
Water Budget for the Middle Rio Grande
DRAFT

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Introduction & Objectives

- The Middle Rio Grande Water Assembly (MRGWA) prepared a water budget for the Middle Rio Grande (MRG) to support Regional Water Plan (www.waterassembly.org)
 - Published in 1999
 - El Grupo Technico led by Frank Titus
- Renewed interest in water planning gave the Assembly incentive to update the plan.
- Frank Titus was again asked to lead the effort. Leadership subsequently assumed by Bruce Thomson
- Objective of this presentation is to describe process & preliminary conclusions.
 - Note: This report is still in DRAFT form. Comments & suggestions are welcome

Justification for Water Budget Update

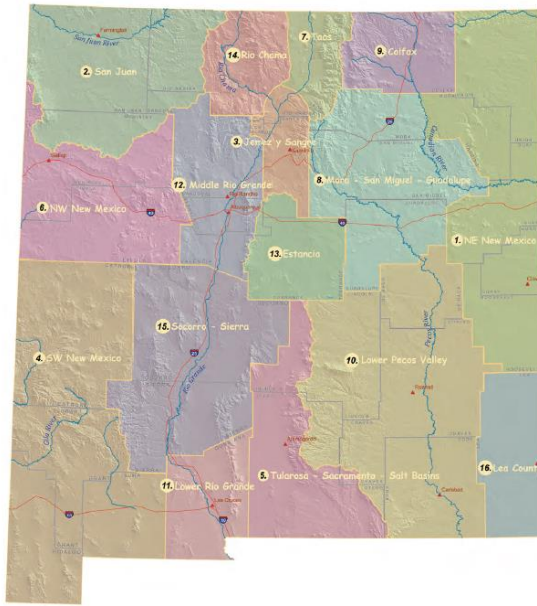
- Important changes since 1999:
 - Surface water diversion by ABCWUA beginning 12/08
 - Extended drought
 - Population growth
 - Conservation efforts
 - MRGCD metering
 - More data available (both quantity & quality)
 - Better quantitative accounting for hydrology - URGSiM

2 Notable Previous Water Budgets

- MRGWA (1999)
 - Volunteer effort
 - Based on 25 year period of record, 1972-1997
- S.S. Papodopolus & Associates (SSPA, 2004)
 - Culmination of multi-year study for NM Interstate Stream Commission
 - Included consideration of statistical variability
 - Based on 50 year period of record, 1950-1999

Boundaries of Water Budgets

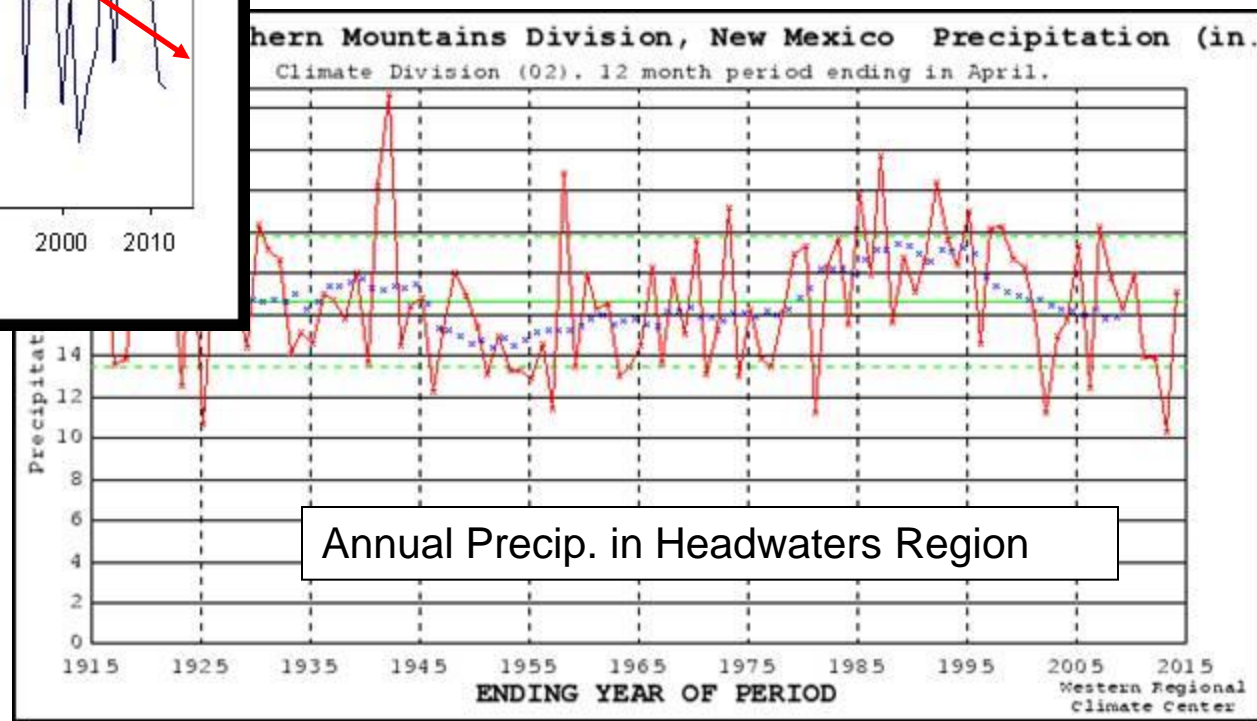
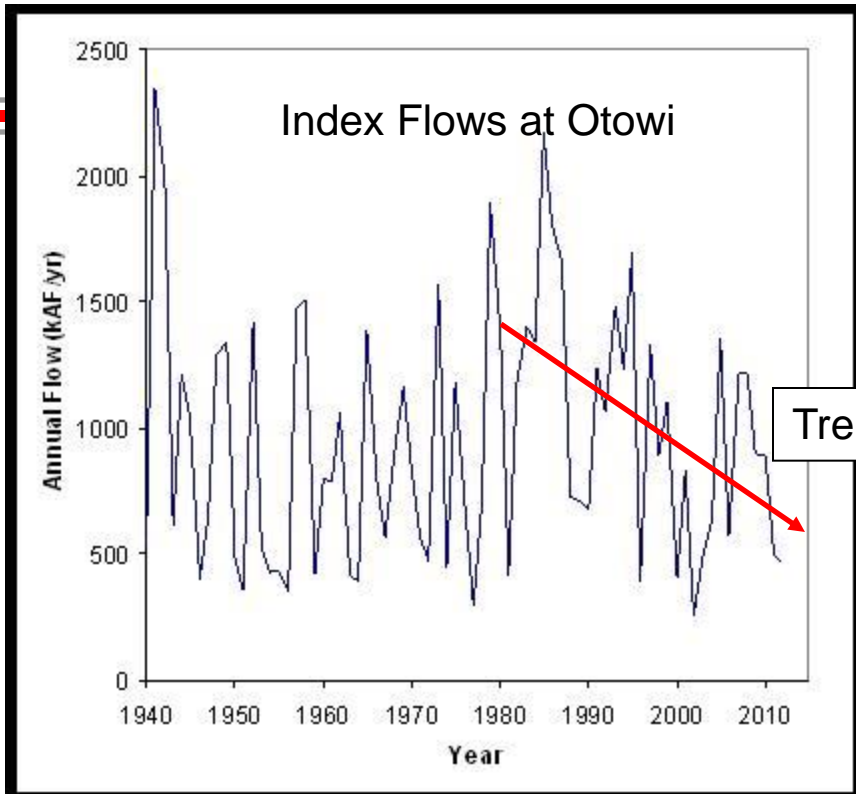
- MRGWA – Cochiti to El. Butte Dam
- SSPA – Otowi Gage to El. Butte Dam
- This study – Cochiti to El. Butte Dam
- Budgets do not coincide with Regional Plan boundaries



The Problem With Averaging - 1

- Previous budgets were based on averaging over long period of record. MRGWA – 25 yrs, SSPA – 50 yrs
- Problem with this approach:
 - What is representative period?
 - Difficult to identify long term trends in supply or use
 - Difficult to capture changes in use or management such as SJC diversion or Cochiti Reservoir
 - There is no such thing as an “average year”

The Problem With Averaging - 2



The Problem With Averaging – 3

(Highly stochastic system)

Location	Period of Record ¹	Average Annual Flow (kAF/yr)	Q ₁₀ ² (kAF/yr)	Q ₁₀ /Q _{avg}
Rio Grande near Cerro, NM	1949-2011	325.4	106	0.33
Rio Chama near Chamita, NM	1971-2011	413.2	214	0.52
Rio Grande at Otowi Bridge, NM ³	1940-2012	951.0	410.8	0.43
Rio Grande at Albuquerque, NM	1974-2011	944.9	436.5	0.46
Rio Grande below Elephant Butte Dam, NM	1917-2011	718.5	422	0.59

¹Period of record used in this analysis.

²Q₁₀ is annual low flow that has a 10% chance of occurrence.

