CITIZENS' WATER ADVISORY COMMITTEE (CWAC)

Wednesday, April 1, 2015, 7:00 a.m.
Director's Conference Room
Tucson Water, 3rd Floor
310 W. Alameda Street, Tucson, Arizona

Legal Action Report

1. Roll Call:
The meeting was called to order by CWAC Chair, Brian Wong at 7:03 a.m. Those present and absent were:

Present:

Brian Wong	Chairperson, Representative, City Manager
Mark Murphy	Representative, Mayor
Jean McLain	Representative, City Manager
Catlow Shipek	Representative, City Manager (arrived at 7:02 a.m., directly after roll call)
Mitch Basefsky	Representative, City Manager
Placido dos Santos	Representative, City Manager
Chuck Freitas	Representative, City Manager
Mark Taylor	Representative, City Manager
Alan Tonelson	Representative, Ward 1
Amy McCoy	Representative, Ward 2
Bruce Billings	Representative, Ward 3
Mark Lewis	Vice Chair, Representative, Ward 5
Kelly Lee	Representative, Ward 6
Alan Forrest	Tucson Water, Director, Ex-Officio Member

Absent:

George White	Representative, Ward 4
Jackson Jenkins	Pima County Regional Wastewater Reclamation Department Director, Ex-Officio Member

Tucson Water Staff Present:

Sandy Elder	Deputy Director
Jeff Biggs	Interim Deputy Director
Andrew Greenhill	Intergovernmental Affairs Manager
Chris Rodriquez	Water Administrator
Melodee Loyer	Water Administrator
Pat Eisenberg	Water Administrator
Britt Klein	Water Administrator
Fernando Molina	Water Program Supervisor
Daniel Ransom	Water Conservation Supervisor
Jane Slama	Water Operations Superintendent
Wally Wilson	Chief Hydrologist
Peter Chipello	Lead Hydrologist
Candice Rupprecht	Public Information Specialist
Johanna Hernandez	Staff Assistant
Kris LaFleur	Staff Assistant

Others Present:

Chris Avery	City of Tucson, Attorney's Office
Amy Stabler	City of Tucson, Ward 6
Michael Block	Metro Water
Ryan Lee	University of Arizona
Julie Brugger	Citizen

2. **Announcements –** Member Lee informed the Committee of a memorandum regarding the requested Internal Audit in relation to the Administrative Service Charges, the topic will be addressed during the course of the meeting. Member Basefsky notified the Committee that David Modeer will be retiring from CAP effective April 30th. No interim has been announced yet; however, a national search will be held for a new General Manager. Member McLain reminded the Committee of the upcoming WRRC presentation the Committee was previously noticed on. Member McLain and Director Forrest encouraged members to attend if they are able.

3. **Call to Audience –** No action taken.

4. **Review of March 4, 2015 Legal Action Report and Meeting Minutes –** Committee Member Tonelson motioned to approve the Meeting Minutes of March 4, 2015. Member Freitas seconded. Motion passed unanimously by a voice vote of 13-0.

5. **Director's Report –**

a. Mayor and Council Items – On April 7th the Mayor and Council will be considering a wheeling agreement between Tucson Water and Metro. This agreement, which has already been approved by Metro's board, is similar to other Tucson Water wheeling agreements. On the same agenda, Mayor and Council will hear discussion the rate schedule and consider the notice of intent to set the public hearing.

b. Department Updates – Tucson Water currently has 51 vacancies, 16 active recruitments and 4 pending new hires.

c. Informational Items – Director Forrest reported on the status of the Committee's request for costs associated with an independent audit of the administrative service charges model. Replacement of the current model will likely cost a couple hundred thousand dollars; review of the current model will likely cost around fifty thousand dollars. Council Member Kozachik has requested that the Independent Audit and Performance Commission (IAPC) consider performing this internal audit, the Director had no objection to this option, and Member Lee provided some additional information on the IAPC make-up and process.

Tucson Water was noticed that the terms for Members Freitas and Shipek have nearly expired, and both members expressed a desire to continue service. Tucson Water has submitted the necessary paperwork to extend their terms. The City Manager's Office has concurred with the requests for reappointment, and the reappointments will be placed on an upcoming Mayor and Council agenda for ratification.

6. **Subcommittee Reports –**

Technical, Policy, and Planning Subcommittee – Subcommittee Chair Murphy reported on recent presentations the Subcommittee received from the University of Arizona on research and also on the status of Inter-AMA firming.

Finance Subcommittee – Subcommittee Chair Billings reported that the Subcommittee has not met since the last CWAC meeting.

Conservation and Education Subcommittee – Subcommittee Chair Amy McCoy reported that the Subcommittee will be meeting at 3pm on Wednesday April 8th; they will be discussing the Strategic Plan and new programing.

RWRAC Update – Member Taylor reported that adoption of the RWRAC Financial Plan, incorporating a rate increase, has been delayed pending responses to Board questions. RWRAC is also discussing the County's plans for sewer infrastructure in the Aerospace Corridor.

7. **Factors in Municipal Water Uses –** Mr. Gary Woodard provided a PowerPoint presentation on factors in municipal water uses. Mr. Woodard reported that national water demand has been dropping steadily, despite population growth, since the late 1980's. Causes of decreased demand, consequences of

decreased demand and future considerations were discussed, with a focus on municipal uses. Drops in demand resulted in decreased revenues for water utilities, over-production of infrastructure, and decreased desire for conservation. Sustained decreases resulted in the need for long-term forecasting and attempts at establishing a new normal. Initial forecasting was based upon population projections, was overly conservative, focused on short-term events, and did not properly address long-term trends. Additionally, too much of the decrease was credited to conservation programs. Fiscal, operational, planning, and perception challenges associated with decreased demands for municipal water users were discussed. Mr. Woodard's study focused on three factors affecting municipal water demand: Changing Tastes (pools, landscapes, new homes), Changing Socio-demographics (composition of households, seasonal residents), and Efficiency Standards (federal mandatory, federal voluntary and neighboring state effects). The study relied upon existing reliable data, and focused on changes and triggers of change. The resulting dynamic model focuses on significant changes in single family residential demand and allows for measuring the effect of multiple variables. Various possible reasons for long-term decreases in demand were discussed. Fixtures and appliances are averaging less water use than their maximum rates. Use of turf and swimming pools are decreasing, whereas use of artificial turf, xeriscape, and efficiency of fixtures and appliances are increasing. Multiple triggers for changes in water use, such as new home owners, and replacement of fixtures, appliances and landscapes that are no longer functional, were discussed. Downward trends for water use of washing machines, toilets and showers were discussed. Trends reflect showers have the most room for improvement for indoor water use. Generally, domestic demand is most affected by the efficiency of new homes, passive conservation, and active conservation efforts. Water demand is not tied to population, economy, conservation or quality of life, as it once was. Discussion on what these results might mean for municipal water users was held.

Member Taylor & McCoy departed at 7:55 a.m.
Member Lee departed at 7:55 a.m. and returned at 7:58 a.m.
Member McLain departed at 8:13 a.m. and returned at 8:16 a.m.
Director Forrest departed at 8:29 a.m. and returned at 8:31 a.m.

8. **Isolated Systems Update –** Tucson Water staff member Melodee Loyer presented a PowerPoint on Tucson Water's Isolated Systems: Silverbell, Rancho Del Sol Lindo, Valley View Acres, Sierrita Foothills Estates, Diamond Bell Ranch, Vista Catalina, Thunderhead Ranch, and Santa Rita Bell Air. Ms. Loyer provided a summary of purchase, services, demands and water rights associated with each of the eight isolated systems discussed. Each system was reviewed in terms of revenues, cost, asset value and market value. Brief discussion was held regarding how the asset value and market value numbers were calculated. Each system was evaluated in regards to if the system pays for itself, if it can be reasonably connected to the central system, and to whom Tucson Water could possibly sell the system. Santa Rita Bel Air and Diamond Bell systems pay surcharges. Overall, the isolated system revenues represent 1.4% of total Tucson Water revenues, the isolated system water use represents 1.06% of the total system use, and the isolated systems represent 6.4% of non-renewable water use. Tucson Water has an established policy for water system acquisition, and has a draft policy for water system divestment. Tucson Water is not actively pursuing the sale of the systems, but has been approached with a proposal to purchase all of the systems in a bundle. Steps are being taken to evaluate this proposal, though ultimately any sale would go through the standard procurement process.

Member Shipek departed at 8:43 a.m. and returned at 8:45 a.m.
Member Freitas departed at 8:45 a.m. and returned at 8:48 a.m.

9. **2014 Pumpage and Storage Roundup** – Tucson Water staff member Wally Wilson provided a PowerPoint presentation on water production for the Tucson Water service area. Graphs represented historic water production for Tucson Water. Total water production in 2014 was 111,459 AF with 79% being CAP, 11% being Reclaimed, 5% Ground Water and 5% TARP. Gallons per capita per day (GPCD) calculations reflected a continued decline in total, total potable, and residential potable demand. Additionally, lost and unaccounted for water has decreased continuously to a low of 7.94%.

10. **Consideration of Formation of Bill Re-Design Ad-Hoc Subcommittee** – Member Freitas commented on the various aspects of the current bill design that he believes need to be focused on. Member Billings noted his concerns regarding consistent billing practices. Vice Chair Lewis informed the Committee that the C&E Subcommittee would also like to have a voice in the redesign of the bill. Member Murphy

motioned for the formation of an Ad-Hoc Subcommittee, seconded by Member Freitas. The motion was amended to include the nomination of Members Tonelson, Freitas, Billings, Shipek and Taylor, with Member Tonelson as Chair. The motion, as stated and amended, was passed by a roll-call vote of 10-0.

Member McLain departed at 9:00 a.m.
Member Lee 9:06

10. Future Meetings/Agenda Items – See projected agenda.

11. Adjournment – Meeting was adjourned at 9:08 a.m.

MEMORANDUM

DATE: March 10, 2015

TO: Chairperson Kevin Oberg, IAPC

FROM: Council Member Kozachik

SUBJECT: Administrative Service Charge Assessed to Tucson Water

Over the course of the past year, Tucson's Citizens' Water Advisory Committee (CWAC) and its Finance Subcommittee have held multiple meetings to review the administrative service charge that is assessed to Tucson Water. The purpose of the administrative service charge is to recover the costs that are incurred by general fund departments in the course of furnishing central services to the enterprise fund utility.

Joyce Garland and Bob Kluze have attended numerous CWAC meetings to explain the cost allocation model used to determine the administrative service charge. Because the cost allocation model itself is very complex, CWAC members voted at their March 4th meeting to request "Tucson Water to assess the costs for procuring an independent third party cost analysis of the services associated with the administrative services charges," motivated by the sentiment that they, as an advisory body, do not have the expertise to review the cost allocation model and its outputs themselves (CWAC Legal Action Report, 3/4/2015).

I would like to request that the Independent Audit and Performance Commission consider conducting the analysis requested by CWAC and generating a report for the Mayor and Council, Tucson Water, and CWAC that comments on the current methodology's success in attributing reasonable costs to Tucson Water for the central services it consumes, the appropriateness of the allocation factors used to determine what portion of each cost receiving departments incur, and any other items that IAPC deems important.

Thank you for your work, and thank you for considering this request.

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CC: Alan Forrest, Director, Tucson Water
Brian Wong, Chairperson, Citizens' Water Advisory Committee
Joyce Garland, Program Director, Budget and Internal Audit
Robert Kluze, Internal Audit Manager, Budget and Internal Audit

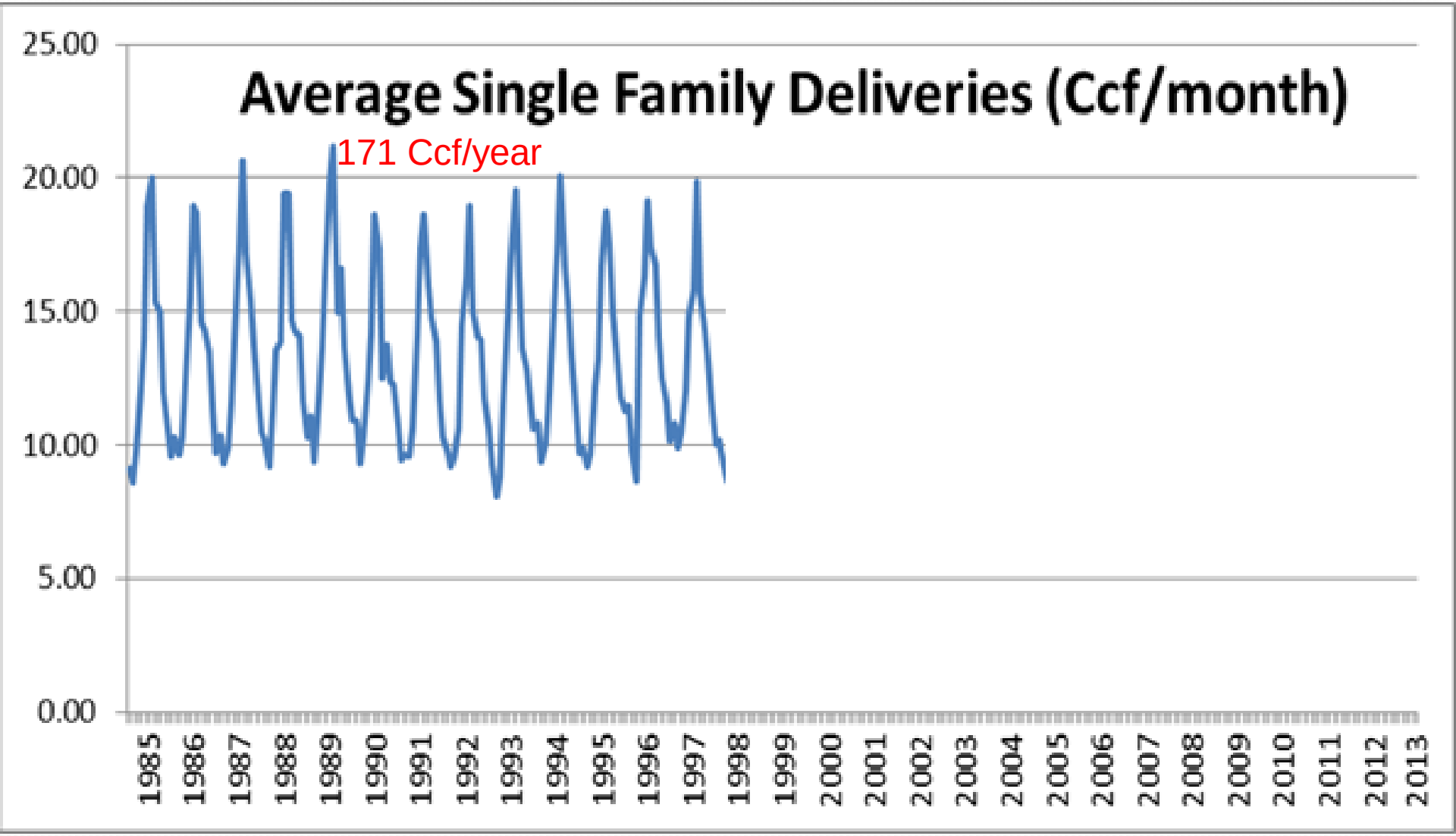
Long-term Trends in Residential Demand: Time for New Perspectives?

Gary Woodard, JD MPP

MONTGOMERY & ASSOCIATES

Citizens Water Advisory Committee
Wednesday, 1 April 2015
Tucson Water

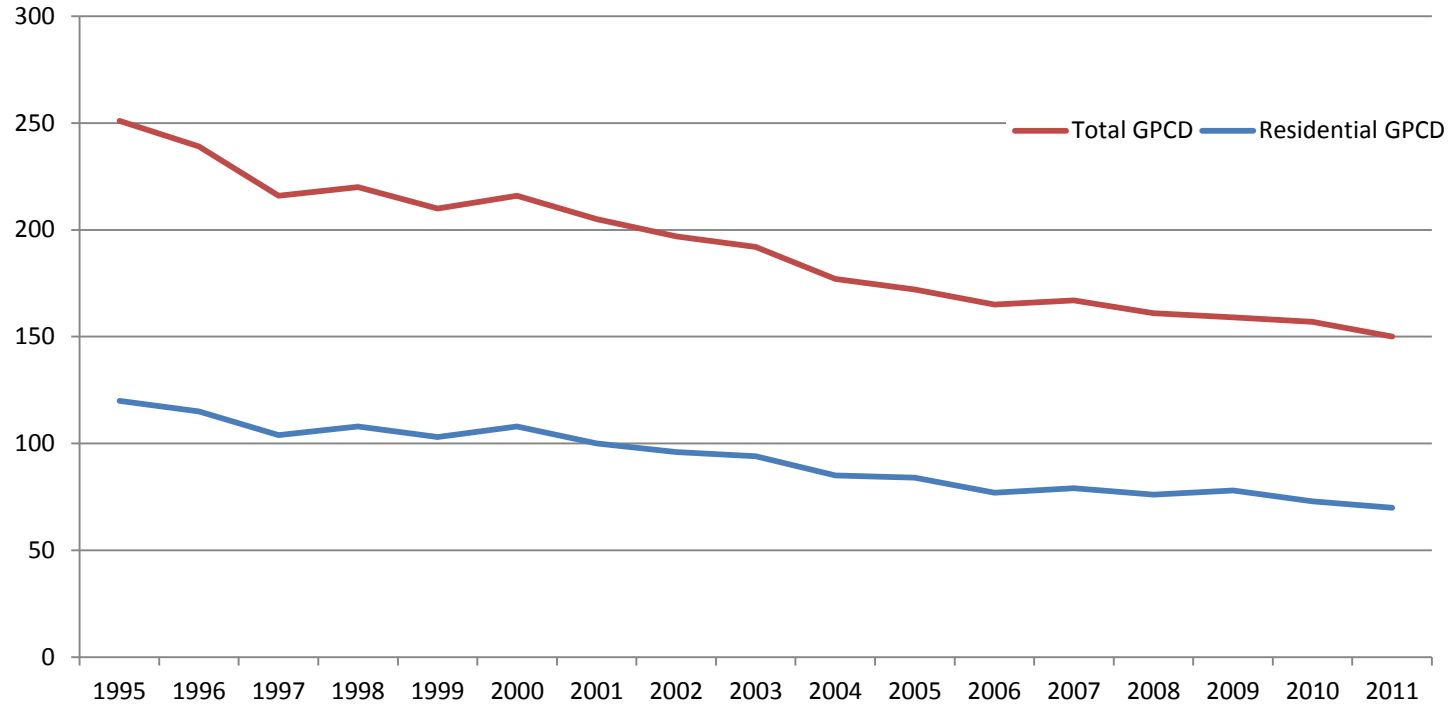
Tucson, Arizona



Albuquerque-Bernalillo County WD deliveries

Deliveries in 2013 were the same as in 1983…

…despite a 70% increase in population, because GPCD was down 40%

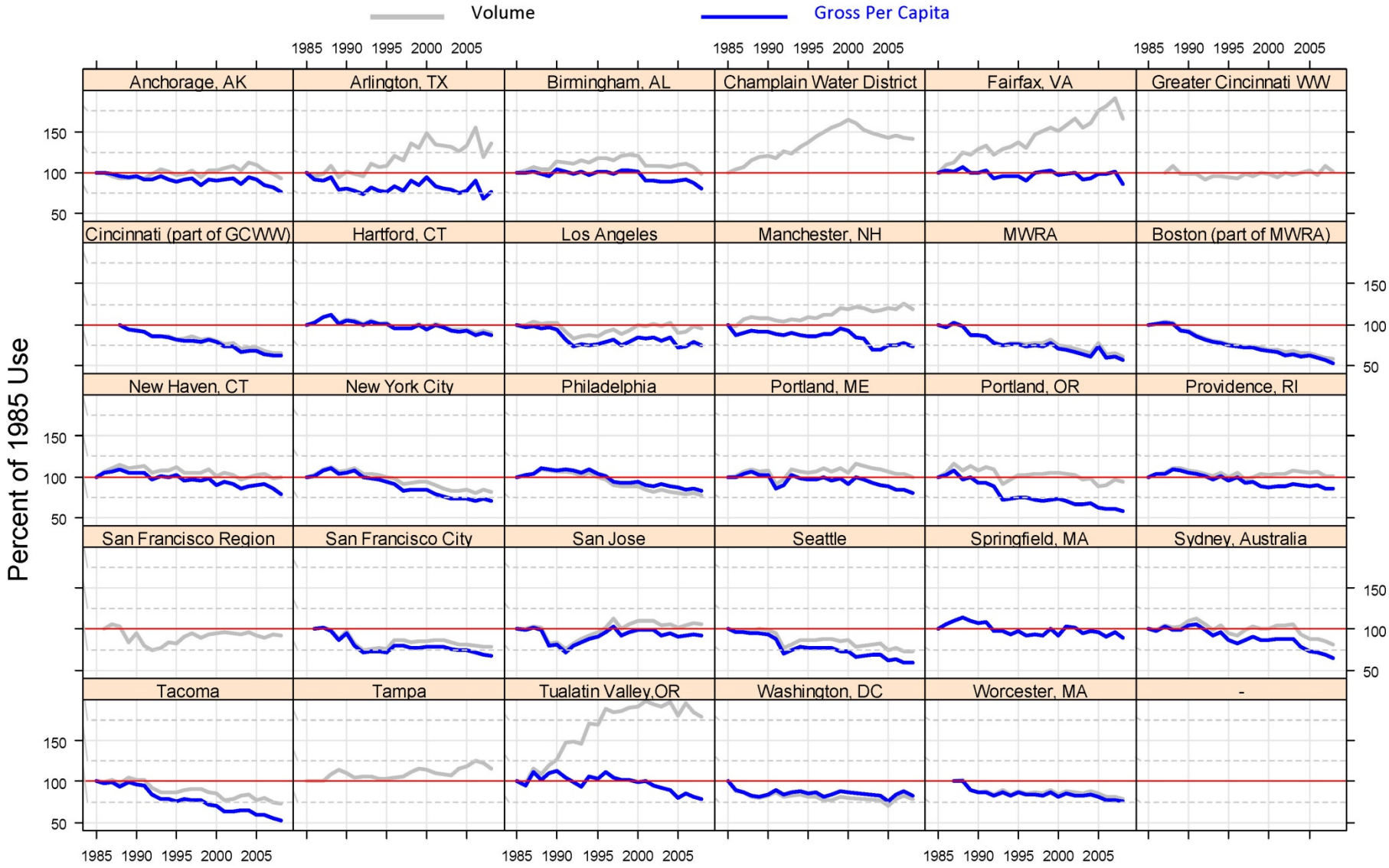


Demand Trends, Pima & Maricopa County

Annual Percent Changes in SFR Water Demand, 2000-2013				
Area	Total	Indoor	Outdoor	Peak Outdoor
Pima County	-2.3	-1.5	-4.8	-4.9
Community Water	-2.0	-1.5	-3.2	-3.6
Metro Water	-2.2	-2.0	-2.8	-2.5
Tucson Water	-2.3	-1.5	-5.0	-5.1
Maricopa County	-2.1	-2.0	-2.3	-2.9

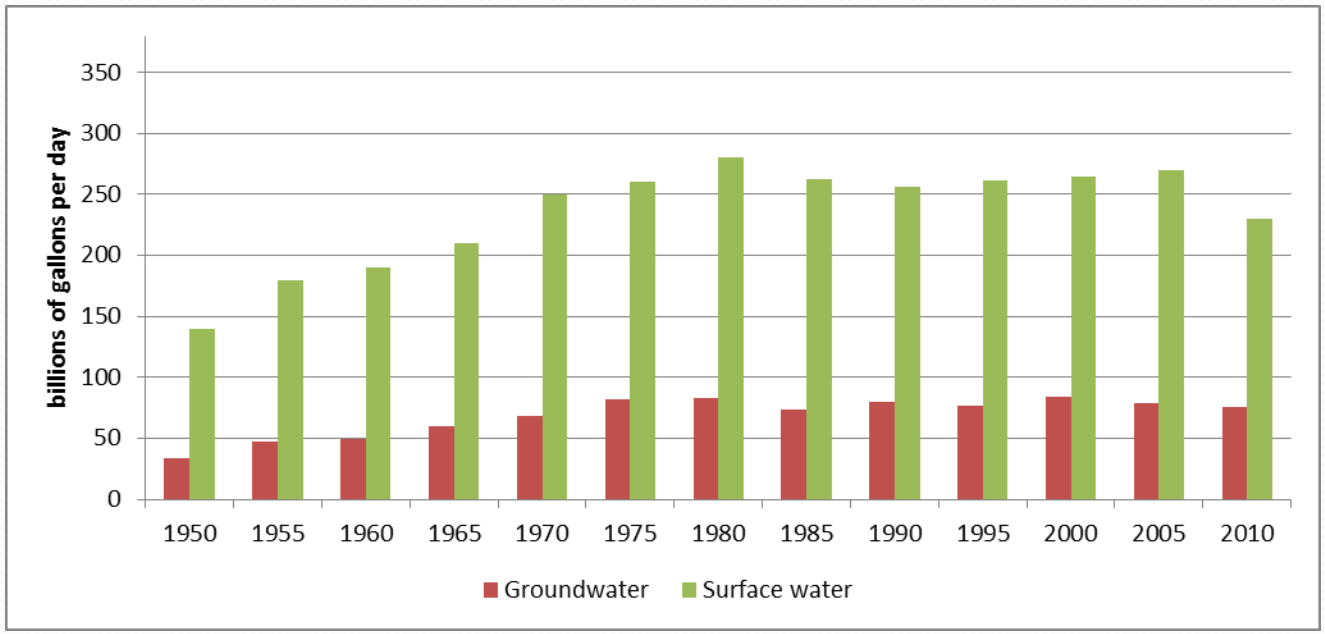
National Water Use Comparison

(Compiled by the Massechusetts Water Resource Authority)



** For a few cities where 1985 data was not available the indexing is on the earliest date provided.*

USGS report shows reduced water diversions



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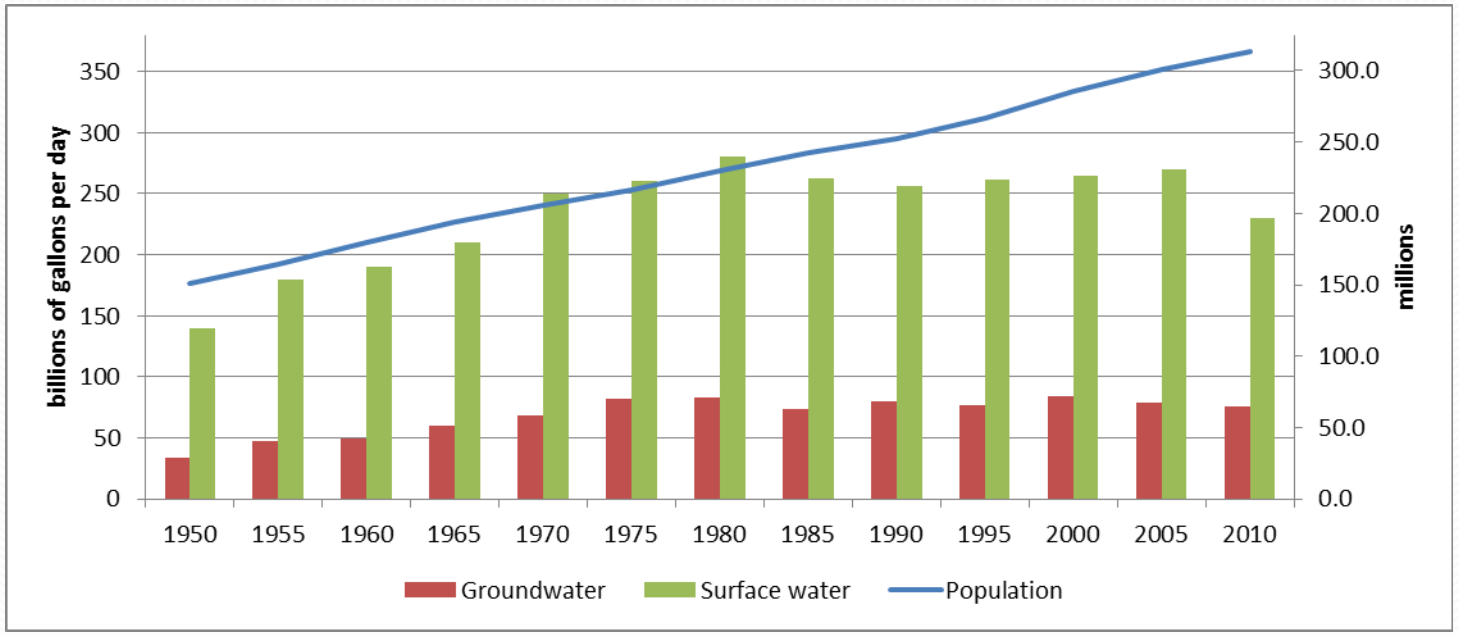
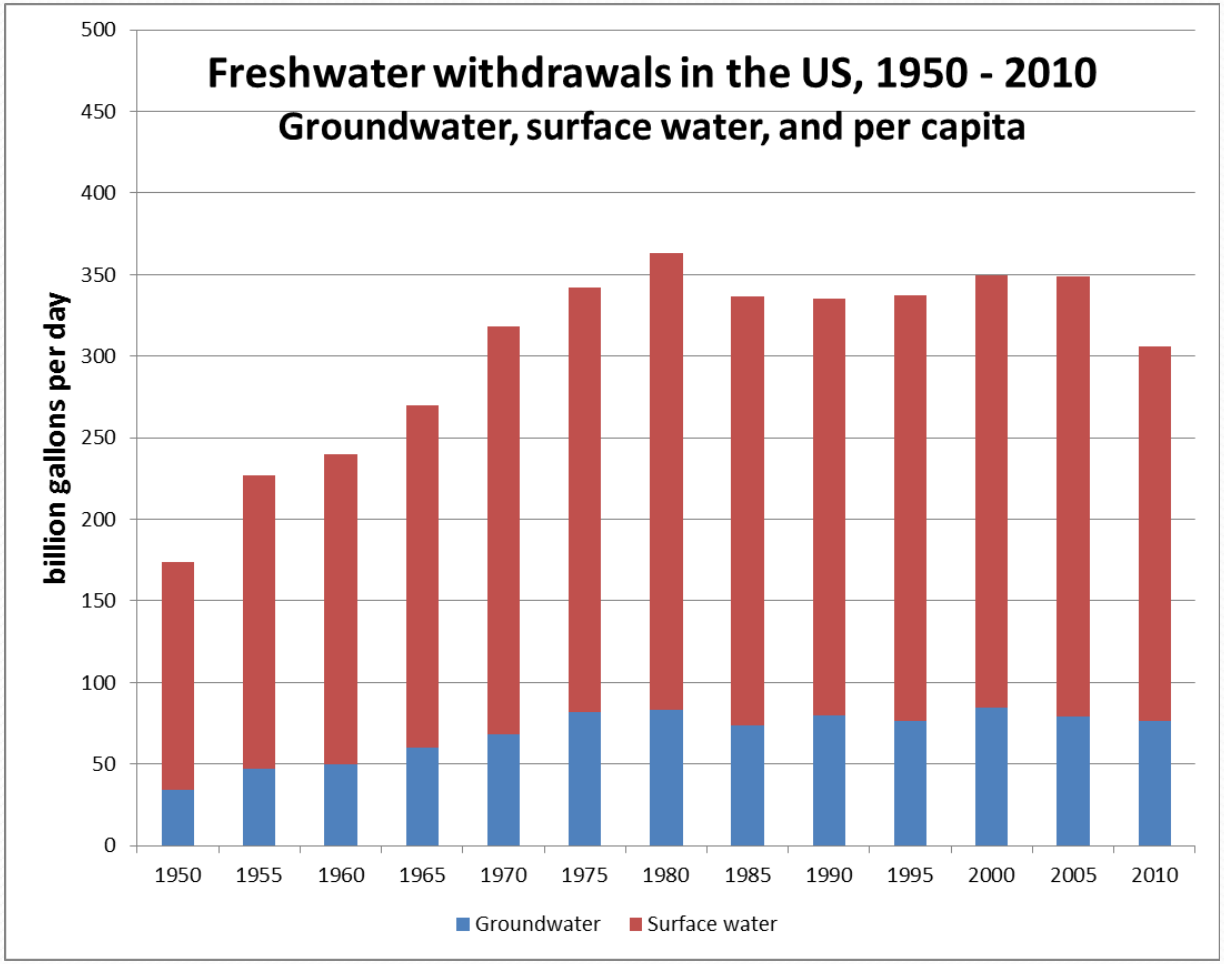


Between 1980 and 2010, we managed to support 85 million more people and a growing economy while reducing water use by 57 billion gallons per day.

