Rethinking the Contribution of Water Conservation

CWAG February 9, 2013
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Western Resource Advocates

WESTERN RESOURCE ADVOCATES

http://
www.westernresourceadvocates.org/

Western Resource Advocates

- Non-profit environmental law and policy organization dedicated to protecting the west's land, air, and water by progressing good policies from the beginning
- Smart Water
  - Urban water policy, conservation and reuse that considers current resources
  - Water conservation planning and technical assistance
    - San Pedro and Verde
  - Arizona studies;
    - Arizona Water Meter Report (2010)
      - Evaluated 15 utilities; promote conservation as a viable alternative; compare and recognize good programs (Prescott received highest score)
      - www.westernresources.org/azmeter
    - Domestic Well Study (2012)

Making a case for conservation

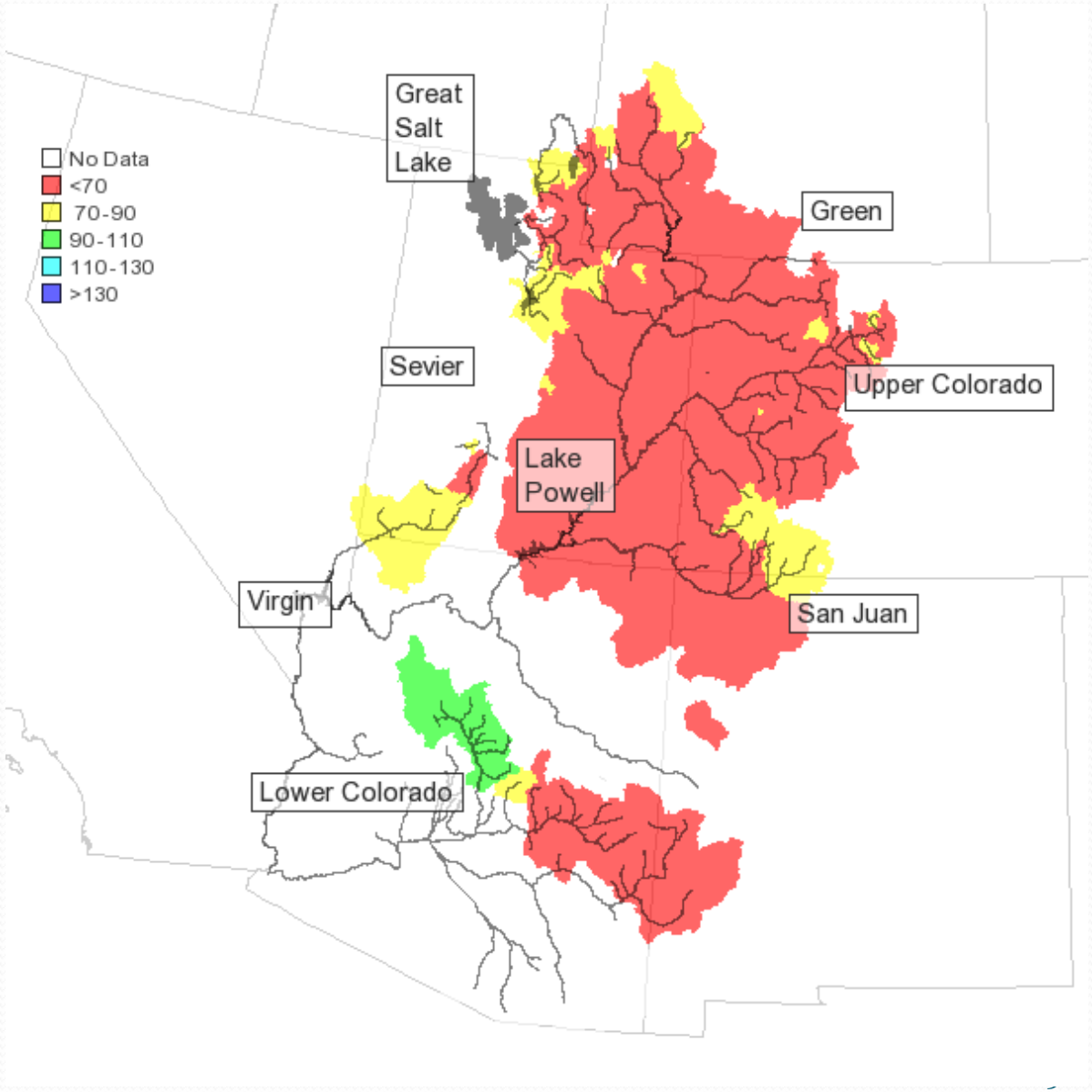
- No regrets strategy to decrease need for additional water supply; typically cheaper, faster, few legal issues, flexible
- Part of the solution – multiple strategies
- Sufficiently included in water resource planning?
  - History of engineering solutions
  - Uncertainty in participation, savings and funding
  - Can we continue to rely on "traditional" supplies?

Making a case for conservation

- Colorado River Water?
  - CYHWRMS – CR pipeline scenarios; significant legal, institutional and cost impediments
    - Leases and transfers expensive, uncertain and competitive
  - NIA (low priority) CAP reallocation – only 17,000 af/year allocated outside CAP service area but on average only 10,000 af/year and some years zero
  - Bureau of Reclamation Colorado River Basin Study scenario predicts 9% reduction in flows, 3.2 million acre-foot shortfall by 2060

Water Supply Outlook, February 1, 2013

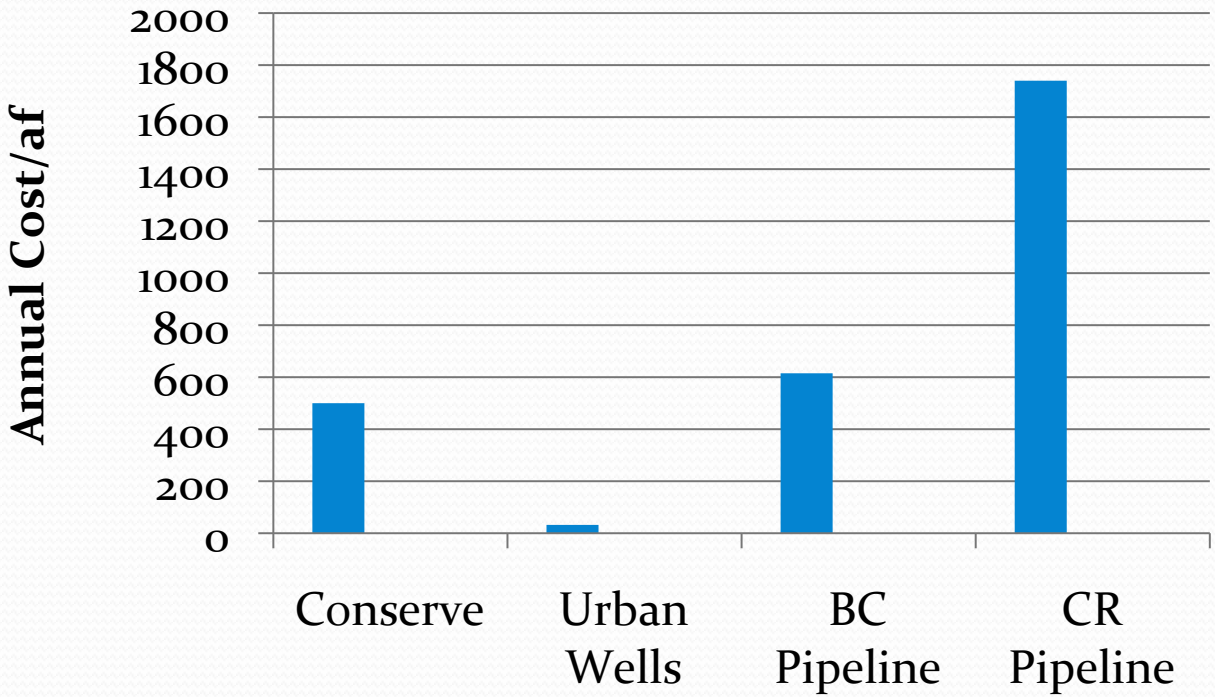
Colorado River Basin Forecast Center



Making a case for conservation

- Groundwater?
  - < 3 maf in storage in Prescott AMA; annual change in storage -11,600 acre-feet/year
  - Water levels declining in most measured wells (costs of deepening)
  - Diminished discharge to springs and streamflow and impacts to riparian communities
  - Aquifer compaction/loss of storage, land subsidence and earth fissuring

