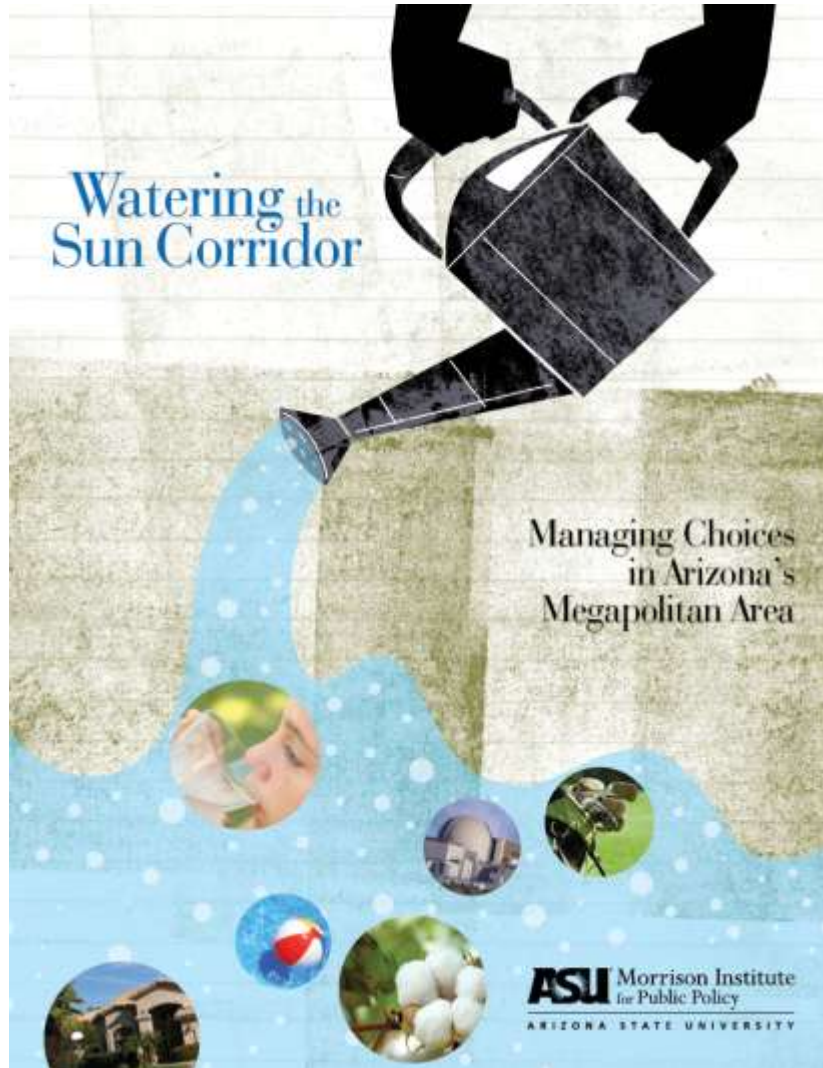


Watering the Sun Corridor

Managing Choices
in Arizona's
Megapolitan Area



ASU Morrison Institute
for Public Policy
ARIZONA STATE UNIVERSITY

Evaluating Sustainability of Projected Water Demands



'Water Scarcity a Bond Risk, Study Warns'

The New York Times

Water Scarcity a Bond Risk, Study Warns

By FLOTTY SCHNEIDER and EMMY S. HERNANDEZ October 22, 2014



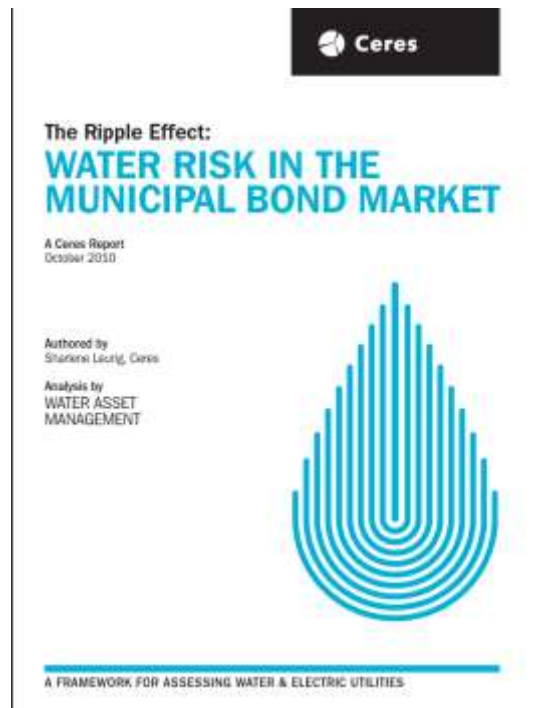
The Steady Lake Road, which supplies water to the Yavapai, stopped to be closed just after a tug on its north shore by the rocks.

The **municipal bonds** that help finance a major portion of the nation's water supply may be riskier than investors realize because their credit ratings do not adequately reflect the growing risks of water shortages and legal battles over water supplies, according to a new study.

As a result, investors may see their bonds drop in value when these risks become apparent, and water and electric utilities may find it more expensive to raise money to cope with supply problems, the study warned.

Looking at significant water bond issuers across the southern part of the country, the report concluded that VNE Street's rating agencies had given similar ratings to utilities with secure sources of water and to those whose water sources were dwindling or were threatened by legal battles with neighboring states.