Total U.S. water diversions peaked 35 years ago



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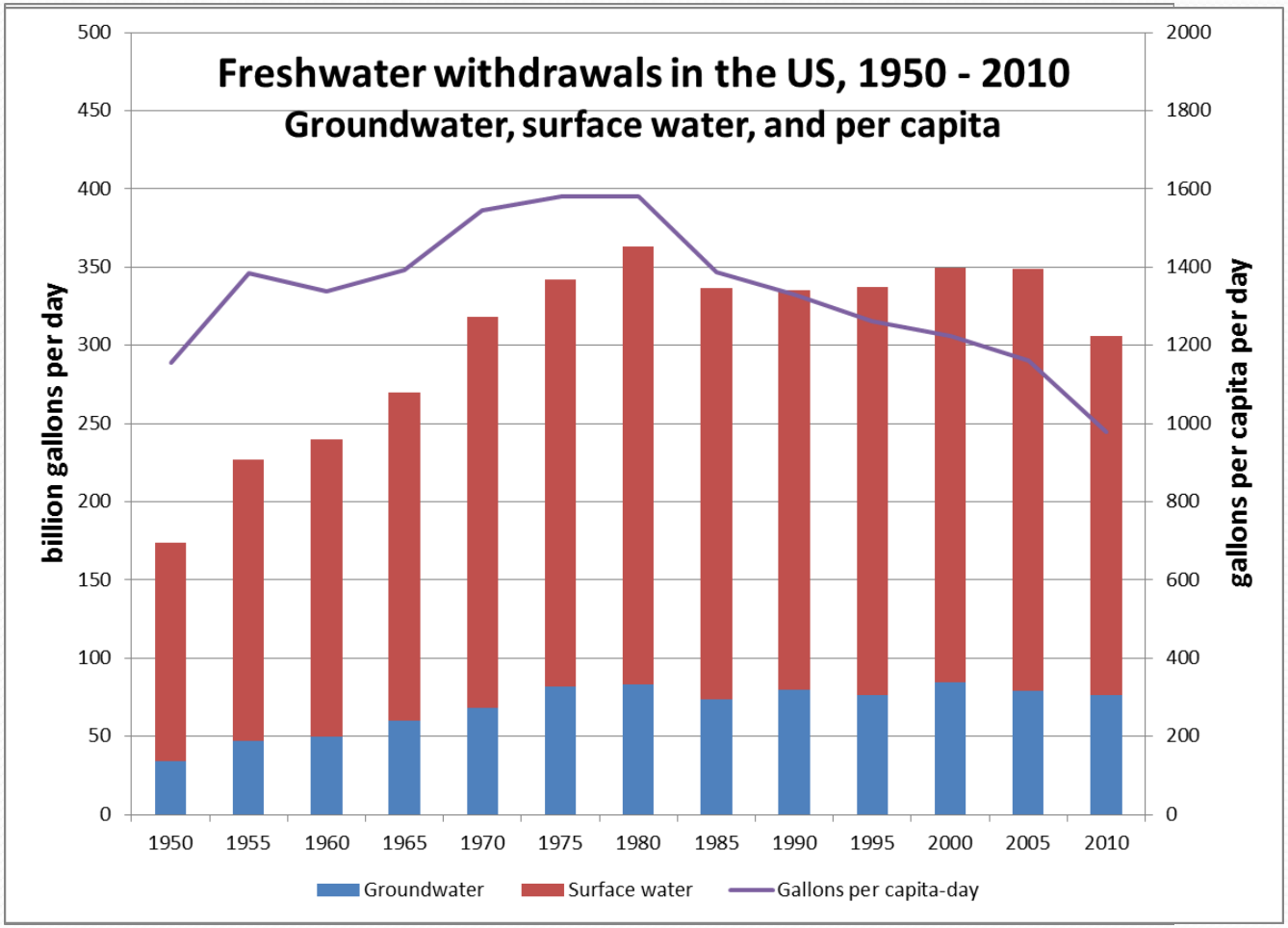


The declines are both wide and deep, occurring in municipal, industrial, agricultural, and power sectors, across the U.S.

Questions this raises:

Why has household water demand been dropping for decades in AZ, NV, NM, and across North America?

And in particular:

- *What are the underlying causes of declining demand?*
- *Which impacts of the "great recession" were temporary?*
- *What will future housing construction look like?*
- *How low could it go?*

Another question - Isn't this a good thing?

Despite growing populations and more customers, many water providers in the Southwest have experienced flat or even declining water demand.

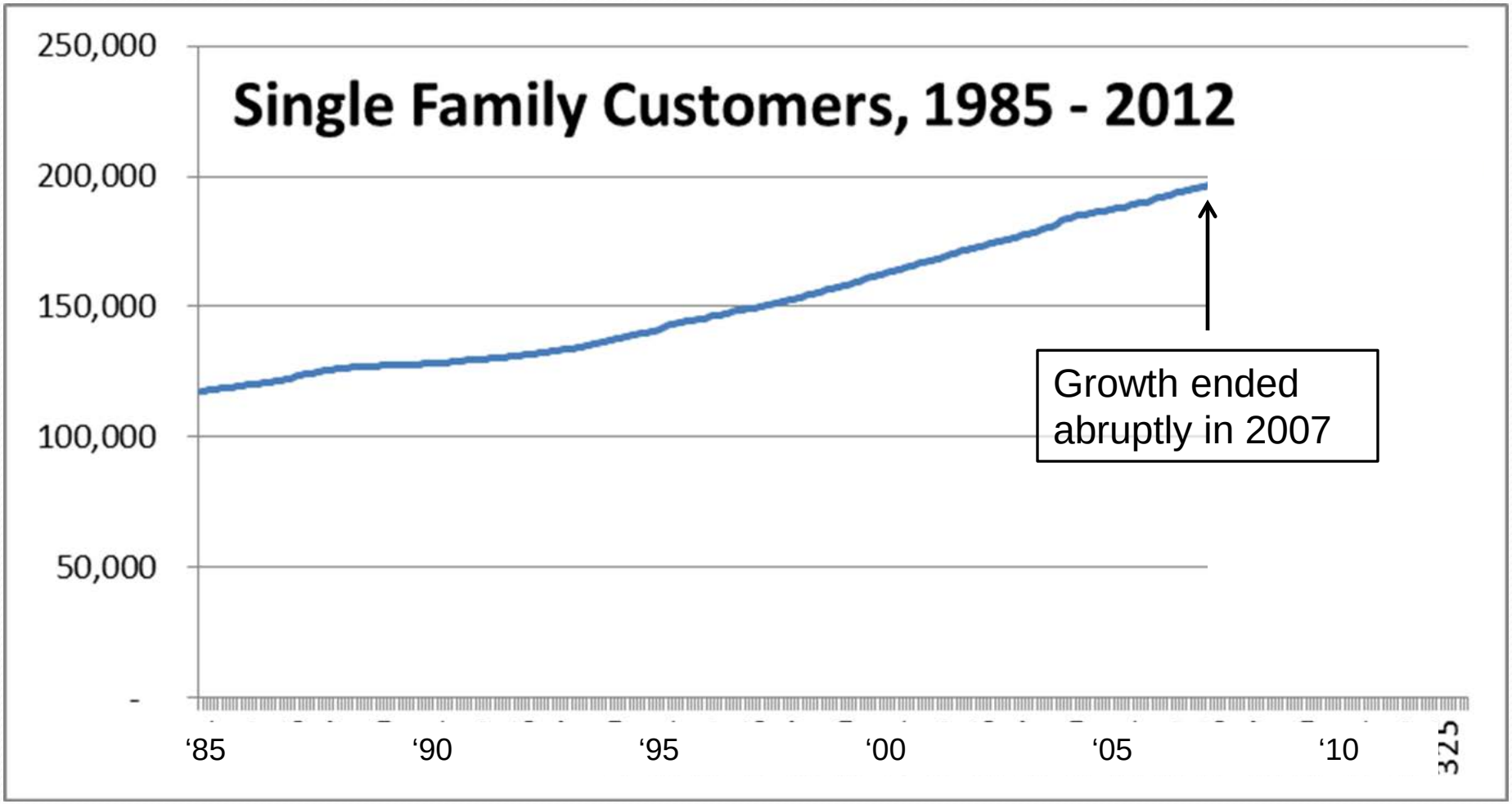
Decreasing per-household demand over the last 20-30 years has offset growing populations.

This saved a lot of water and a lot of money.

Then the "Great Recession" came along…

Housing collapse abruptly stopped new hookups

Tucson Water



The housing bubble burst resulted in:

- plunging hook-up fees
- paying for unused system capacity
- vacant homes not using water
- delinquent water bill payments
- political resistance to rate hikes

Result was steeper declines in demand and substantial reductions in utility revenues.

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Other consequences include:

- an aversion to water conservation spending;
- a deeper interest in understanding long-term demand declines; and
- the need to improve ability to forecast future demand trends.

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Given the long-term declines in demand, why were so many caught by surprise?

Misperceptions to trend lines can include:

- Over-reacting to short-term events
- Under-reacting to or explaining away turning points
- Defining the long-run by the most recent short-run – “the tail wagging the dog”
- Better to have too much capacity than not enough – can “grow into” premature capacity
- Being optimistic during economic booms and pessimistic during downturns
- Waiting for things to “bounce back” or “return to normal”

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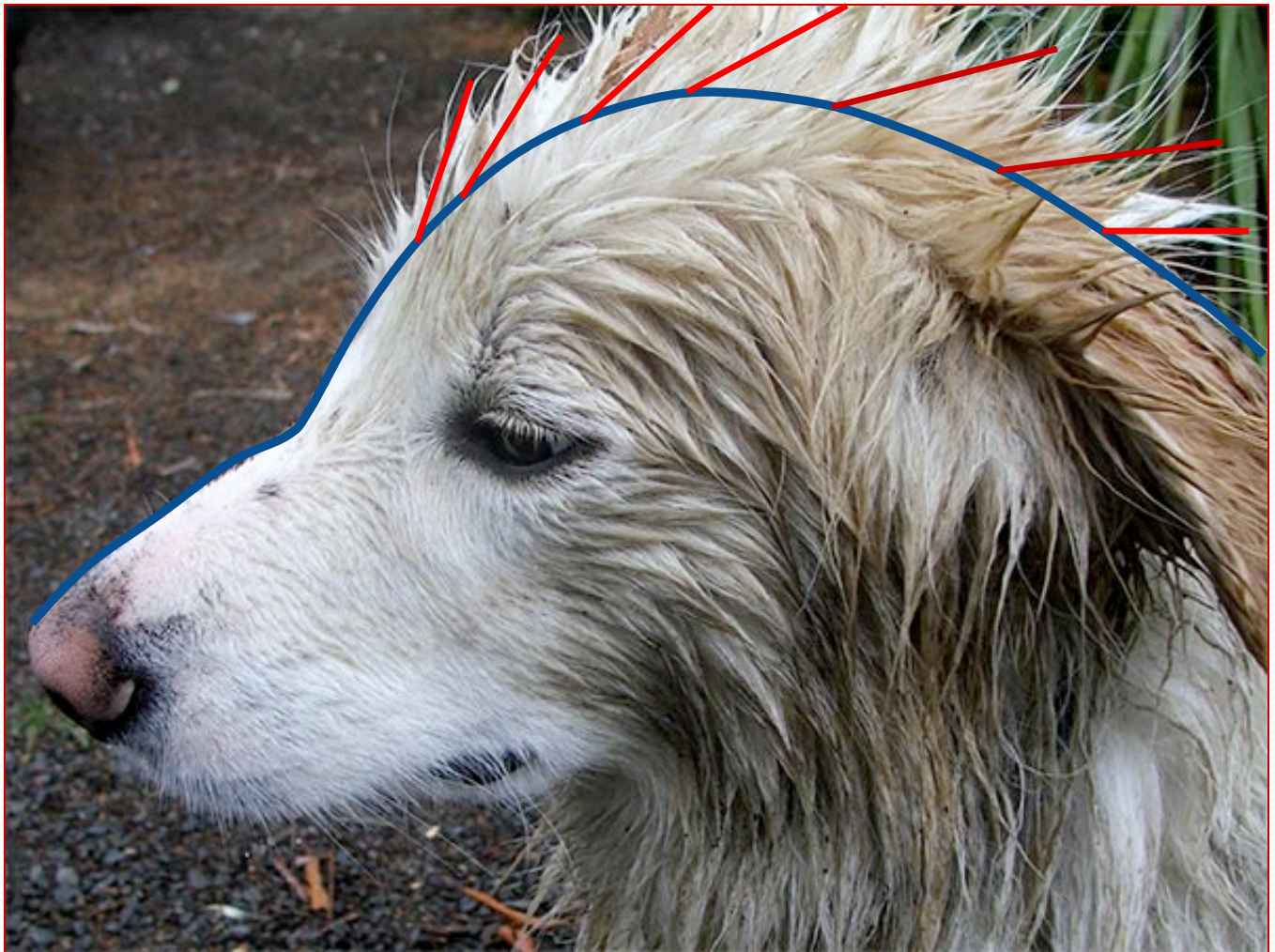
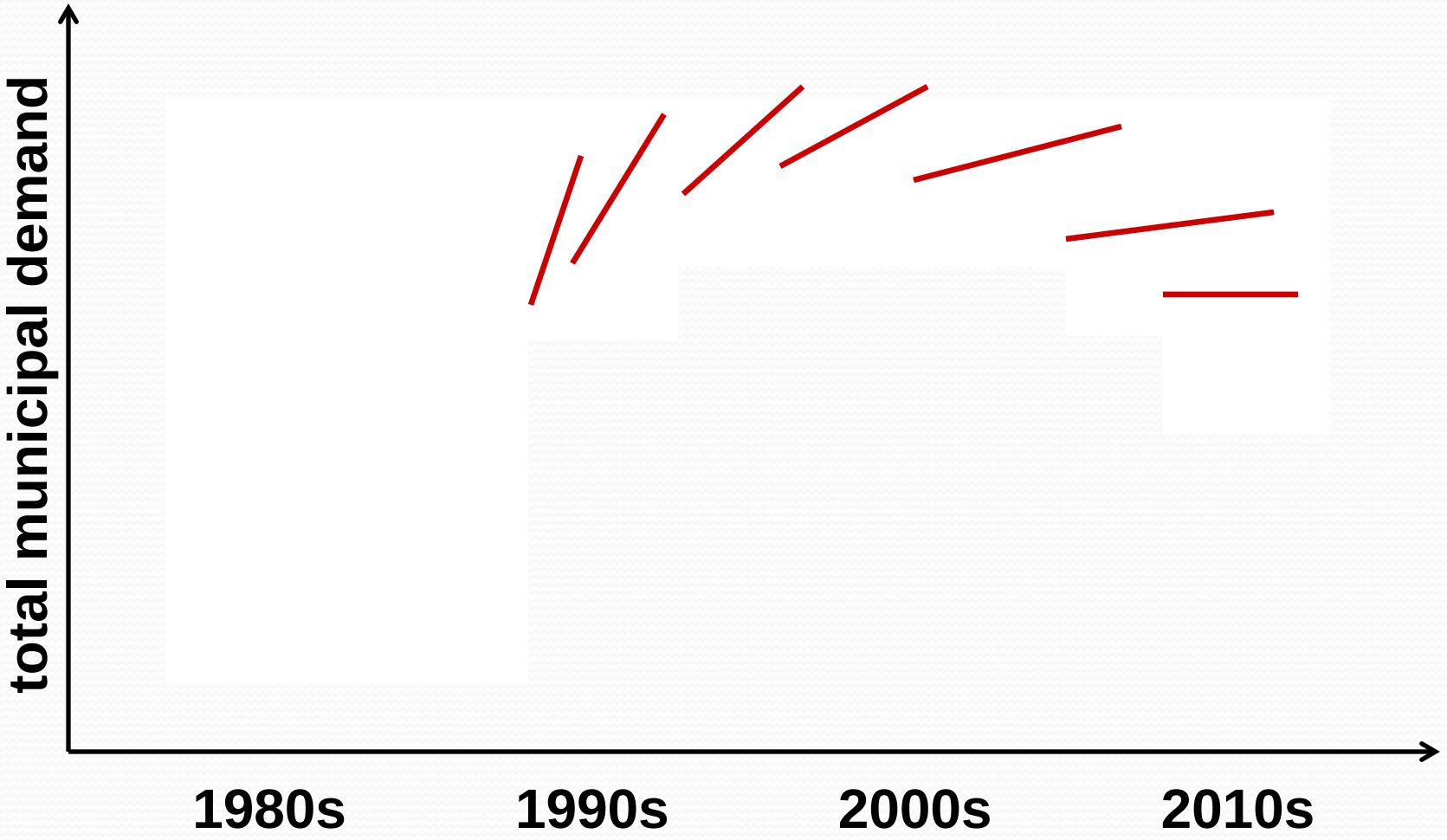
What's a doghair demand curve?



Building a doghair demand curve:



Seattle – total deliveries

Dog-hair demand curves result from:

- Tying demand to population projections
- Being overly conservative
- Over-reacting to short-term events
- Ignoring or misinterpreting long-term trends

Other ways to be blindsided:

Assume most or all changes in water demand rates are due to active or deliberate conservation programs…

…and incidentally protect the underlying rationale for large hook-up fees.

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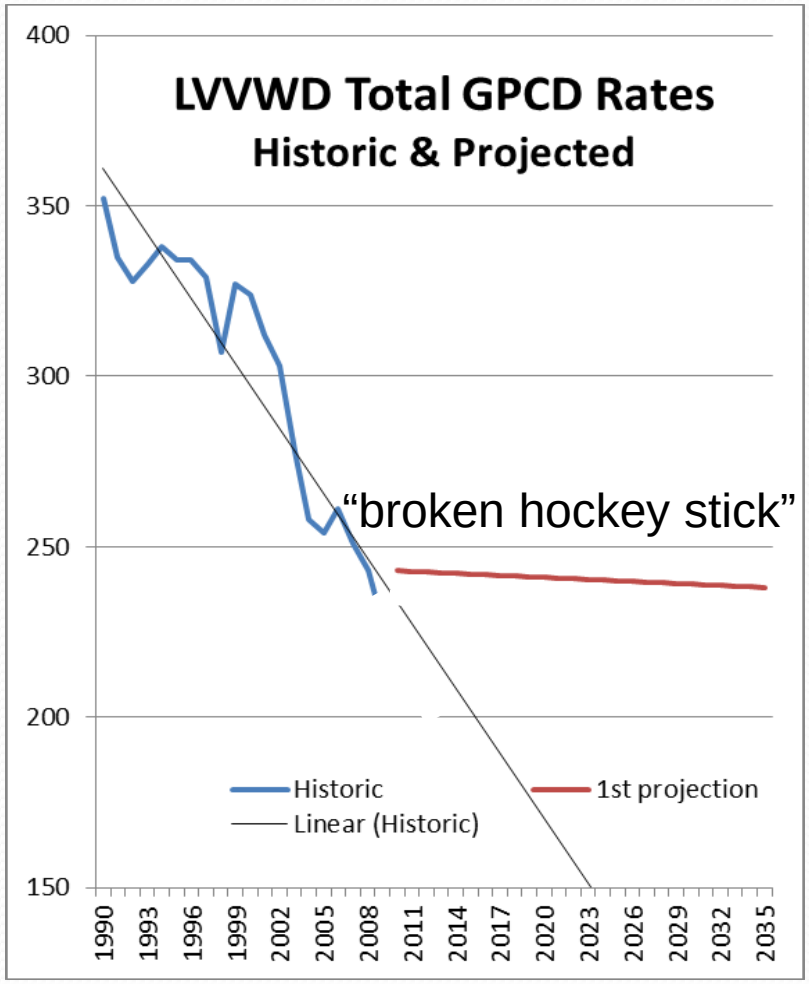
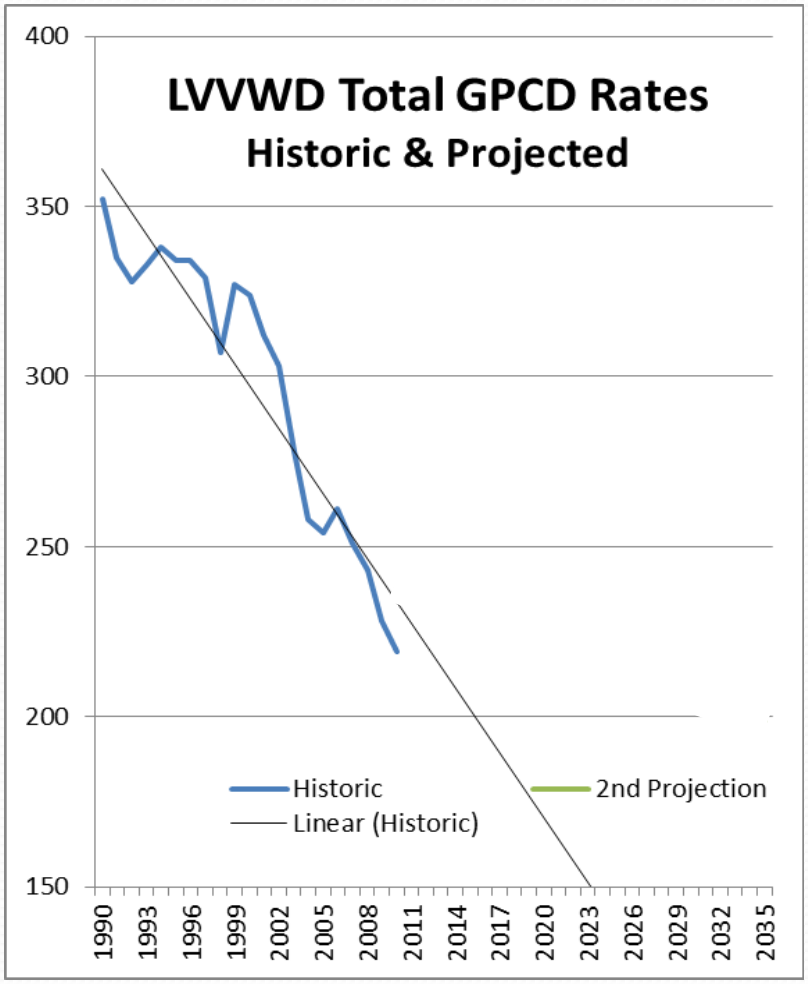
Las Vegas Valley Water District gpcd rates





Not understanding or denying the trend creates planning challenges…

Water providers, wholesalers, wastewater plant operators, water regulatory agencies must adjust:

- optimal timing of capital improvements
- acquisition of new supplies
- rate setting
- budgeting uncertainties
- design of water conservation programs
- reuse of reclaimed water

…and some unintended consequences

Lower demand in new developments means:

- fire flows increasingly determine pipe sizes
- water stays in distribution system longer – “water age”
- more chlorine must be added, at new points
- water becomes warmer

All this results in more disinfection byproducts, such as THMs, and can lead to more hydrant flushing or DBP treatment.

…and some wastewater consequences

Lower demand in new development has some interesting wastewater treatment consequences:

- ADEQ and Table 1
- Tempe and contract with Reclamation
- Trend toward reuse/recharge of all A & A+ class effluent, but quantities are uncertain

Summary of issues raised

A number of issues have arisen, including:

- fiscal consequences
- operational issues
- planning challenges and
- public perception issues.

Water providers & regulators supporting this work:

- Tucson Water
- Central Arizona Project
- Bureau of Reclamation
- AZ Dept. of Water Resources
- SAWUA
- Metro Water
- Comm. Water - Green Valley
- Pima County Wastewater

Additional work for litigation support in Clark County

- Salt River Project
- Central Arizona Project
- Bureau of Reclamation
- AZ Dept. of Water Resources
- Chandler
- Gilbert
- Glendale
- Mesa
- Peoria
- Scottsdale
- Tempe

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Specific questions & concerns

- Are some recession-caused drops in demand permanent?
- What will new housing look like in 3-5 years?
- Why the sharp drop in pools?
- Is turf dead?
- Is demand becoming more seasonal?
- How to adjust rate-making?
- How to distinguish between active and passive conservation?