Conservation is Cheaper



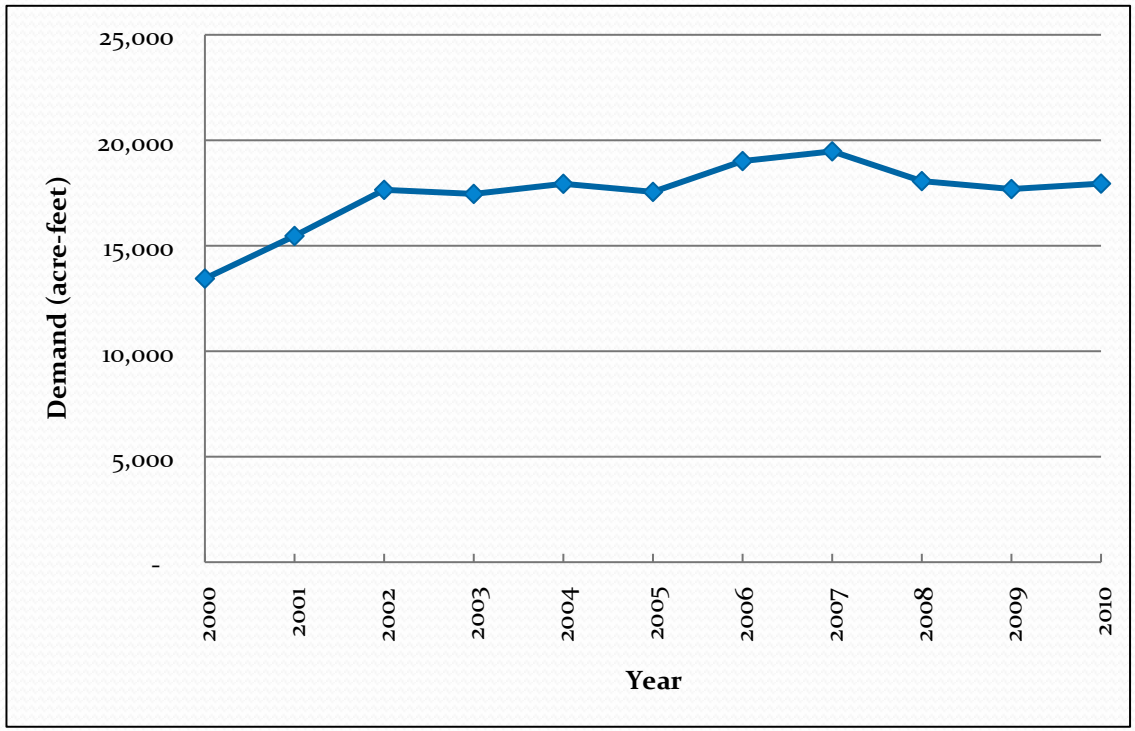
Supply development costs from Reclamation CYHWRMS Study

Conservation is Faster and Flexible

- Tailor-able, Adaptable, Transferable
- Loss reduction
- Rates
- Rebates/replacement
- Retrofits
- Land use
- Ordinances
- Public norming

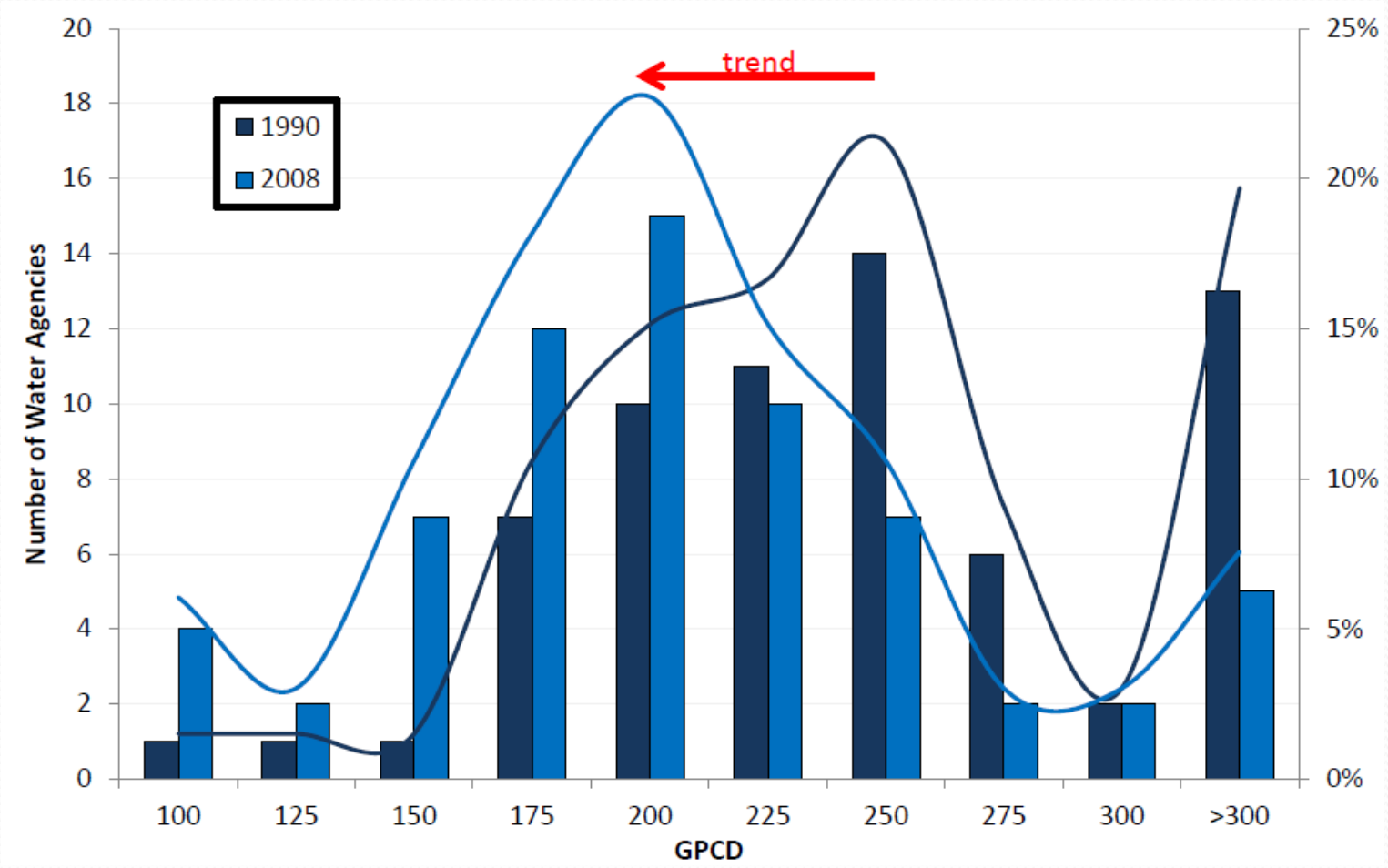
Water supply infrastructure?

