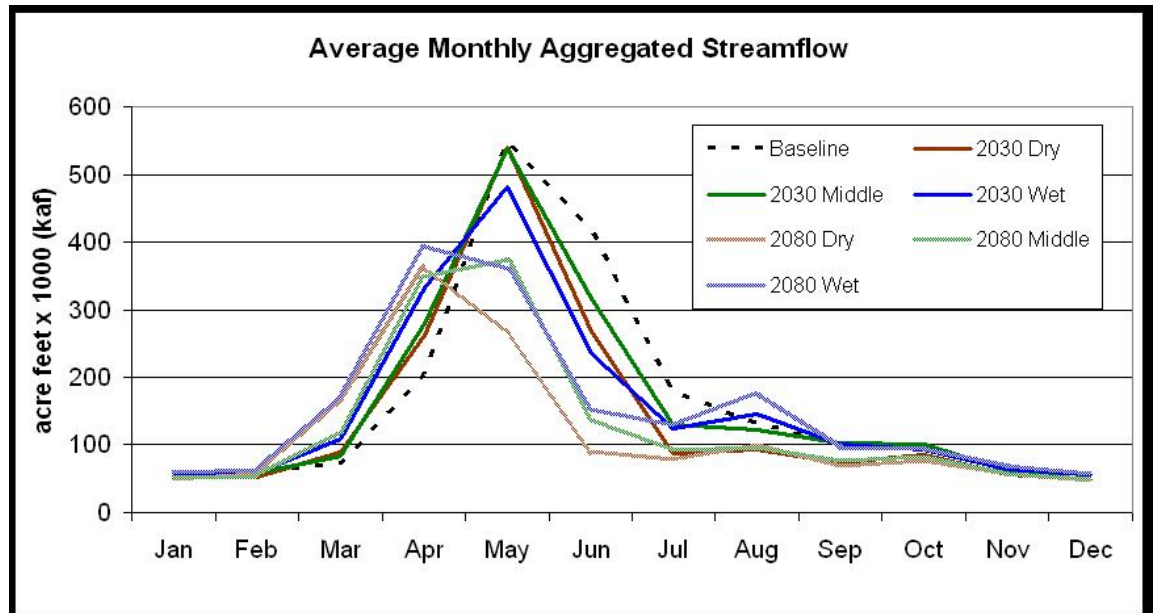


Impacts of Climate Change

(Hurd & Coonrod, 2007)

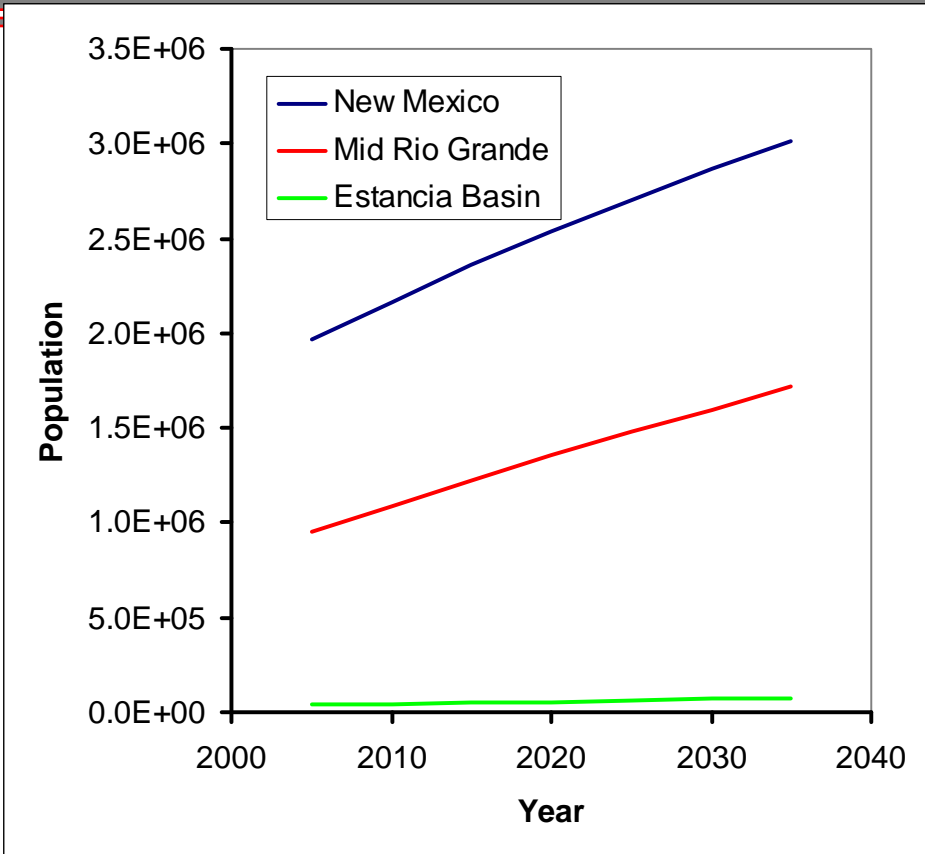
- Less snow pack
- Earlier snow melt
- Increased evaporation