³Flows at Otowi Bridge are the Rio Grande Compact Index Flows (i.e. doesn't include SJC water)

Tributary	Drainage Area (mi ²)	Q _{average} (kAF/yr)	Q ₁₀ (kAF/yr) ¹	Period of Record
Conejos River, CO	821	66.7	48	1953-2011 ²
Costillo Creek, CO	200	11.2	0.4	1966-2011
Red River, NM	185	56.7	33.7	1979-2011
Embudo Cr, NM	305	59.5	19.6	1924-2011
Rio Chama, NM	3,159	413.2	214	1971-2011
Galisteo Creek, NM	670	7.4	2	1942-1970
Jemez River, NM	1,038	43.1	13.9	1944-2011
SWRP - Albuquerque, NM ³		59.6		2002-2011
Rio Puerco, NM	6,057	28.9	8.5	1941-2011
Rio Salado, NM ¹	1,394	10	0.9	1948-1984

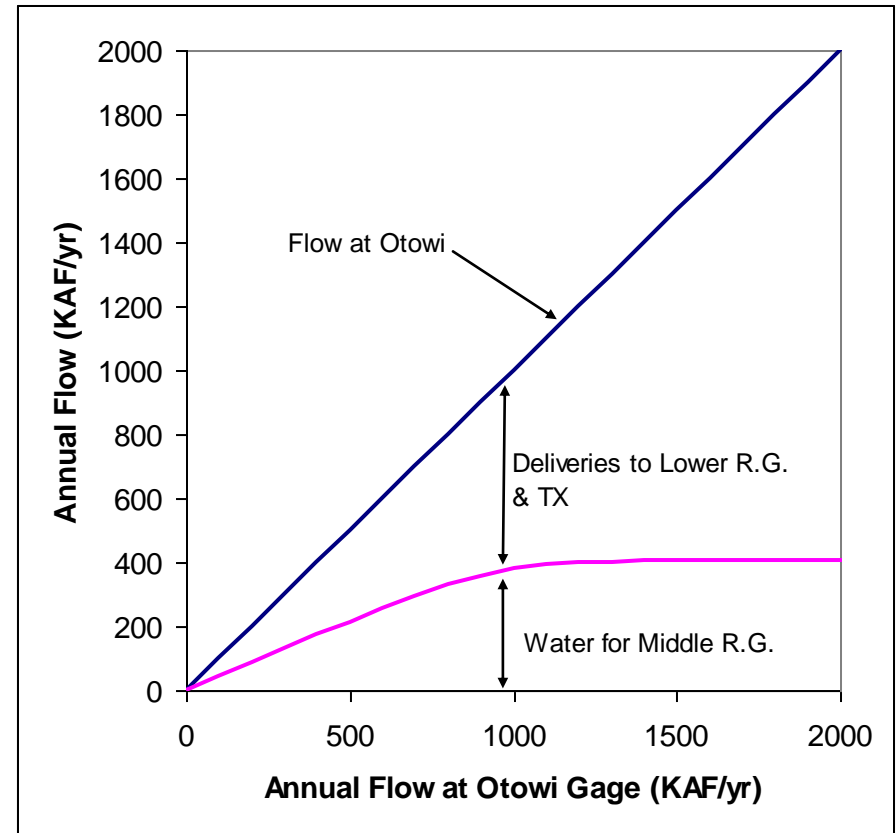
¹Q₁₀ is annual low flow that has a 10% chance of occurrence.

²Data from CO Dept. of Water Resources CONPLACO gage

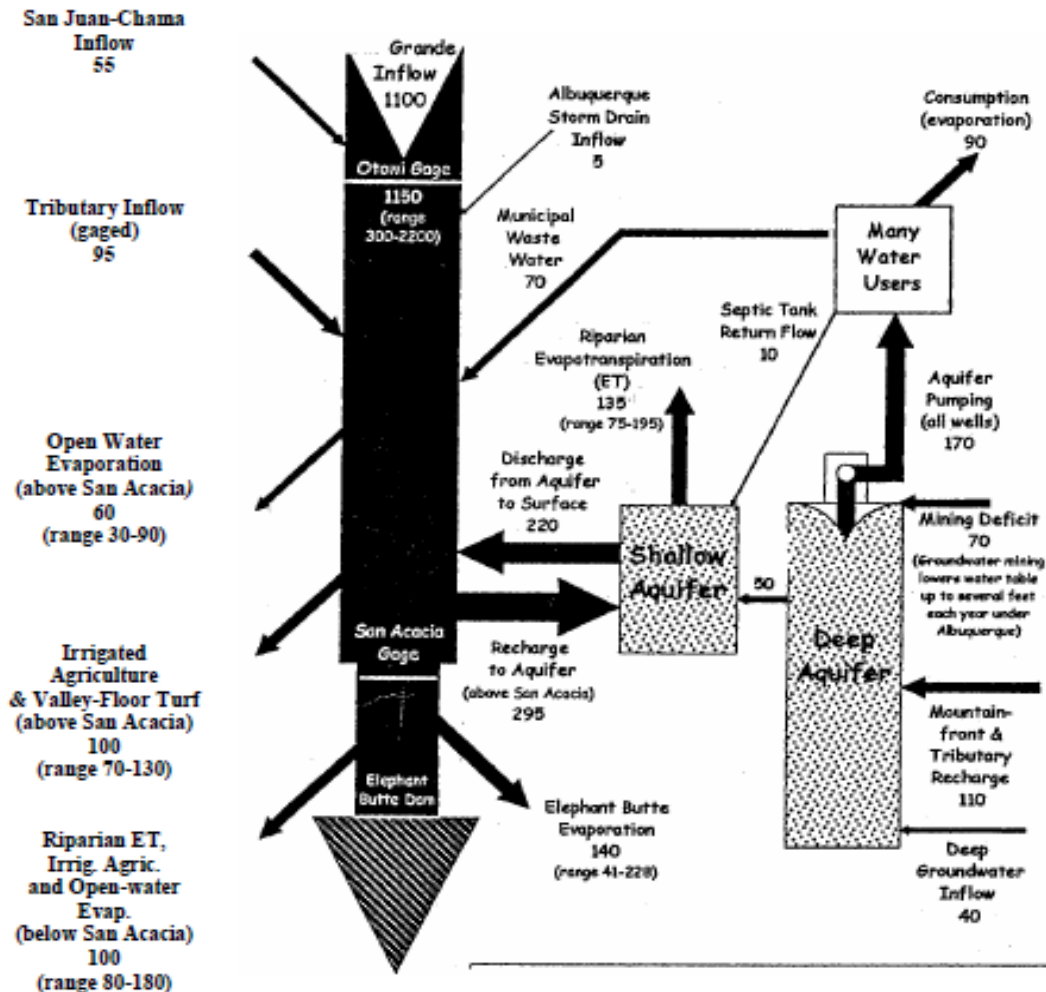
³Southside Water Reclamation Plant, Albuquerque, NM

Rio Grande Compact (1938)

- Establishes water allocations among CO, NM, TX
- Deliveries to Southern NM & TX depend on native flows at Otowi Gage (index flows)
 - Difference between Q_{Otowi} and $Q_{\text{El. Butte}}$ is water available to Middle Rio Grande



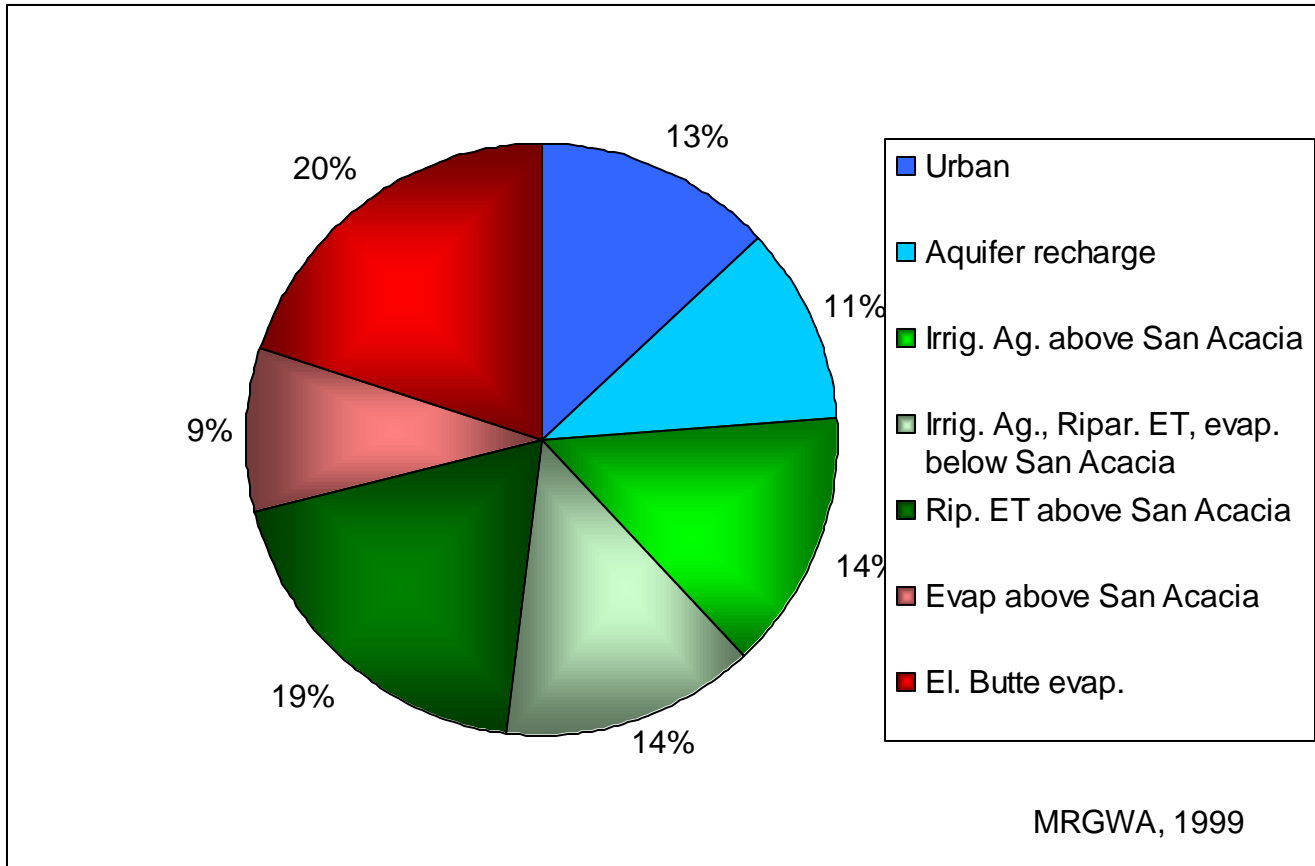
MRGWA Water Budget – Wiring Diagram



To Downstream Users
(range 300-1435)