Good news: Prescott AMA conservation programs, per capita demand declining, muni demand stable



Prescott AMA Municipal demand

Per capita rates are declining (1%/year) - include in planning now so future supply need is not inflated



Cohen, M. 2011. *Municipal Deliveries of Colorado River Basin Water*. Pacific Institute, Oakland, CA.

Not all low hanging fruit is gone….

- *New technologies; emphasize "**hard-wired**" conservation - 41 gpcd interior currently readily*

Average daily household indoor use of retrofit homes						
Toilets	Clothes Washers	Showers	Faucets	Other	Total	Per Capita (2.4 pph)
18.4	21.1	21.6	18.2	19.6	98.6	41

Assumes 1.28 gpf toilet; 12-15 gal/load washers, 1.5 pgm shower head, 0.5 gpm sink aerators
Source: Aquacraft, 2011

- Prescott Valley - 5,400 pre-code housing units (37%)
- Prescott – 11,700 pre-code housing units (62%)

Measures

- Sufficient analysis to efficiently target programs
- Potential Savings
  - HET Rebate or replacement - 9,500 gal/year;
    34 toilets = 1 af ; $300/af
  - Waterless urinals - 40,000 gal/year;
    8 urinals = 1 af; $440/af
  - On-demand hot water pump – 7,500 gal/year;
    43 pumps = 1 af; $800/af
- *Implementation challenges-economy, ethic, $$, staff*
- *Exterior typically harder (100% "lost")*
- *Expand beyond residential*
  - *Target losses, large commercial, industrial, domestic well users*

Rainwater capture

- *Lot scale rainwater harvesting-residential and commercial ordinances and rebates*

  (Tucson, Sierra Vista)
- *Incorporation of low impact development design (Tucson, Flagstaff, Sierra Vista, Fort Huachuca est. 6-7 af/year)*

Rainwater harvesting tank. Photo: Christina Bickelmann

Conservation and land use

- *Tie conservation to land use policies - e.g. including "smart development" in city Comprehensive plans and ordinances*

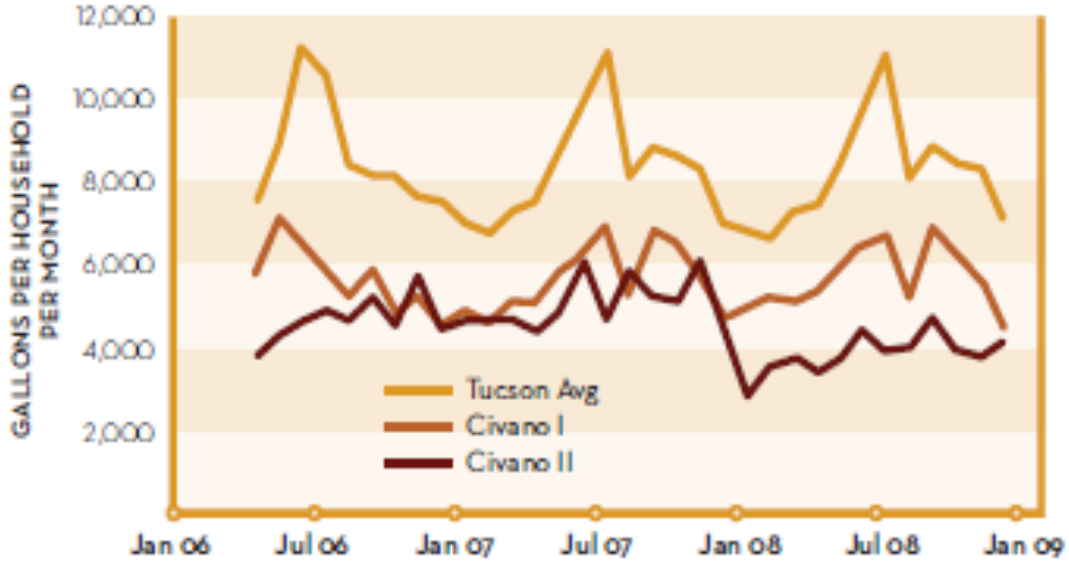


Figure 10. *Water use at Civano I, Civano II, and the Tucson average.*

Conservation and land use

- *Cochise County SVS Water Conservation Overlay Zone*
  - *Gray water lines plumbed to at least 2 fixtures and capped for optional future use*
  - *Hot water on demand systems for sinks and showers*
  - *Irrigation sensors on automatic sprinkler systems*
  - *Credits for other measures that increase water efficiency*

- *SVS strategic effluent recharge*
  - *Sierra Vista EOP*
  - *Tribute new development*

Conservation and growth

Water demand offsets for new development – Santa Fe

- developer must implement, or pay a fee in lieu of implementing, actions that offset the impacts of their proposed project on water resources

- Original program focused on toilet retrofit; revised to create a City Water Bank that sells conserved water to developers and expanded water conservation options

Conservation and growth

- Santa Fe City water bank includes:

  1) voluntary water conservation credits;

     -customer contracts with city to retrofit or change use

     -city pays customers for fixtures, monitors use

     - conserved amount goes to bank

  2) city water fixture and appliance rebate program savings;

  3) fixture "give-away" program 50% of the conservation savings goes to the bank

  Offset programs should require > 1:1 offset and can address different objectives

Funding and Collaboration

- Effective conservation programs need $$$

The Cochise WATER PROJECT

  - Sierra Vista Subwatershed regional non-profit with initial foundation funding focused on reducing the groundwater deficit
  - Collaboration with city, businesses, water providers, etc.
  - Advantage of flexibility, dependable funding, non-political

    Projects:

    0.8 gpf toilet replacement (not rebates)
    on-demand hot water pump rebate
    high profile rainwater harvesting installations (e.g. mall)
    commercial waterless urinals and auto-shut off faucets
    residential rainwater harvesting rebates
    green plumber training

Social/Public norming

- *Provide information to ratepayers on how their use compares to other customers*

Strong social norm message:

"As we enter the summer months, we thought that you might be interested in the following information about your water consumption last year:

Your own total consumption June to October 2006: 52,000 gallons

Your neighbors' average (median) consumption June to October 2006: 35,000 gallons

You consumed more water than 73 percent of your neighbors"

Researchers found lasting reductions in use from conservation messages with social comparisons

Need to do a better job of communicating the effectiveness and economic and environmental benefits of conservation

*"Communicate the **why**"*

Celebrating Arizona's Rivers

Each month during Arizona's centennial year, we will profile a different river in celebration of the state's precious natural resources. From the mighty Colorado to the smallest ephemeral streams, these waterways have supported Arizona's people and places for thousands of years. With good stewardship and thoughtful planning, they will continue to flow into Arizona's next 100 years.

September 2012: The Verde River

Top image: Watershed of the Verde River in relation to other Arizona rivers. **Bottom image:** Detail of the Verde River watershed.

The Verde River traverses approximately 185 miles through Arizona's dramatic "transition zone," where the Mogollon Rim drops thousands of feet in elevation from the pine forests of the Colorado Plateau through rugged mountains and canyons to the desert below. The lush, free-flowing Verde north of Horseshoe Reservoir supports many unique and endangered plant and animal species, and has supported human civilization for thousands of years. A 40-mile stretch of this portion of the Verde is designated as a "Wild and Scenic River" (one of only two such designations in Arizona).

Tuzigoot National Monument, near the town of Clarkdale, protects the remains of a hilltop pueblo built by the ancient Sinagua people around 1,000 A.D. The Sinagua also built the well-preserved cliff dwellings at Montezuma Castle National Monument along Beaver Creek, a tributary of the Verde. Historically, the Verde has supported trappers, military encampments, and mining, farming, and ranching communities. Today, the watershed supports a rapidly growing region of central Arizona, river-based tourism and recreation, and the lands of the Yavapai-Prescott Indian Tribe, the Salt River Pima-Maricopa Indian Community, and the Yavapai-Apache and Ft. McDowell-Yavapai Nations.