- Earlier peak runoff
- Up to ~29% reduction in runoff by 2080



Population Growth (BBER)

- Population growth will dramatically increase demand



Environmental Flows (E-Flows)

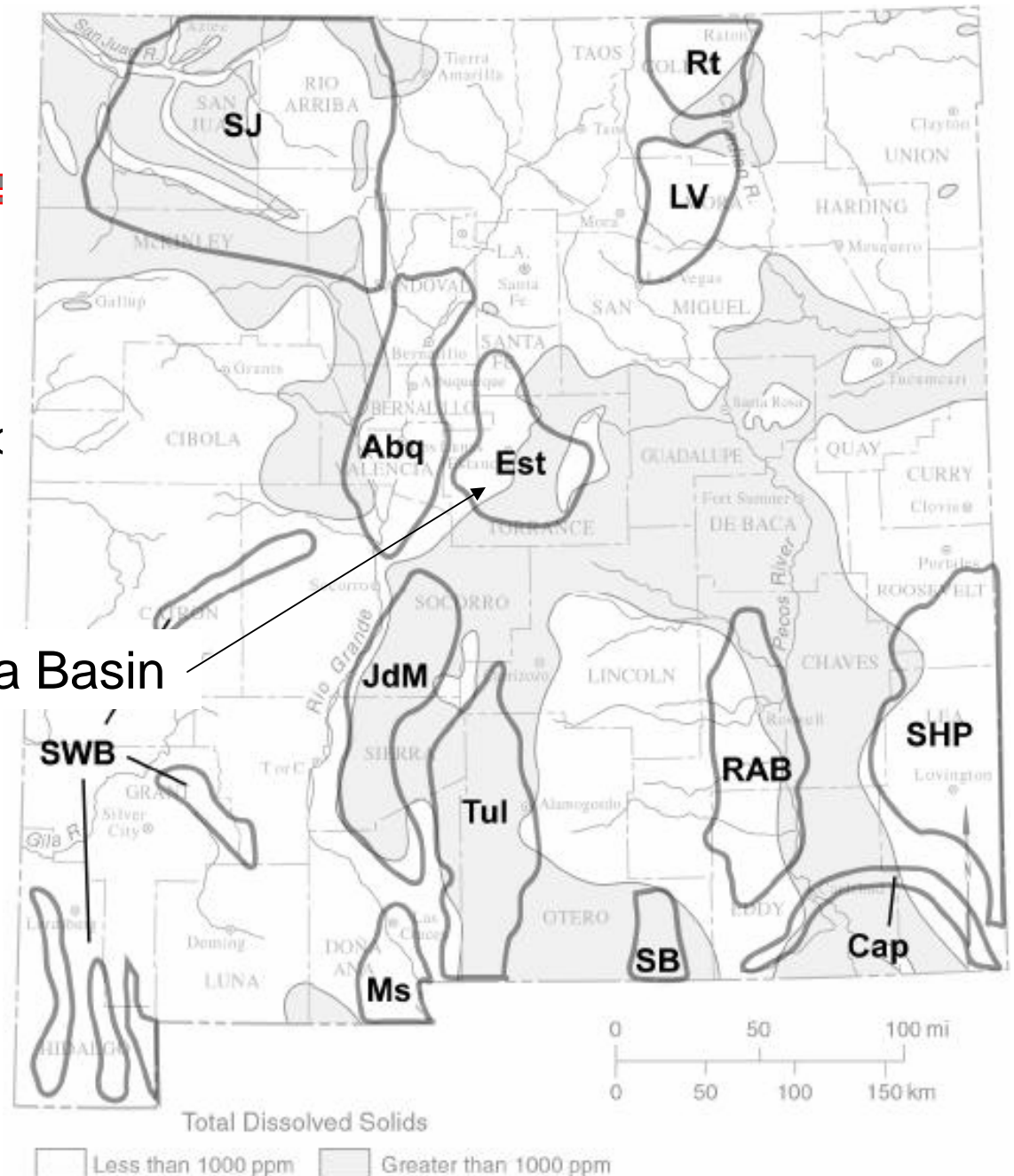
- State water law didn't create water rights for environment – aquatic organisms & riparian ecosystem
- Endangered Species Act requires protection of threatened & endangered species
 - Rio Grande Silvery Minnow, Southwest Willow Flycatcher
 - Species survival requires proper amounts of water at proper time
- Issues
 - Quantity of water
 - Quality of water
 - When water is delivered
 - Structures in river