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Factors affecting municipal water demand:

Economics
- Water & sewer rates
- Income levels

Changing Tastes
- Pools
- Landscapes
- New homes

Environment
- Persistent drought
- Climate change
- Urban heat island

Conservation
- Education & preachments
- Rebates & give-aways
- Demonstration sites

Changing Socio-demographics
- Composition of households
- Seasonal residents

Efficiency Standards
- Federal mandatory
- Federal voluntary
- Neighboring state effects

New Technology
- Smart meters
- Next generation washers
- Smart irrigation controllers

New approach to demand forecasting

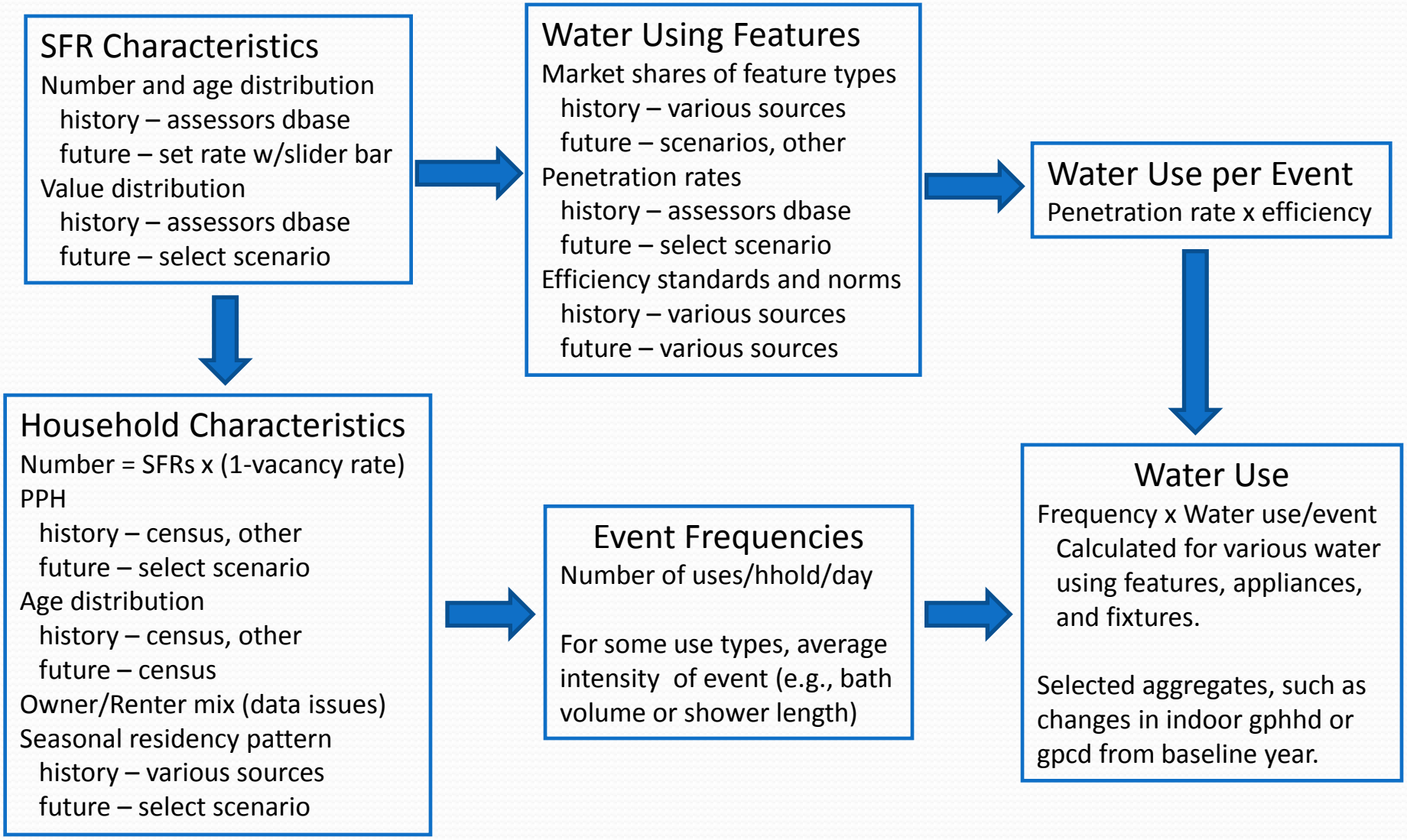
Most studies of municipal demand:

- Focus on small subset of factors
- Attempt to measure water associated with particular use(s) or change in use

This study of municipal demand:

- Looks at all significant factors
- Relies on existing information on water use rates whenever possible
- Focuses on rates of change in stocks of appliances, fixtures, and landscape characteristics
- Examines triggers of change

Model Structure for Residential Demand Trends

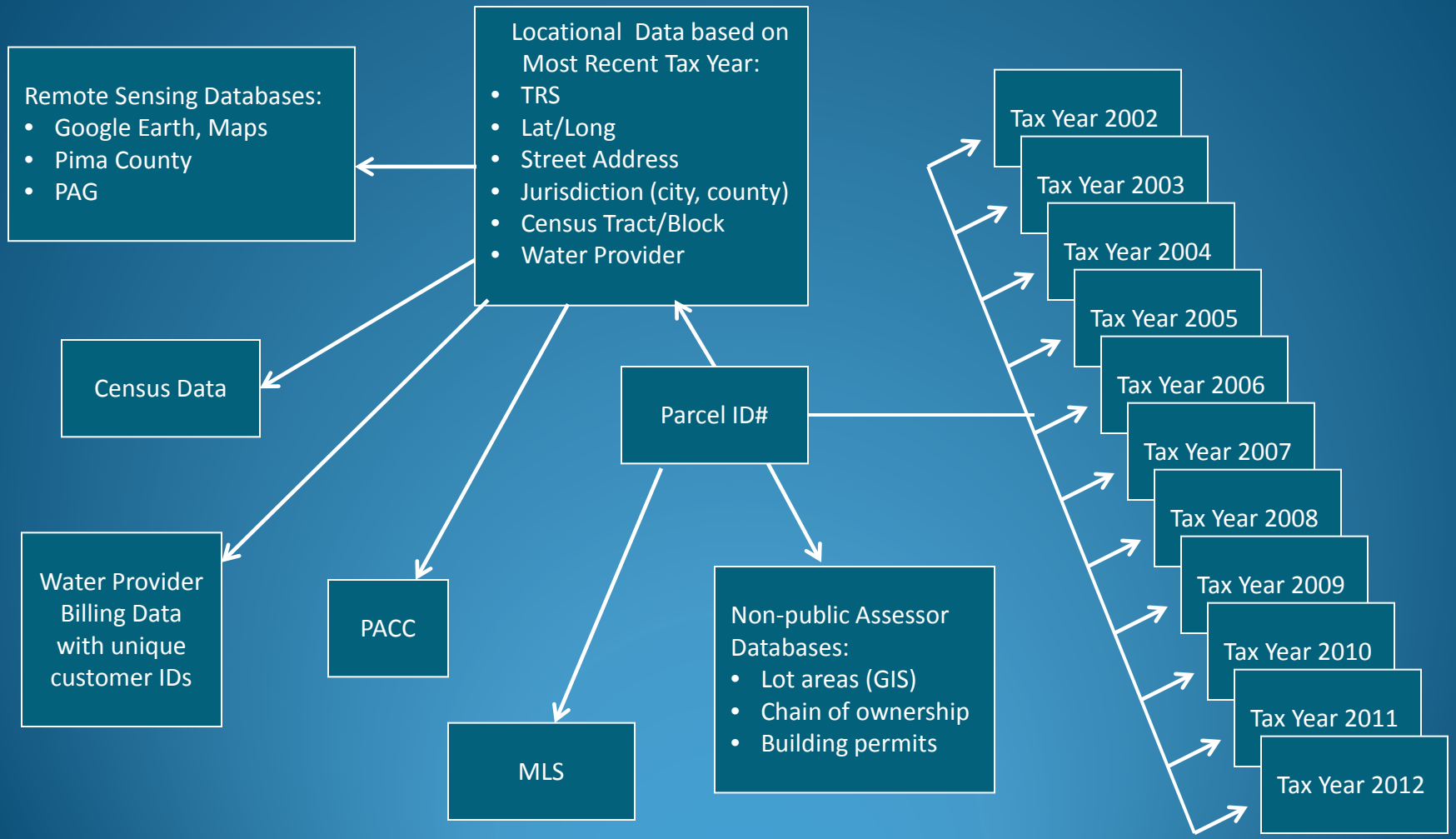


What we modeled… and didn't model

This is a model of significant changes in SFR demand, not absolute levels of demand. We modeled those demand factors that account for substantial amounts of water and that are, or may be, changing at a significant rate.

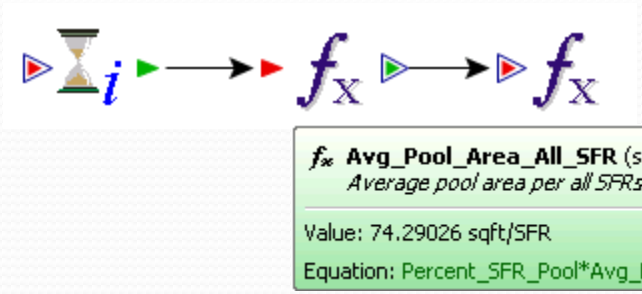
We did not model demand components that appear relatively stable or that account for relatively minor amounts of water (e.g., car washing, garbage disposals) or that have all but disappeared (e.g., winter Rye in Pima County, evaporative coolers in Maricopa County).

Databases for Pima County Demand Trends Project



Why a dynamic simulation model?

- **Integrates significant SFR water demand**
- **Addresses uncertainty**
- **Compares scenarios**
- **User interface**
- **Transparent**
- **Graphical outputs**

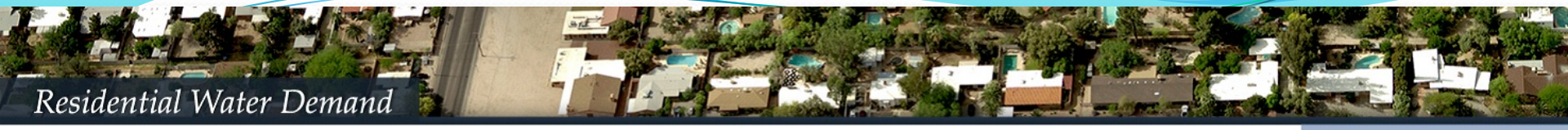


Users can ask “What if?” questions and define a scenario

Adjustable factors include:

- Housing markets
- Socio-demographcs
- Device water use efficiency
- Mandates and rebates
- Increase in water-conscious consumers

Users can also select a pre-defined scenario



EDIT INPUTS & RUN MODEL

DOCUMENTATION

EDIT INPUTS & RUN MODEL

VIEW RESULTS

- Summary
- Demographics
- Indoor Uses
- Outdoor Uses

Before you can edit inputs, the model must be in edit mode, with **Live Model** selected in the Scenarios dropdown in the box to the right.

- To activate edit mode, press **F4**. To activate results mode, click Run.
- To save a scenario for future use, click +.
- To run the model using a preset or saved scenario, select an option from the Scenarios dropdown and click Run.

SCENARIOS
Run Model & Select / Save Scenarios
Live Model | Run | + | -

Reset Inputs to Baseline

DEMOGRAPHICS

Annual birth rate, %
1 — 1.27 — 1.4

Annual growth rate of new SFRs, %
0 — 1.2 — 4

Annual sales rate of existing SFRs, %
0 — 6.5 — 12

Houses flipped, % existing homes
0 — 0.25 — 2

INDOOR USES

Clothes washer efficiency, gals/load
Current

Start date, 2-gpm shower head mandate
2016

Year dual-flush toilet rebate began
Never

OUTDOOR USES

Annual backyard turf removal rate, %
0 — 4 — 8

Annual pool removal rate per year, %
0 — 0.15 — 0.3

Evaporative cooler consumption, gpd
20 — 30 — 40

SAWUA · TUCSON WATER · CAP CENTRAL ARIZONA PROJECT · YOUR WATER. YOUR FUTURE. · U.S. Department of the Interior Bureau of Reclamation · Arizona Department of Water Resources · Metro Water District · Pima County Regional Wastewater Reclamation Department

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Predefined scenarios

In addition to modifying the baseline scenario to create a scenario, the user can select predefined scenarios of:

- Long-term economic upturn
- Long-term economic downturn
- Long-term drought conditions

Dynamic simulation allows models to incorporate deep and complex linkages

Selecting an economic scenario changes

the rate of housing construction

and the distribution of new homes by value

which affect percent of new homes with pools

and the average size of pools

both of which affect outdoor water demand

New SFRs also have larger households with more pre-adults

which changes overall household socio-demographics, and

frequency of use of appliances & fixtures

which affects all facets of indoor demand

And more linkages…

Selecting an economic scenario also changes

the rate of sales of existing houses

and the distribution of existing home sales by value

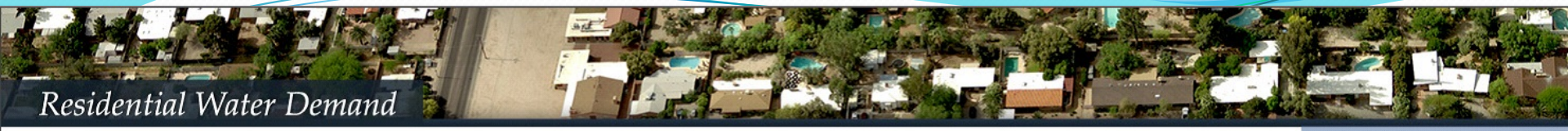
which affect home remodeling

which affects indoor water demand

Sales of existing SFRs also trigger conversion of swamp to AC

which affects outdoor demand

Everything affects everything, and this model captures that.



Residential Water Demand

VIEW RESULTS › INDOOR USES

DOCUMENTATION ›

EDIT INPUTS & RUN MODEL

VIEW RESULTS

- Summary ›
- Demographics ›
- Indoor Uses ›
- Outdoor Uses ›

Click a button below to view results for the last model run. To compare results for two or more scenarios, run each one first.

The graphs will display each variable individually. You can toggle between variables using the dropdown menu at the top of the results window.

CLOTHES WASHERS	SHOWERS	TOILETS
Market Share	Market Share	Market Share
Penetration Rate	Penetration Rate	Penetration Rate
Average Water Consumption per Load	Average Water Consumption per Shower	Average Water Consumption per Flush
Loads per Day by Age Cohort	Baths/Showers per Day by Age Cohort	Flushes per Day by Age Cohort
Water Consumption per SFR	Water Consumption per SFR	Water Consumption per SFR
Total Consumption for Service Area or County	**Total Consumption for Service Area or County**	**Total Consumption for Service Area or County**

SAWUA

TUCSON WATER

CAP
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U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

ARIZONA DEPARTMENT OF WATER RESOURCES

METRO WATER DISTRICT

Pima County Regional Wastewater Reclamation Department

MONTGOMERY & ASSOCIATES

Possible factors of long-term decline:

- water (and sewer) rate increases
- more effective water conservation programs
- declining household sizes (PPH)
- changing tastes in landscaping
- more water-efficient fixtures and appliances in new homes
- replacement of inefficient fixtures, appliances in older homes
- declines in popularity of backyard pools, use of pool covers
- shrinking lot sizes
- swamp coolers replaced by AC
- more seasonal (part-time) residents

One way that PPH can decrease…

…and some alternative mechanisms:

- delayed age at first marriage
- more people never marrying
- declining birth rates
- more single-parent families
- increased longevity
- more affordable housing
- rising incomes

What does declining PPH actually do?

- Increases the number of homes needed for a given population…
- Which results in a newer housing stock…
- With more efficient fixtures and appliances and therefore lower indoor demand rates…
- But with more landscapes and pools per capita, thereby increasing outdoor demand rates.

Evidence suggests PPH no longer declining:

- Boomerang kids
- Growing percentage of 3-generation households
- More alternate household living arrangements
- Building industry responding with “home within a home” floor plans

But households are still changing:

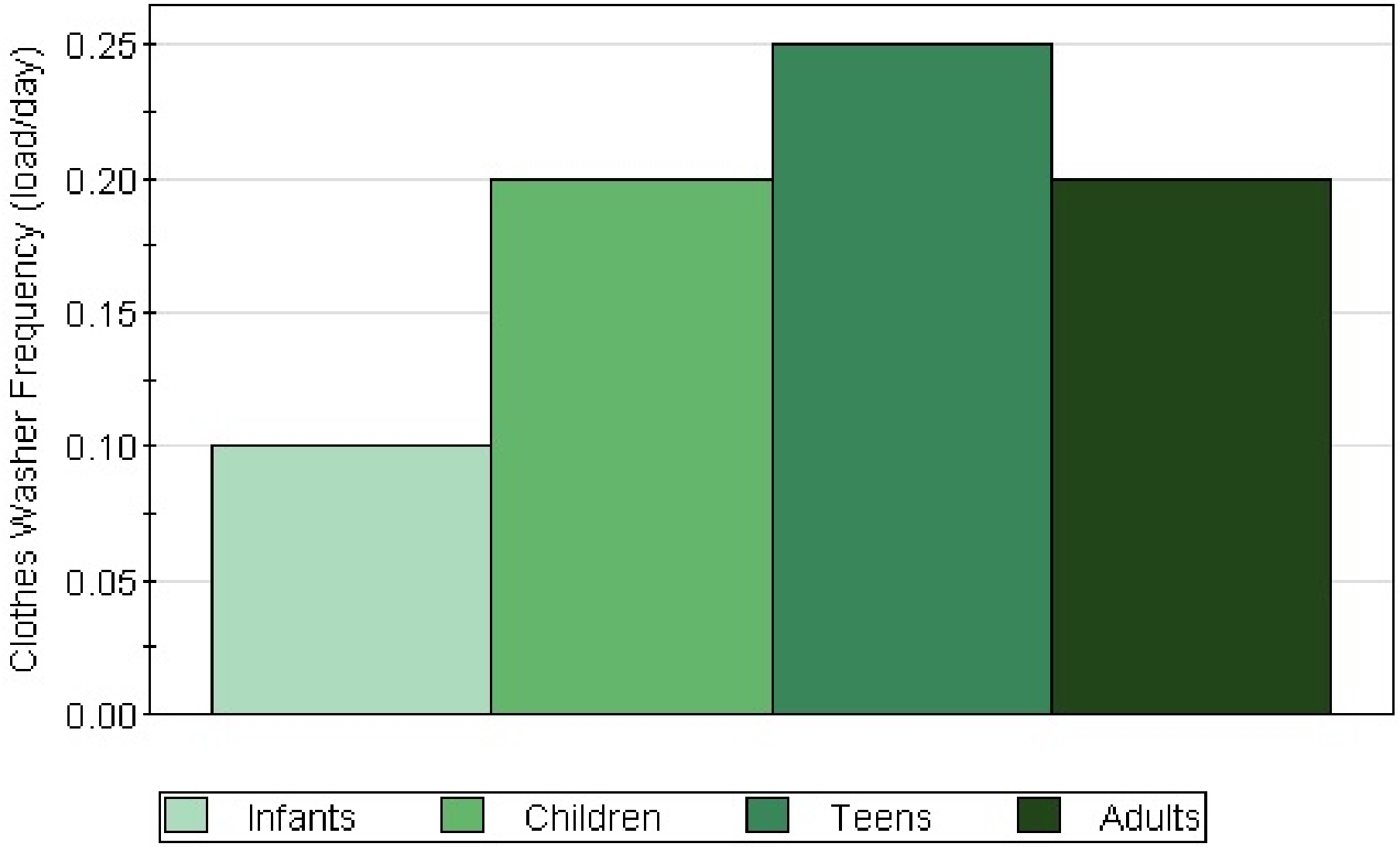
- Fewer infants, children and teens
- More 1-adult households, including with children
- More retirees and snowbirds
- In general, a graying population

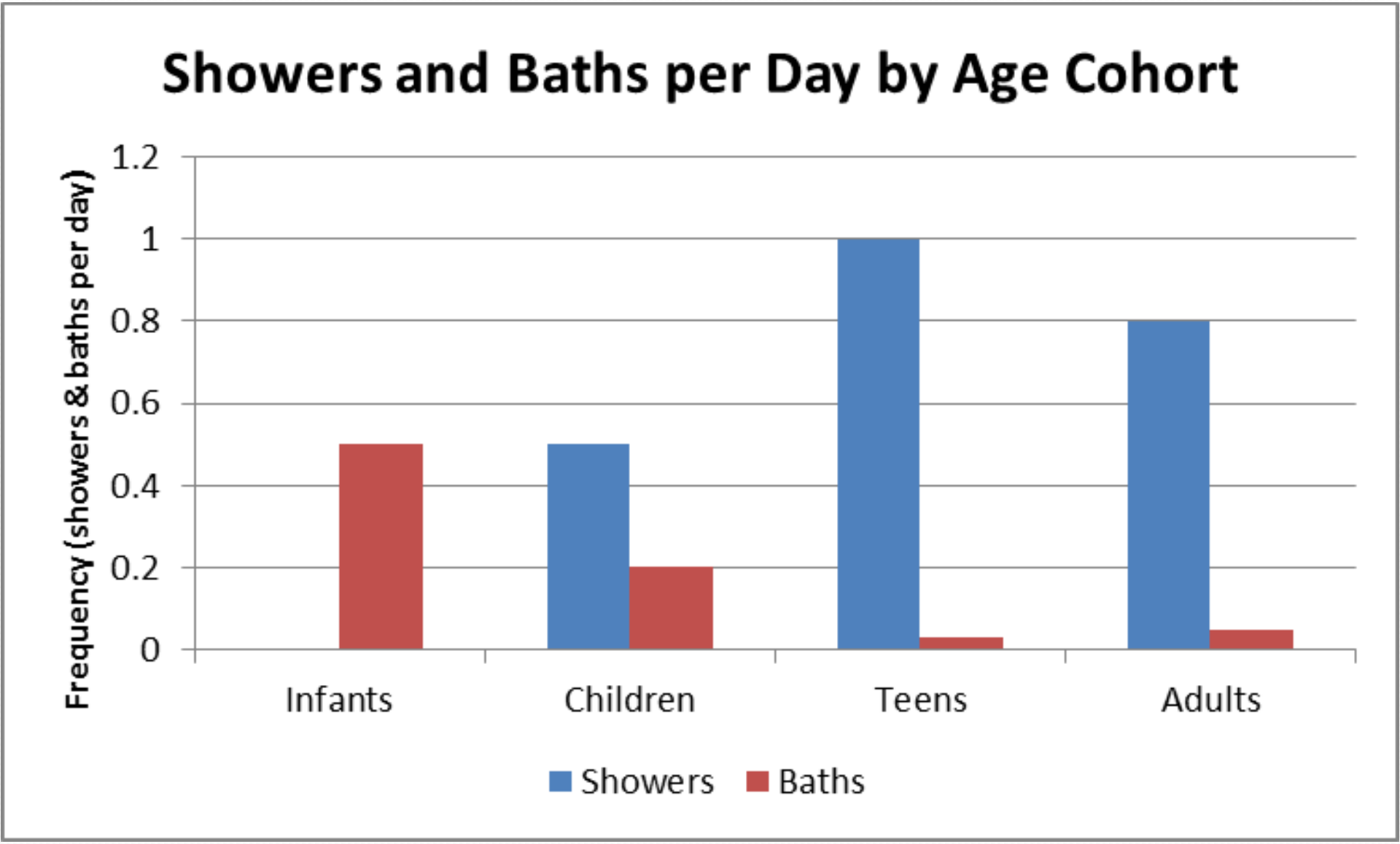
Changes in households are affecting frequencies of indoor water uses

Regressions run on AquaCraft WRF data reveal:

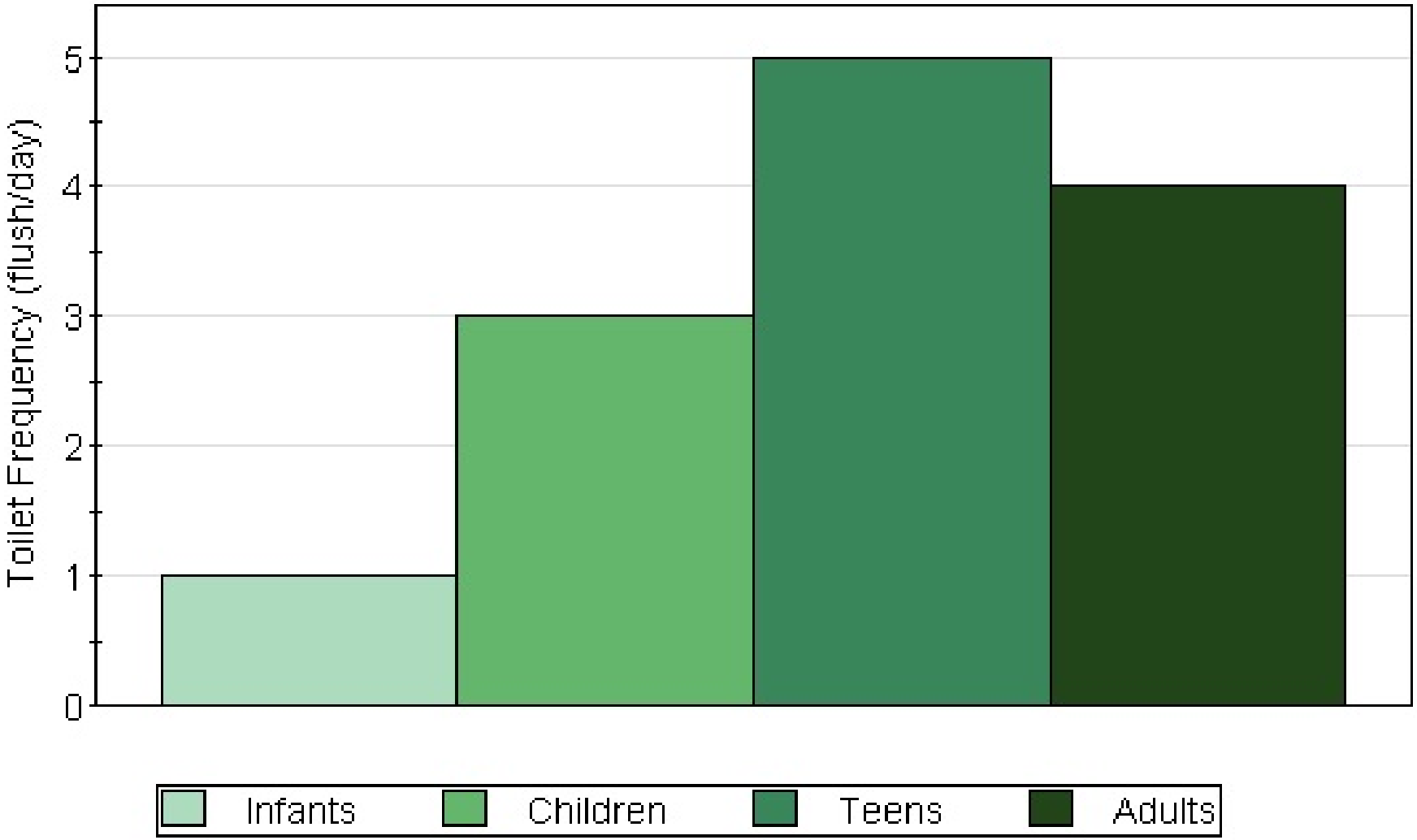
- Shower, clothes washer, and dish washer usage is affected by temperature
- Infants don’t flush toilets or take showers
- Children account for most baths
- Teenagers really do take more frequent and longer showers than adults
- Most usage rates hold across 9 urban areas

Clothes Washer Loads per Day by Age Cohort in 2020




Showers and Baths per Day by Age Cohort
Frequency (showers & baths per day)
1.2
1
0.8
0.6
0.4
0.2
0
Infants
Children
Teens
Adults
Showers
Baths

Toilet Flushes per Day by Age Cohort in 2020



AquaCraft study also reveals real-world usage rates for fixtures and appliances:

- 1.6 gpf toilets average about 1.45 gpf
- 2.5 gpm shower heads average about 2.1 gpm
- Clothes washers appear to use their rated water demand
- Biggest issue with water used for dish washing is whether the household has, and uses, a dishwasher

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Reduced turf irrigation due to:

- Abandonment
- Reductions in area
- Replacement with xeriscapes, drought-tolerant plant species
- Restrictions in new construction
- Less winter over-seeding with rye grass
- Replacement with artificial turf

A market exists for plastic grass

Many sellers of artificial turf for residences:

- 10 in Pima County
- 22 in Maricopa County
- 15 in Clark County

Major increases in last year!

Three top marketing pitches are:

#3 – Have your own backyard putting green!

#2 – It's a great place for the kids to play!

#1 – Do it for your dogs!

We recently had a Tucson Turf Lawn installed, and with 4 dogs it has made all the difference. The interior of our home is much cleaner without the dogs tracking in dirt from the yard. Thank you! - *Karen F., Tucson, AZ*

I wanted to let you know how much we love and enjoy our new backyard patio with your turf. Even our dog loves it. She rolls and sleeps on it (and doesn't dig or rip at it!).

Source of the quotes and pictures is:
www.tucsonturf.com/testimonials.html
NOTE – ***not one photo or mention of kids.***

Our new puppy loves her new lawn, as do all of us.

My two small puppies love their new playground. They used to tip-toe around on the rocks - now they run and play like crazy! After playing and chasing each other on the grass for awhile, they love to lay on the grass to catch their breath (and pose for a quick pic). Thanks again. - *Sam*

Changing face of the American family

Only 33% of households have children, and the figure is declining.

About 45% of households have at least one dog.

Turf in Pima County:

- 35% of SFRs have some backyard turf
- 22% of SFRs have a backyard pool
- Correlation between turf and pools is ZERO!