Geography. The Verde River originates as a complex of springs approximately 21 miles north of Prescott in the Big Chino Valley, near Paulden. It then flows southeast, entirely supported by these springs for 24 miles, until it reaches another set of springs called Mormon Pocket. Below Mormon Pocket, the Verde gains flow from tributaries and springs, then enters the Verde Valley at approximately river mile 47, near the town of Clarkdale.

Shortly downstream from Clarkdale, the Verde flows through Deadhorse Ranch State Park, where for a six-mile stretch it is designated as the Verde River Greenway State Natural Area. As it flows through the town of Cottonwood, the river is diverted into the Cottonwood Ditch for irrigation purposes –one example of many such diversions throughout the Verde Valley. A few miles south of Cottonwood, the Verde is joined by a major year-round tributary, Oak Creek, which flows off the Mogollon Rim through a dramatic canyon and the red-rock country of Sedona.

As it continues through the Verde Valley, the river is joined by Beaver Creek before passing through the town of Camp Verde; it is then joined by West Clear Creek, Fossil Creek (Arizona's second Wild and Scenic River), and the East Verde River. The Verde's Wild and Scenic designation begins six miles south of Camp Verde and ends

http://www.westernresourceadvocates.org/water/rivers.php

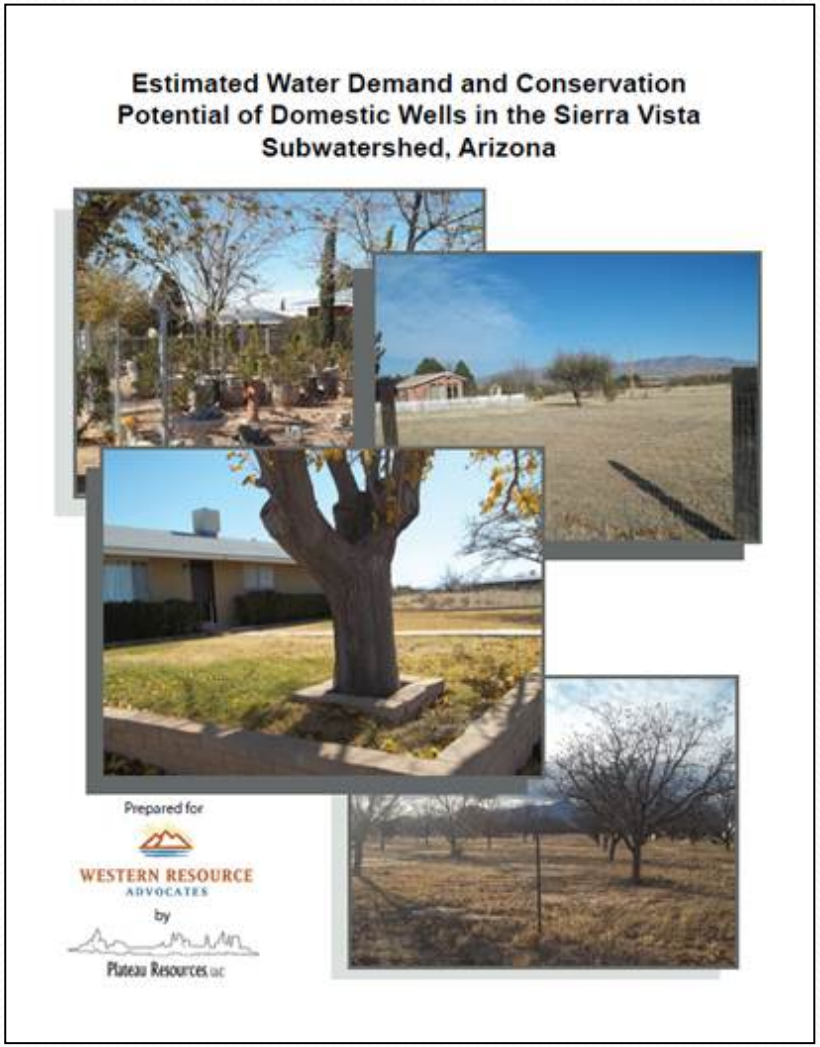
Conservation and the Prescott 4MP

- ADWR proposes no further regulatory conservation requirements
- In an area of limited alternative supplies, conservation is even more important and should be part of the deficit reduction strategy
- Management Plan requirements that strengthen conservation + meaningful coordinated regional planning (that incorporates conservation) to reach safe-yield
  - Revisit Best Management Practices Program; consider mandatory programs with measureable savings
    - 5 programs ; 2 education and awareness
    - e.g. Prescott landscape conversion success
  - Conduct independent study focused on goal, metrics, savings

Conservation and the Prescott 4MP

- Additional conservation/recycling requirements for existing and new industrial groundwater rights and permits
- Domestic (exempt) wells
  - Continuing questions about contribution to overdraft in AMA budget
  - Non-regulatory conservation program implementation
  - Target programs where there is most conservation potential in sensitive areas

Domestic Well Conservation Potential



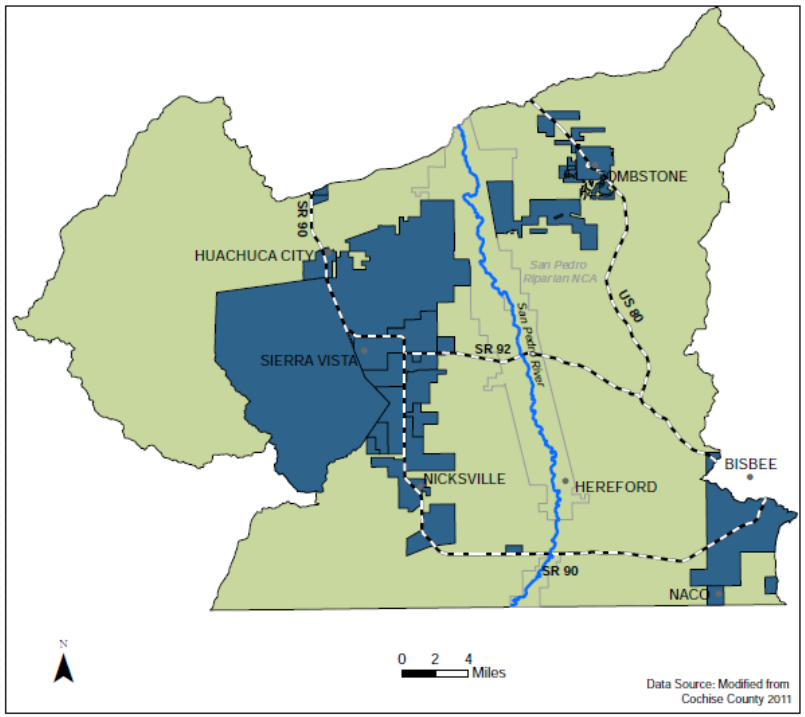
- Upper San Pedro Partnership sustainability goal
  - Conservation, recharge projects have reduced deficit (5,100 af)
- Question about demand of unmetered domestic wells
  - High estimate
  - Meter study failure
- Critical for planning purposes

Study Approach

- Not focused on quantifying demand, focused on conservation opportunity, river benefit, data for planning
- Is it possible to identify domestic well water conservation potential using proxies for metered demand?
  - Housing age indicator of plumbing fixture use
  - Remote sensing to identify irrigated areas
  - Identify and target conservation programs and savings
  - Develop a methodology transferable to other areas

Study area

- Unincorporated area outside water provider service area
- 12,000 residents (16% of total), 5,000 parcels