What About Brackish/Saline Water?

- ~75% of ground water in NM is brackish/saline (Reynolds, 1962)
- Aquifers are not recharged hence not sustainable source of supply

Estancia Basin



Looming Train Wreck

- Train Tracks (i.e. challenges with no obvious resolution in sight):
 - Acquisition of water rights to satisfy withdrawal permits (Rio Rancho, Hunning Ranch, etc.)
 - Resolution of Pueblo Water Rights
 - Impacts of climate change
 - Environmental flows
 - Population growth



Concluding Thoughts

- State is facing extraordinary challenges in which water will likely determine future economic & social characteristics
- Present water laws & regulations are inconsistent & incomplete.
- Little linkage between development & water resources
- Water managers have little statutory authority:
 - Pray for drought! (Force the issues to be addressed & give politicians “cover”)
- Water resources in NM are finite and limited – there are no new sources
 - Allocation of resource is a “zero sum game”
 - We’re all in this together
- Resolution will require uncommon good faith collaboration by all



References & Websites

- Albuquerque Bernalillo County Water Utility Authority – www.abcwua.org
- Bruce Thomson – www.facebook.com/Thomson4AMAFCA
- Longworth, John W., Valdez, Julie M., Magnuson, Molly L., Albury Sims, Elisa, and Keller, Jerry, (2008). [New Mexico Water Use by Categories 2005](#), Technical Report 52, NM Office of the State Engineer, Santa Fe, NM, 111 p. (available on OSE web site)
- Middle Rio Grande Water Assembly - www.waterassembly.org/
- Natural Resources Conservation Service – www.nrcs.usda.gov
- New Mexico Bureau of Geology & Mineral Resources - <http://geoinfo.nmt.edu/>
- New Mexico State Engineer (& NM Interstate Stream Commission) – www.ose.state.nm.us
- Regional water plans - www.ose.state.nm.us/isc_regional_planning.html
- S.S. Papadopulos & Associates (SSPA) (2006). Middle Rio Grande Water Budget: Present and Projected, report to the NM Interstate Stream Commission, Santa Fe, NM, 8 p.
- University of New Mexico Water Resources Program – www.unm.edu/~wrp
- US Geological Survey (USGS) - <http://nm.water.usgs.gov/>
- Utton Transboundary Resources Center, UNM School of Law (Water Matters!) - <http://uttoncenter.unm.edu/>
- Western Regional Climate Center (precipitation data) - www.wrcc.dri.edu/htmlfiles/westevap.final.html