Water Risk in the Municipal Bond Market



Population, Immigration, and the Drying of the American Southwest

Backgrounder

November 2010

Population, Immigration, and the Drying of the American Southwest

By Kathleen Porter

This Backgrounder offers an historical overview of the social causes of water in the American Southwest, where the water situation is becoming increasingly dire during a protracted — but not unprecedented — drought in the arid region. The two reasons for demographic trends that drive high rates of US and, it is noted, Southwest population growth, the greatest evidence that indicates there is significant stress for the region's most populated, arid, but the largest three population that will need of immigration systems of its present high rate.

Key findings include:

- The Southwest is the fastest growing region in the United States, the world's fourth fastest growing nation.
- The United States is one of the world's most populous nations, young China and India in the early 2000s will have more than 300 million people.
- Immigration is responsible for nearly all of the population growth in California. In other areas of the Southwest, immigration has slowed between 30 and 60 percent of population growth.
- Immigration has been responsible for more than half the population growth in the American Southwest in the decade.
- If current trends — especially immigration — continue, the US population could approach 500 million by mid-century, and new billions by the rest of the century or shortly thereafter. The United States is one of just eight nations that will hold half of all population growth through 2050, with more immigrants for the United States and for the global environment.
- This growth occurs despite the astronomical costs of two presidential administrations that the United States should have reduced population and immigration, leaving immigration to lay in their administrations.
- The nation's high growth rate has continued despite a roughly eightfold increase in birth rate since 1970.
- The Southwest has been hit by a protracted drought, although one of the less serious than other regions in the past. Global warming likely will worsen the frequency and severity of droughts.
- When the water crisis hit in the Southwest, the Colorado River, was divided up among the region's states under the 1922 Colorado River Compact, some water was apportioned from each state's rivers. These reserves have grown more with drought, which could worsen the stress with global warming.
- Reservoir "bank" the region's limited water supplies for use in drought. Lake Mead and Lake Powell — the Colorado River reservoir that are the main water holding reservoirs on which most of the Southwest is dependent — are rapidly drawing down their water potential and could use dry only the reserves.

Kathleen Porter is a former journalist and editor specializing in environmental and water issues and a life-long resident of the American Southwest, now living near Albuquerque.

The Last Drop: Climate Change and the Southwest Water Crisis



Frank Ackerman
Elizabeth A. Stanton
Stockholm Environment Institute-U.S. Center

February 2011

 **SEI** STOCKHOLM
ENVIRONMENT
INSTITUTE

'Water Use in the Southwest Heads for a Day of Reckoning'

The New York Times

Water Use in Southwest Heads for a Day of Reckoning

By MICHELLE KRAMER/AGENCE FRANCE PRESSE



The Southern Nevada Water Authority is monitoring water levels at Lake Mead in central Arizona, where that state's water supply is being cut off because of drought. (AP Photo/Chris Wedel)

LAKE MEAD NATIONAL RECREATION AREA, Nev. — A rare, unthinkable day is looming on the Colorado River.

Facing a sudden end to the Southwest's 22-year drought, the distribution of the river's dwindling bounty is likely to be reconsidered as early as next year because the flow of water cannot keep pace with the region's demands.

For the first time, federal estimates issued in August indicate that Lake Mead, the heart of the lower Colorado basin's water system — irrigating lettuce, citrus and wheat in reclamation corners of the Sonoran Desert, and tennis and golf courses from Las Vegas to Los Angeles — could drop below a crucial demarcation line of 1,075 feet.

If it does, that will set in motion a temporary distribution plan approved in 2007 by the seven states with claims to the river and by the federal Bureau of Reclamation, and water deliveries to Arizona and Nevada would be reduced.