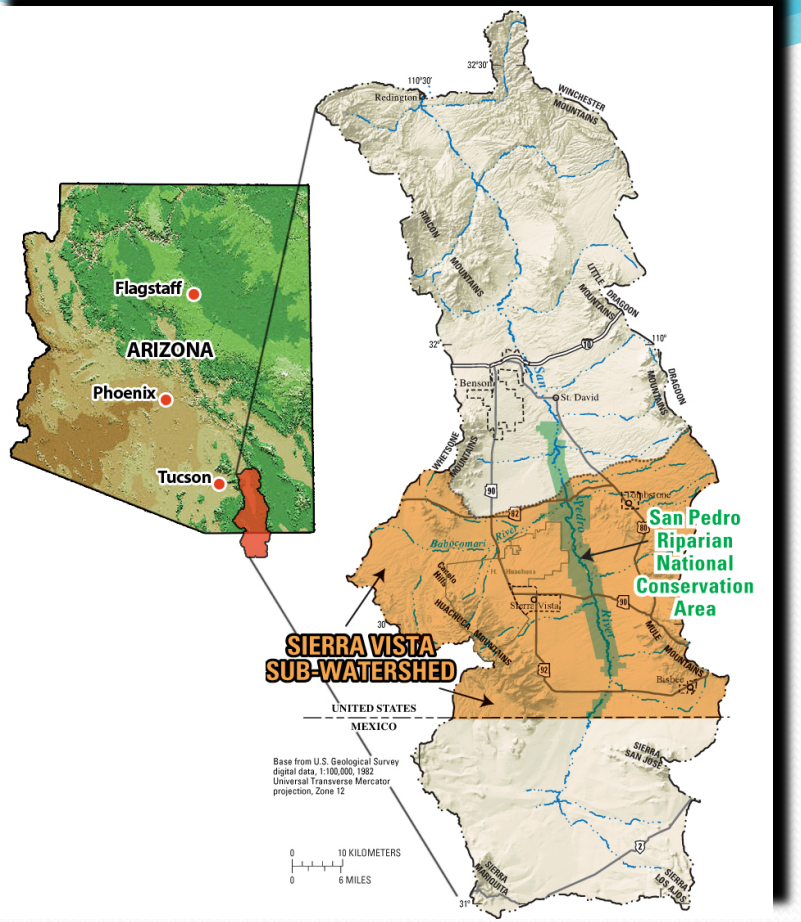


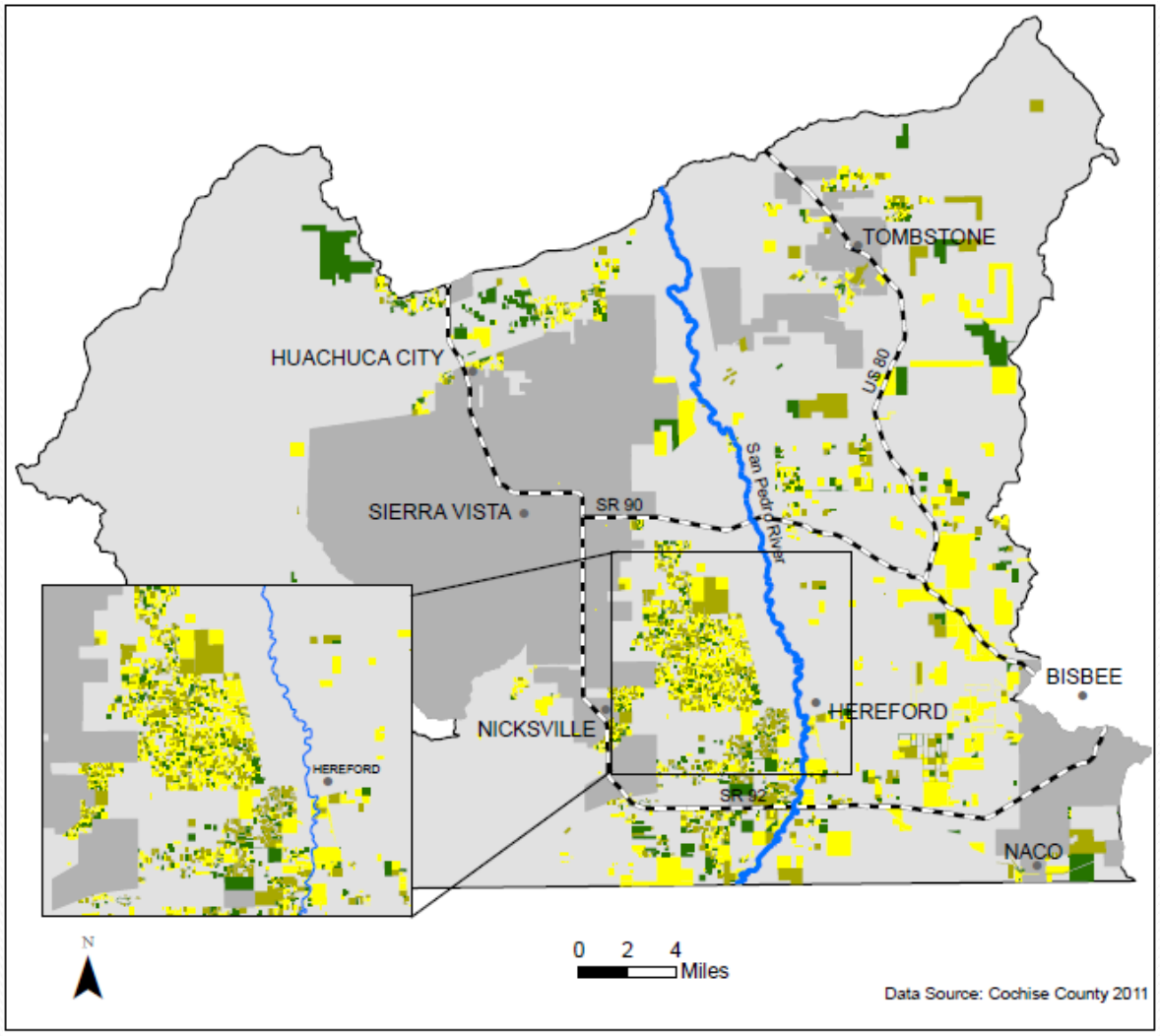
Photo courtesy of TNC

Indoor Demand

- Cochise County *Assessor Records* to identify construction dates
  - Prior to 1997 (2,190 houses)
  - 1997-present (2,140 houses)
  - No dates for 690+ houses – some data problems

- Estimated *indoor demand based on large-scale studies*
  - Prior to 1997 – 69 gpcd (AWWA 1999)
  - 1997 to present – 48 gpcd (Aquacraft, 2011)
  - HE fixture retrofit – 41 gpcd achievable (Aquacraft, 2011)
  - Potential savings:
    - 7 to 28 gpcd / 200 afy @ 100% from HE retrofit
    - + 30 afy @ 100% from on-demand hot water recirculation systems

- Septic tank recharge does not equal indoor demand – indoor conservation important
  - 40% of the 80% discharged to the leach field available for recharge (EEC, 2002)



Legend

- City or Town
- Water Provider Service Areas

Year Built

- Before 1997 (~2,230 parcels)
- 1997 to 2004 (~1,330 parcels)
- 2005 to Present (~810 parcels)

Target pre-1997 homes first

Outdoor Demand

- Remote sensing-National Agricultural Imagery Program (NAIP)
  - 1-meter, 4-band imagery, June 2010, with visual analysis and *ground-truthing* – some areas that appeared to be irrigated were not (native grasses)
  - Based on spectral signature grouped areas into 5 types
  - Quantified use by multiplying acres mapped in each category by its annual watering requirement and application efficiency