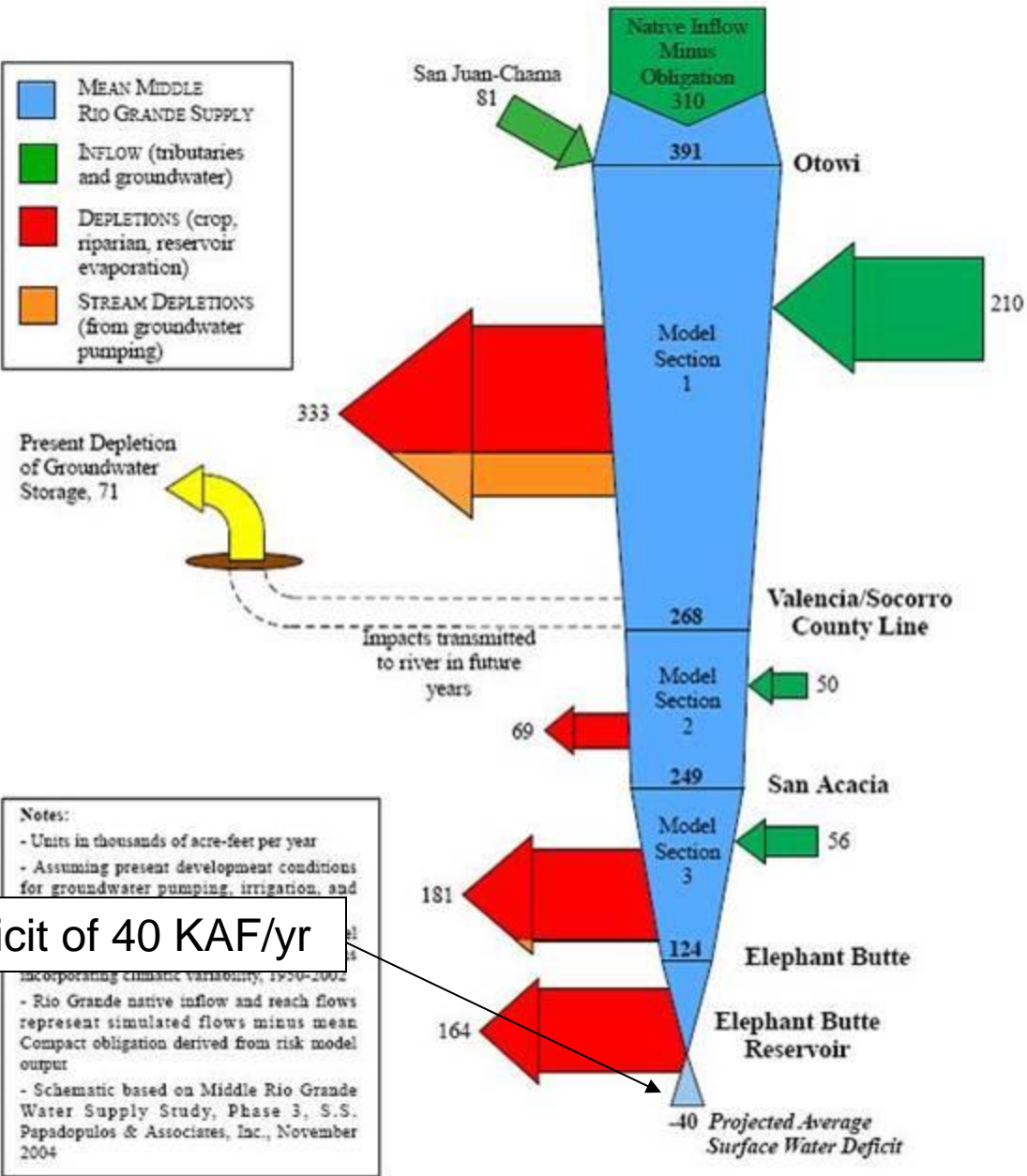
850 Water delivery calculated from this water-budget analysis
 729 Average of wet water deliveries 1972-1997 from Rio Grande Compact records
 786 Average deliveries mandated by the compact 1972-1997
 799 Average Elephant Butte effective supply (delivery plus change in storage)