Watering the Sun Corridor

Managing Choices in Arizona's Sun Corridor



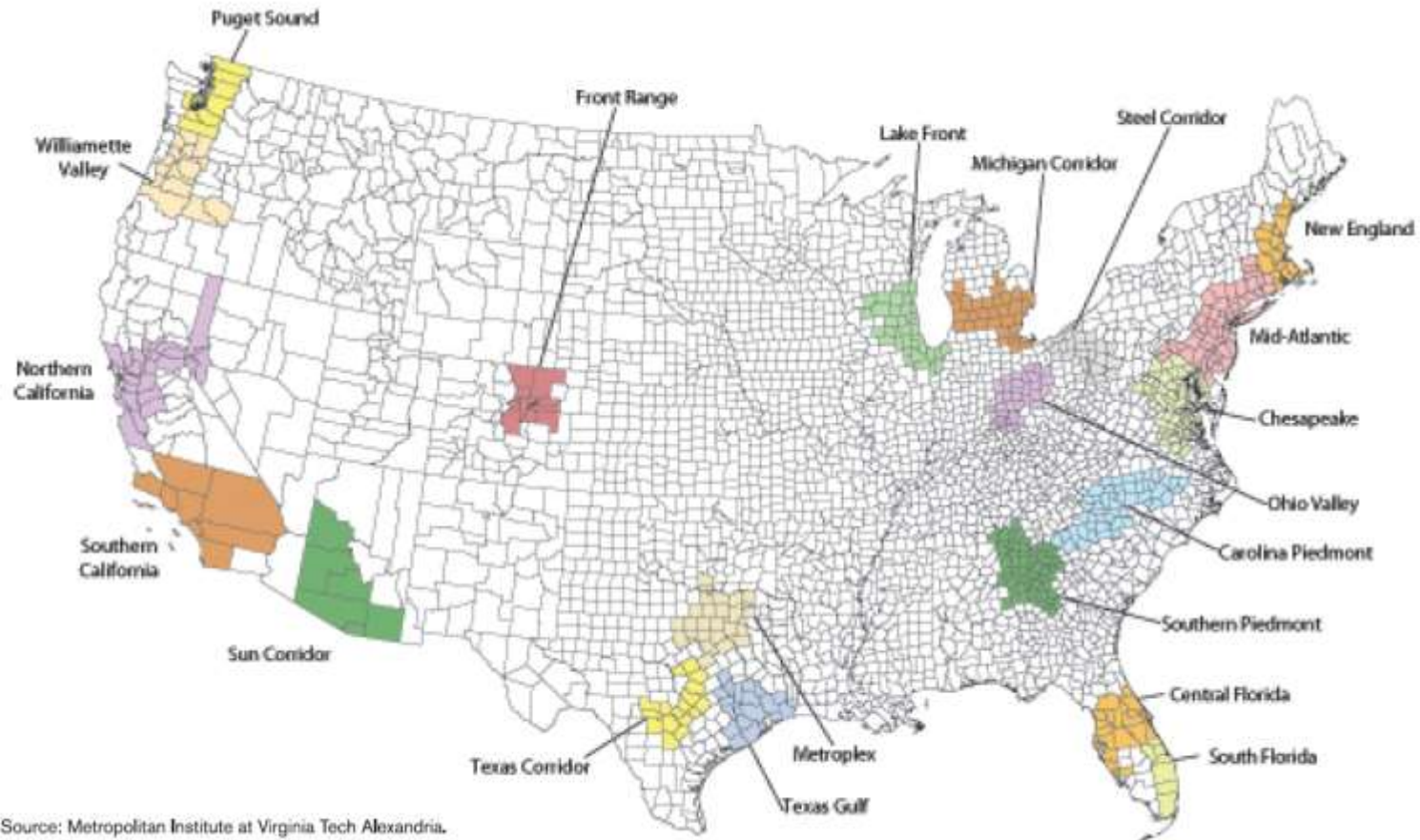
Megapolitan: Arizona's Sun Corridor



Watering the Sun Corridor

Managing Choices in Arizona's Sun Corridor

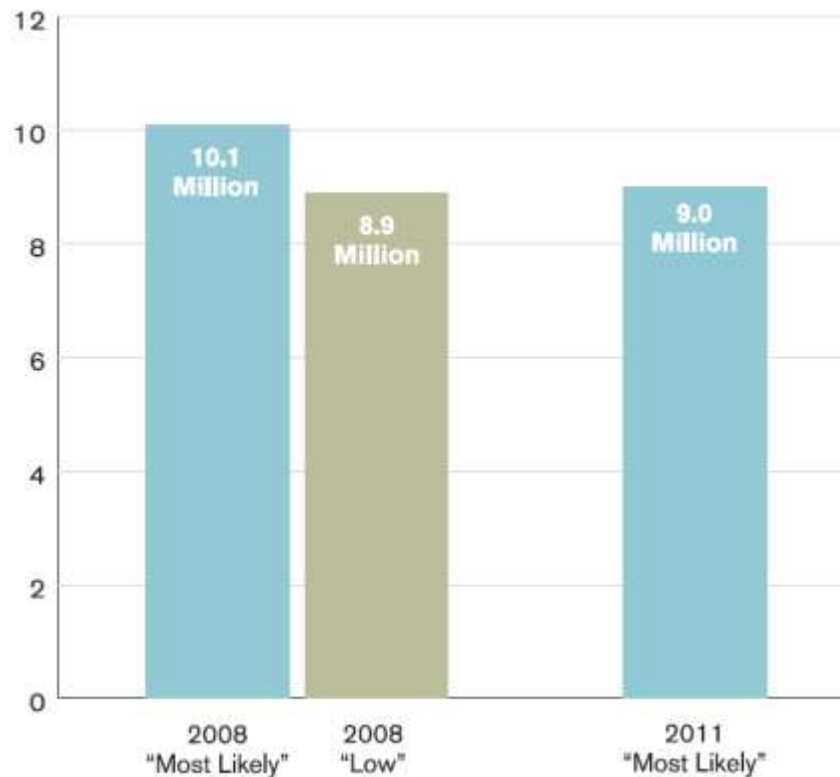
A Megapolitan is Taking Shape



Watering the Sun Corridor

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9 MILLION PERSON SUN CORRIDOR BY 2040 REMAINS MOST LIKELY POPULATION PROJECTION



Source: Morrison Institute for Public Policy, ASU.