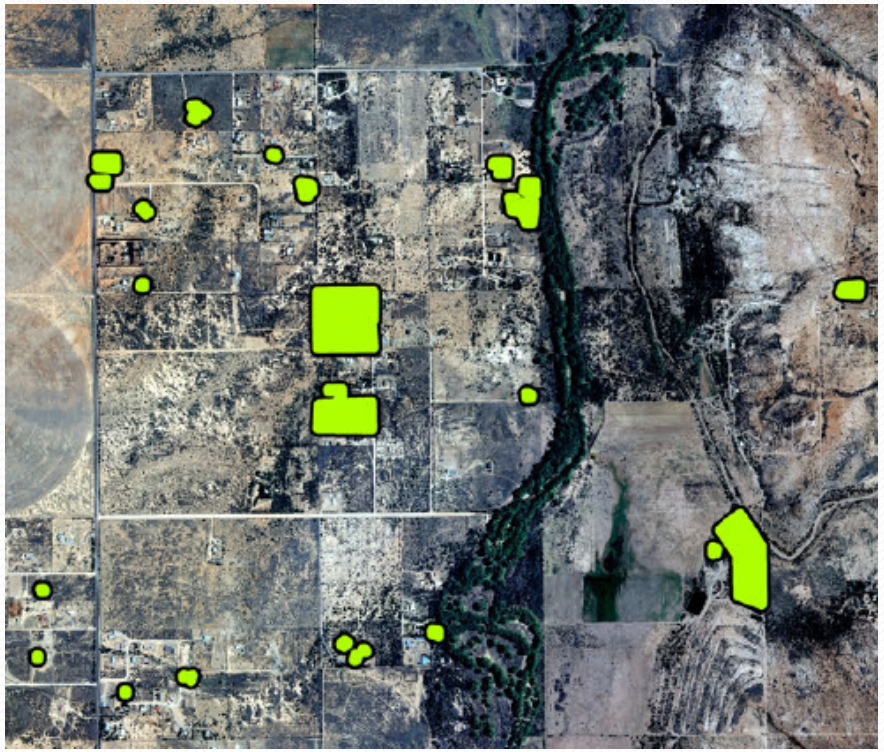
ESTIMATED OUTDOOR WATER USE IN THE STUDY AREA DURING 2010

Type	Number of Areas Mapped	Total Area (acres)	Annual Watering Requirement (feet)	Assumed Application Efficiency	Estimated Annual Outdoor Water Use (acre-feet)
Pasture	**10**	**31.6**	**2.3 to 3.3**	**70 to 85%**	**86 to 149**
Orchards	**18**	**20.1**	**1.3 to 2.8**	**70 to 90%**	**29 to 80**
Turf	**165**	**12.4**	**0.0 to 2.6**	**40 to 75%**	**0 to 81**
Landscape Plants	**115**	**8.5**	**0.3 to 2.7**	**40 to 95%**	**3 to 57**
Pools	**64**	**0.5**	**4.2**	**Near 100%**	**2**
Total	***372***	***73.1***	**---**	**---**	***120 to 369***

Note: Local data used as available. Some turf is non-irrigated natural grasses

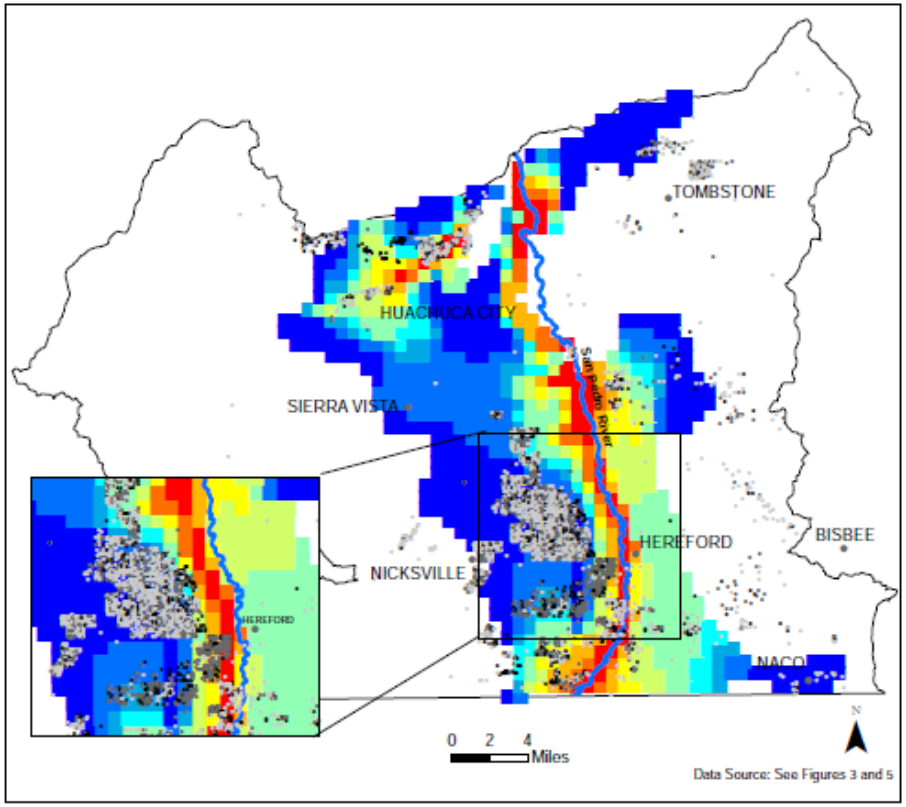
Outdoor Water Conservation

- Improve orchard and pasture irrigation efficiency
  - 46 afy @ 20% improvement
- Rainwater harvesting for landscaping
  - 57 afy @ 100%
- Surveys, metering, site visits, higher resolution imagery to improve outdoor demand estimate
- Other outdoor uses- evaporative coolers, livestock, dust control, etc.



Hereford area – June 2010

Potential Pumping Impact



Legend

0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

Computed capture of streamflow, riparian evapotranspiration, and springflow along the San Pedro River as a fraction of pumping after 25 years of constant rate withdrawals from shallow wells.

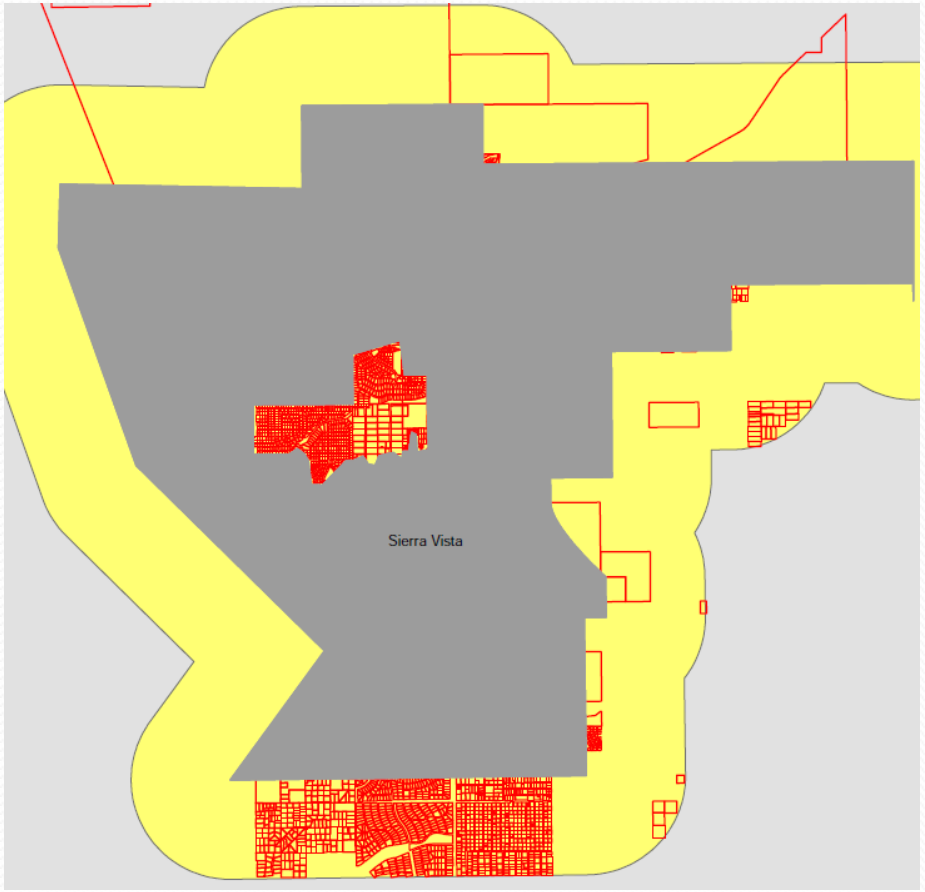
Age of Single-Family Homes Served by Domestic Wells