MRGWA Water Budget – Depletions by Category



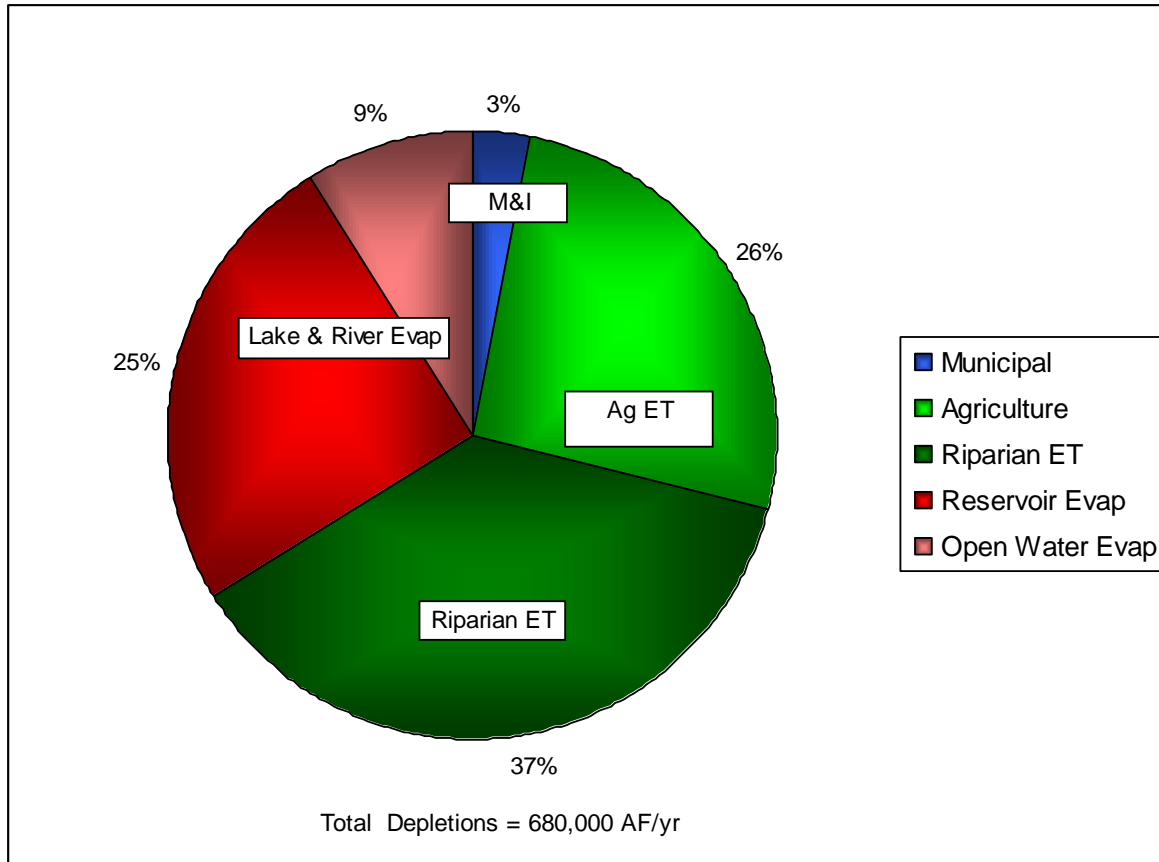
SSPA Water Budget by Proportional Flows

- Budget for avg. conditions in 2000



Annual deficit of 40 KAF/yr

SSPA Water Budget – Depletions by Category

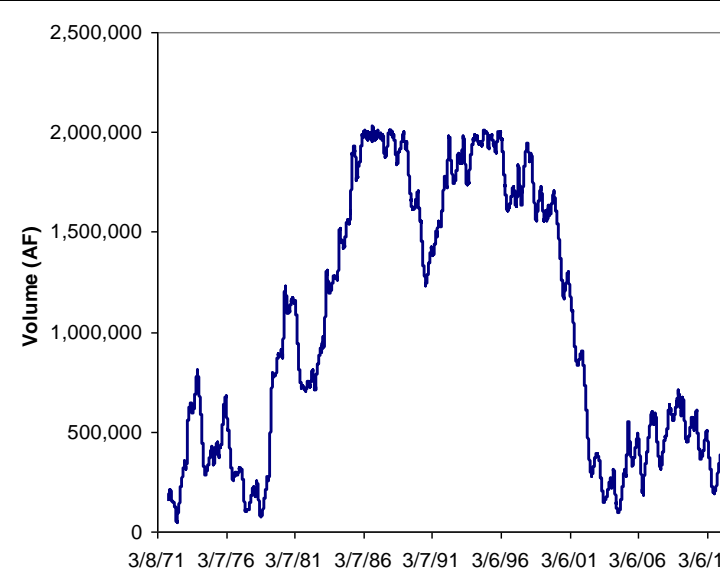


MRGWA 2014 Water Budget Update

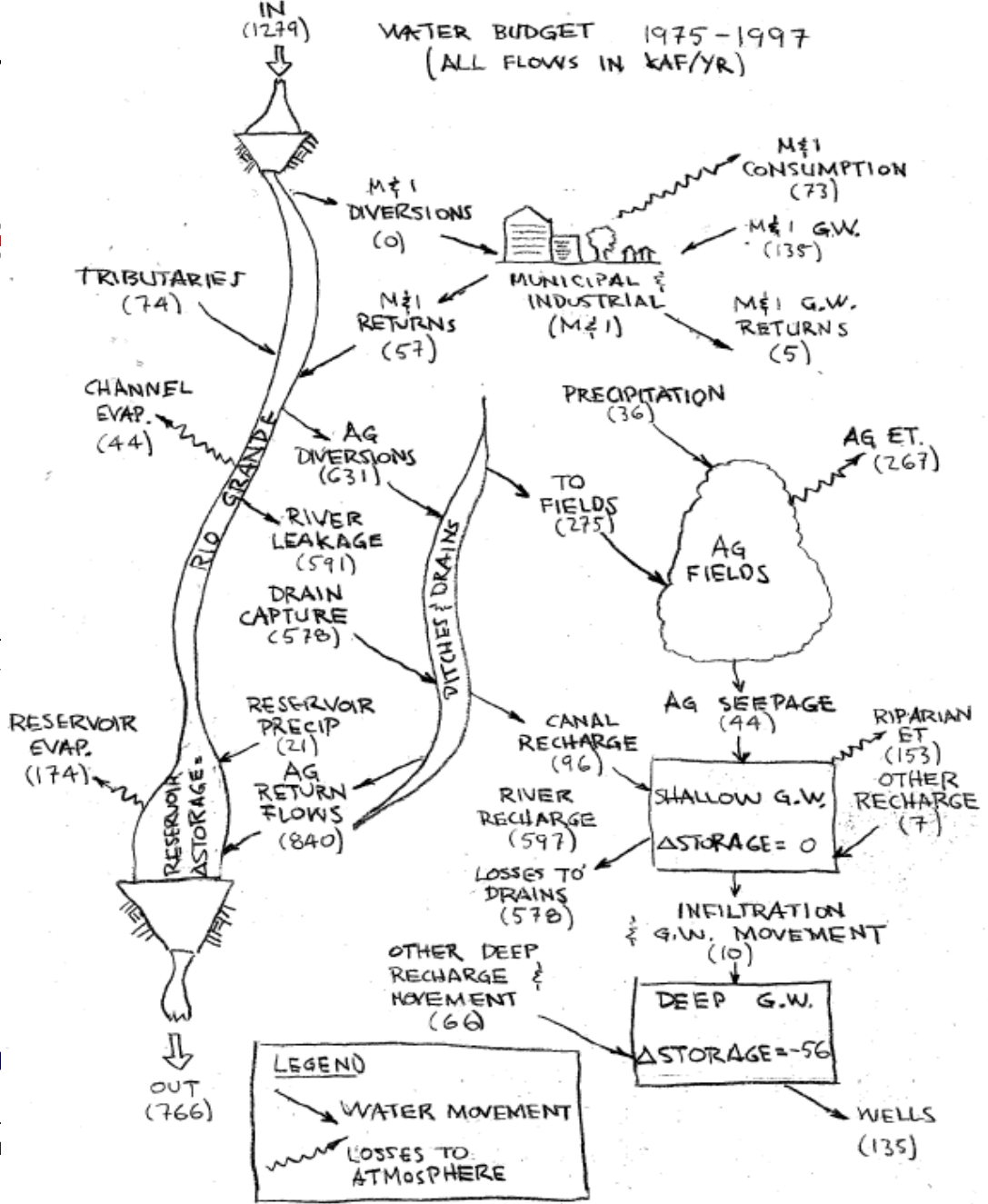
- Used URGSiM (USBOR 2013, Appendix E) – System dynamics model developed by SNL & Jesse Roach (TetraTech)
 - Used in this study for monthly accounting – not forecasting
 - Updated to include hydrologic information through 2012
 - Allows calculation of flows that are difficult/impossible to measure including: ET, ground water recharge, evaporation
- Considered 3 time frames:
 - 1975-1997 – similar to MRGWA (1999) budget
 - 2000-2012 –period that more closely resembles “average” precipitation & flows
 - 2008-2012 – includes changes due to: 1) ABCWUA SJC diversion, 2) record drought

MRGWA 2014 Water Budget (1975-1997 Data)

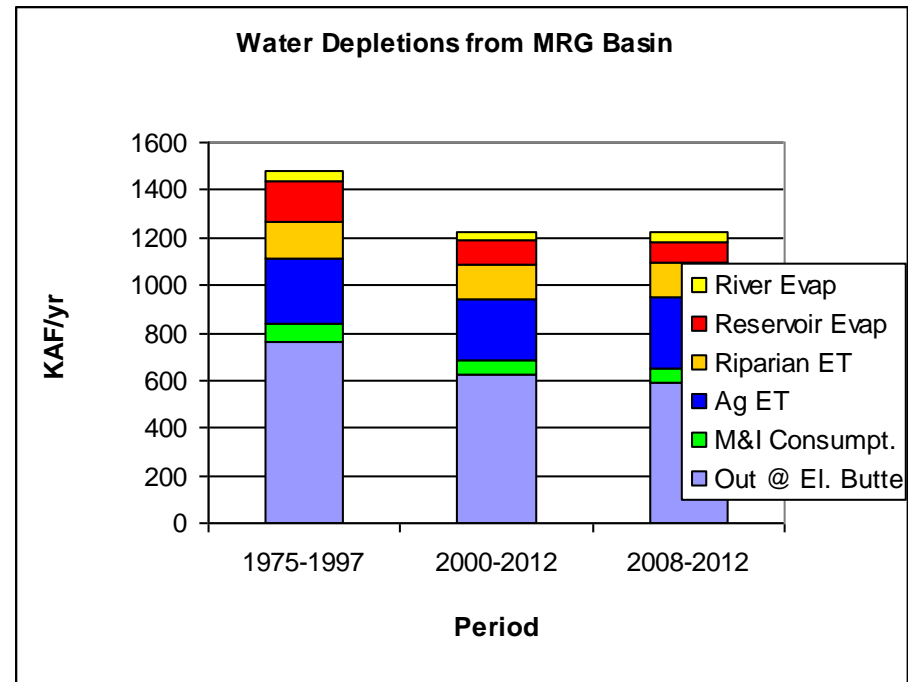
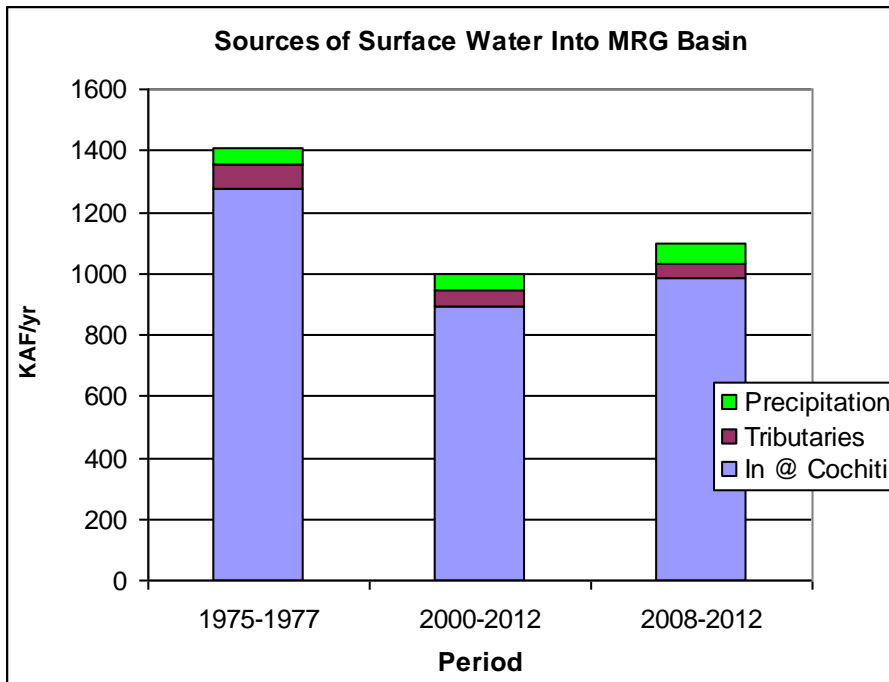
- Comparison to 1999 budget:
- In = 1,279 KAF/yr vs 1,100
- Out = 766 KAF/yr vs 792
- Improved spatial resolution
- Ann. increase of 12 KAF/yr