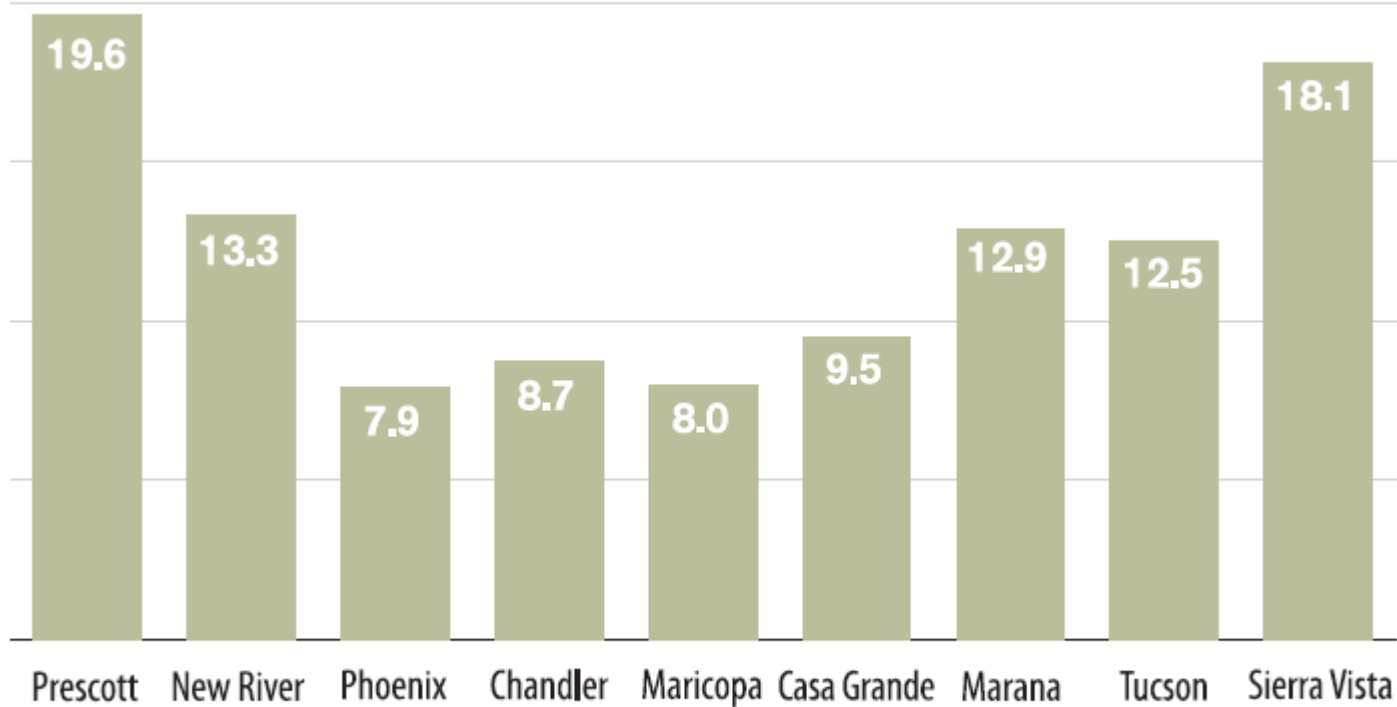
Sources of Water for the Sun Corridor

- A. Three Concepts: Supply, Stationarity and Variability
- B. The Water Sources
- C. Climate Change
- D. Future Water Supplies

Watering the Sun Corridor

Managing Choices in Arizona's Sun Corridor

AVERAGE ANNUAL RAINFALL IN INCHES



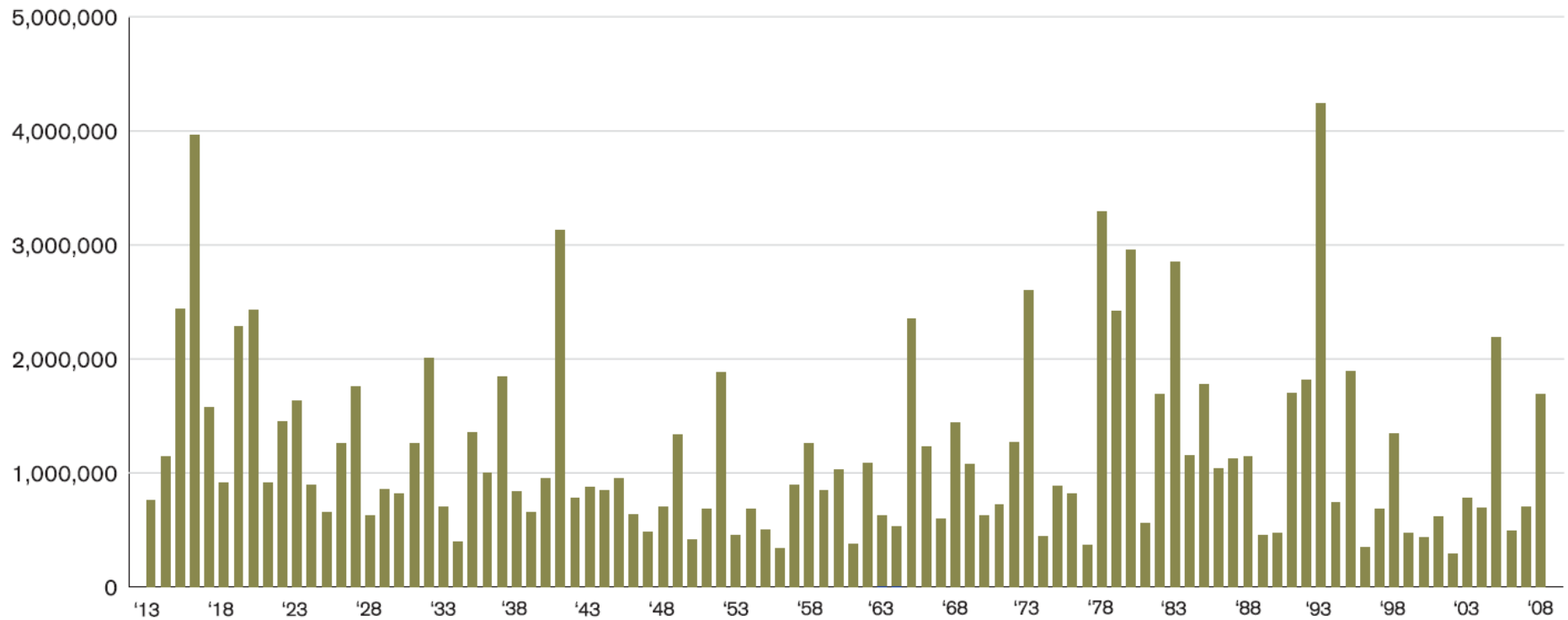
Source: Federal Research Division, Library of Congress, Country Studies-Arizona Weather.