- Before 1997 (~2,190 parcels)
- 1997 to 2004 (~1,330 parcels)
- 2005 to Present (~810 parcels)

- Groundwater capture by well pumpage that impacts ecosystem by reducing stream flow, spring discharge and riparian ET
- Fraction of groundwater capture by wells in uppermost water-bearing zone
- Simulated 25 year constant pumping rate

Water/Sewer service area extension

- Pros
  - Effluent for regional management
  - Drinking water reliability to users
  - Well maintenance cost avoidance
  - Conservation messaging
- Cons
  - Expensive to utility and user
  - Prior homeowner investment
  - Acceptability

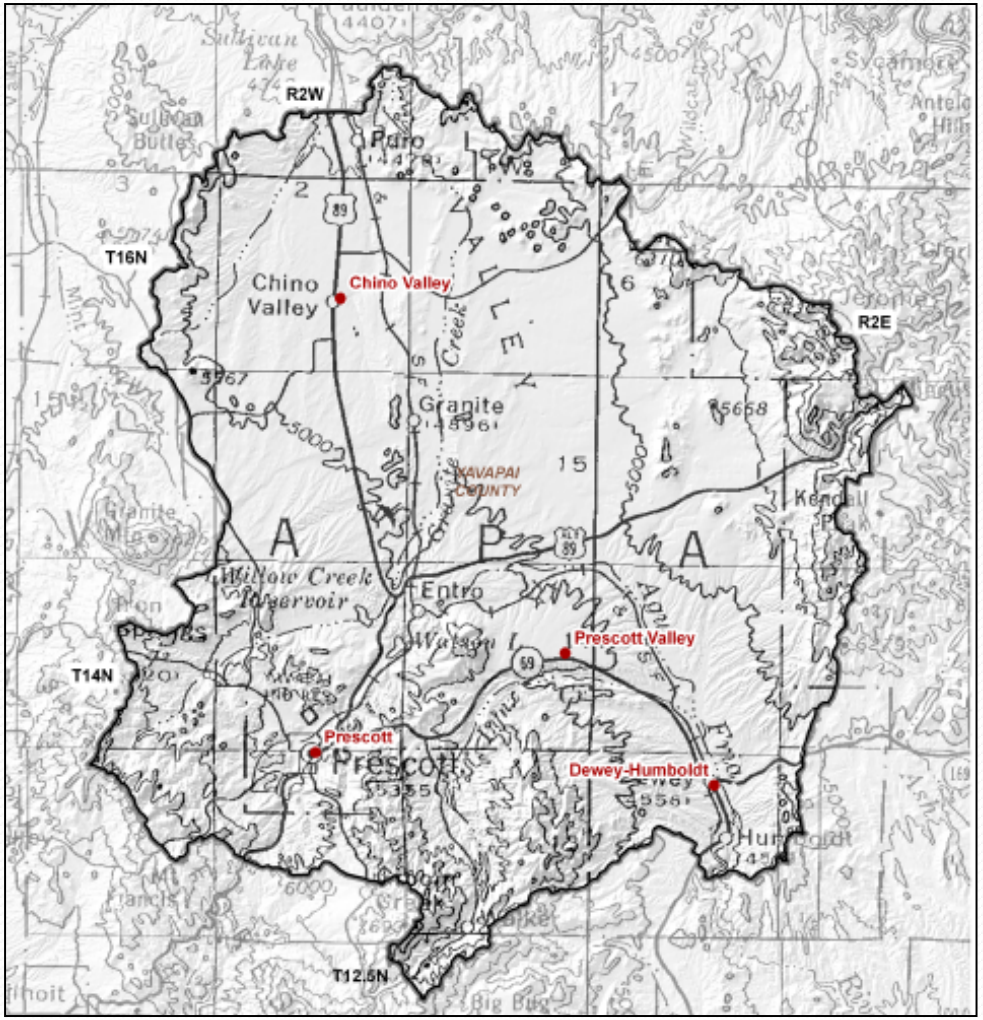


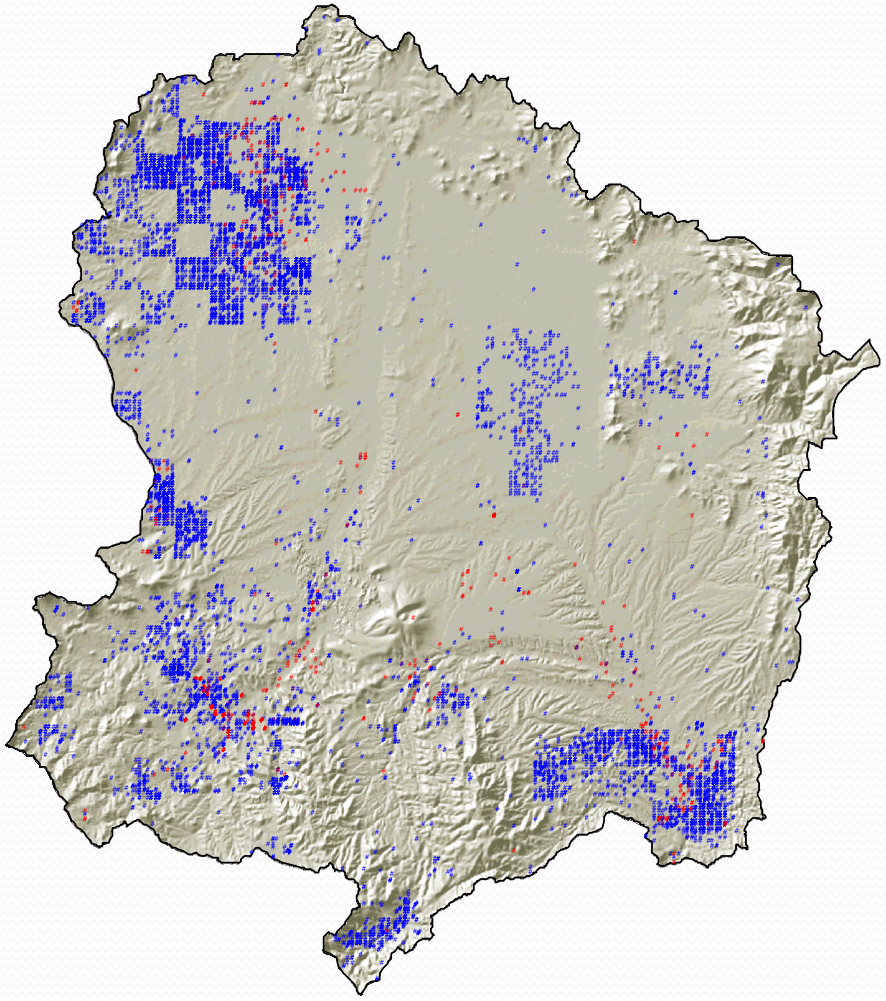
Sewer Service area – 1 mi. buffer

Comparison of Domestic Well Use

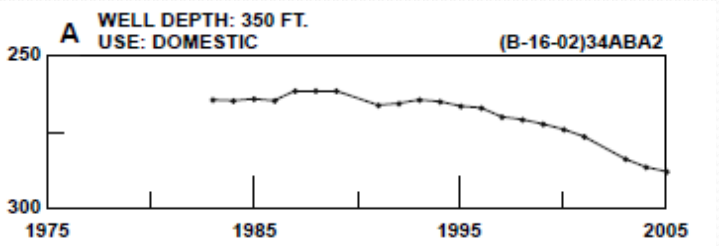
Location	Year	Number of Homes	Average Annual Use (acre-feet)		Data Source
			Per capita	Per household	
Metered					
Sierra Vista Subwatershed[1]	Between 2005 and 2007	8	0.12 (107 gallons per day)	0.24	Daily (2011a)
Sierra Vista, AZ[2]	2010	799	0.09 (76 gallons per day)	0.21	Liberty Water Company (2011)
Near Santa Fe, NM[3]	2009	250	---	0.30	Chavez (2010)
Estimated or Assumed Values					
Sierra Vista Subwatershed	Current	---	0.13 (118 gallons per day)[4]	0.31[5]	USFWS (2007)
			0.35 (312 gallons per day)[6]	0.84[5]	USGS (2010)