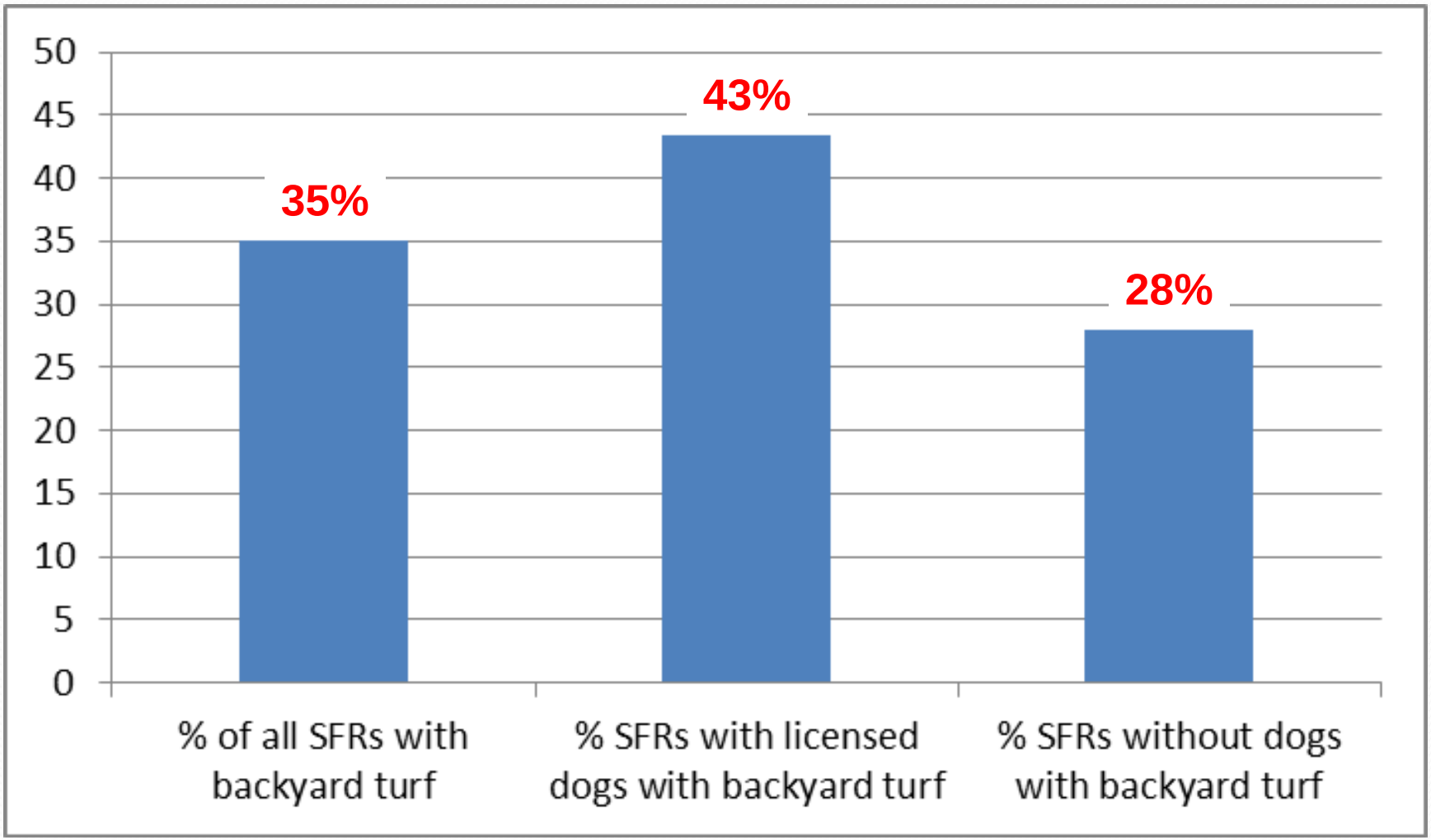
What factors are driving backyard turf?

Dog stats from PACC & PetSmart

- 20% of Pima County households have a licensed dog
- Fewer than half of dogs in Pima County are licenses
- About 45% of households have one or more dogs.

PACC provided a random sample of 500 addresses of licensed dog owners.

Dog ownership and backyard turf are definitely correlated



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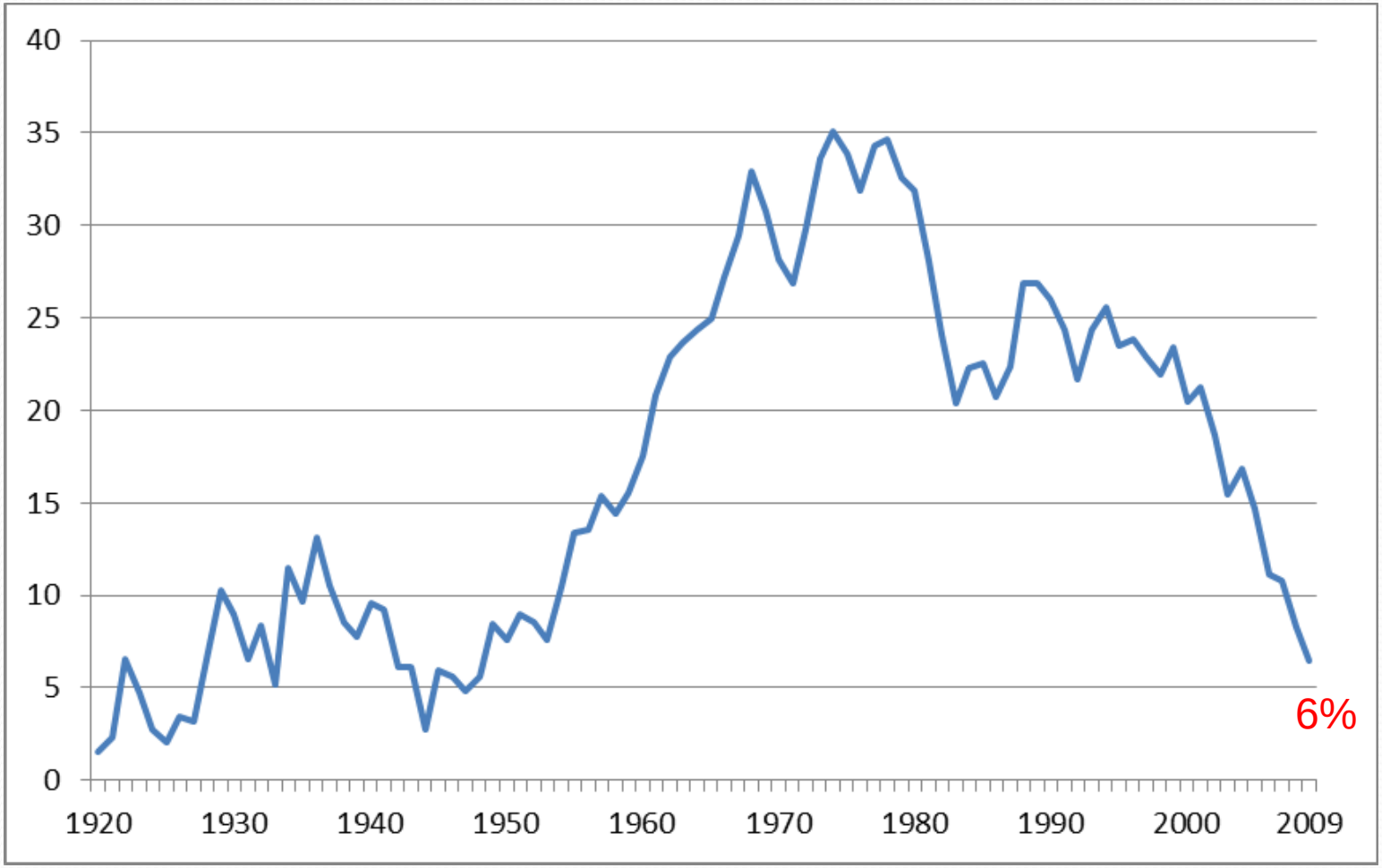
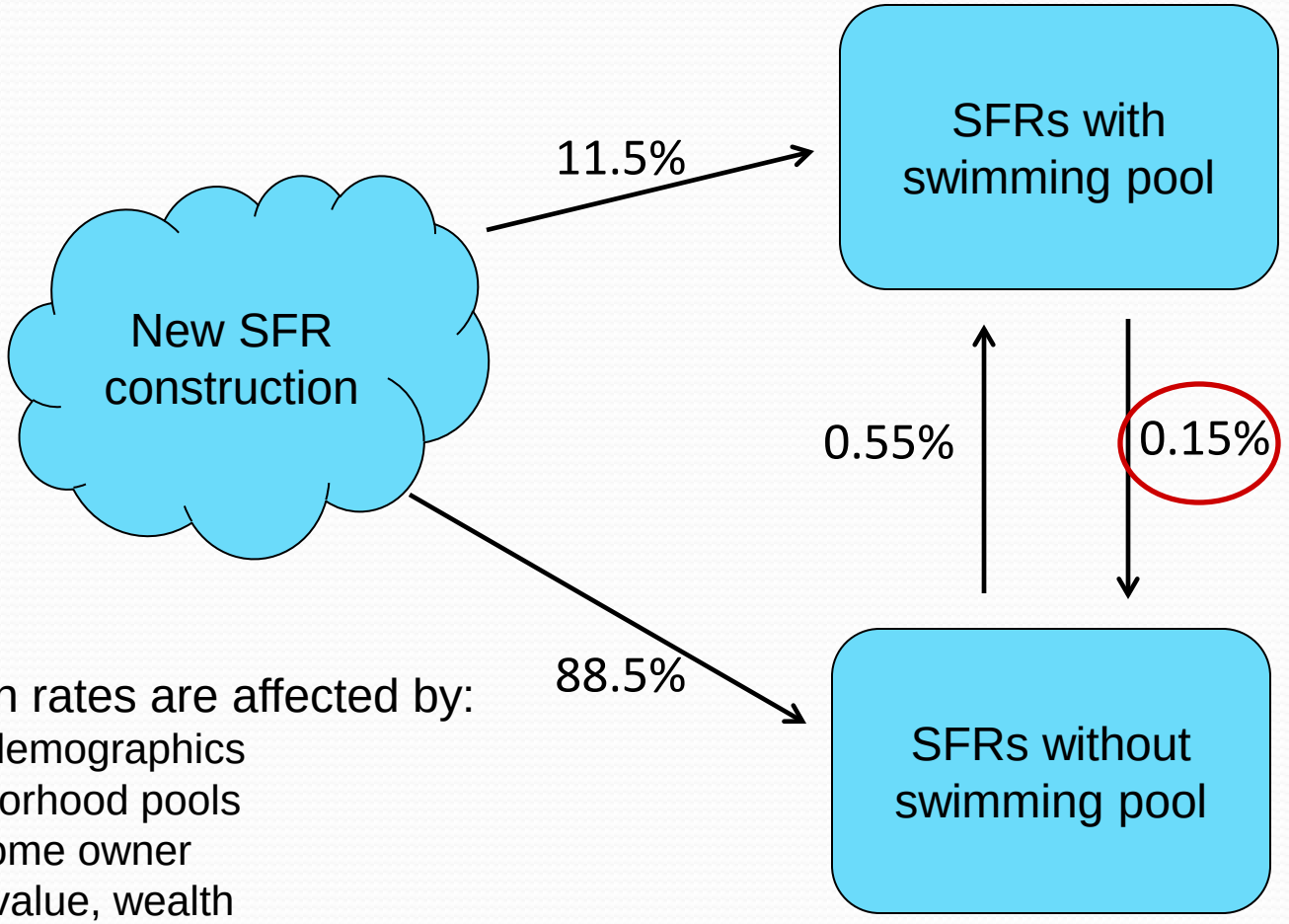
Other outdoor water uses - pools



20% of SFRs have a pool, but the popularity appears to have been in decline for decades.

Home swimming pools and transition rates



Transition rates are affected by:

- PPH, demographics
- neighborhood pools
- new home owner
- home value, wealth

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When do anecdotes become a trend?

Maybe when humorists start to notice….

F Minus, *Arizona Daily Star*, Jan. 5, 2013

…or maybe when someone discovers a profit motive.

ARCSA
American Rainwater Catchment Systems Association

Webinar:
Swimming pools converted to rainwater harvesting tanks

Swimming pools are fun, but are they worth the time and effort?

Feb. 26, 2013

See how you can save time and money by converting a swimming pool to a rainwater harvesting tank.

$20 for Members
$40 for Nonmembers

When it's a home improvement topic in the paper, it's passe.

New uses for old swimming pools

Convert space into useful, attractive landscape features

Mark "Eb" Eberlein, near a pond on his property, put a deck over the swimming pool and created a cistern that stores rainwater for a Painted Hills home's garden and desert landscaping. *Arizona Daily Star, March 7, 2013.*

Pools are not only scarcer, they're shrinking

Swimming pools built today are only a bit more than half the size of pools installed in the 1970s and early 1980s.

What's a spool?

"Stu sure is getting a lot of use out of the new lap pool."

Close to Home by John McPherson, 12 Aug. '13

Typical pools – past, present, future

Backyard pool trends

Backyard pools today are increasingly used by adults for exercise, not by families for recreation. Most important factors reducing per-household pool demand are:

- Smaller surface area
- Less popular
- More likely to be removed

What about net-zero pools?

The concept of a *trigger*

Why does someone decide today to put in a pool, or to replace their evaporative cooler with AC, or to buy a horizontal-axis clothes washer?

Why today and not yesterday, or a month ago?

What triggers these types of decisions?

Transitions can be triggered by:

- new home owners
- switch between owner-occupied and rented
- major home renovation
- water-using fixture or appliance or landscape dies
- targeted conservation program, e.g., rebate
- having kids / empty nest syndrome
- contagion effect – the neighbors do something
- drought, price shock, recession, etc.

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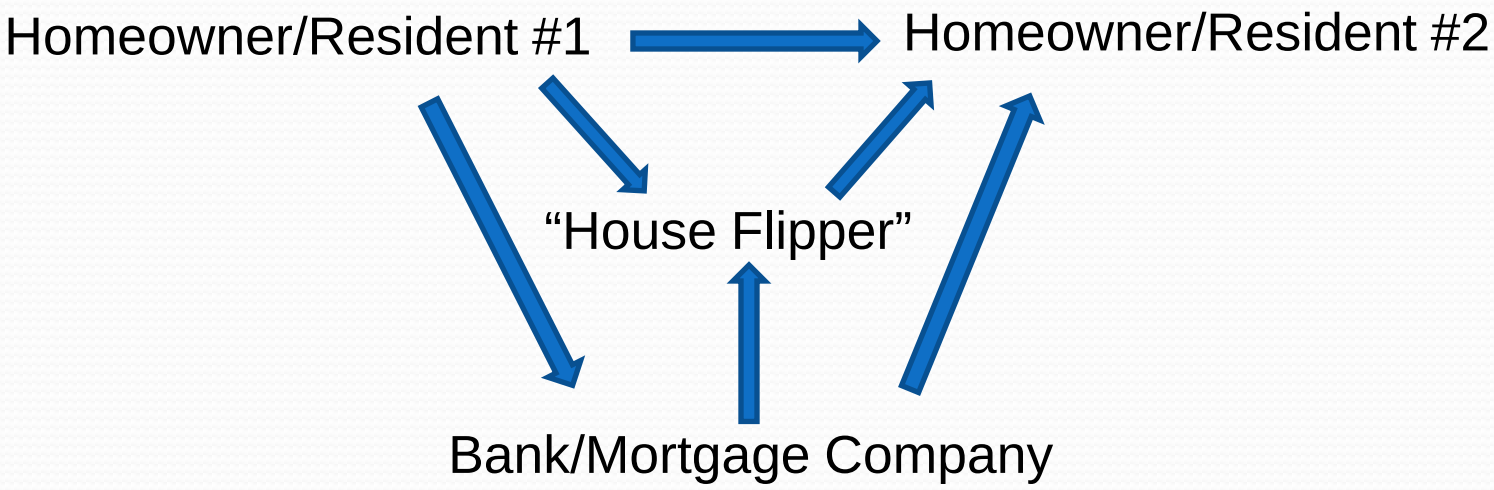
Home ownership transfers



How many foreclosed homes have landscapes die due to irrigation turned off or system failure?

How many homes that are “flipped” have bathroom remodels and/or new washer/dryers installed?

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Is house flipping a water conservation trigger?

What is effect of house flipping on demand?

A house with 3 owners within 1 year is likely to:

- be over 10 years old and not well-maintained
- get new water-efficient fixtures in bathrooms and kitchen
- have one or more new water-using appliances
- have its landscaping reduced
- be sold to an investor and then rented

Another major trigger – it died

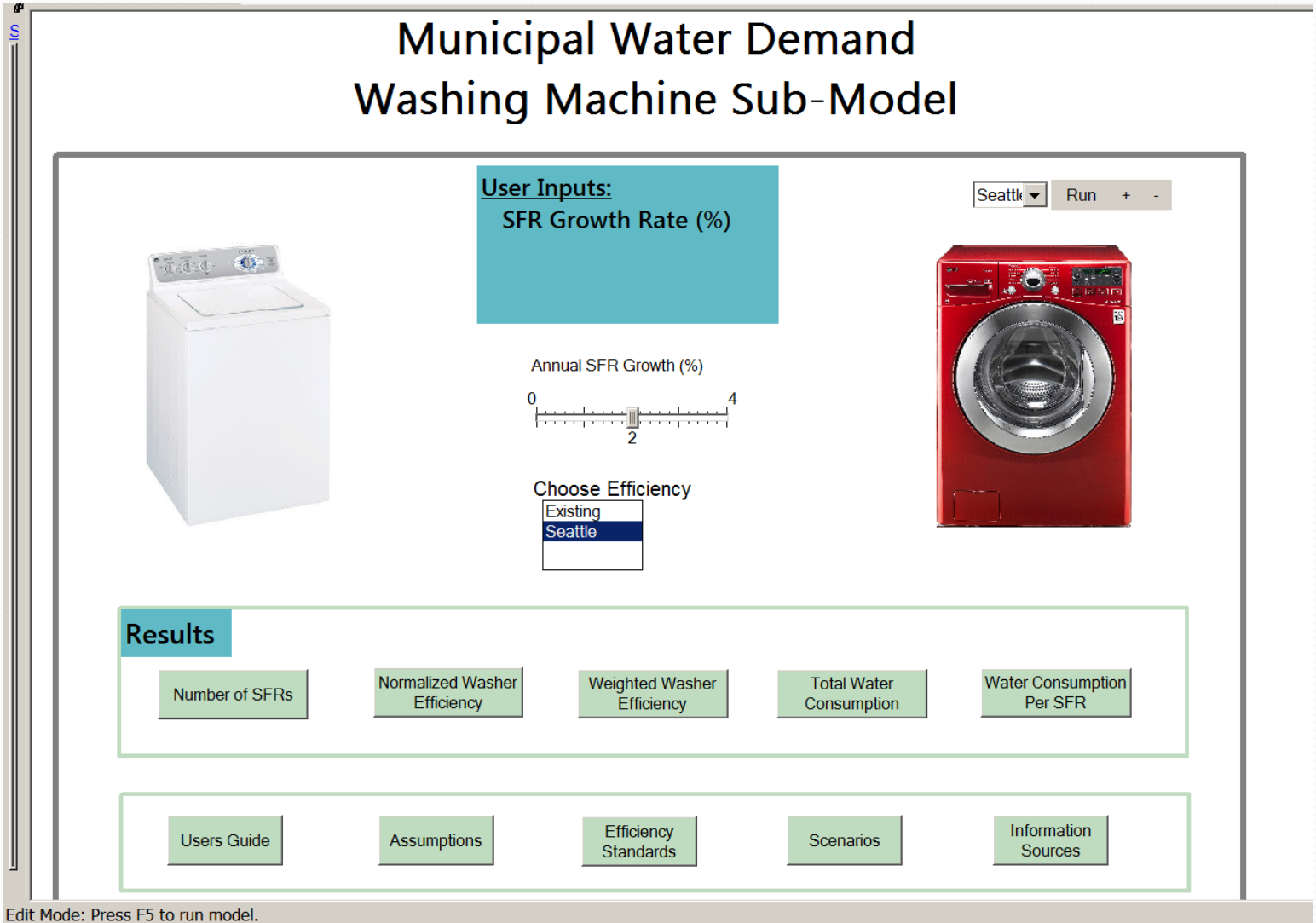
End of useful life for appliance or fixture can trigger water savings because:

- new appliances and fixtures are increasingly efficient
- voluntary standards have become de facto standards

Landscape vegetation also has a finite lifespan, and landscapers are planting more drought-resistant species

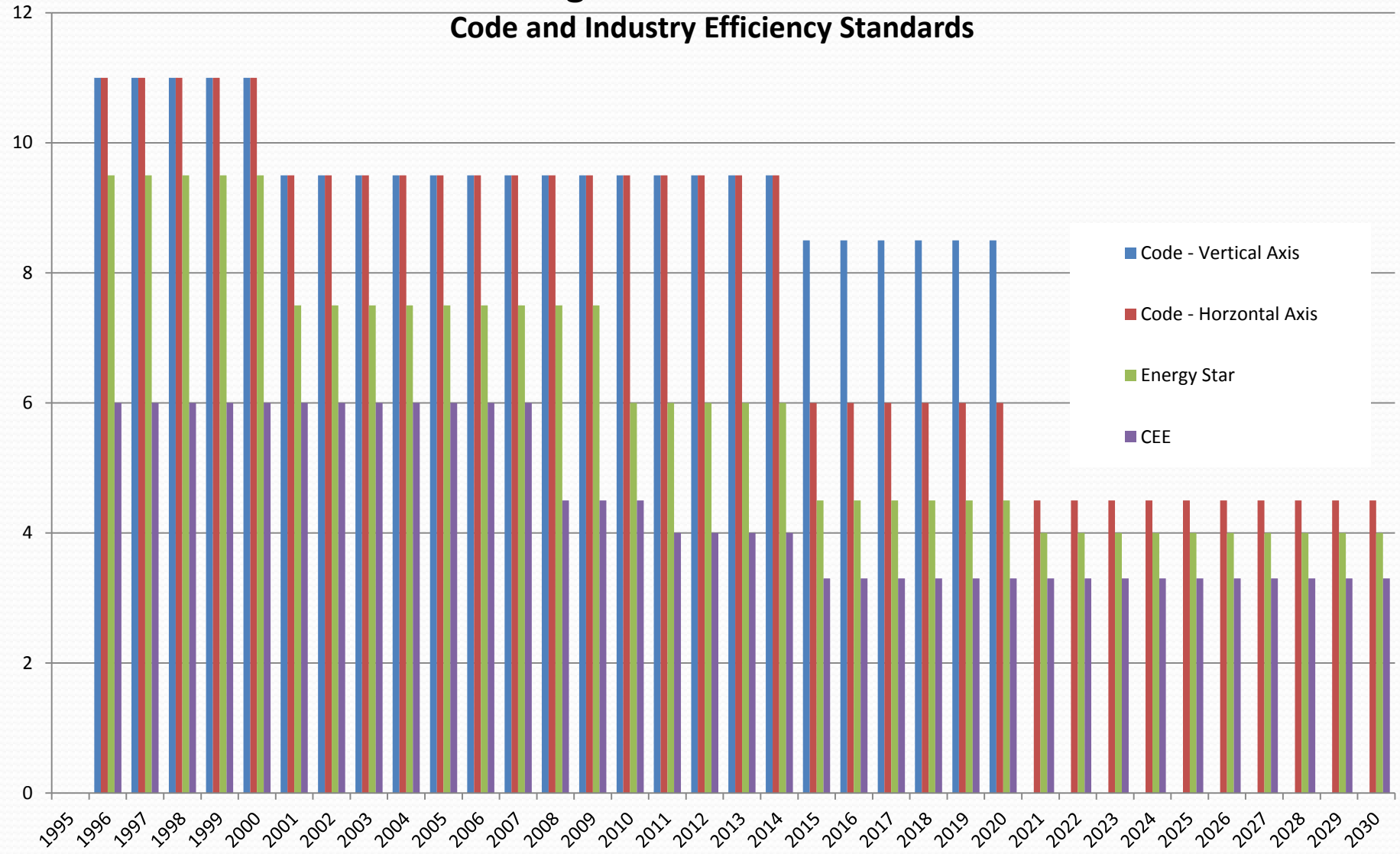
Swimming pools never die of natural causes, but old ones may be removed.