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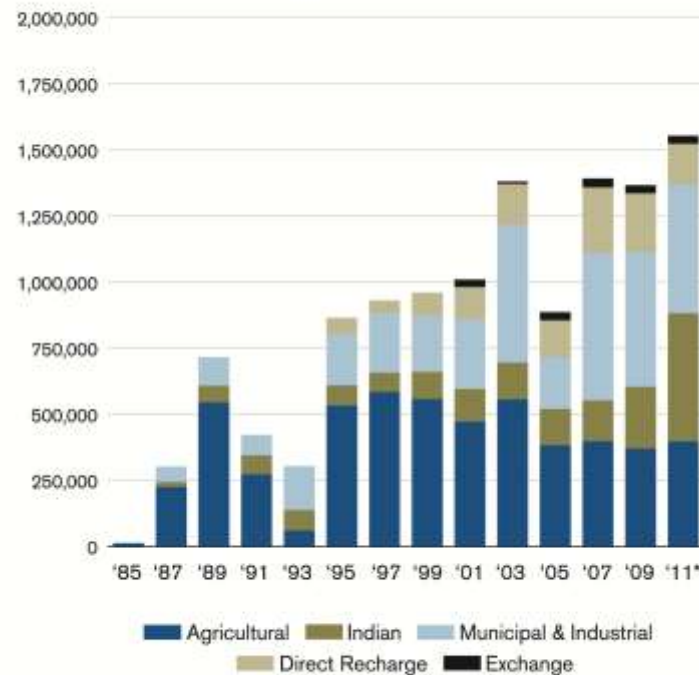
SALT RIVER, TONTO CREEK, AND VERDE RIVER COMBINED ANNUAL INFLOW, IN ACRE FEET 1913-2008



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**CAP DELIVERIES BY END USER
IN VOLUME OF ACRE FEET, 1985-2011**



* Forecasted.

Source: Central Arizona Project.

Summary of Existing Sun Corridor Supplies

Salt/Verde	800,000 Average Af/Yr
Other Surface Water	250,000 Average Af/Yr
Natural Groundwater Recharge	260,000 Average Af/Yr
Colorado River	1,500,000 Af/Yr
TOTAL	2,810,000 Average Af/Yr

What about Climate Change?

- NOAA estimate: 10-20% reduction in rainfall
- BOR projection for Colorado River: 9% decline by mid century

15% reduction here: cuts 2.8 MAF annual “supply” inputs
to 2.4 MAF



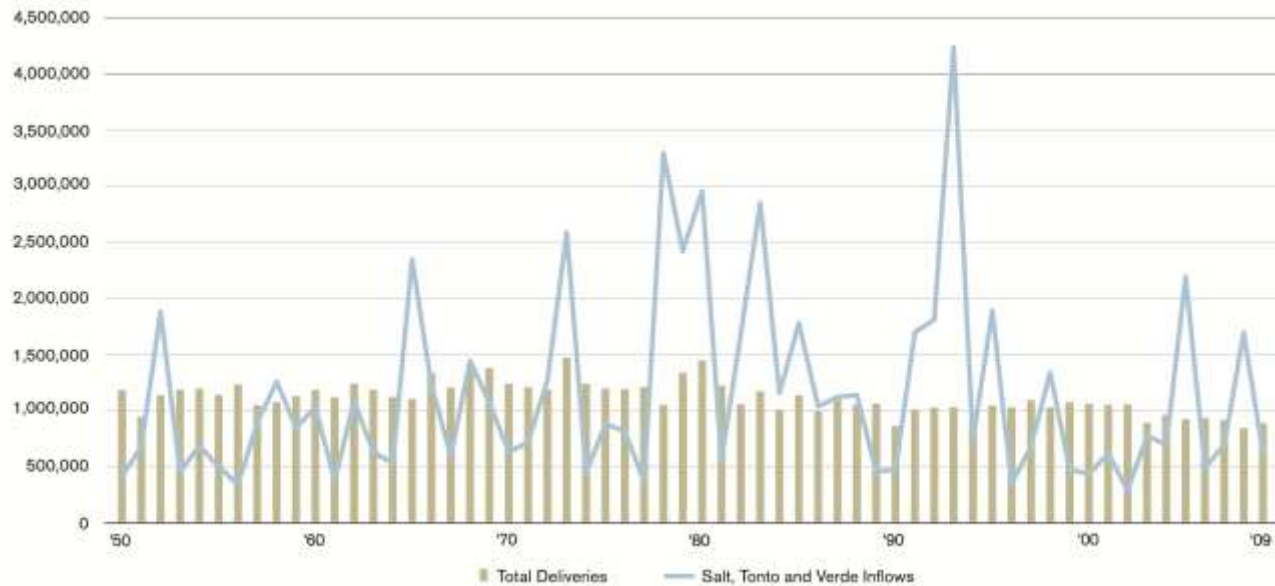
Managing a Desert Water Supply: From Variable to Reliable