Statewide *('standard' domestic use when filing an application to appropriate water)*			0.20 (180 gallons per day)	0.48[5]	ADWR (2011b,c)
Adjudication Areas *(suggested domestic use when filing adjudication claims)*			0.17 (150 gallons per day)[7]	0.41[5]	

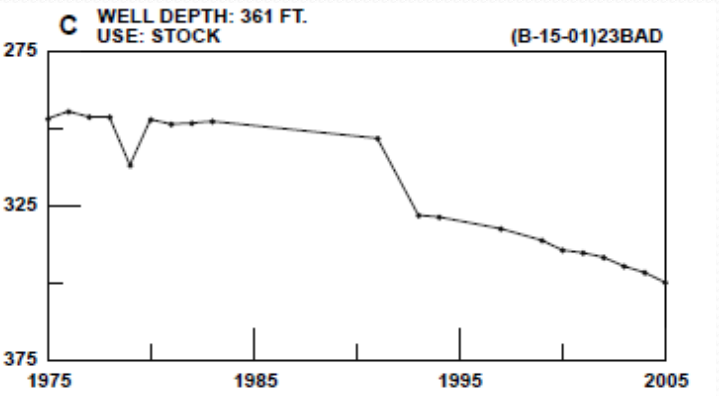
Domestic wells (blue) in the Prescott AMA (c. 2005)

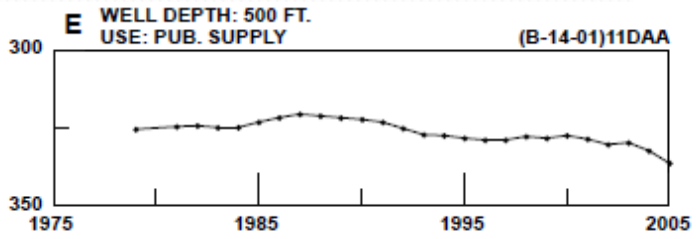


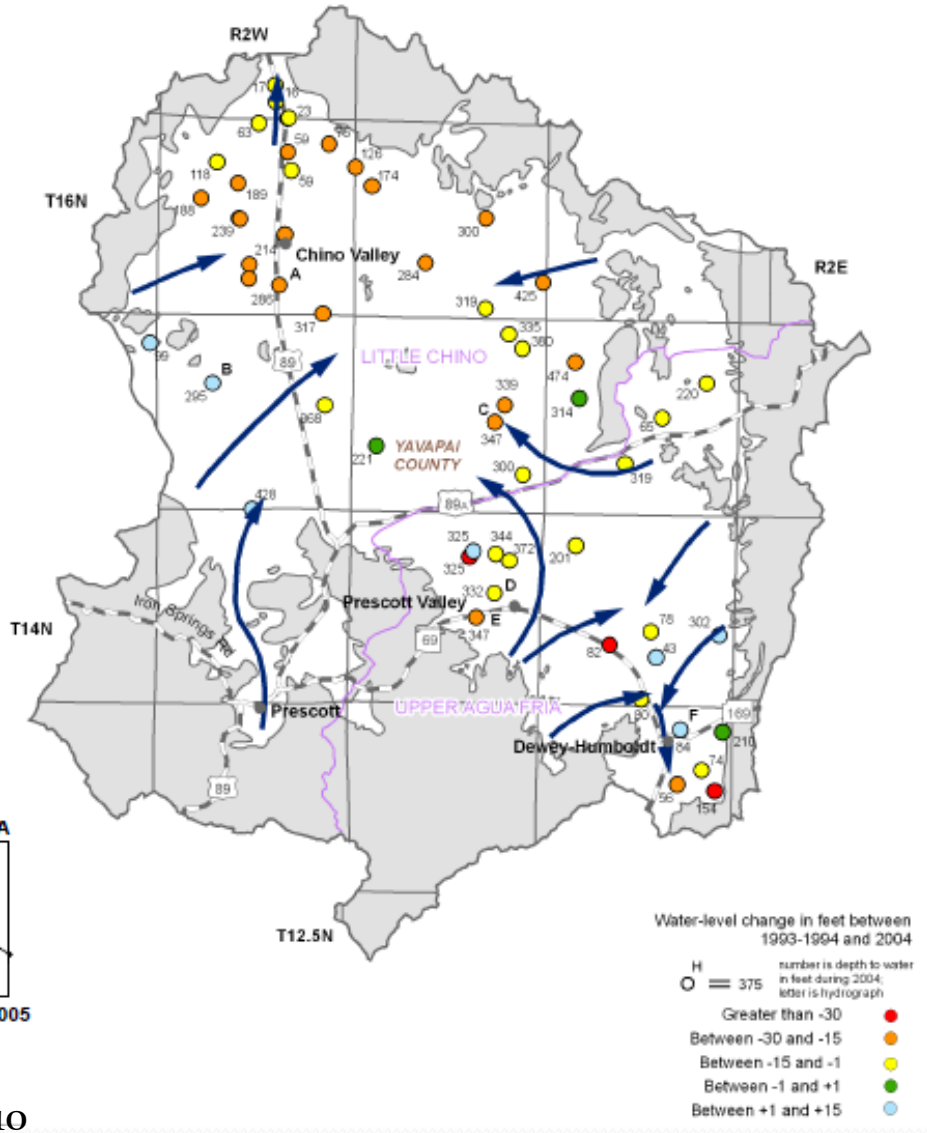


Water level changes









Source: Arizona Water Atlas, Vol. 8, 2010

Prescott AMA and San Pedro Subwatershed (SVS) Domestic well comparison

Area	# Domestic Wells or households	Est. Demand	Approx. AF/well or household	% of total area demand	% pop. served
Prescott AMA	11,035 (wells)	2,069*	.19	9%	18%
SVS (study)	5,020** (household)	1,100	.22	7%	16%
SVS (USGS)	NR	4,680	.84	28%	19%

* Assumes 90 gpcd
** Unincorporated area only

Conclusions

- Transferable, low cost methodology that provides a first approximation of domestic well use and ability to target conservation programs

- Conservation programs should first focus on greatest conservation potential (older homes and irrigation) in proximity to areas of concern

Study available at: http://www.westernresourceadvocates.org/water/SVS_domestic_well_conservation_June.pdf

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