Clothes washers as prime example

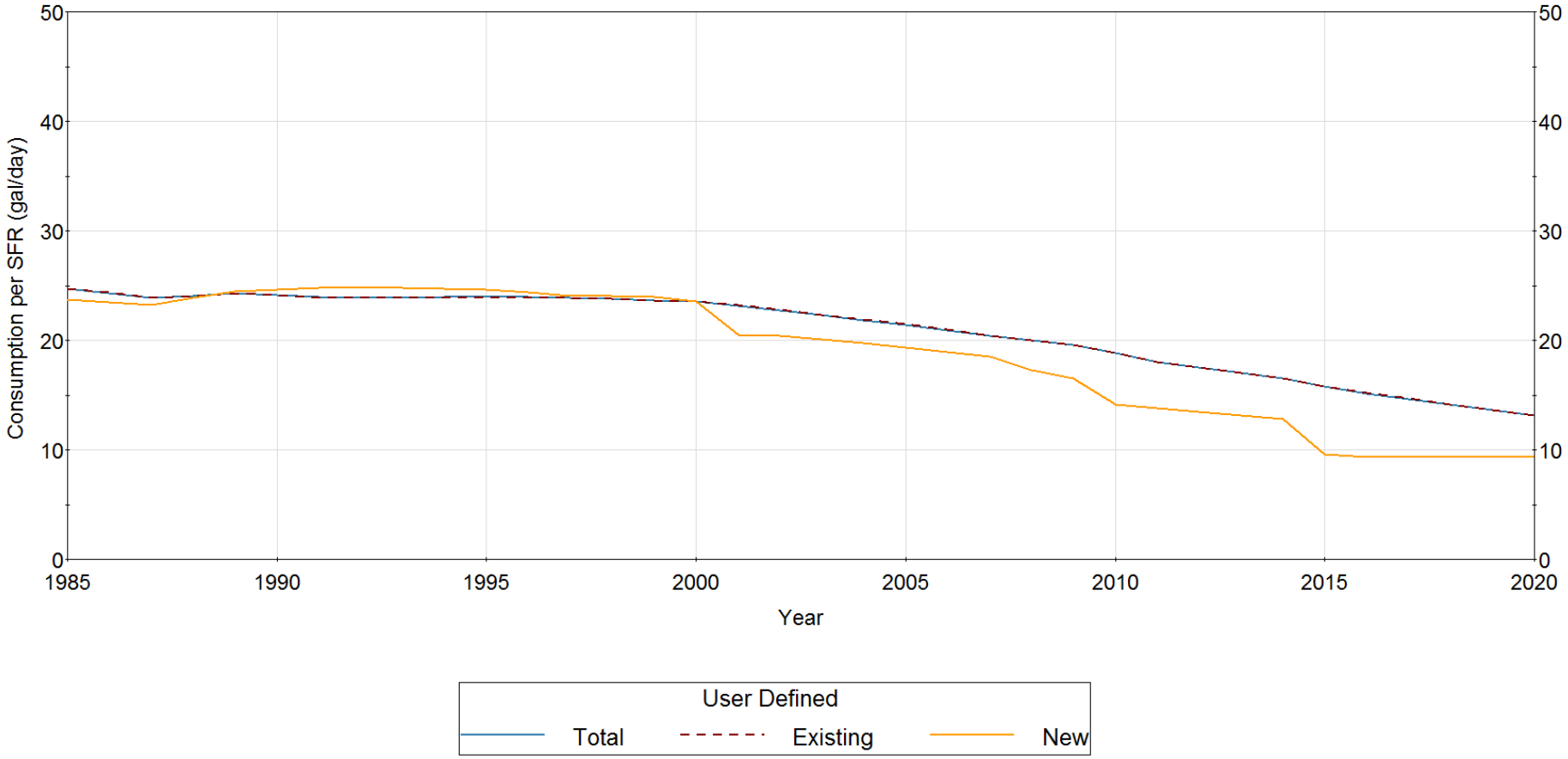


Washing Machine Water Factors

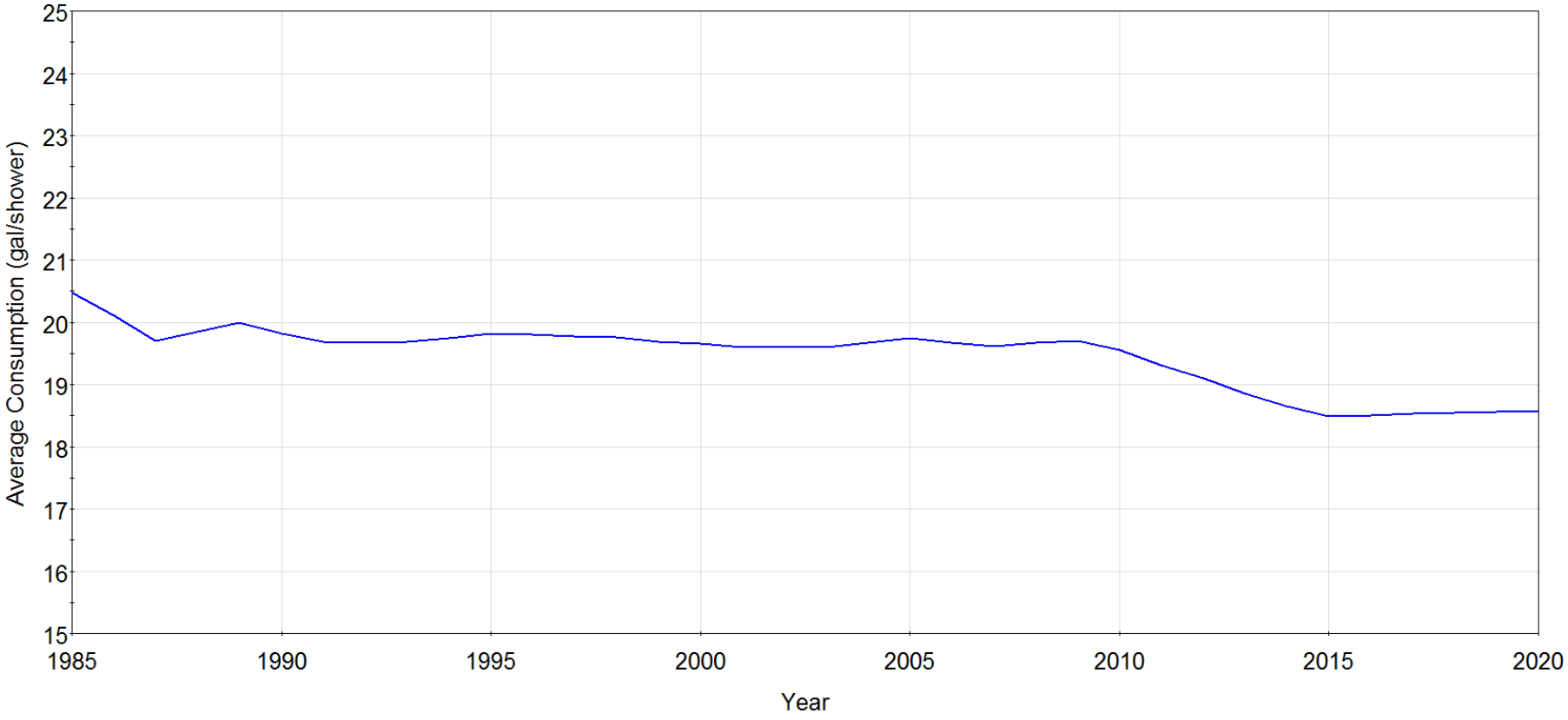
Code and Industry Efficiency Standards



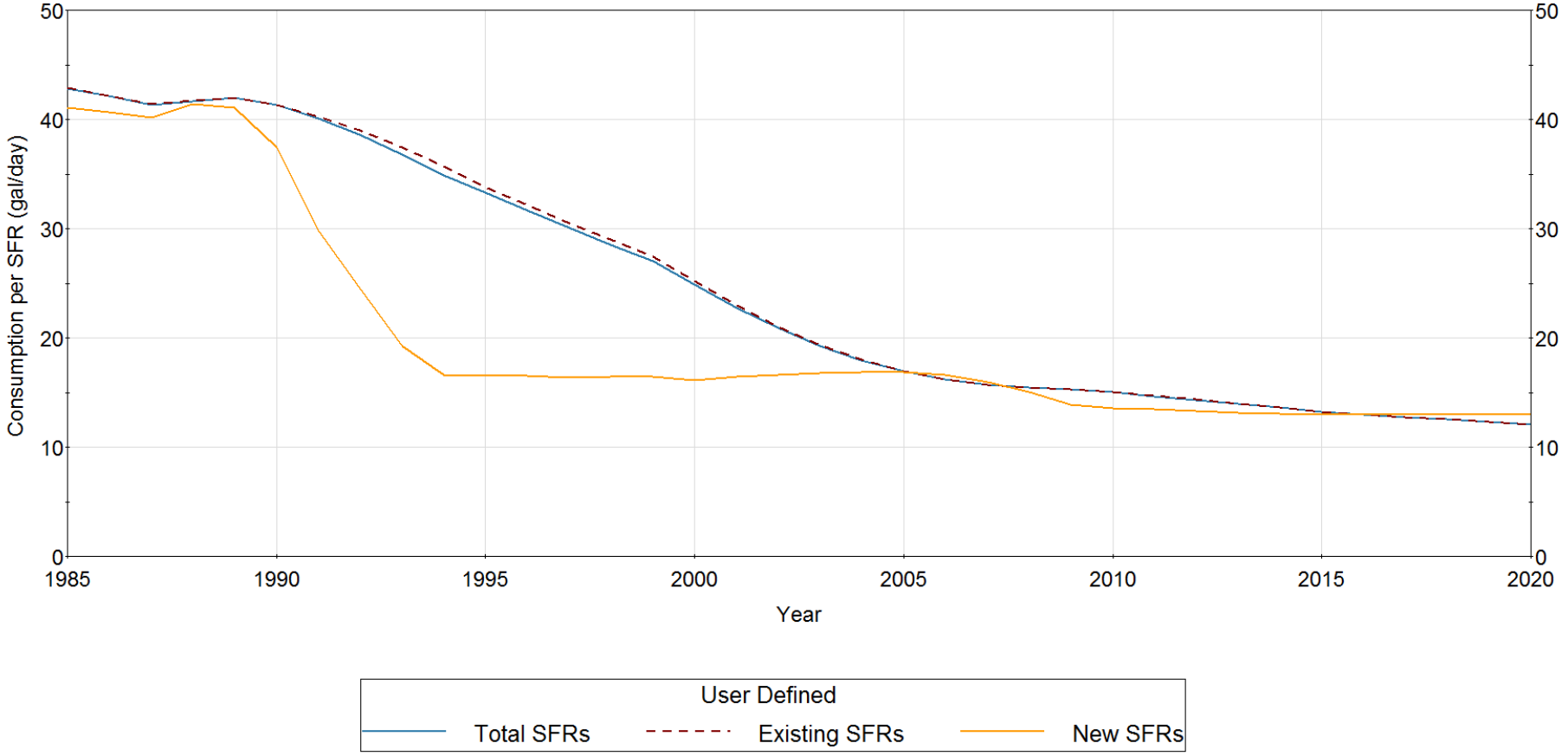
Clothes Washer Water Consumption per SFR



Average Water Consumption per Shower



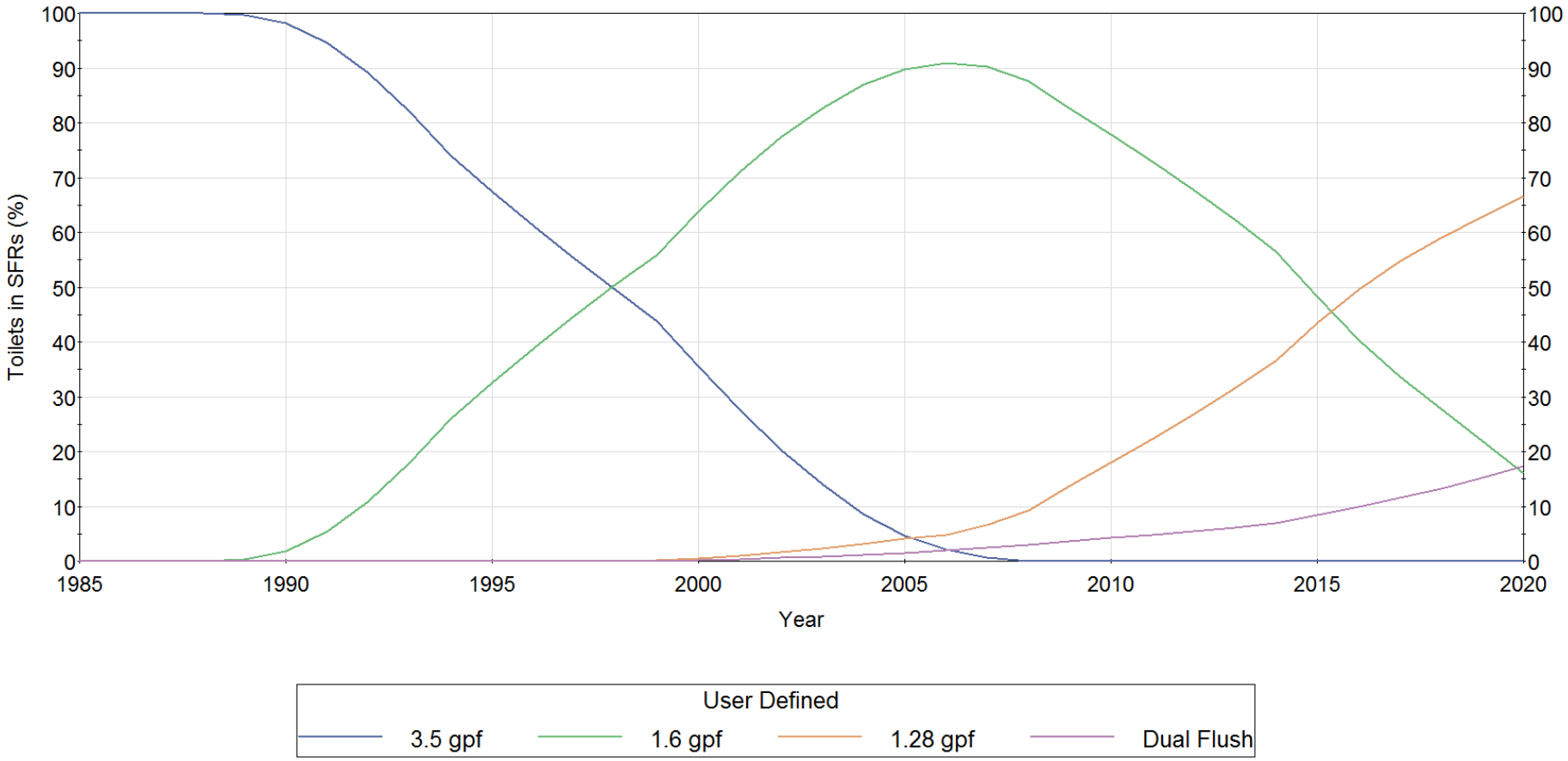
Toilet Water Consumption per SFR



National voluntary standards and state mandatory standards are having impacts:

- Dishwashers – 76 of 80 models sold by Best Buy meet the voluntary Energy Star standard;
- Toilets – 17 of 19 models sold in Home Depot and 22 of 23 models sold in Lowe's meet or exceed the CalGreen and Texas 1.28 gpf standard

Toilet Penetration Rate



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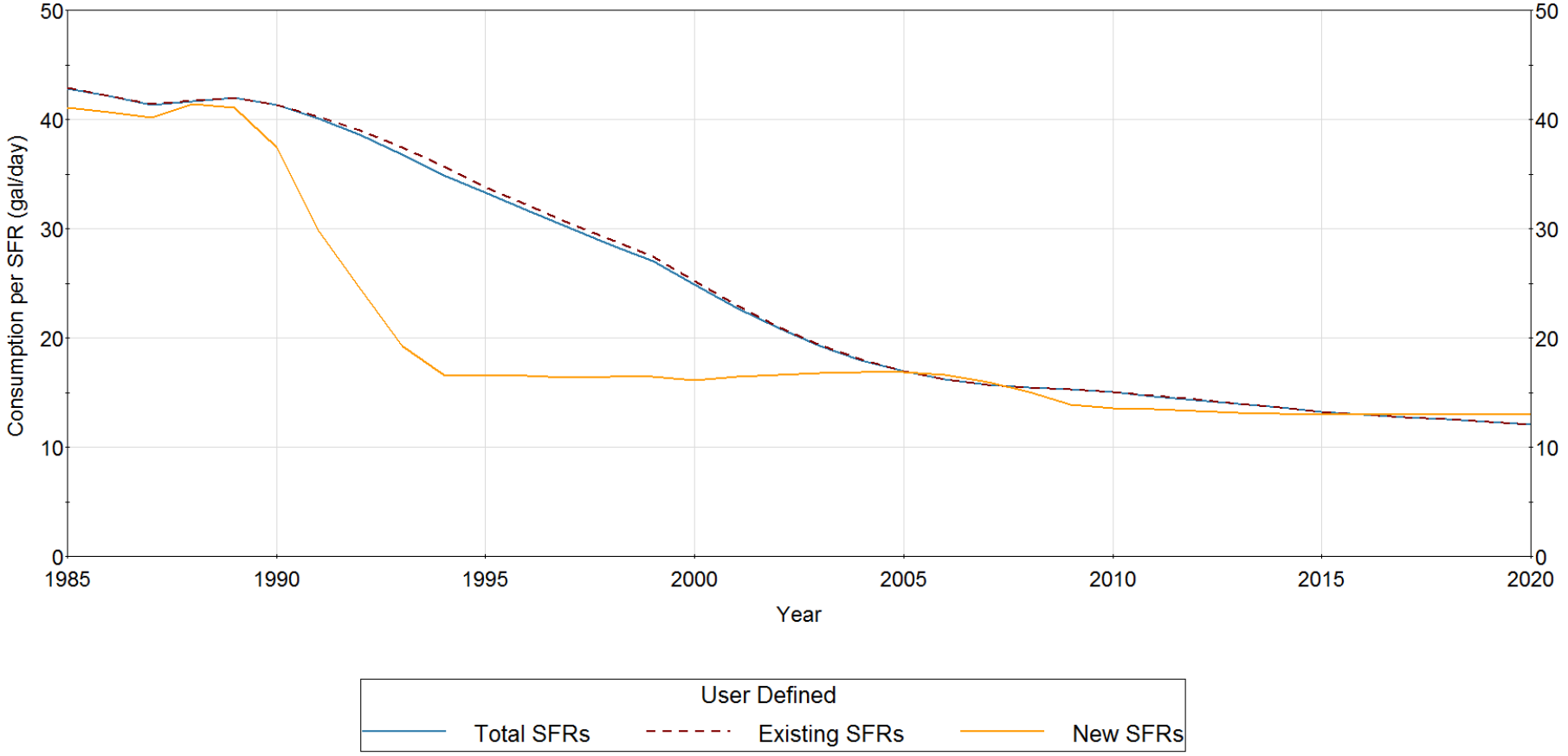
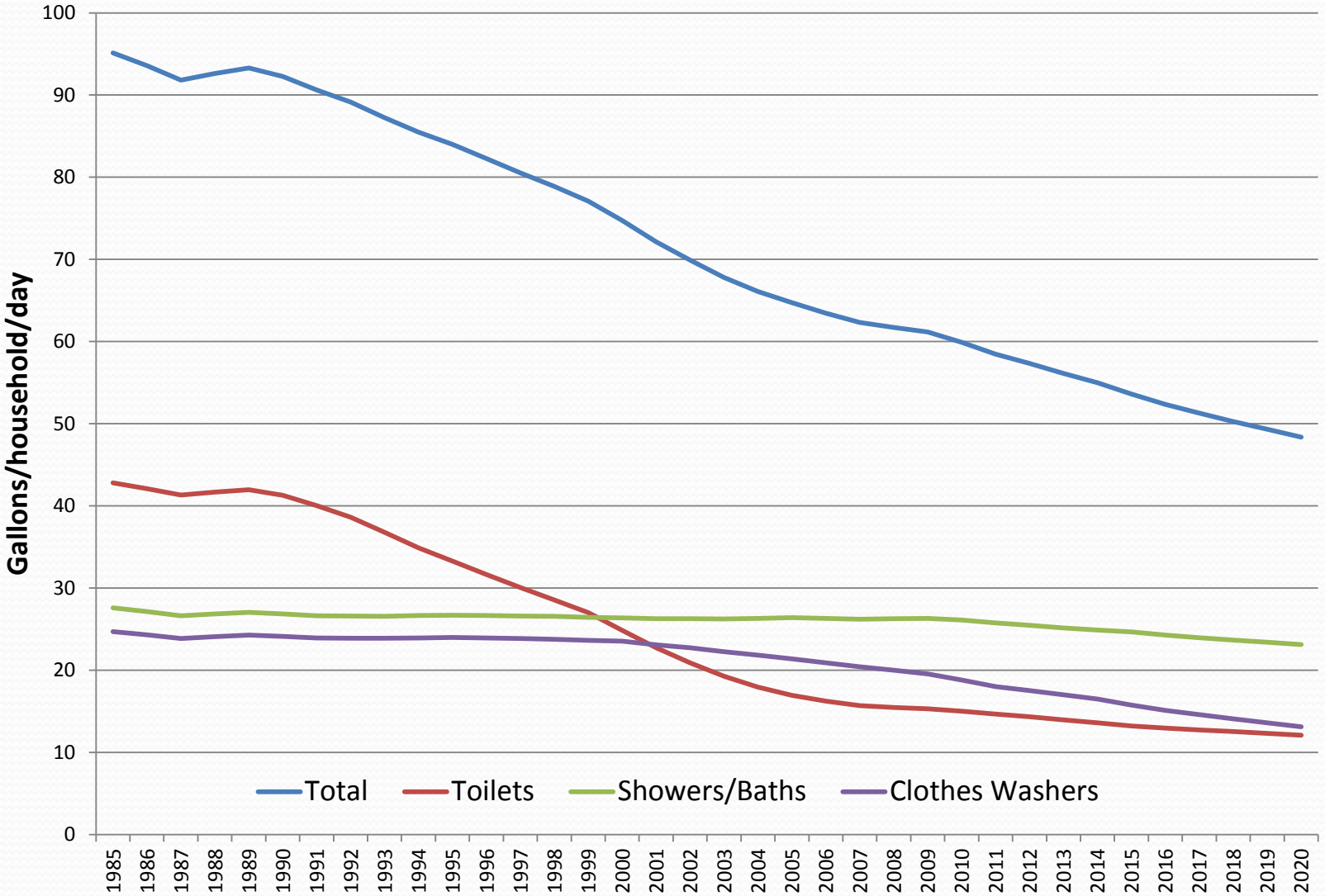


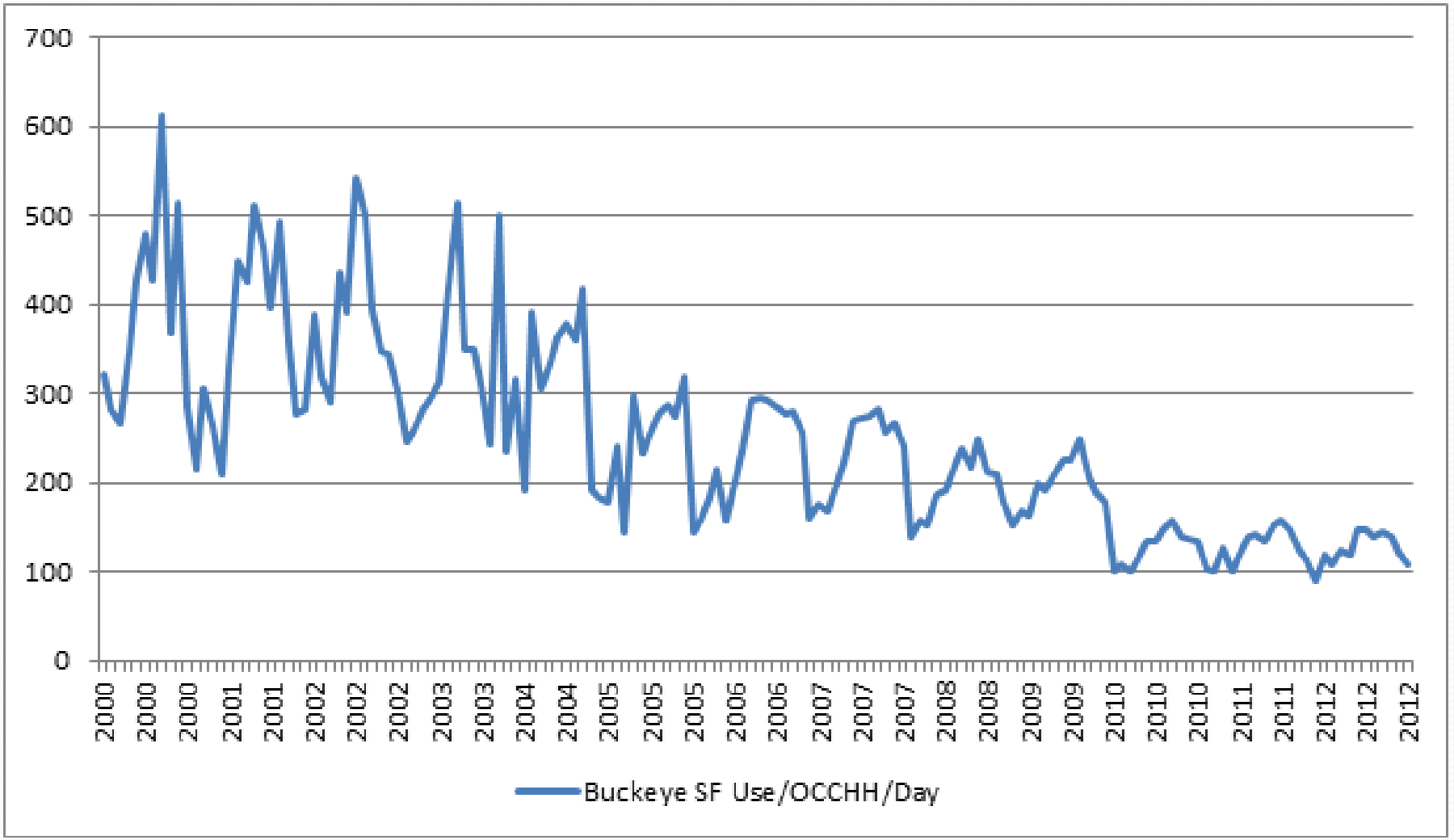
Pima County Indoor Demand Trends



New home construction situation

- Post-bubble shakeout left only 7 national builders
- Four of them claim their homes are “sustainable”, “green”, and/or efficient
- Two of them appear to be serious
- New homes will continue to be more water-efficient, both indoors and outdoors
- Market forces will decide how hard builders push the trend; government not currently having any real effect

Buckeye, AZ – example of hypergrowth



Recap and Conclusions - 1

Three factors are driving declines in domestic demand:

- Adding new, water-efficient houses to existing housing stock
- Active conservation efforts – program-related
- "Passive conservation" driven by changes in tastes and preferences and more efficient devices

In most cases, active conservation is the third-most important factor, but it often gets all the credit/blame.

Recap and Conclusions - 2

Average consumption forecast for Pima County:

Indoor

- **Toilets: gradual decline, levelling off**
- **Clothes Washers: accelerating decline**
- **Showers: frequency slightly up, baths down (aging pop.)**

Outdoor

- **Pools: gradual decline**
- **Evap Coolers: gradual exponential decline**
- **Turf: front yards all but gone, backyard likely decline**

Overall: gradual decline

Recap and Conclusions - 3

- We are far past peak cooler
- We are well past peak lawn
- We appear to be near peak pool
- Largest component of indoor demand is now showers/baths. This is the logical place to focus conservation efforts. If…

Recap and Conclusions - 4

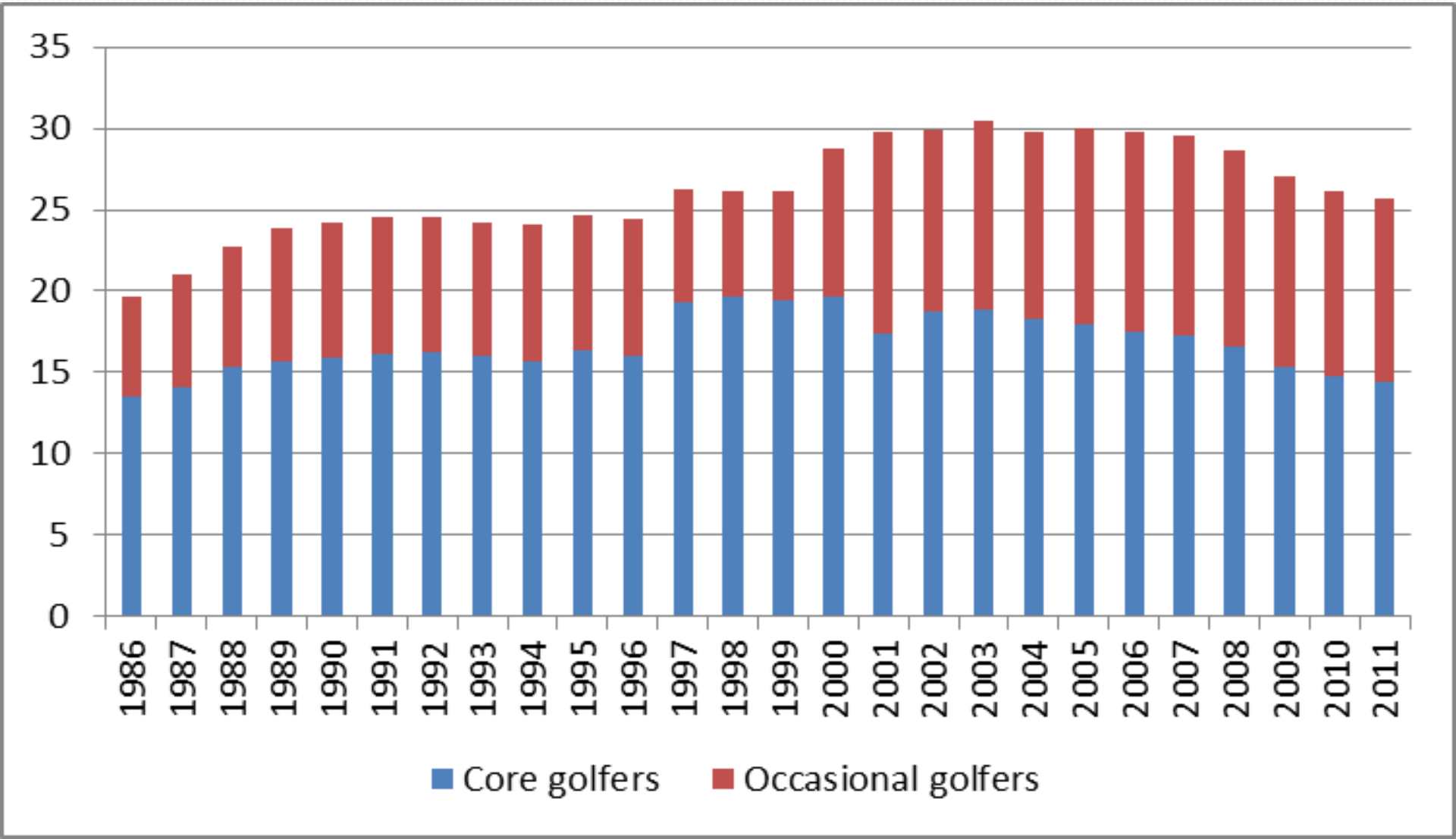
- Water demand is no longer tightly tied to population, economic output, conservation efforts, or quality of life…
- …and the downward trends are expected to continue through the end of the decade and beyond.

New perspective #1: Beware water misers

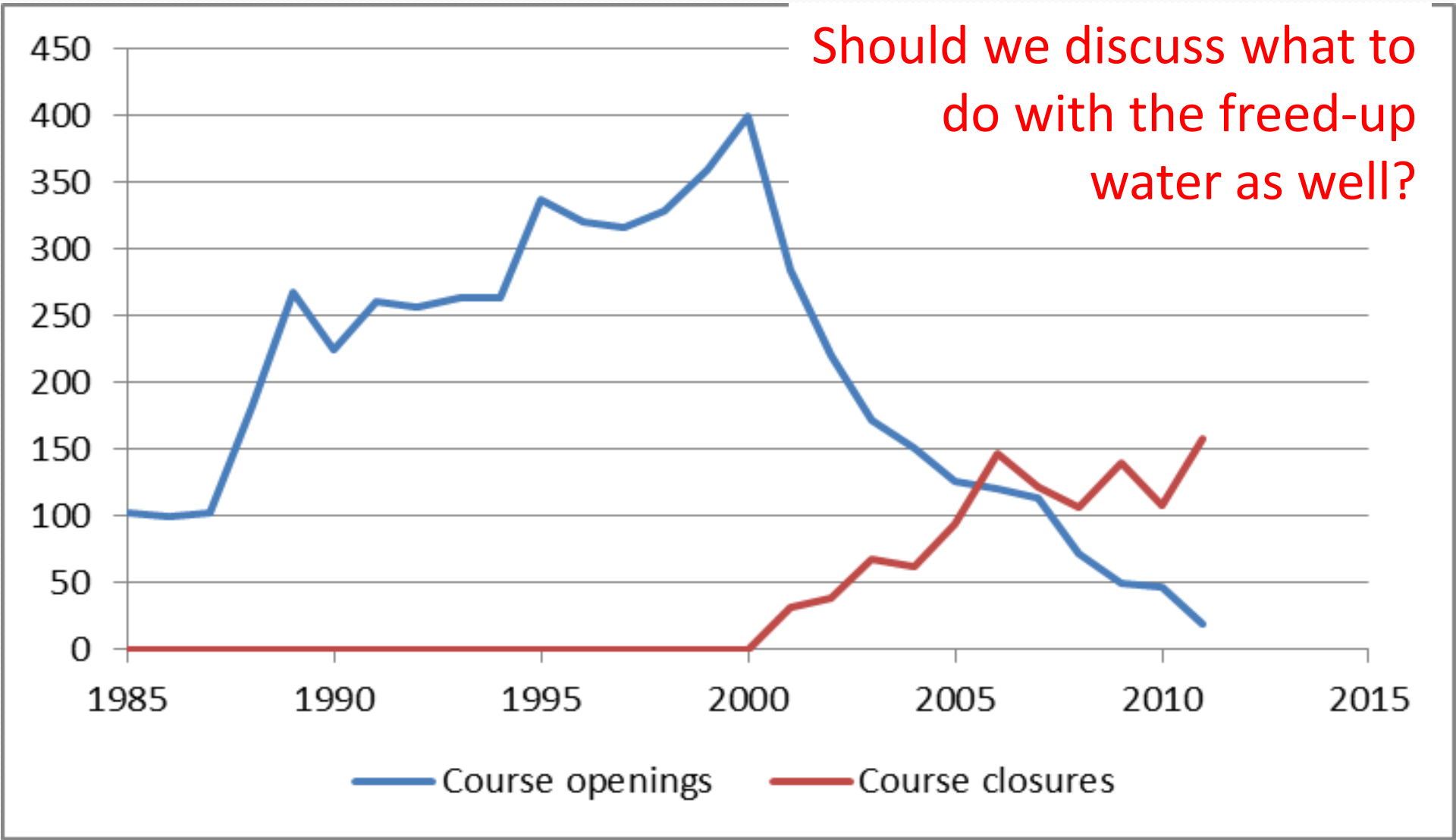
We need to change our water budget conversations from: “How can we further reduce demand?”