- A. Salt River Project
- B. Central Arizona Project
- C. Managing Groundwater
- D. Reclaimed Water
- E. Conclusions on Supply and Reliability

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Managing Choices in Arizona's Sun Corridor

SRP DELIVERIES FROM COMPLETION OF HORSESHOE DAM THROUGH THE PRESENT

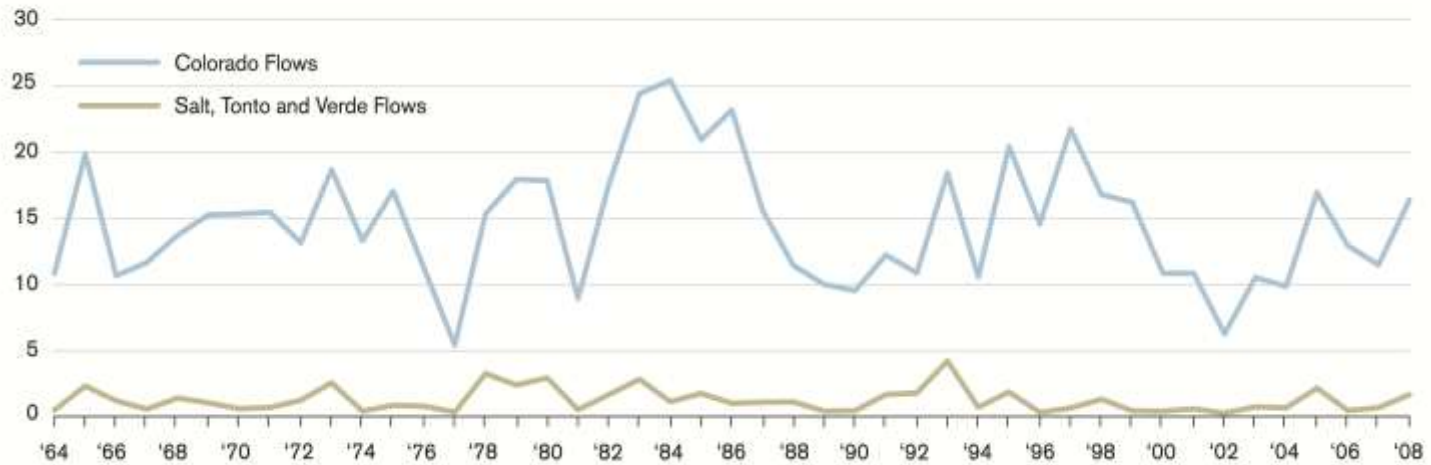


Source: Salt River Project.

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Managing Choices in Arizona's Sun Corridor

COLORADO AND SALT, TONTO AND VERDE FLOWS, IN MILLION ACRE FEET



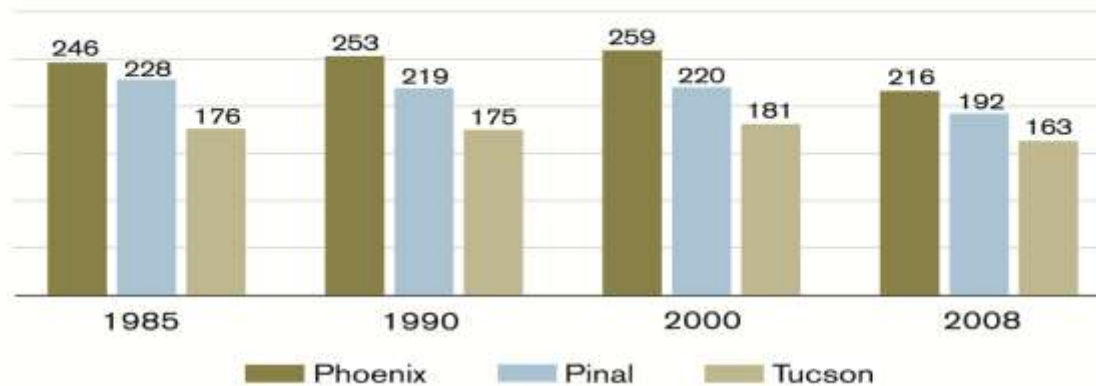
Demand: Where Does the Water Go?

- A. Urban Water Use
- B. Agriculture
- C. Price and Conservation
- D. The Natural Environment

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Managing Choices in Arizona's Sun Corridor

**GALLONS PER CAPITA PER DAY RATES
FOR CENTRAL ARIZONA AMAS**

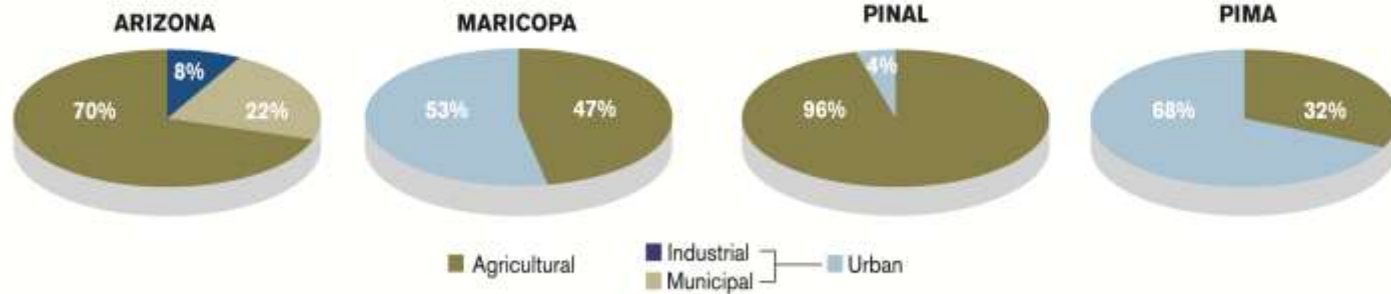


Source: ADWR.