Elephant Butte Reservoir volume

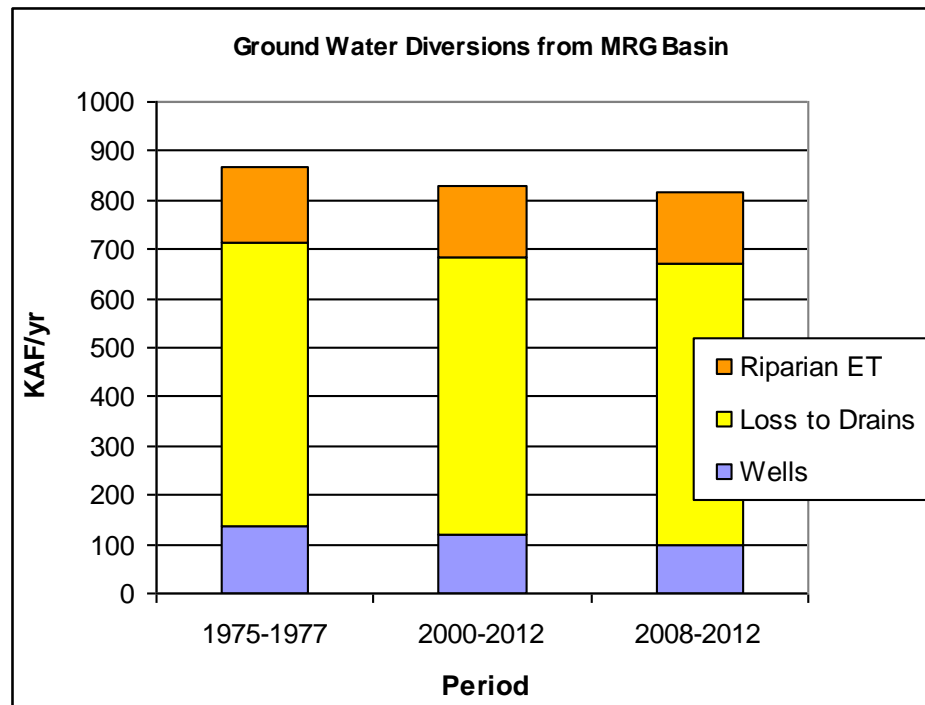
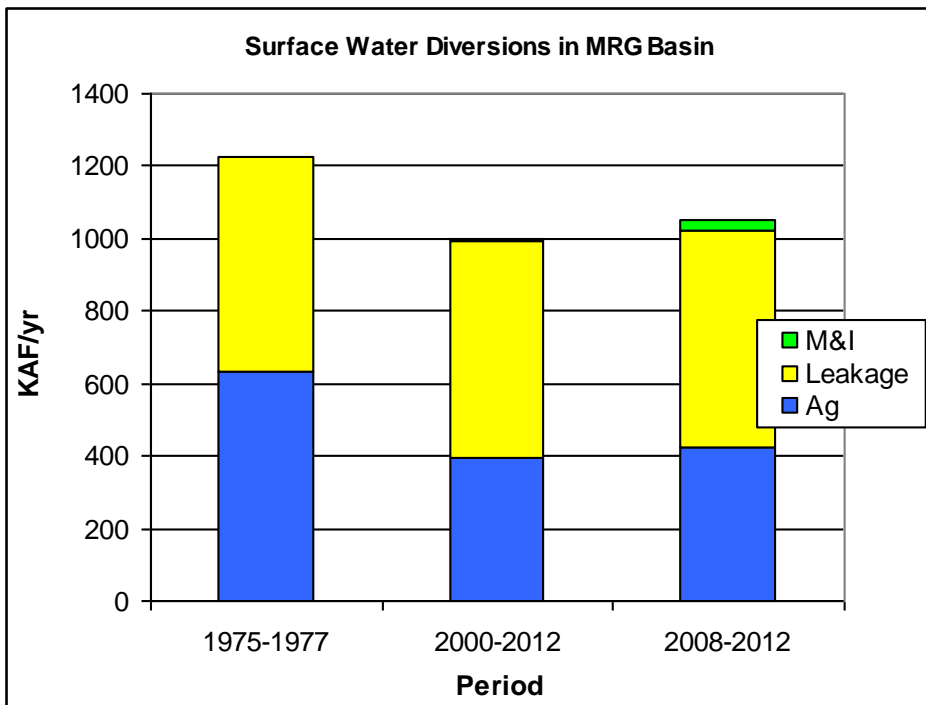


Changes Over 3 Budget Periods - 1



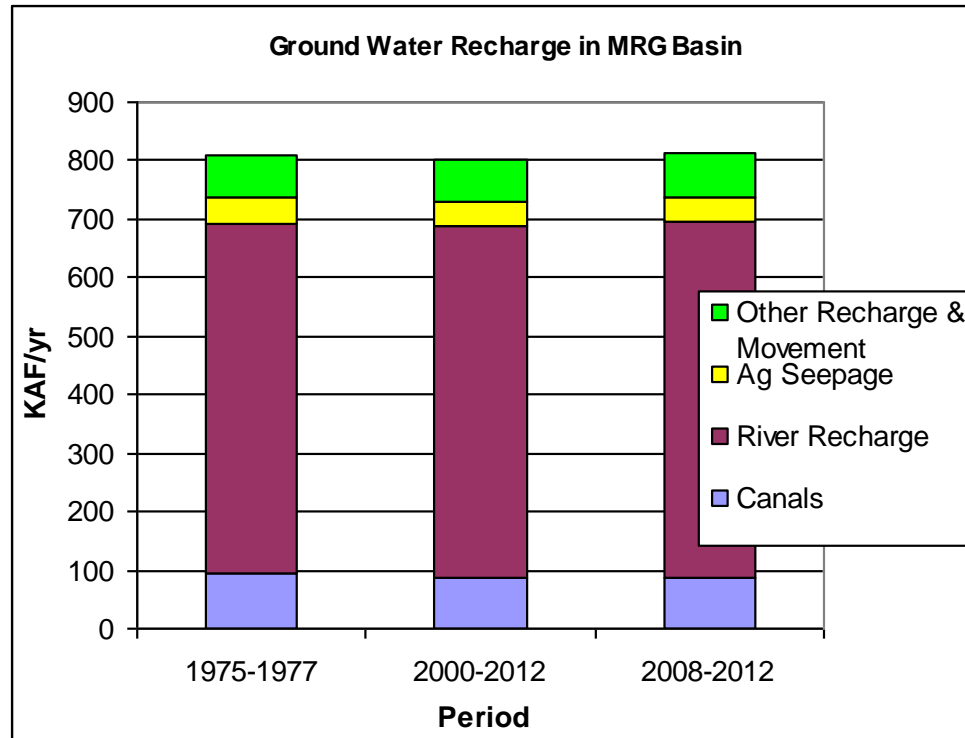
- Importance of river flow as source of supply
- Decreased inflows since 2000 due to drought
- Decreased outflows since 2000 due to reduced Compact deliveries

Changes Over 3 Budget Periods - 2



- Surface water diversion by ABCWUA began 12/08
- Decreased ground water pumping by ABCWUA