To:
“How can we best use the water that we have to maximize our quality of life and protect future generations?”

Fewer golfers are playing less frequently



…creating a need to repurpose closed courses.



New perspective #2: What are the limits to efficiency?

- Toilets – from 5 gallons to 3.5 to 1.6 to 1.28 to 1 (dual)
- Shower heads – from 4 gallons/min to 2.5 to 2.0 to 1.5
- Clothes washers – from 40 gallons/load to 27 to 23…

New clothes washing technology may reduce water usage to under 8 gallons/load.

New perspective #3: Who are our customers?

- Middle class is disappearing
- Post-labor economy is looming
- Dogs rule
- Home ownership is in retreat
- Younger people don’t aspire to traditional SFRs

New perspective #4: Why are we pricing water this way?

- Steep block pricing tiers create revenue volatility
- Need rates to reflect fixed price aspects of utility
- No correlation exists between poverty and low demand
- Indoor water use may be an inferior good

MONTGOMERY & ASSOCIATES
Water Resource Consultants

FINAL TECHNICAL MEMORANDUM
Pima County Residential Water Demand Study
Project Deliverables 11a & 11b

PROJECT DELIVERABLE 11a

The Scope of Work defines Deliverable 11a as the agenda for and summary of the final meeting and training session.

The final Meeting and Training Session, convened on Friday, October 17, 2014, began with a quick review of project goals and objectives, followed by a PowerPoint presentation and discussion of project findings and how they were incorporated into the forecast models. This was followed by a demonstration of the Pima County model. During a break, provider-specific models were installed on panel members' laptops. Training and guidance was then provided on using the provider-specific models for forecasting demand changes, addressing various "What if?" questions, and generating user-defined scenarios.

The meeting agenda and this brief summary of the final meeting of the advisory panel are contained in Deliverable 1a, Formation and Meetings of Project Advisory Panel.

PROJECT DELIVERABLE 11b

The Scope of Work defines Deliverable 11b as a final technical memorandum delivered to all participating agencies.

Relevant information, in the form of text, tables, and graphics, has been incorporated into the provider-specific models and the linked supporting website, along with basic instructions on model use and parameters incorporated into baseline scenarios.

This supplemental technical memorandum documents and summarizes key analyses and conclusions, as well as the modeling process. This includes a summary of Montgomery & Associates' (M&A) overall understanding of the key factors underlying residential demand declines in Pima County, their rates of change, and associated triggers. Conclusions are presented, and areas where additional research or analysis would be most beneficial are noted. As stated in the Scope of Work, relevant databases compiled for the Project will be provided to participating agencies in a convenient format upon request.

PROJECT BACKGROUND AND ISSUES

Per-capita and per-household rates of water demand have been declining for several years in most municipal service areas in Pima County, as well as throughout Arizona, and across the Southwest. These declines are part of a broader trend in water use and diversions, documented by the US Geological Survey's Circular 1405, "Estimated Use of Water in the

United States in 2010." Released in November 2014, the report documents water use trends from 1950 through 2010. As shown on **Figure 1** below, both groundwater and surface water withdrawals increased steadily through 1980, at rates that generally outpaced population growth. But total per capita water use plateaued between 1975 and 1980 at just under 1,600 gallons per capita per day (gpcd), and has declined briskly since, dropping below 1,000 gpcd in 2010.

The bottom line is that between 1980 and 2010, we managed to support 85 million more people and a growing economy while reducing water use by 57 billion gallons per day. The trends are both wide and deep, occurring in municipal, industrial, agricultural, and power sectors throughout the US.

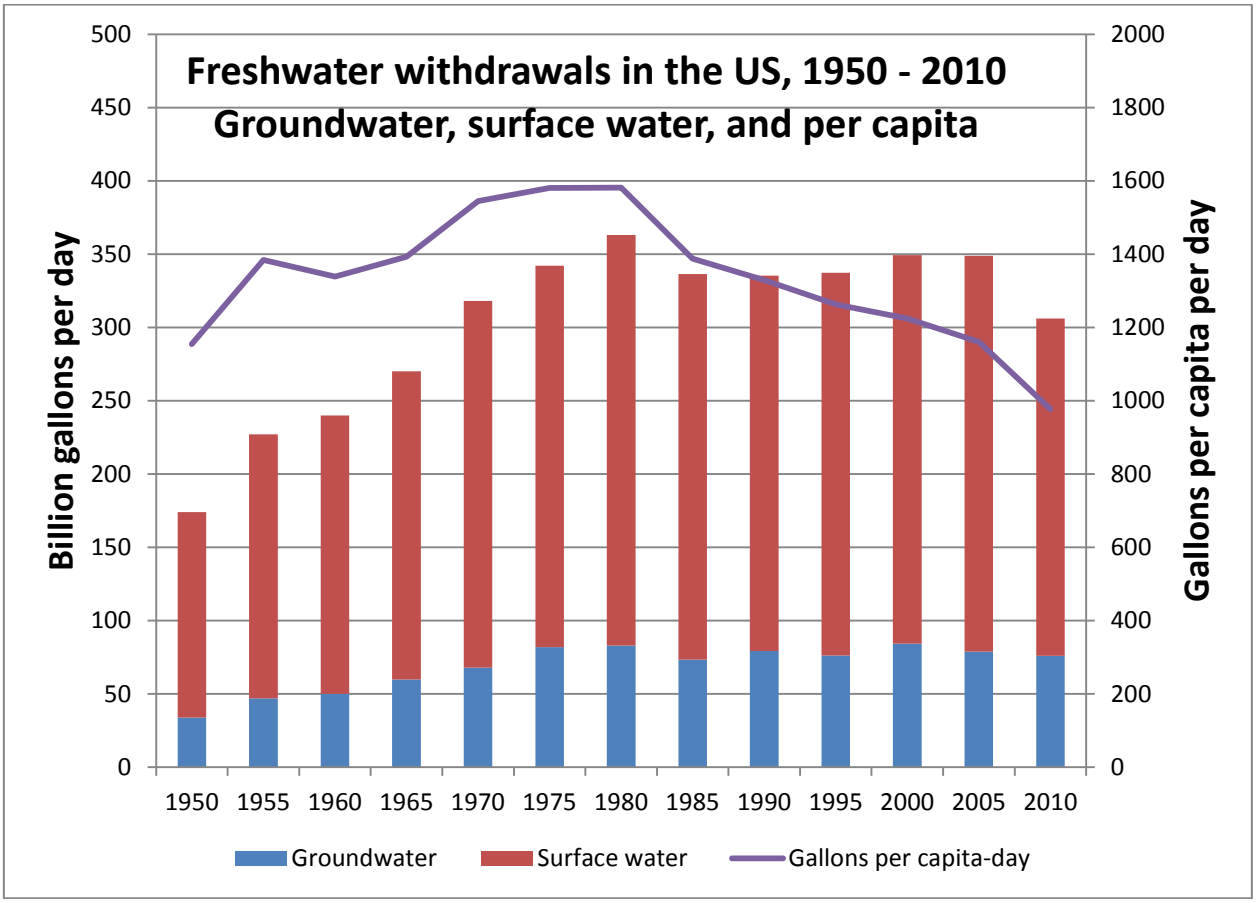


Figure 1. Declines in freshwater withdrawals and gpcd rates in the US, 1950 - 2010. Source: data from US Geological Survey Circular 1405.

Despite over 20 years of declines in municipal demand rates, many providers in rapidly growing areas were unaware of or paid little attention to the trend. Their focus was more on providing service to new customers, particularly during the housing bubble. The near-cessation in housing construction and new customer hookups triggered by the collapse of the

housing bubble and ensuing "great recession" focused attention on the trend in declining per-household demand, as declining demand and a precipitous drop in hook-up fees created financial and planning challenges for the utilities.

IMPACTS OF DECLINING RATES OF DEMAND ON WATER UTILITIES

Unanticipated declines in municipal water demand created numerous issues and challenges for water and wastewater providers. These included the following:

- Fiscal Consequences
  - revenues dropping more than expenses
    - conservation-oriented rate structures exacerbate this problem
  - budgeting uncertainties
- Operational Issues
  - declining supply of reclaimed water
  - increased water age impacts, including:
    - lower residual disinfectant levels
    - higher disinfection by-product levels
  - uncertainties as to available system capacity in wastewater plants
  - uncertainties about wastewater volumes from new developments
- Planning Challenges
  - optimal timing of capital improvements
  - acquisition of new supplies
  - rate setting
  - design of water conservation programs
- Public Perception Issues
  - water conservation blamed for rate hikes
  - customers feel they are being punished for conserving

PARTICIPATING AGENCIES

The impacts of these unanticipated declines in municipal water demand generated interest in determining their causes and forecasting demand rates. A consortium of water providers and regulators came together under the Southern Arizona Water Utilities Association to fund this project. Supporting utilities and agencies included:

- Southern Arizona Water Utilities Association
- Tucson Water
- Central Arizona Project
- US Bureau of Reclamation
- Arizona Department of Water Resources
- Metro Water
- Community Water Company of Green Valley
- Pima County Wastewater

QUESTIONS AND CONCERNS ADDRESSED

The supporting utilities and agencies were polled to determine the specific questions and concerns they wanted the project to address. These included:

- What are the underlying causes of declining single family residence (SFR) demand?
- Which impacts of the "great recession" were temporary?
- What will future housing construction look like in 3-5 years?
- How low could SFR demand go?
- Why has there been a steep decline in backyard swimming pools?
- Is the decline in turf permanent?
- Is demand becoming more seasonal?
- How can active and passive conservation be distinguished?

HISTORIC TIME SERIES ANALYSIS

The time series analysis component of this project involved examining historic monthly SFR demand rates over the period 2000 through 2013 to assess trends and to compare rates of decline across service areas. The objectives of this analysis were to:

- Verify or refute the assumptions that per-household SFR demand is currently declining across Pima County and that the decline began several years ago;
- Observe whether declines in per-household demand are occurring across all three municipal service areas, despite differences in housing stocks, growth rates, and demographics, and assess the approximate magnitudes of change; and
- Attempt to determine whether and to what degree the declines appear to be occurring in both indoor and outdoor SFR demand.

The results of this analysis are summarized in **Table 1** below. Also included in the table are average rates of demand calculated for Maricopa County in a parallel project.

Area	Annual Change in Demand, by Component (Percent)			
	Total	Indoor	Outdoor	Peak Outdoor
Pima County	-2.3	-1.5	-4.8	-4.9
Community Water	-2.0	-1.5	-3.2	-3.6
Metro Water	-2.2	-2.0	-2.8	-2.5
Tucson Water	-2.3	-1.5	-5.0	-5.1
Maricopa County	-2.1	-2.0	-2.3	-2.9

Table 1. Summary of historic average annual percent change in per-household SFR demand, 2000 through 2013

The average annual percent changes in SFR demand are remarkably similar, falling between 2.0% and 2.3%. Using minimum month demand as a proxy for indoor demand and the difference between total demand and this minimum as a proxy for outdoor demand allows calculation of rates of decline for these demand components. Annual percent declines in indoor demand are less in Pima County and the three service areas, but it should be noted that indoor demand is substantially larger than outdoor demand, so absolute rates of decline are similar.

Note that the time series analysis is not directly connected to the dynamic simulation forecast model. That model focuses on the impact of changes in key factors of demand over time, and what might be triggering those changes at the household level. None of the estimated trends in this analysis are intended to be projected into the future, or are otherwise used in building the forecast model.

MODELING APPROACH AND MODEL STRUCTURE

This project took a somewhat atypical approach to modeling and forecasting SFR demand. Most studies of municipal demand focus on a small set of factors such as price or attempt to measure the impact on water demand associated with one particular water use (e.g., turf irrigation) or a particular conservation measure (e.g., a rebate program). By contrast, this study of municipal demand took a more comprehensive approach. In particular, the modeling effort attempts to:

- Look at significant factors of SFR demand;
- Make use of existing information on water use rates whenever possible;
- Focus on rates of change in stocks of appliances, fixtures, and landscape characteristics;
- Examine key triggers of household changes that affect water demand.

MODELING SCOPE

This is a model that is designed to forecast significant ***changes*** in SFR demand, not absolute levels of demand. We modeled those demand factors that account for substantial amounts of water and that are, or may be, changing at a significant rate. We did not model demand components that appear relatively stable or that account for relatively minor amounts of water (e.g., car washing, garbage disposals) or that have all but disappeared from SFR customers (e.g., overseeding with winter Rye grass).

DYNAMIC SIMULATION MODELING

The demand forecasts are made using a dynamic simulation model (DSM). This type of modeling environment was selected because it offers the following features:

- It integrates all significant sources of SFR water demand
- Allows uncertainty to be directly addressed
- Facilitates the construction and comparison of scenarios, including user-defined scenarios

- Has a relatively simple and clear user interface
- Provides a high level of transparency in modeling inputs and assumptions
- Provides several types of graphical outputs

The DSM disaggregates SFR demand into the following basic units and time steps:

- Household demographics are defined by persons per household (PPH) and four age cohorts (infants, children, teens, and adults)
- Time step is 1 year
- Housing stock includes existing, new, and relatively new homes
- Home values are defined by seven value classes

Model users can ask "What if?" questions and define scenarios by adjusting the following types of input parameters:

- Housing markets
- Socio-demographcs
- Appliance or fixture water use efficiency
- Mandates and rebates
- Increase in water-conscious consumers

Users can develop their own scenarios by adjusting several of these model inputs. Alternatively, users can select one of four pre-defined scenarios:

- Baseline conditions
- Long-term economic upturn
- Long-term economic downturn
- Long-term drought conditions

MODEL STRUCTURE

The structure of the DSM is shown on **Figure 2** below. Total SFR water demand is the sum of demands generated by various fixtures, appliances, and landscape features. Each of these is calculated as the average water used per event (e.g., a toilet flush) and the frequency of those water use events (e.g., flushes per household per day). Determining water use per event involves estimating market shares, penetration rates, useful lifespans, and likely future efficiency standards. Determining the frequency of water uses involves analyzing household characteristics, including PPH and age cohorts.

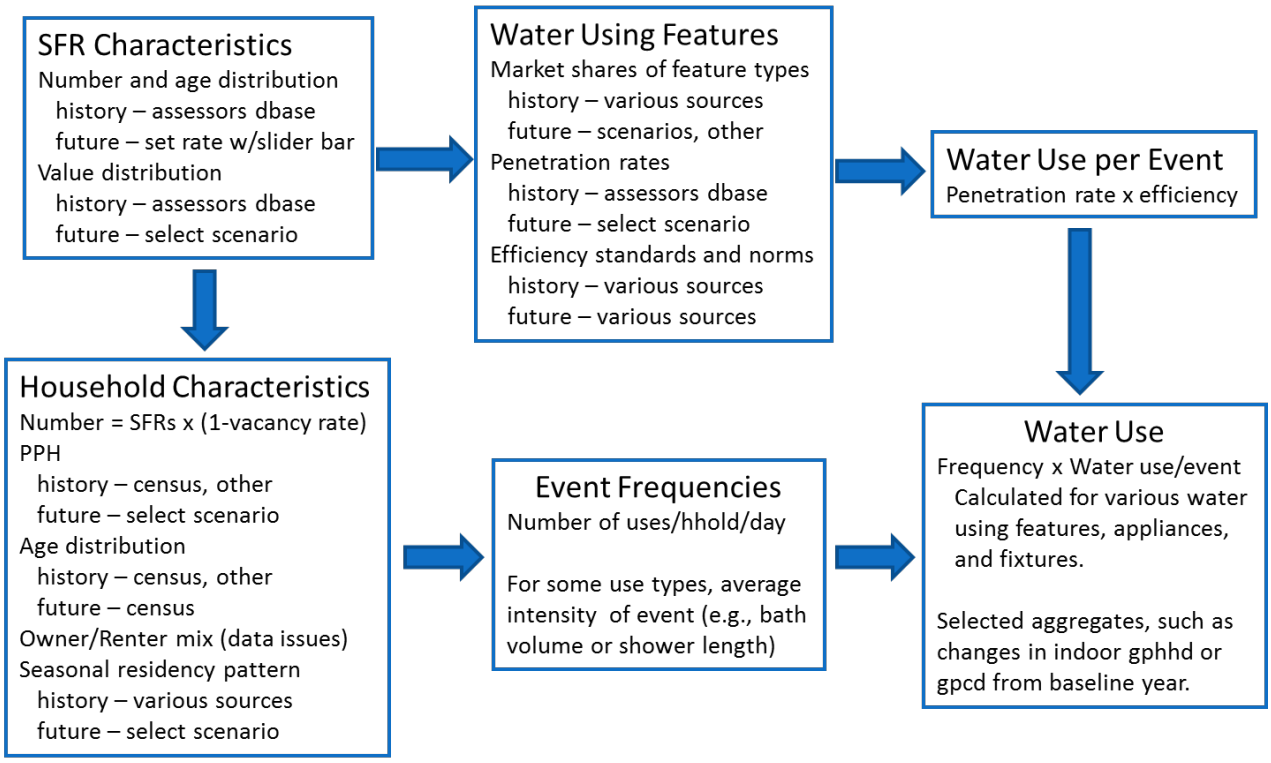


Figure 2. Structure of Dynamic Simulation Model of SFR Water Demand

DEMAND FACTORS INVESTIGATED

An attempt was made to identify and investigate rates of change in all significant factors of SFR water demand that were suspected of contributing to changes in demand over time. These factors include:

- Socio-Demographic Factors
  - declining household sizes (PPH)
  - shifting socio-demographics
  - increasing numbers of seasonal (part-time) residents
- Outdoor Demand Factors
  - changing landscape tastes and preferences
  - evaporative coolers replaced by air conditioning (AC)
  - declines in popularity of backyard pools, use of pool covers
- Indoor Demand Factors
  - replacement of inefficient fixtures such as toilets in existing housing
  - replacement of appliances such as clothes washers in the existing housing stock
- Impacts of New Home Construction
  - more water-efficient fixtures and appliances in new homes
  - shrinking lot sizes
  - turf and pools

- Triggers of Change
    - new home owner, and home flippers
    - end of useful life for fixtures, appliances, landscape components

It should be noted that the Scope of Work did not include a detailed investigation of the impacts of household socio-demographics on demand. However, over the course of the project, a highly relevant data set became available from AquaCraft, Inc. of Boulder, Colorado. These data provided valuable detail about how household characteristics impact frequency of various indoor water uses. They also provided insight into penetration rates of various water-using appliances and fixtures. In addition, the data gave real-world estimates of water use per event, instead of engineering estimates. For example, it was determined that on average, 2.5 gallon per minute shower heads actually use about 2.1 gallons per minute.

Because of the value of this information, the decision was made to perform econometric and statistical analysis on the data and utilize these findings in construction of the DSM.

DATA SOURCES

Because of the breadth of factors included in the DSM, a wide array of data sources was tapped. These are shown schematically on **Figure 3** below. Data were cross-linked through parcel ID number and street address, as indicated by the arrows.

Of particular importance are annual databases provided by the Pima County Assessor's office. The Assessor's office also provided building permit data and provided special data sets on home sales. SFR demand data were provided by the participating utilities. Other key sources of data include the US Census, various sets of remote sensing images, and the Pima Animal Care Center (PACC).

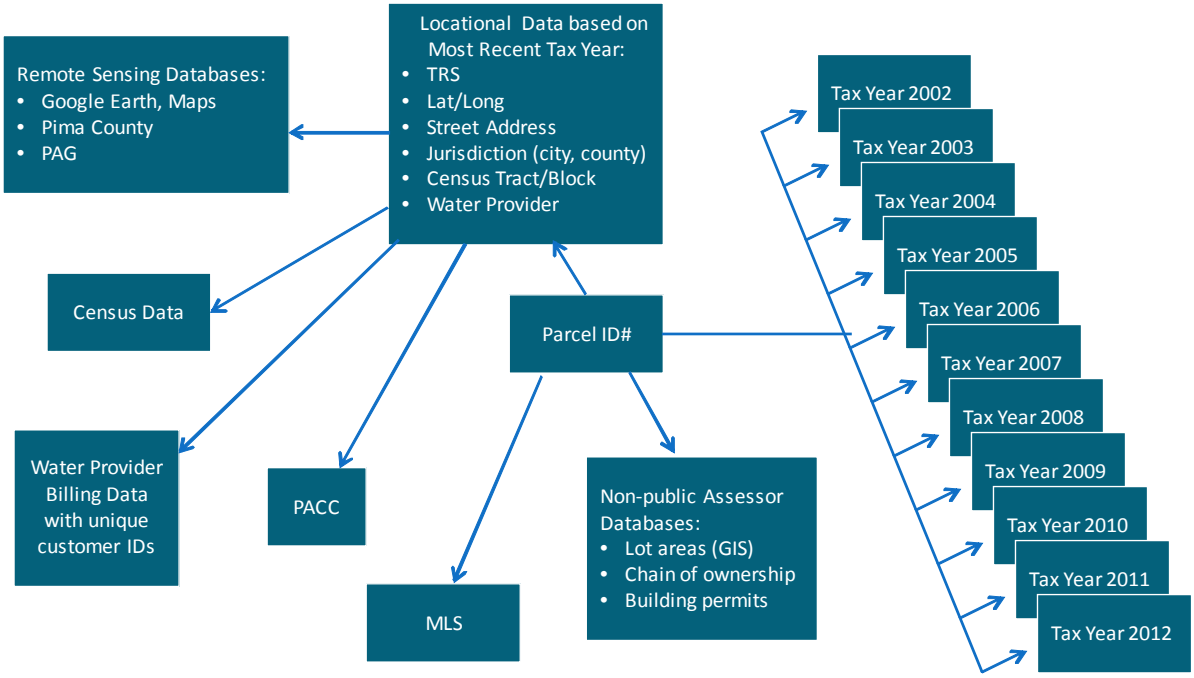


Figure 3. Databases for Pima County Demand Trends Project

SOCIO-DEMOGRAPHIC FACTORS

Informal polling of water professionals on the likely causes of declining SFR demand produced a number of potential explanations, as listed above. However, the most frequently offered explanation was a long-term decline in the number of persons per household, or PPH. Closer analysis cast doubt on this hypothesis, for two reasons.

First, declining PPH can clearly reduce per-household indoor demand, but it is not clear that it reduces per-household outdoor demand, as the number of persons in the household does not affect irrigation needs of landscapes or evaporation rates from swimming pools.

Declining PPH has an even more ambiguous impact on per-household demand. It increases the number of homes needed to house a given population, which triggers more home construction. This results in a newer housing stock, with more efficient fixtures and appliances and therefore lower indoor demand rates. But having a given population occupy more homes also means there are more landscapes and pools per capita. As discussed below, new homes have, on average, more water-efficient landscapes and are less likely to have a pool. This decreases average per-household outdoor demand, but it increases per capita outdoor demand, because it increases the total number of landscapes and pools for the given population.

A more direct challenge to the hypothesis is that data suggest that PPH leveled off during the 2000s. It appears that it may not be currently declining, for the following reasons:

- More “boomerang kids” moving back in with their parents
- A growing percentage of households with three generations
- More households with alternate living arrangements

That this is more than anecdotal is supported by the home building industry responding with options such as “home within a home” floor plans.

While PPH may no longer be declining, significant differences in PPH across service areas can help explain differences in SFR demand rates. Furthermore, the demographics of households continue to shift, even if household size has stabilized. The more relevant trends include:

- fewer infants, children and teens
- more 1-adult households, including with children
- more retirees and snowbirds
- in general, a graying population

These changes in households can help explain differences in demand patterns across service areas, and are incorporated into the forecast model to predict changes in demand going forward.

Econometric regressions and statistical analysis run on data provided by AquaCraft reveal many details of indoor demand. The following are a few examples:

- shower, clothes washer, and dish washer usage is affected by temperature and therefore seasonal, but not to a great extent;
- infants don’t contribute to toilet flushes or showers
- children account for most baths, which use much more water than showers
- teenagers really do take more frequent and longer showers than adults

Most of the usage rates revealed by the data hold across all nine urban areas involved in the study. This suggests that these indoor patterns and trends likely are relevant to Pima County. Of most interest is how age cohorts affect frequency of fixture and appliance use. **Figures 4, 5, and 6** below show relative frequencies of use for infants, children, teens, and adults.

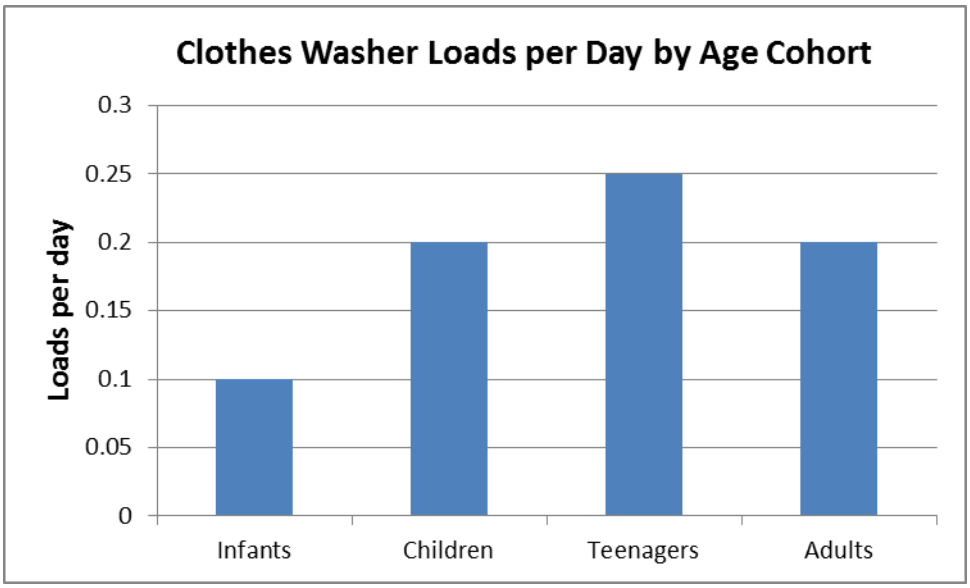


Figure 4. Frequency of clothes washer use as a function of age cohorts.
Source: data from AquaCraft study of residential demand trends.

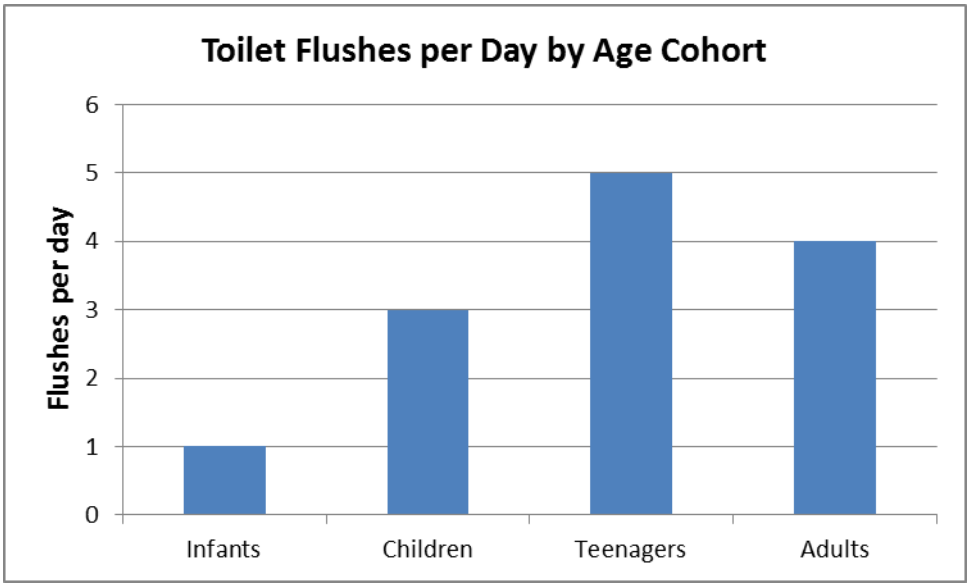


Figure 5. Frequency of SFR toilet flushes as a function of age cohorts.
Source: data from AquaCraft study of residential demand trends.