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WATER USE PROFILES FOR ARIZONA AND THREE COUNTIES

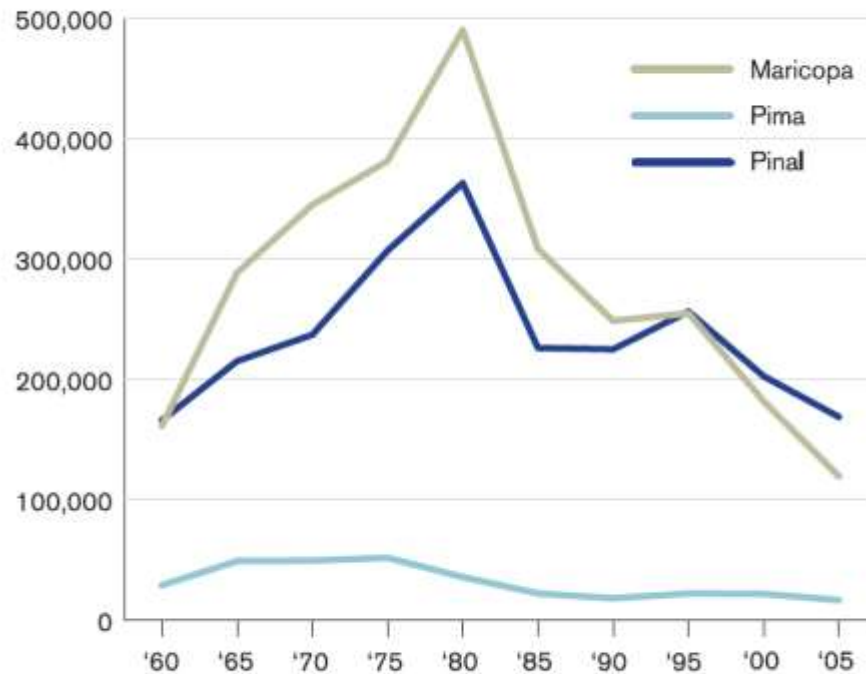


Source: *Arizona Water Atlas*, Vol. 8 (2010), Arizona Department of Water Resources.

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Managing Choices in Arizona's Sun Corridor

TOTAL NUMBER OF ACRES PLANTED FOR ALL AGRICULTURAL PURPOSES BY COUNTY

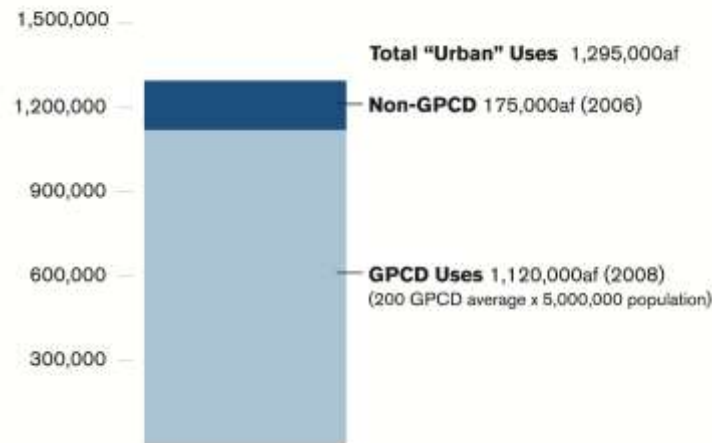


Source: Morrison Institute for Public Policy, ASU; data from the U.S. Department of Agriculture, National Agriculture Statistics Service, 2007.