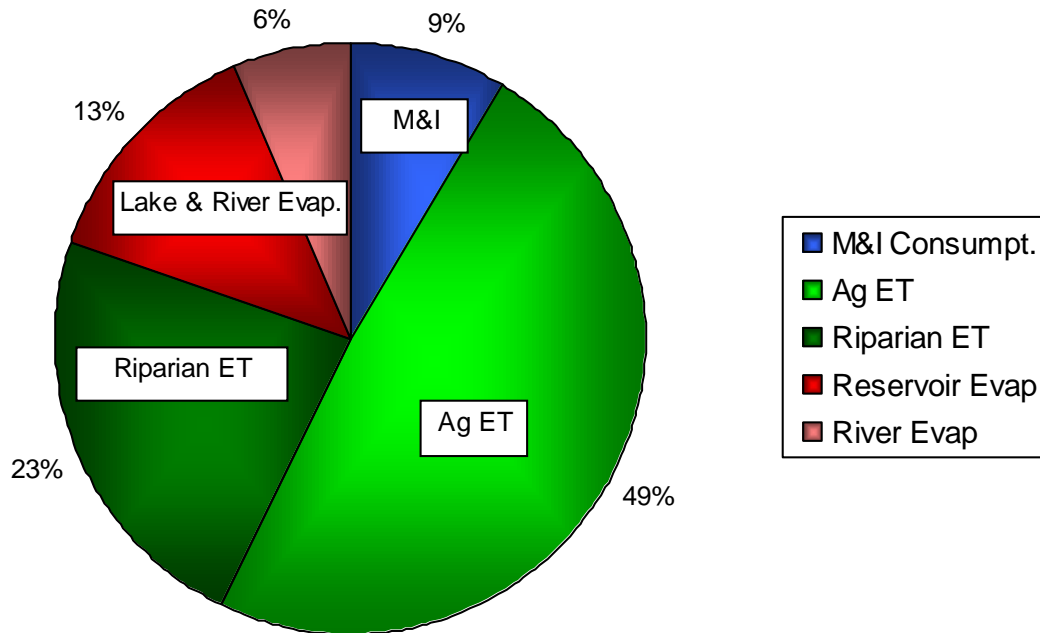
Changes Over 3 Budget Periods - 3



- Little change in ground water recharge

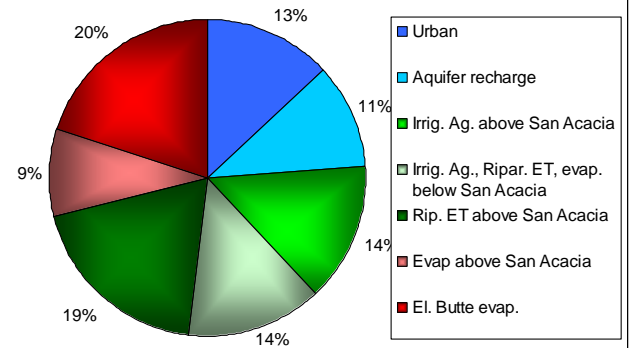
Distribution of Water Losses from MRG Basin 2008-2012

MRGWA Depletions 2008-2012



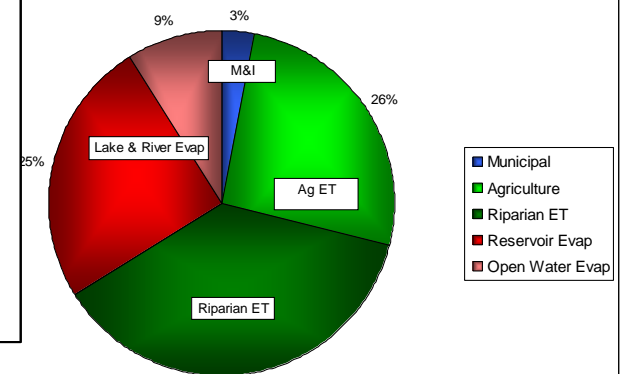
Total Losses = 628,000 AF/yr

MRGWA Depletions 1972-1997



MRGWA, 1999

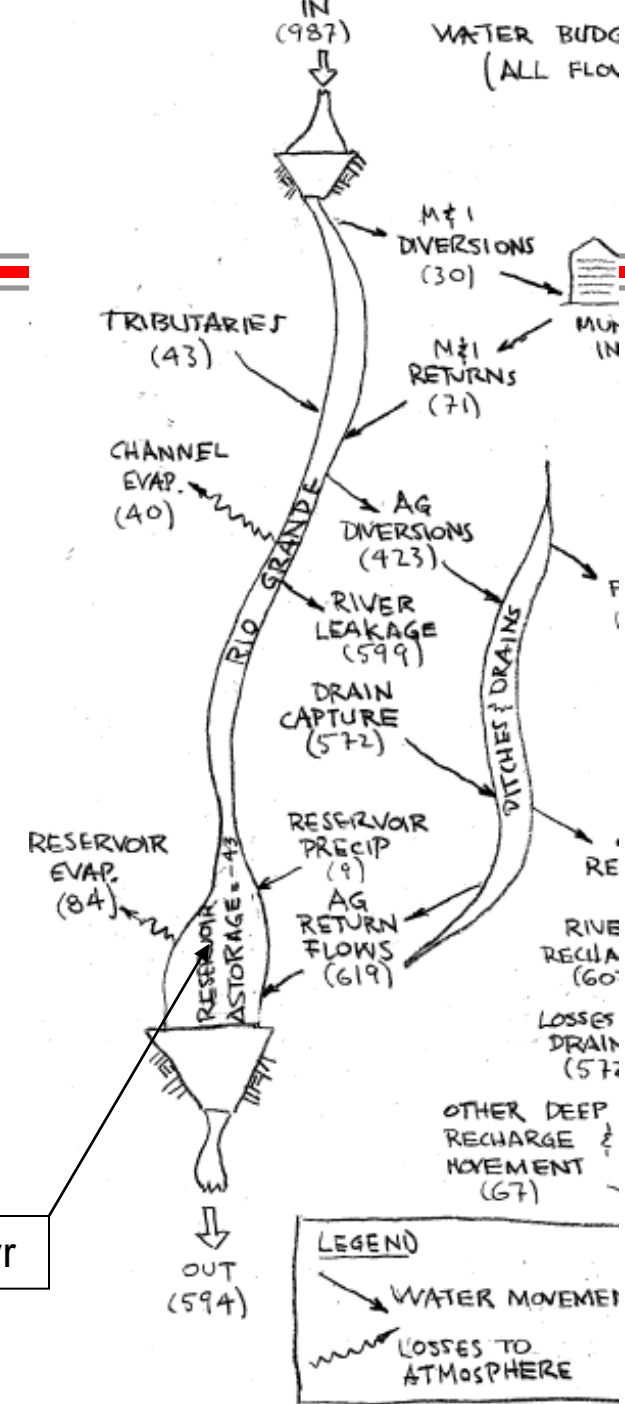
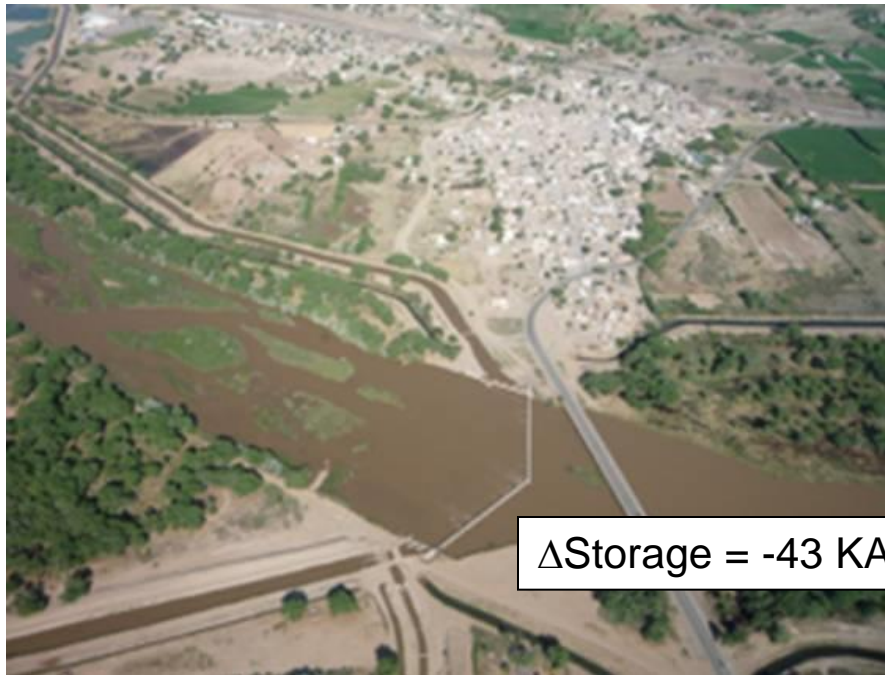
SSPA Distribution for 2000