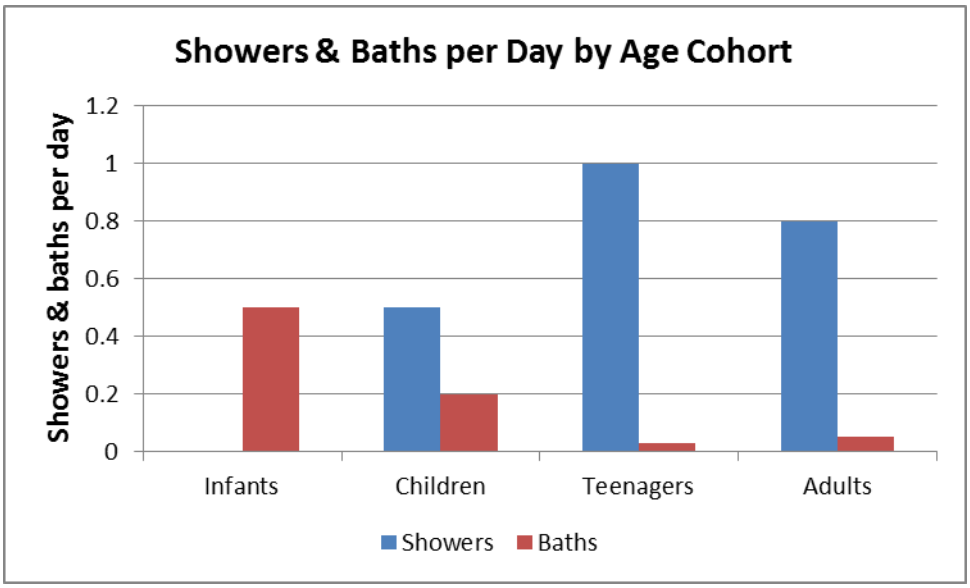


Figure 6. Frequency of showers & baths as a function of age cohorts.
Source: data from AquaCraft study of residential demand trends.

POPULATION ESTIMATE ISSUES

One question raised by the time series analysis described above is, why did demand drop faster during the recession? There are a number of reasons why it might have been expected to drop slower, rather than faster. These include:

- Fewer new homes with lower demand rates being added to the housing mix
- Unemployed and underemployed people likely spending more time at home
- Fewer meals being eaten out of the home and more meals being prepared at home
- Reduced rate of kitchens and bathrooms being remodeled, thereby reducing the transition rate to more efficient appliances and fixtures
- Possibly fewer vacations away from the home

It appeared these factors were overwhelmed by cutbacks in outdoor irrigation and more careful use of indoor water, possibly triggered by reductions in household income or fears of such income reductions. Note the time series revealed no evidence of any post-recession rebound in demand, but did suggest in some instances that the rate of decline in SFR demand may have lessened between 2010 and 2013.

There now is another explanation for these observed trends. The 2010 census reported lower population levels than were being estimated, suggesting that population levels slowed and even dropped during the housing collapse and ensuing recession to a greater degree than was realized at the time. If in fact population levels were somewhat lower than estimated in the 2008 through 2010 time period due to cessation of in-migration and significant out-migration, then the declines in demand were less than they appear during the recession, and greater than they appear in the early post-recession years.

One final finding regarding changes in household composition focuses on the possible impact of dogs on backyard turf. Currently, SFRs are roughly twice as likely to have one or more dogs as they are to having one or more children. About 20% of Pima County households have one or more licensed dogs, but fewer than half of dogs in Pima County are licensed. It appears that about 45% of households have one or more dogs, and the figure likely is somewhat higher for households in SFRs. The potential impact of dog ownership on outdoor demand is discussed below.

OUTDOOR DEMAND FACTORS

The three factors of outdoor demand analyzed in this project are irrigated turf, evaporative coolers, and swimming pools. For each, a handful of characteristics and trends were studied:

- Irrigated turf:
  - Frequency and area of irrigated turf in backyards, existing housing stock
  - Frequency of overseeding with winter Rye grass
  - Various modes for reducing or eliminating turf
  - Lot sizes
- Swimming pools
  - Frequency as a function of date of home construction
  - Average surface area of existing pool stock
  - Frequency and characteristics of new pools in existing and new homes
  - Removal of existing pools
  - Deployment of pool covers
  - Potential impact of lot size
- Evaporative coolers:
  - Frequency in existing housing stock as function of home construction date
  - Frequency in new housing
  - Impact of home age and home value on frequency of conversion to AC

Note that we did not attempt to study and quantify water use trends for all outdoor water demand components, such as spas, car washing, and patio misting systems. The most significant omission is non-turf landscaping. While analyzing other types of landscaping and their irrigation systems would be useful, that effort was beyond the scope of this project.

CHANGING TASTES IN LANDSCAPING AND TRENDS IN TURF

That irrigated turf has been disappearing from SFR neighborhoods in Pima County is apparent to any long-time resident. This is particularly true (and easy to see) for front yards. Irrigated turf in front yards is now a rarity in most neighborhoods, and winter Rye has all but disappeared from SFRs. Virtually no new homes have front or side yard turf.

While front and side yard turf exists mostly for esthetic reasons, backyard turf has a variety of potential uses, most of them recreational in nature. Possibly for these reasons, backyard turf is now far more prevalent than turf in front yards. Yet it, too, appears to be much less

common than before. We attempted to gather a comprehensive list of the mechanisms that are leading to reduced turf and its associated irrigation:

- Abandonment or reductions in area
- Replacement with xeriscapes, drought-tolerant plant species
- Restrictions in new construction
- Less winter over-seeding with rye grass
- Replacement with artificial turf

Remote sensing images were used to compare randomly chosen SFR properties in the Community Water, Metro Water, and Tucson Water service areas for spring of 2006 and 2014. This analysis revealed that backyard turf is disappearing, but changes are bi-directional; there is a significant rate of new irrigated turf being installed in backyards in the Metro Water and Tucson Water service areas, but a greater rate of turf removal.

The remote sensing analysis was also used to determine frequencies of pools and spas, and to look for evidence of pool cover use. The analysis revealed that 35% of SFRs in Pima County have some irrigated backyard turf, while 22% of SFRs have a backyard pool. This latter figure agrees closely with data from the County Appraiser's Office. An unexpected finding was that the correlation between backyard turf and pools is zero. This suggested that fewer households are investing in their backyards to create family recreational spaces.

DOGS AS DRIVERS OF WATER DEMAND

It appears that over half of SFR households in Pima County have one or more dogs, while only about one in four have any children. Anecdotal evidence of dogs as a driver of backyard artificial turf led us to ask the PACC to provide a random sample of 500 addresses of licensed dog owners. These data were used with remote sensing images to reveal a strong correlation between dog ownership and irrigated backyard turf, as shown on **Figure 7**.

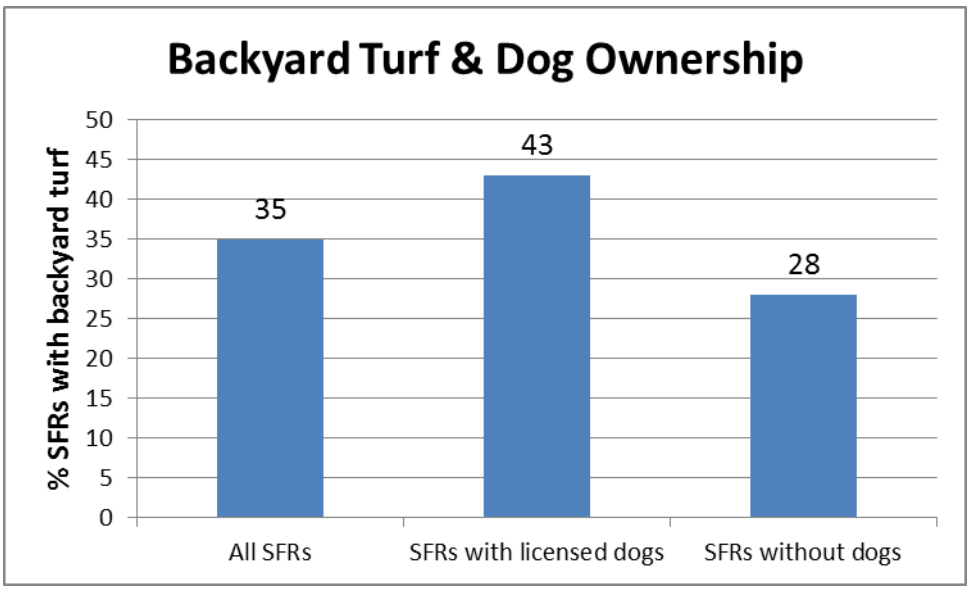


Figure 7. Occurrence of backyard turf is affected by dog ownership.

LOT SIZES AND LANDSCAPABLE AREAS

An oft-mentioned factor in declining outdoor water demand is the perceived reduction in average lot size over time. Curiously, that was the impression over 20 years, ago, but analysis of County Appraiser's data showed no significant changes in lot size over time. Analysis of more recent data does show a trend towards smaller lots during the housing bubble as land prices soared. Once the bubble burst, land prices plummeted, and lot sizes began to increase again. Tempering this cycle and reducing the changes in landscapable area was the increased frequency of two-story homes built during the housing bubble, and their reduced frequency more recently.

POOL FREQUENCY, SIZE, AND POOL COVERS

Slightly over 20% of the SFRs in Pima County have a backyard swimming pool. The distribution is highly variable over space and time, being strongly correlated with home value and date of home construction. **Figure 8** below shows that backyard pools grew in popularity from the end of World War 2 through the 1970s, when roughly a third of homes had a backyard pool. The rate has plunged since, and is currently below 5% for recently built homes.

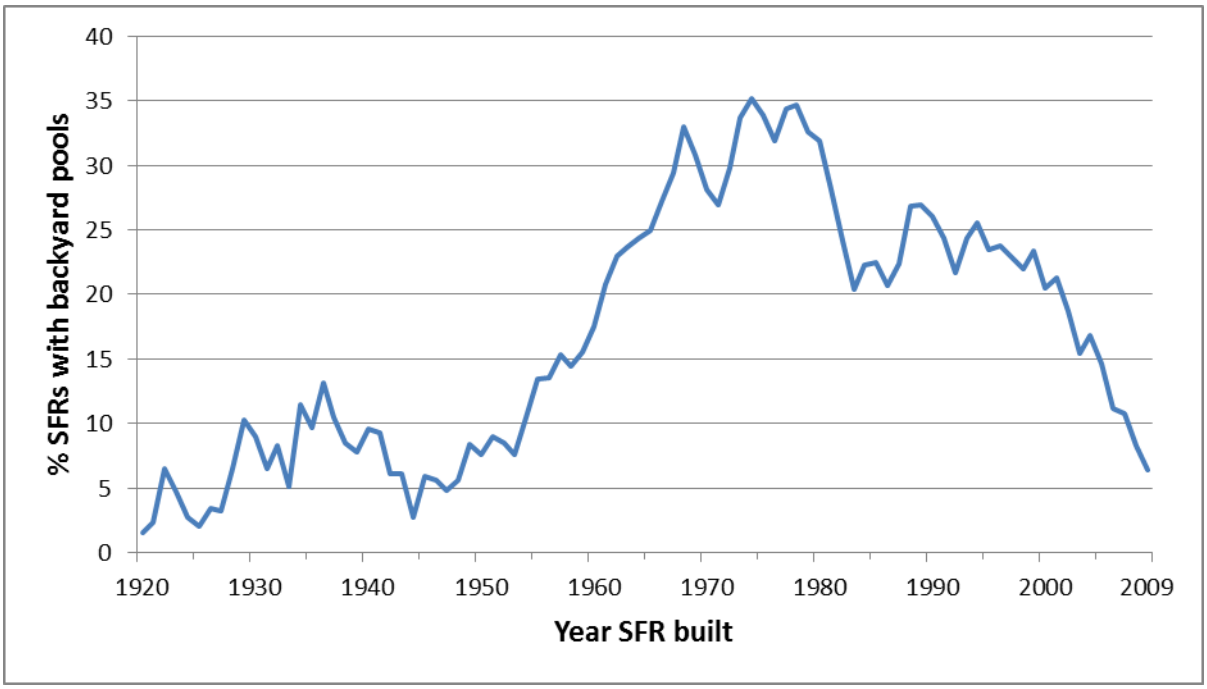


Figure 8. Frequency of backyard swimming pools as a function of SFR construction data. Source: Pima County Assessor's data.

Analysis of County Assessor data shows the expected strong correlation between home value and pool frequencies. Discussion with experts in the pool industry revealed that in addition to home value and wealth, household demographics affect the popularity of pools. The graying of the population and reductions in PPH over preceding decades greatly reduces the frequency of pool installations to serve the recreational needs of traditional families. Anecdotal evidence suggests that another factor may be the increased likelihood of households in new homes having access to a neighborhood recreational facility with pool.

Data from the County Assessor's Office revealed the likelihood that homes built in the previous decade would have a pool; data also revealed transition rates for older homes. **Figure 9** shows that roughly one in 200 existing homes without a pool has one installed every year. It also revealed a small but growing fraction of existing homes where pools are being removed. This is consistent with anecdotal evidence of a surge in pool removals.

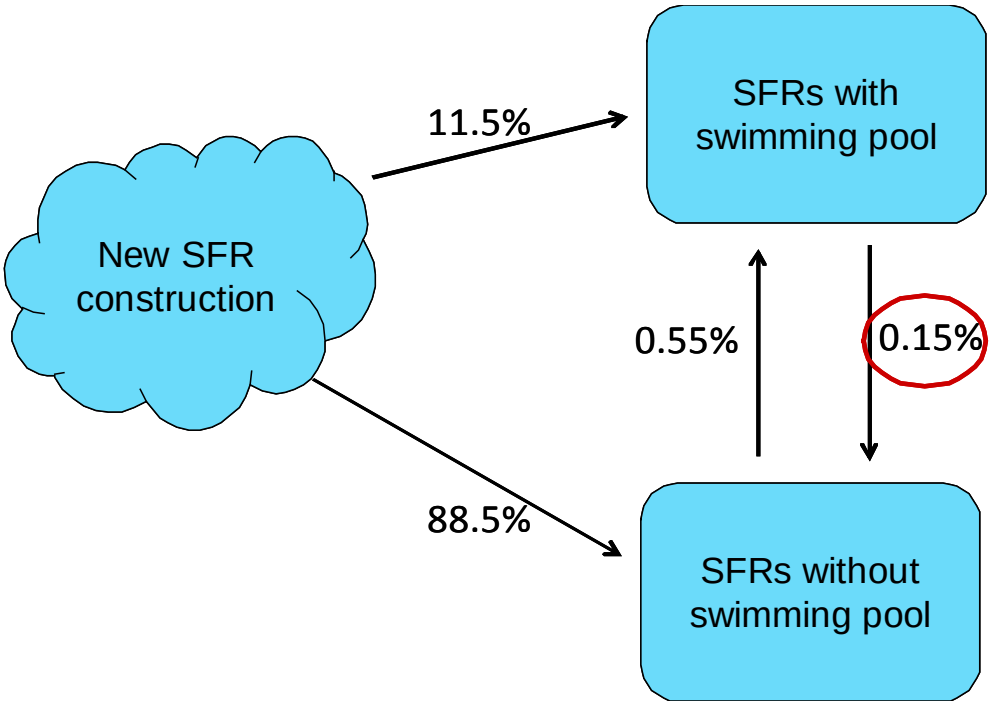


Figure 9. Annual transition rates for pools in SFRs over the last 10 years

Building permit data aggregated by Pima County revealed that not only are pools growing scarcer over time, they also have shrunk significantly in size. These data, and discussions with industry experts, suggest that swimming pools built today are slightly more than half the size of pools installed in the 1970s and early 1980s. In the 1970s, households installed large (550 square foot), kidney-shaped pools with a deep end and a shallow end for toddlers. Today, the typical new pool is closer to 300 square feet, and likely to be a lap pool for adult exercise. Some prognosticators see swimmable spas, or "spools" that are under 200 square feet in area as the next development.

Thus, new pools are not only scarcer, they are losing less water through evaporation. Evaporative losses can be greatly reduced by swimming pool covers, but our survey of remote sensing images revealed less than 5% of pools had a pool cover deployed. This was consistent with observations by pool experts.

In summary, backyard pools are becoming:

- less likely to be installed
- more likely to be removed
- smaller in size
- used by adults, not families with children
- highly unlikely to have a swimming pool cover deployed when not in use

EVAPORATIVE COOLERS

Evaporative or "swamp" coolers are considered an outdoor water use because demand is highly seasonal and virtually all the water is consumptively used through evaporation. Evaporative coolers were the dominant form of home cooling in Pima County through the 1950s, as seen on **Figure 10** below. Homes built as late as the 1960s and 1970s were still more likely to have evaporative coolers than refrigerative AC, but the numbers were roughly equal. Then, in the late 1980s and early 1990s, evaporative coolers rapidly disappeared from new home construction.

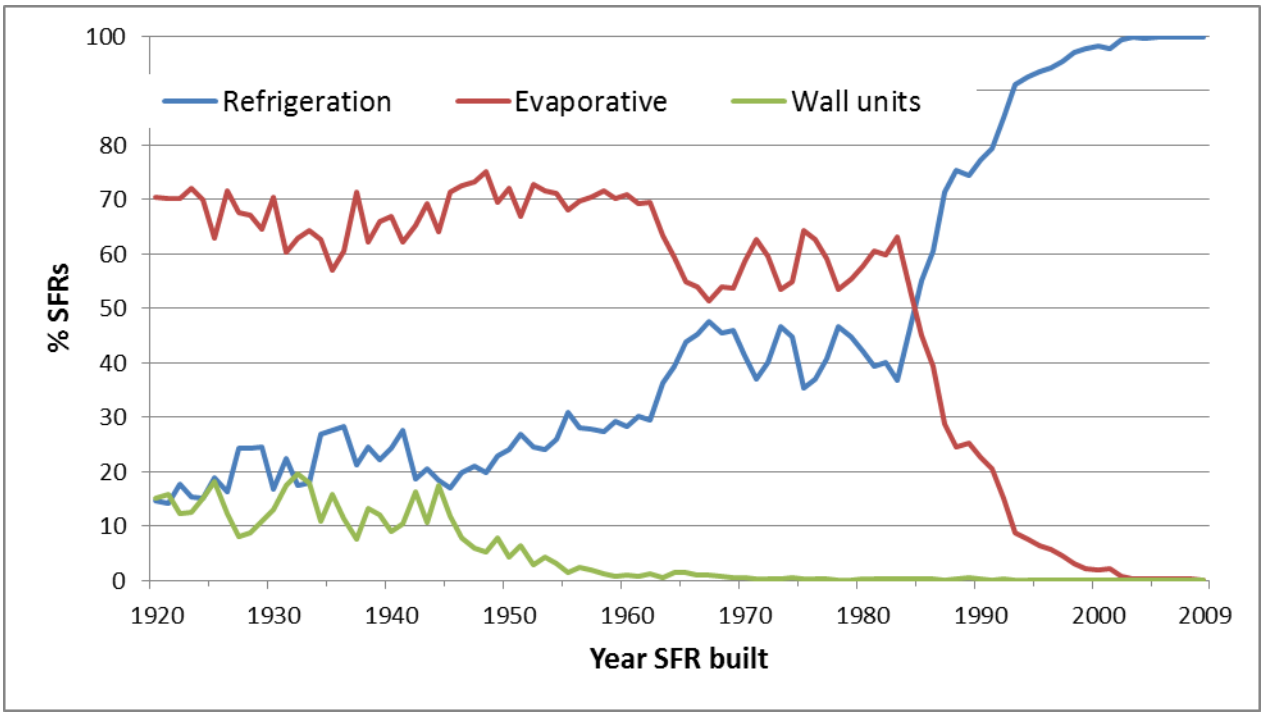


Figure 10: Current home cooling as a function of home construction date, Pima County.

In addition, older homes have been steadily converting from evaporative cooling to AC systems. The two main conversion triggers appear to be a new home buyer and the evaporative cooler reaching the end of its useful life. Unfortunately, the County Assessor's database has inaccurate information on frequency of evaporative coolers, and the majority of conversions to AC are done without a building permit. Thus, our ability to accurately measure conversion rates is severely hampered. What is clear is that the great majority of remaining evaporative coolers are in older, low-value homes. We presume that these households face serious budgetary constraints in converting to AC systems, and thus the conversion rate is gradually decreasing over time.

INDOOR DEMAND FACTORS

The three major sources of indoor water demand are toilet flushing, clothes washing, and showers and baths. As these fixtures and appliances reach the end of their useful lives or are replaced during remodeling, they are replaced with new models that tend to be considerably more water efficient. As a result, the water use per event has been declining for at least 25 years, since federal mandatory conservation standards were imposed. Note that Tucson Water took steps to encourage installation of 1.6 gallon per flush (gpf) toilets prior to the national standards.

National voluntary standards and mandatory standards in neighboring states are impacting indoor water demand by altering the fixture and appliance markets. Today, 95% of the dishwasher models sold by Best Buy meet the voluntary Energy Star standard and 97% of the toilets sold in Home Depot and Lowe's meet or exceed the CalGreen and Texas 1.28 gpf standard. **Figure 11** shows how average toilet-related indoor demand plunged between 1990 and 2006, and how demand associated with clothes washers has declined, and is forecast to decline at an accelerating rate in the future.

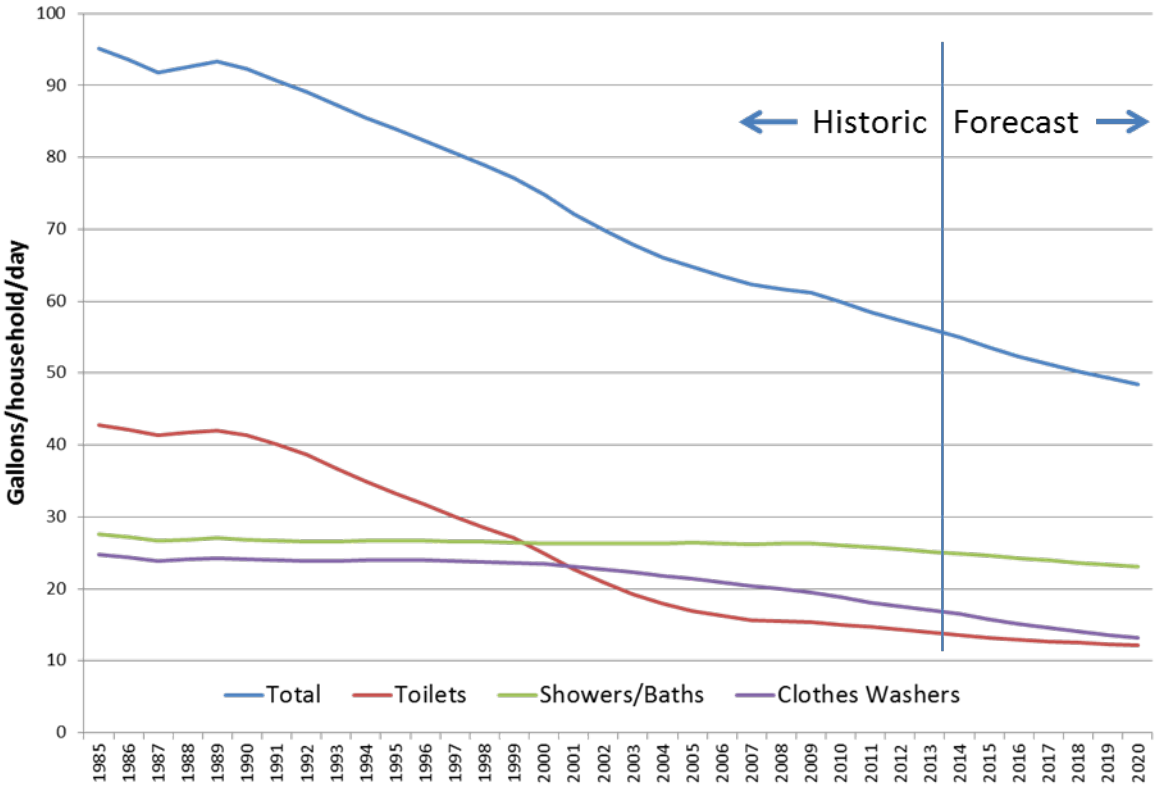


Figure 11. Modeled household demand from toilets, showers/baths, and clothes washers, 1985-2020.

Analysis of AquaCraft study data also revealed real-world usage rates for fixtures and appliances. As expected, actual usage rates were less than the maximum allowed usage

rates, with 1.6 gpf toilets averaging about 1.45 gpf and 2.5 gpm shower heads averaging about 2.1 gpm.

The data also suggest that there are diminishing returns to increased water efficiency for toilets. The same appears to be true for dishwashers, although the newer, more efficient models may reduce faucet use for rinsing. Indoor water demand would be lowered significantly if a higher percentage of households have, and use, a dishwasher rather than washing dishes in the sink.

IMPACTS OF NEW HOME CONSTRUCTION

The post-housing bubble real estate shakeout left only seven national builders constructing most new SFRs in the US, Arizona, and Pima County. While the home building industry has yet to fully recover, certain trends are evident:

- Four of the large home builders claim their homes are "sustainable", "green", and/or efficient in their marketing materials and on their websites;
- Two of the home builders appear to have taken substantial steps to back up these claims, installing fixtures, appliances, and irrigation systems that exceed mandatory standards;
- It is too early to tell if those builders touting energy and water efficiency will do better in the market, or how important water efficiency is to the average home buyer;
- Nevertheless, it is clear that new homes will continue to be substantially more water-efficient than existing housing stocks, both indoors and outdoors, and will probably become somewhat more water efficient over time.

Note that how hard builders push these trends is being driven by market forces. Local governments are not currently having any real effect through ordinances, possibly out of reluctance to do anything that might retard the nascent home building recovery.

TRIGGERS OF CHANGE

One key question in modeling and forecasting SFR water demand is, why does someone decide today to put in a pool or replace their evaporative cooler with AC, or buy a horizontal-axis clothes washer? Why today and not yesterday, a month ago or a year ago? What events trigger these types of decisions?

Several types of events can trigger household changes and transitions that impact water demand. Some of the more likely ones are:

- new home owners
- transition between owner-occupied and rented
- major home renovation
- water-using fixture or appliance or landscape component reaches end of useful life
- targeted conservation program, e.g., rebate

- having children / experiencing empty nest syndrome
- contagion effect – the neighbors did something
- drought, price shock, recession, etc.

This project focused on two types of transitions, those associated with a change in home ownership, and appliances, fixtures, or landscape components reaching the end of their useful life.

HOME OWNERSHIP TRANSFERS AND IMPACTS

The simplest change in home ownership occurs when one resident owner sells a house to a new resident owner. However, there are many other paths to new ownership, some of which became far more prevalent after the housing bubble burst. Some of these paths are depicted on **Figure 12** below.

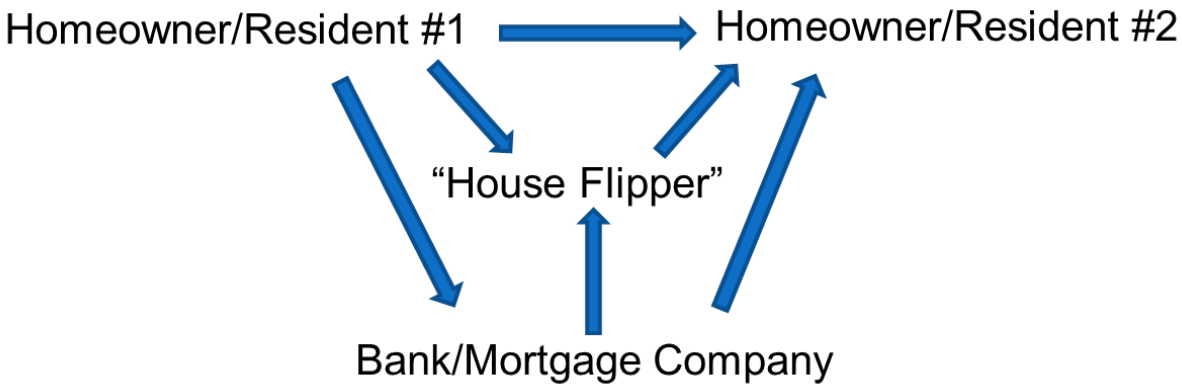


Figure 12. Paths of transition in home ownership.

These alternate pathways to changes in home ownership raise a number of questions, such as:

- How many foreclosed homes have landscapes die due to irrigation turned off or system failure?
- How many homes that are "flipped" have bathroom remodels and/or new washer/dryers installed?
- What are the numbers of houses flipped over time?