Watering the Sun Corridor

Managing Choices in Arizona's Sun Corridor

CURRENT APPROXIMATE "URBAN" WATER USE IN THE SUN CORRIDOR

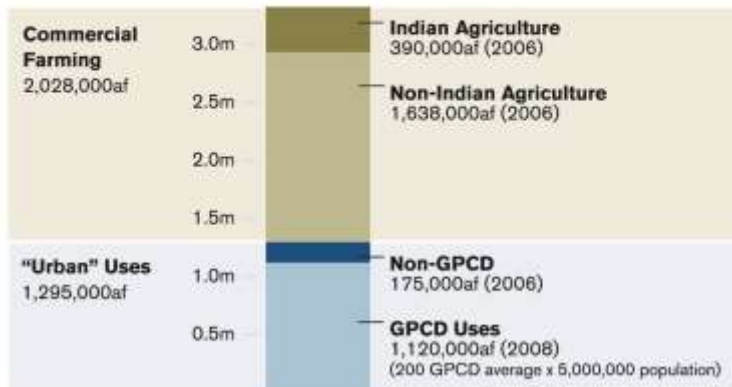


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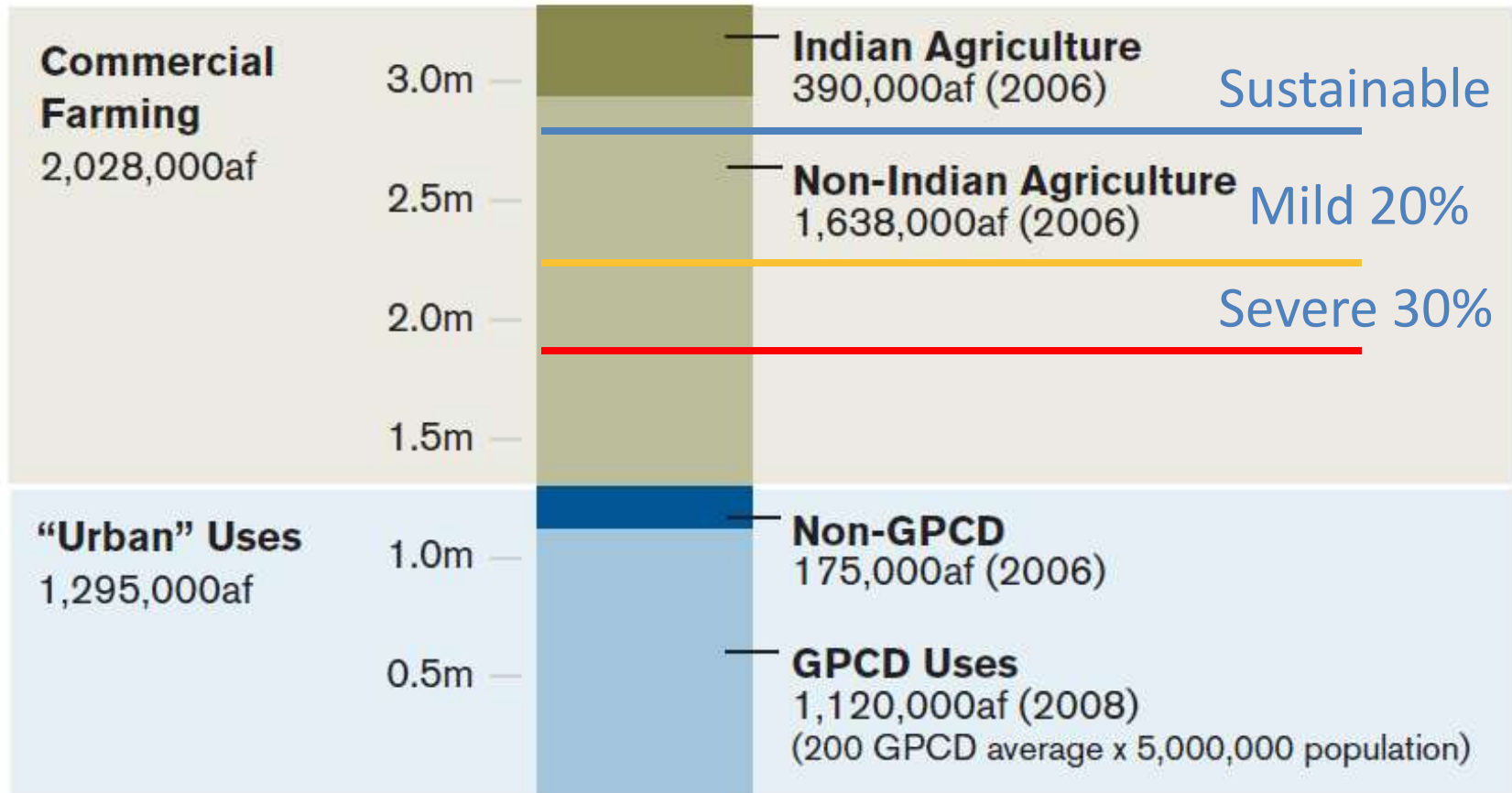


CURRENT APPROXIMATE TOTAL WATER USE IN THE SUN CORRIDOR



Water Supply	1,800,000af	2,000,000af	2,200,000af
Per Capita Use	Approximate Population		
200 GPCD (.22 af/yr)	8,182,000	9,100,000	10,000,000
150 GPCD (.17 af/yr)	10,588,000	11,765,000	12,941,000

CURRENT APPROXIMATE TOTAL WATER USE IN THE SUN CORRIDOR



Water Supply	1,800,000af	2,000,000af	2,200,000af
Per Capita Use	Approximate Population		
200 GPCD (.22 af/yr)	8,182,000	9,100,000	10,000,000
150 GPCD (.17 af/yr)	10,588,000	11,765,000	12,941,000

500,000 af for Agriculture (1/4 today's Water Use)

Water Supply	1,300,000 af	1,500,000 af	1,700,000 af
Per Capita Use	Approximate Population		
200 GPCD (.22 af/yr)	5,700,000	6,600,000	7,600,000
150 GPCD (.17 af/yr)	7,600,000	8,900,000	10,100,000

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The Dilemma of the Sun Corridor: How Should We Choose to Live?

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Managing Choices in Arizona's Sun Corridor

- 
- Where Should We Grow?
 - Density
 - Landscaping
 - The Lifestyle of Affluence
 - Agriculture
 - Aesthetics & Urban Environment
 - The Natural Environment