Total Depletions = 680,000 AF/yr

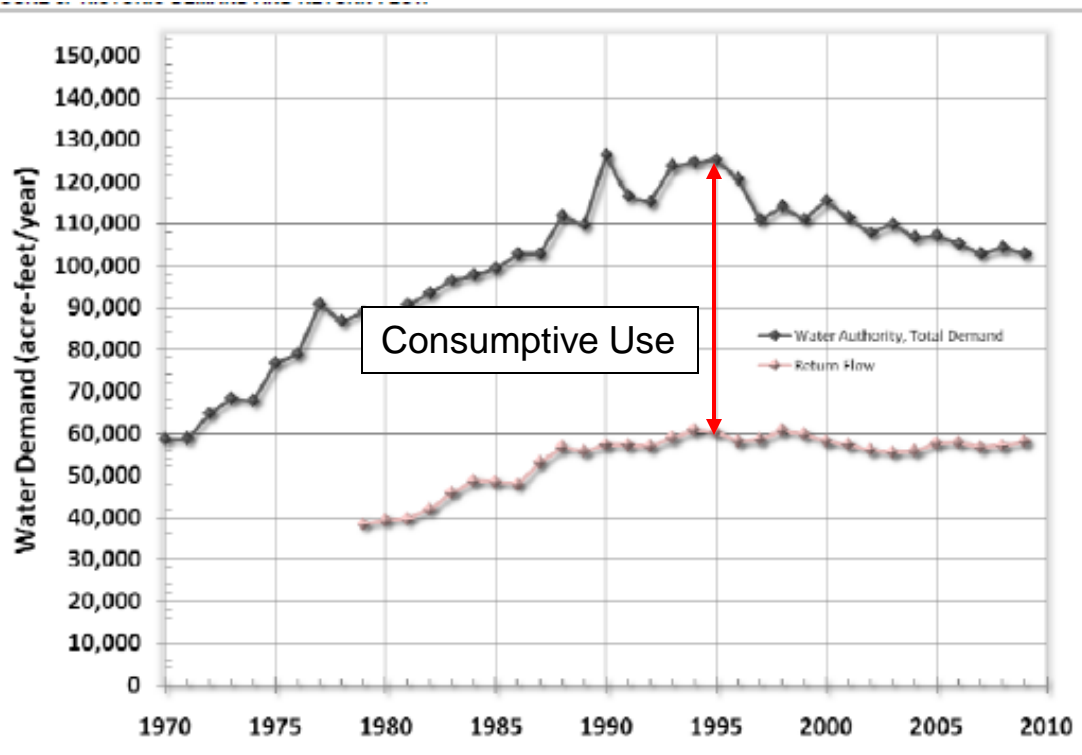
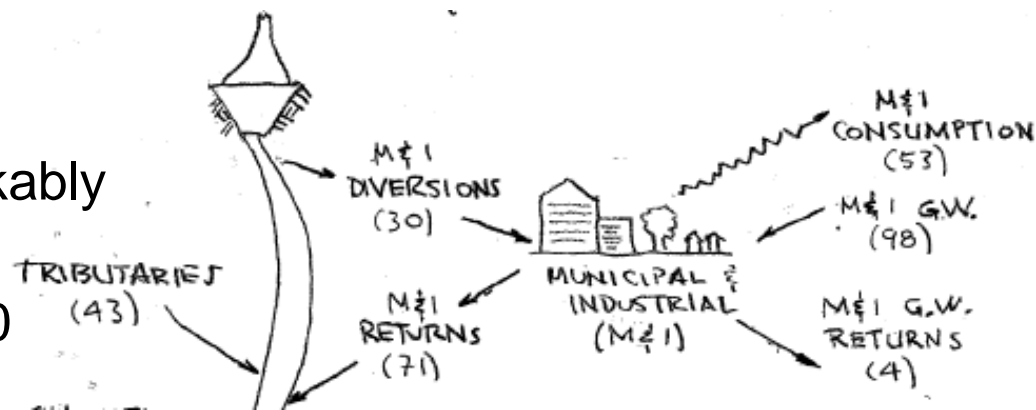
2008-2012 Details: The River

- Diminished inflows & outflows
- Large open water evap. losses (124 KAF/yr)
- Large diversions for ag (423 KAF/yr)
- Large river leakage (599 KAF/yr), mainly to drains
- El. Butte lost ~200 KAF during this period



2008-2012 Details: Municipal & Industrial Use

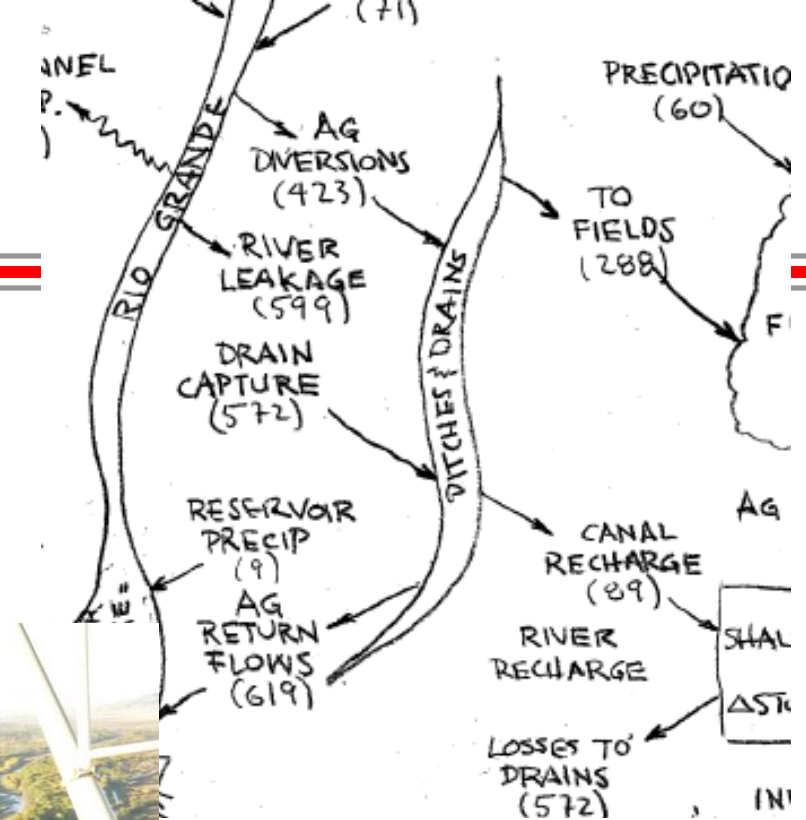
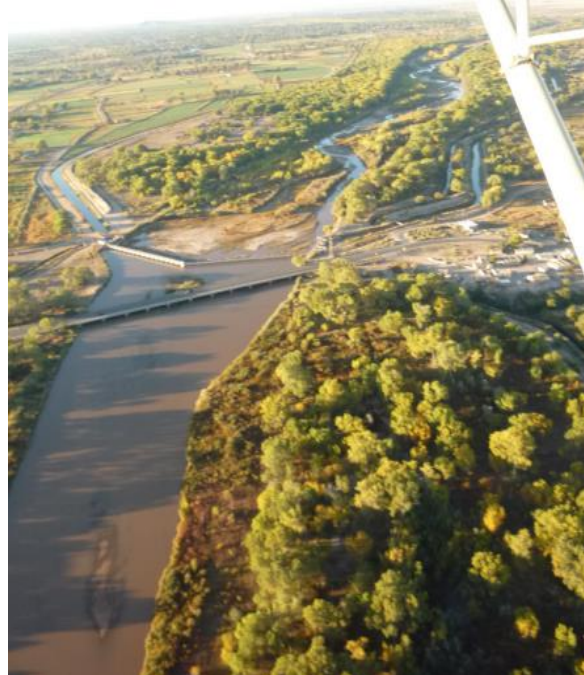
- Conservation has been remarkably successful
 - ABCWUA reduced use >10 KAF/yr



2008-2012 Details: Ditches & Drains

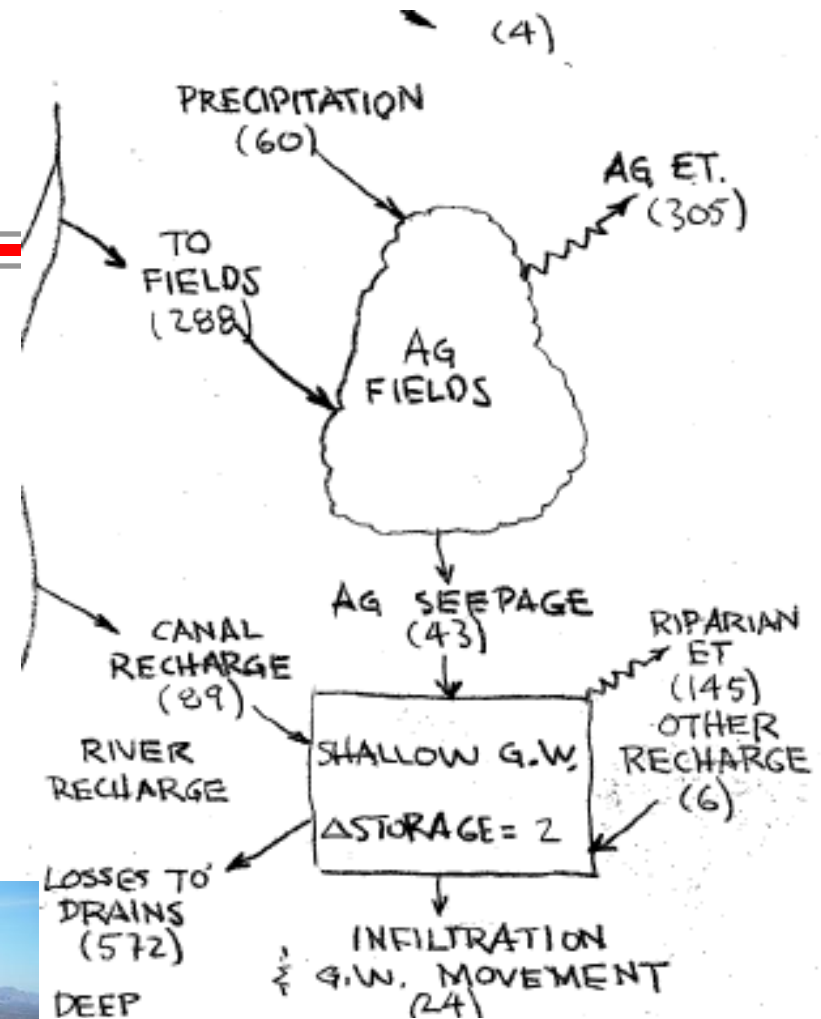
- Drain purpose – lower water table to prevent water logged soils & subsequent salinization
- Drains capture river leakage & ag return flows:

$$Q_{\text{Return Flow}} \sim Q_{\text{El. Butte}}$$



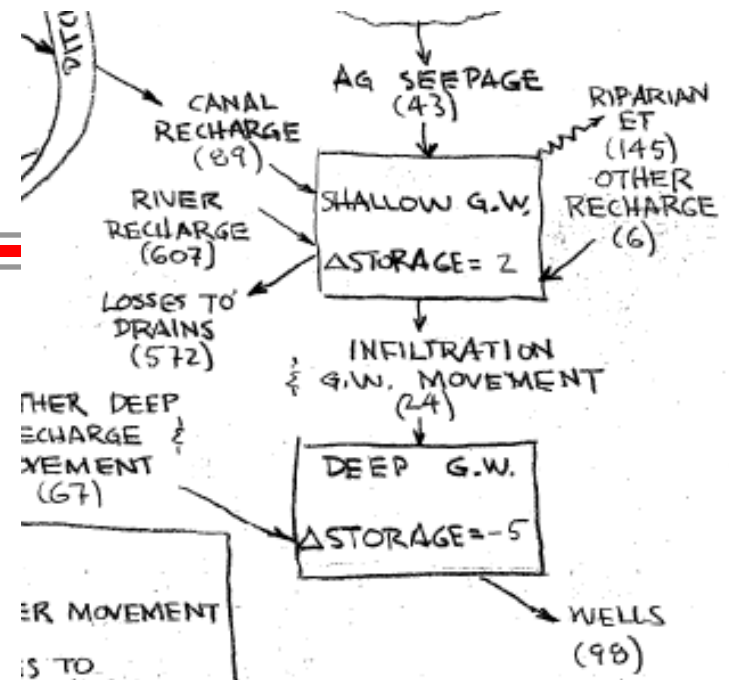
2008-2012 Details: Ag & Shallow Ground Water

- ET found by calculation & has large uncertainty
- Net depletion from ag ET ~240 KAF/yr (Total ET – precip)
 - Some experts think it's too high
- Depletion from riparian ET ~145 KAF/yr
 - Some experts think it's too low

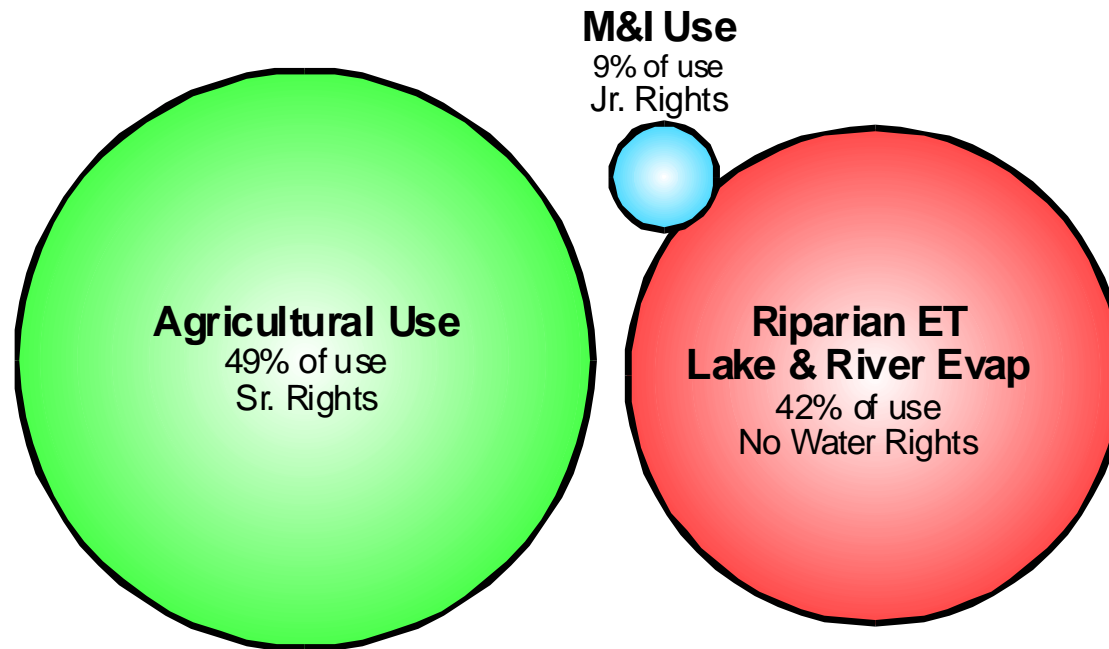


2008-2012 Details: Ground Water

- Most recharge is to shallow aquifer from the river
- The shallow aquifer subsequently returns most of its water to drains
- Conservation & SJC project have reduced G.W. mining to 5 KAF/yr from 56 KAF/yr over 1975-1997 period



The Problem As A Venn Diagram

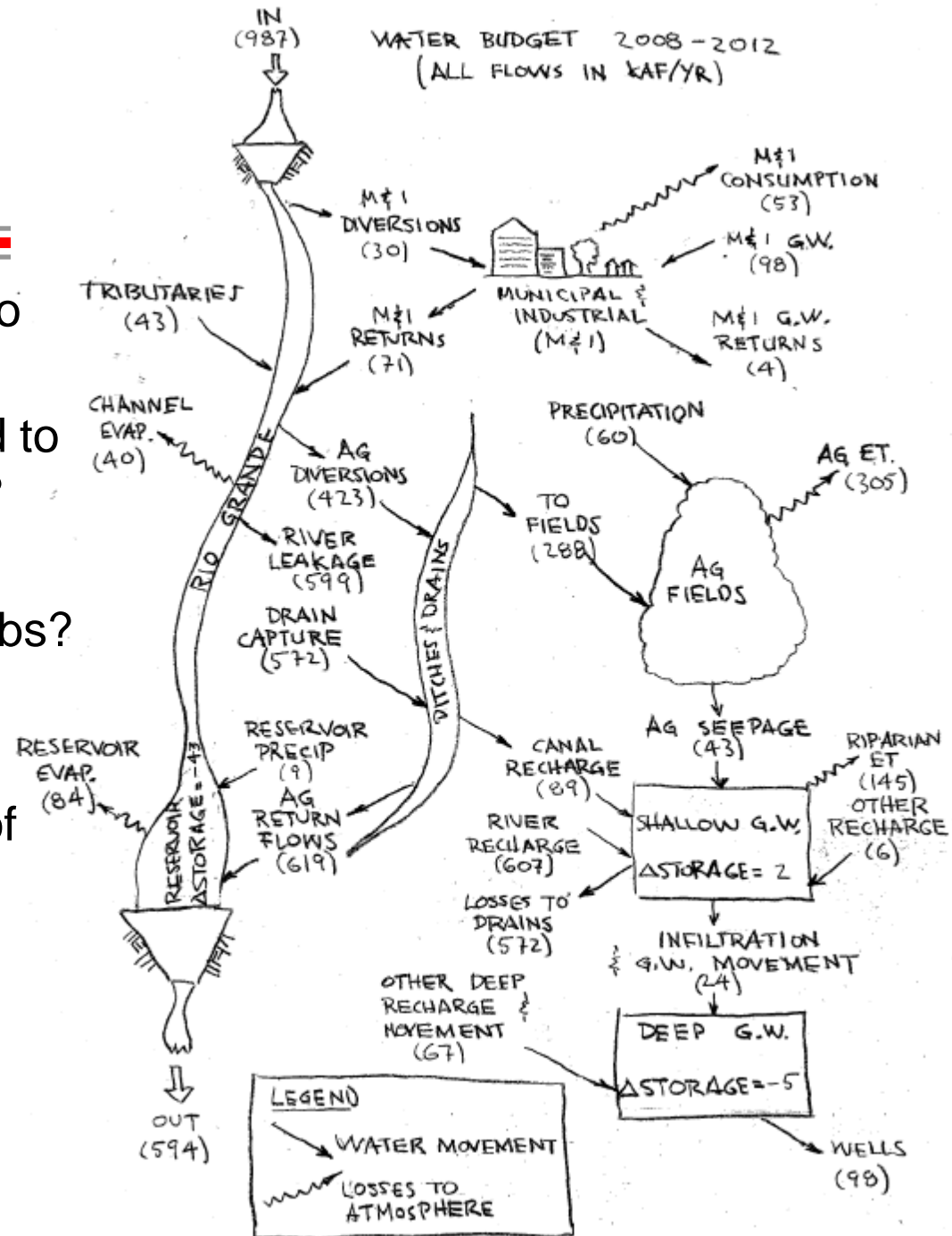


Diameters are proportional to % depletion

The interests of Middle Rio Grande Basin water users largely do not overlap.

The Grand Challenge: 3 Questions

- What changes can be made to bring basin into balance?
 - What knobs can be turned to change consumptive use?
 - Now & for future
- Who has authority to turn knobs?
- What are the incentives to change water use?
 - What are consequences of not changing?



MRGWA Water Budget Task Force Members

- Bruce Thomson (Chair) – UNM
 - Jesse Roach – SNL/TetraTech
 - Dagmar Llewellyn – USBOR
 - Dave Jordan – Intera
 - Nabil Shafike – NM ISC
 - Elaine Hebard – MRGWA
-
- With input from John Fleck (Abq. Journal), Howard Passell (SNL), John Stomp (ABCWUA)