HOUSE FLIPPING IMPACTS

House flippers in both Pima and Maricopa County were interviewed anonymously. Among the findings were that house flipping is highly cyclical, and few house flippers engage in the activity for more than a few years. House flipping appears to have been more prevalent in Maricopa County. The house flipping process, from purchase to resale, almost always takes less than a year, and typically less than 6 months. The number and type of changes that are made to the house are a function of house condition, initial purchase price, condition of other homes in the immediate neighborhood, and overall market conditions.

For the purposes of this project, a flipped house was defined as one with three owners within six months, with the second sale being for a significantly higher price than the first sale. Interviewed house flippers indicate that such houses are likely to be over 10 years old, not well-maintained, and not recently updated or remodeled. The house flipper is likely to do the following:

- install new water-efficient fixtures in bathrooms and kitchen
- install one or more new water-using appliances
- reduce the home's landscaping by removing dead and unattractive plant material and putting down low-maintenance ground covers such as decomposed granite
- be subsequently sold to an investor who then rents it

Thus, we conclude that house flipping almost certainly contributes to reductions in SFR demand. However, because the house typically transitions from an owner-resident with a small household to a renter-resident with possibly a larger household, one cannot directly estimate demand reductions.

END OF USEFUL LIFE FOR APPLIANCES, FIXTURES, AND LANDSCAPES

Eventually, appliances and fixtures break or their performance declines to a point where they are replaced by a new device. While the useful life of any particular fixture or appliance is highly variable, there are published values for average useful life. The forecast model focuses on the replacement of toilets and clothes washers over time.

The end of useful life for an appliance or fixture can trigger water savings because, as noted above, new appliances and fixtures have become increasingly water efficient over time, in part because some voluntary standards have become de facto standards.

Some landscape species also have a finite lifespan, and eventually must be replaced. Landscape architects and landscapers are far more likely to suggest planting more drought-resistant species than in the past, so this creates a similar trend towards more water-efficient landscaping. A well-maintained swimming pool can last indefinitely, but old, larger ones may be more likely to be removed, as described above.

CONCLUSIONS

Three major factors are driving declines in domestic demand:

- The addition of new, highly water-efficient houses to the existing housing stock;
- Active conservation efforts, including rebate programs, local ordinances, and demonstration sites; and
- Passive conservation driven by changes in household residents' tastes and preferences and more efficient appliances and fixtures in the market.

In most cases, active conservation appears to be the least important factor, but it often gets all the credit for declines in per-capita or per-household water demand and all the blame

for the rate increases that can ensue. Socio-demographics, dominated by the graying of America, is impacting frequency of various indoor water uses, while contributing to changing tastes in backyard landscaping and declines in swimming pool construction.

The forecast model for Pima County SFR water demand out to 2020 shows:

- Indoor demand:
  - Toilets – continuing declines in per-household demand, but gradually levelling off
  - Clothes Washers – accelerating decline in per-household demand
  - Showers – now the largest component of indoor demand, due to major gains in toilet and clothes washer efficiency. Shower frequency is increasing slightly, while bath frequency is decreasing slightly, due to an aging population.
- Outdoor demand:

  Pools – gradual decline

  Evap Coolers – gradual decline towards zero

  Turf – gradual decline in backyards, front yard turf all but gone

Overall: continuing gradual decline in both indoor and outdoor demand

Factors ***not*** driving municipal water demand are also worth noting. Demand is no longer tightly tied to population, economic output, conservation efforts, or quality of life. The downward trends in per-household SFR demand are expected to continue through 2020 and into the next decade.

UNANSWERED QUESTIONS AND POTENTIAL ADDITIONAL ANALYSIS

This project answered most of the questions posed by the sponsoring agencies on declining SFR demand and provided many insights into future levels of demand. However, the following additional tasks would strengthen, enhance, and or extend study findings:

- Extend the model's forecasting period beyond 2020.

- Add the remaining indoor demand components so that the model would be useful for forecasting SFR-generated wastewater flows rather than just changes in flows.

- Add a Monte-Carlo tool to explicitly deal with key uncertainties in data and assumptions would provide better understanding of model projections.

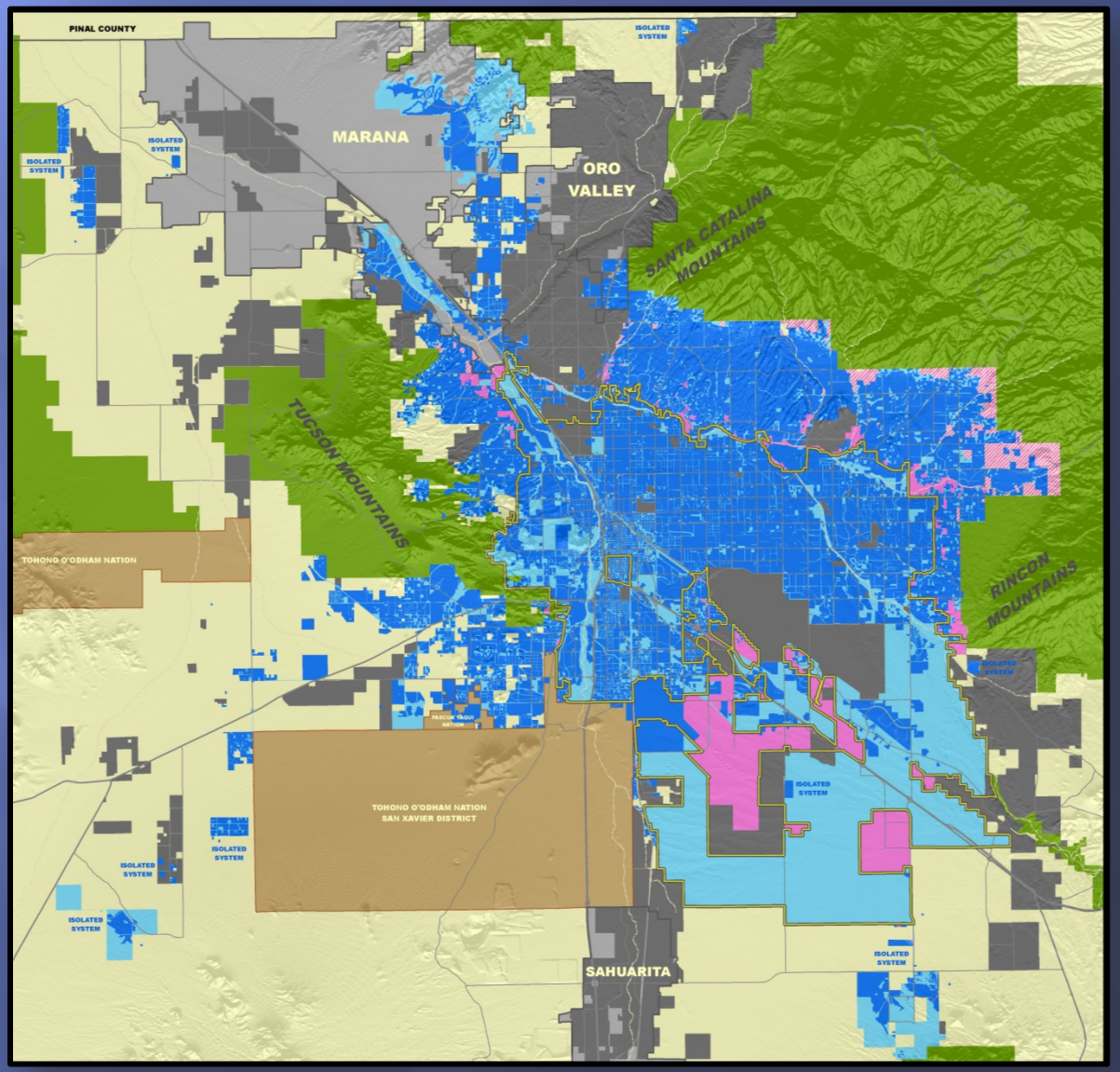
- Replace the current user inputs with a pull-down menu of population growth assumptions and related demographic shifts that correspond to updated population estimates and projections.

- Broaden the model to include multi-family residential (MFR) and non-residential customer classes to provide more information about total demand and total projected wastewater flows.

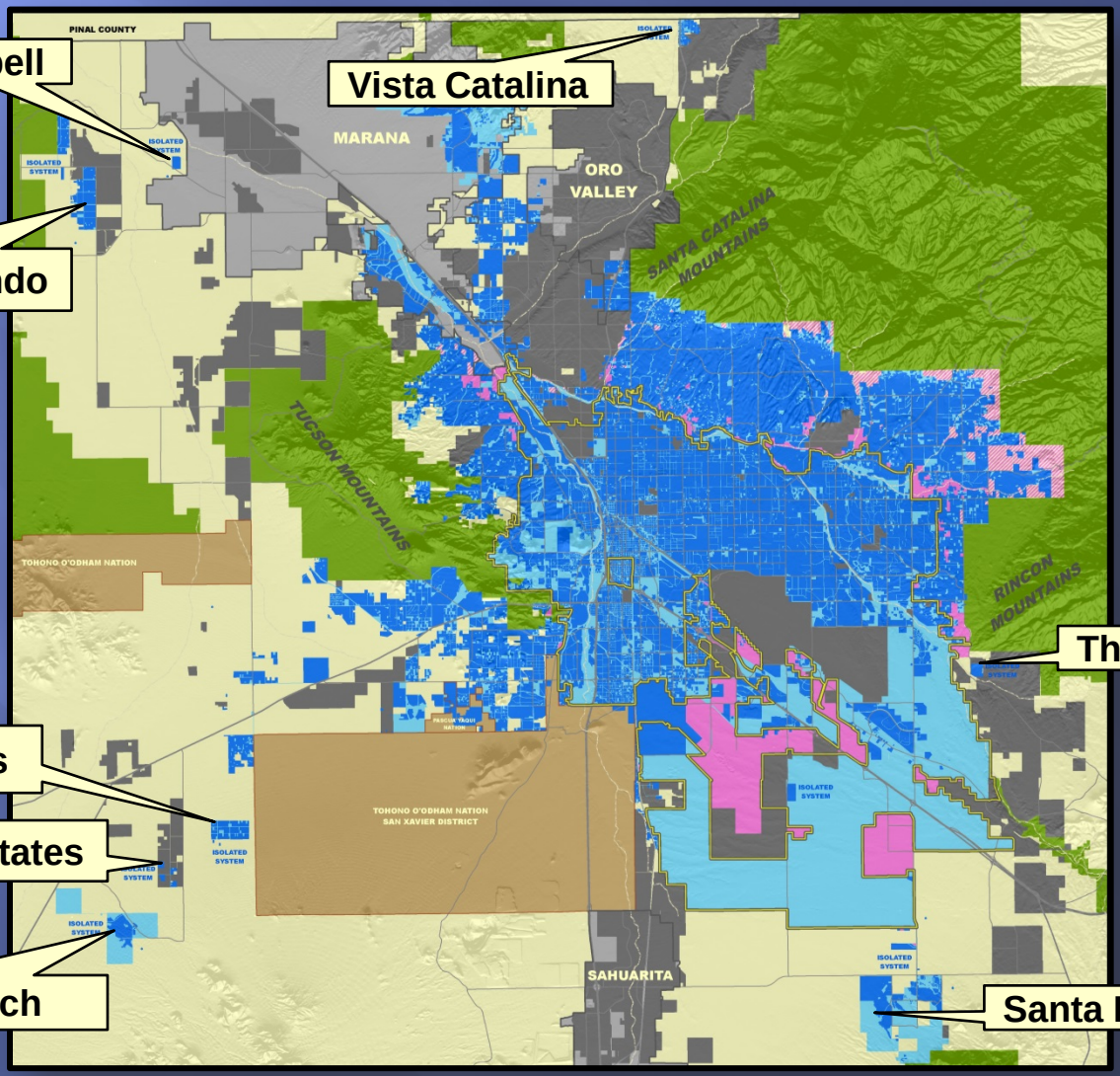
- Use the model as a tool to begin determining appropriate new guidelines for water supply and wastewater pipeline sizing in response to decreasing demand for new construction. Use the model outputs to begin planning future rates structures and estimating future revenues associated with decreasing demand for new construction.

Impact of Isolated Water Systems

Presented By: Melodee Loyer



Tucson Waters' Isolated Water Systems



Silverbell

Vista Catalina

Rancho Del Sol Lindo

Thunderhead Ranch

Valley View Acres

Sierrita Foothills Estates

Diamond Bell Ranch

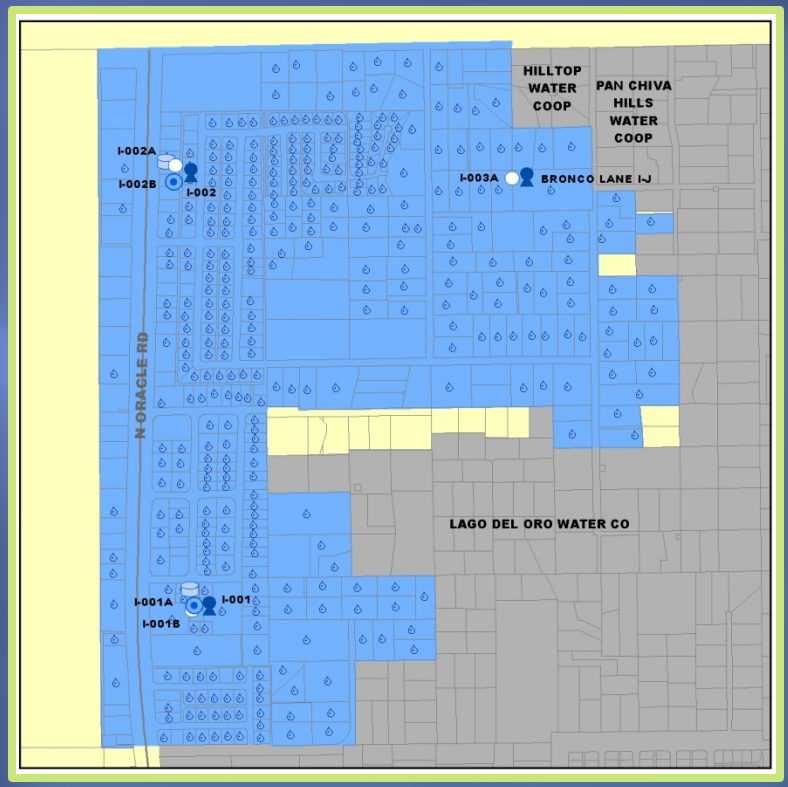
Santa Rita Bel Air

Vista Catalina

Year	Number of Services	Average Demand (AF/Yr)
2010	384	107
2011	377	102
2012	372	98
2013	379	100
2014	372	97

Purchased in 1959 .

Reason for Purchase:
Opportunity to expand water service area



Water Rights:
Large municipal provider
Regional recovery

Diamond Bell Ranch

Year	Number of Services	Average Demand (AF/Yr)
2010	226	64
2011	217	64
2012	216	57
2013	216	52
2014	218	52

Purchased in 1971 .

Reason for Purchase:

Opportunity to expand water service area

Water Rights:

Type 2

Large municipal provider

Regional recovery

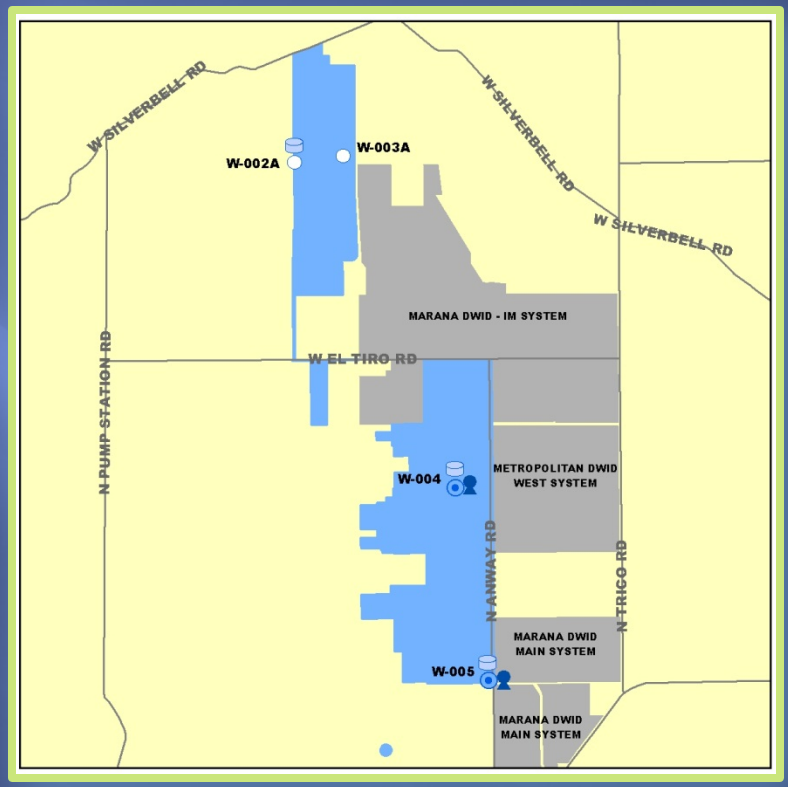
Rancho Del Sol Lindo

Year	Number of Services	Average Demand (AF/Yr)
2010	1013	306
2011	1001	295
2012	983	285
2013	979	267
2014	989	265

Purchased in 1961 .

Reason for Purchase:

Opportunity to expand water service area



Water Rights:

Type 1

Large municipal provider

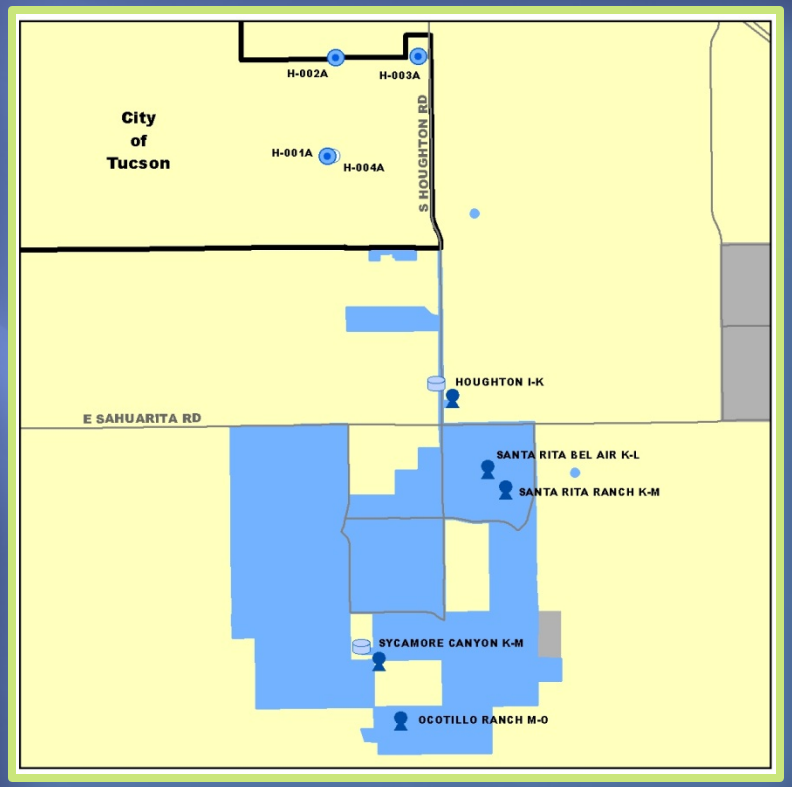
Regional recovery

Santa Rita Bel Air

Year	Number of Services	Average Demand (AF/Yr)
2010	2218	672
2011	2335	679
2012	2436	639
2013	2540	656
2014	2629	684

Purchased in 1973 .

Reason for Purchase:
Citizens Water Agreement



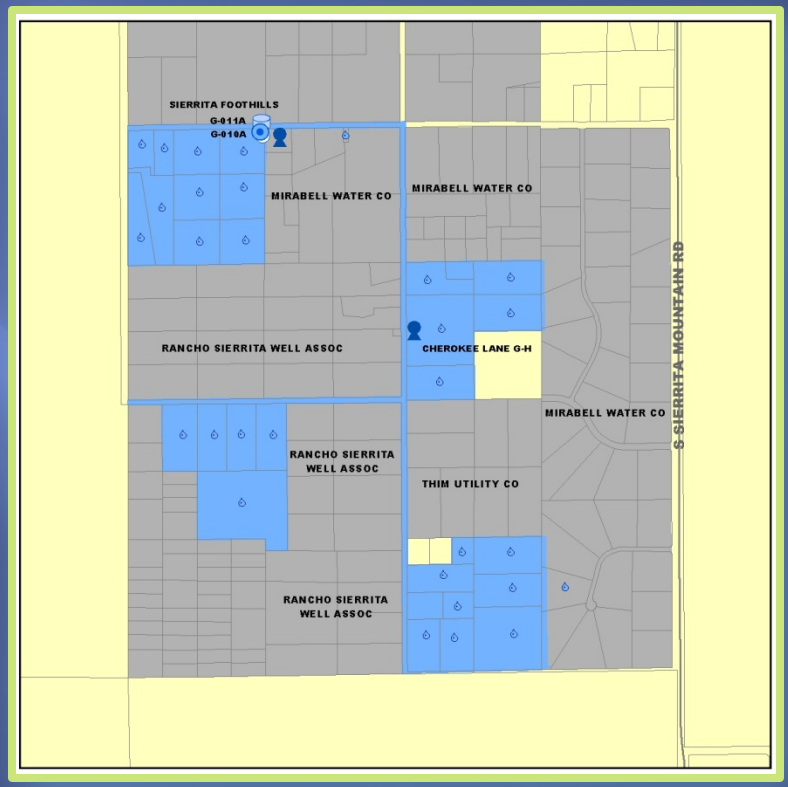
Water Rights:
Type 2
Large municipal provider
Regional recovery

Sierrita Foothills Estates

Year	Number of Services	Average Demand (AF/Yr)
2010	27	9
2011	26	8
2012	28	8
2013	29	8
2014	28	8

Purchased in 2003 .

Reason for Purchase:
Opportunity to expand water service area



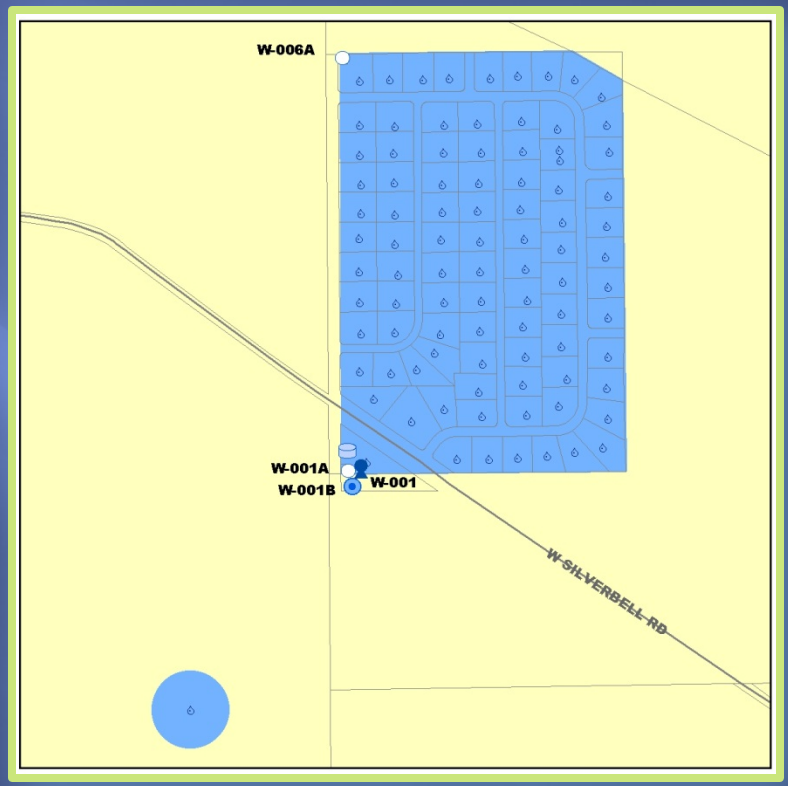
Water Rights:
Large municipal provider

Silverbell

Year	Number of Services	Average Demand (AF/Yr)
2010	86	24
2011	83	23
2012	84	22
2013	82	20
2014	82	20

Purchased in 1994 .

Reason for Purchase:
Opportunity to expand water service area



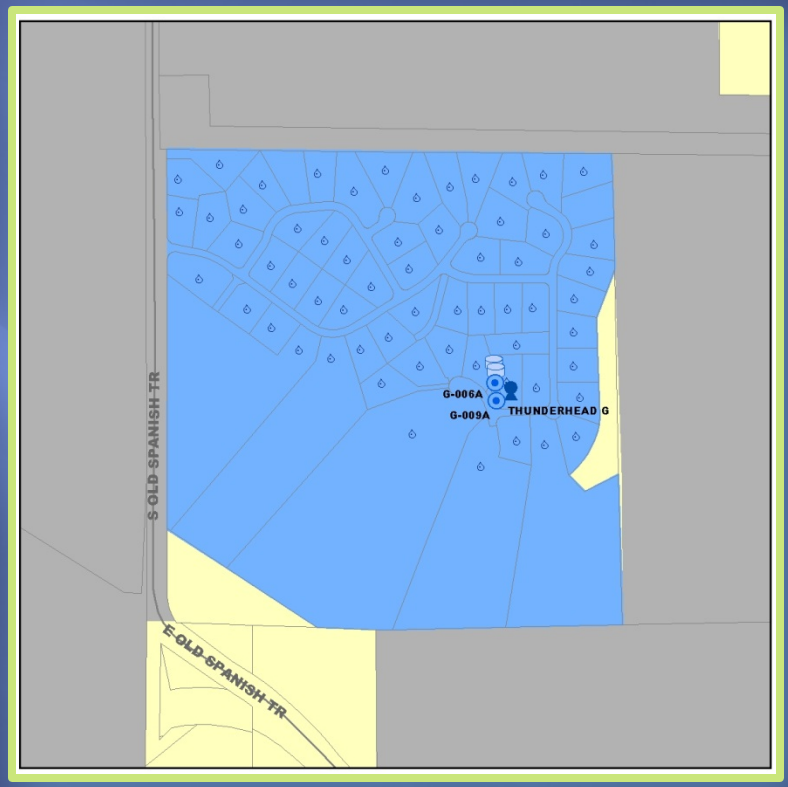
Water Rights:
Type 1
Large municipal provider
Regional recovery

Thunderhead Ranch

Year	Number of Services	Average Demand (AF/Yr)
2010	57	22
2011	56	23
2012	56	21
2013	57	21
2014	57	20

Purchased in 1996 .

Reason for Purchase:
Opportunity to expand water service area



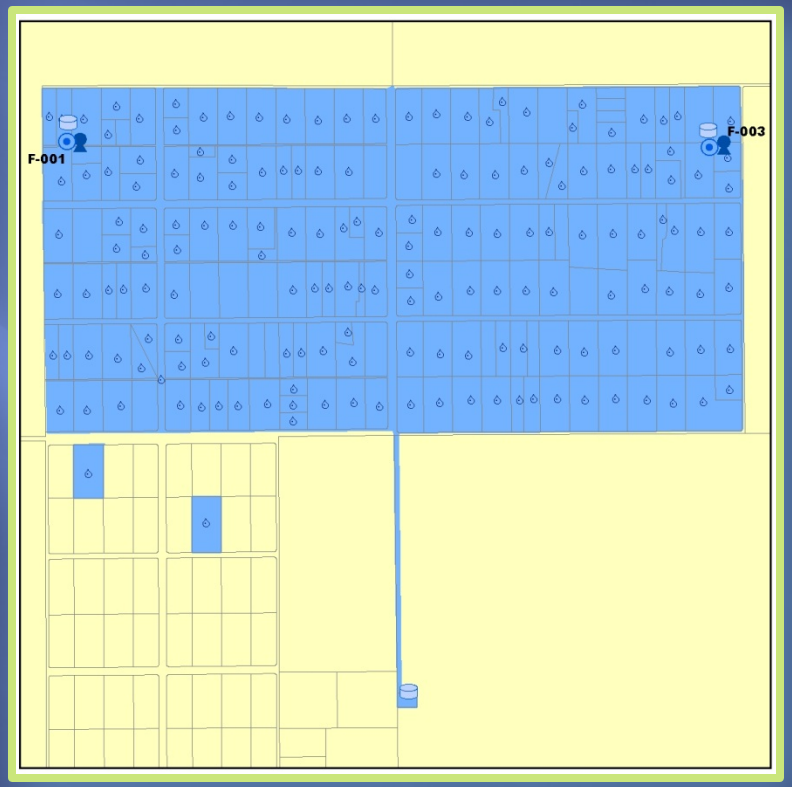
Water Rights:
Large municipal provider

Valley View Acres

Year	Number of Services	Average Demand (AF/Yr)
2010	158	61
2011	158	58
2012	159	48
2013	156	50
2014	152	46

Purchased in 1971 .

Reason for Purchase:
Opportunity to expand water service area

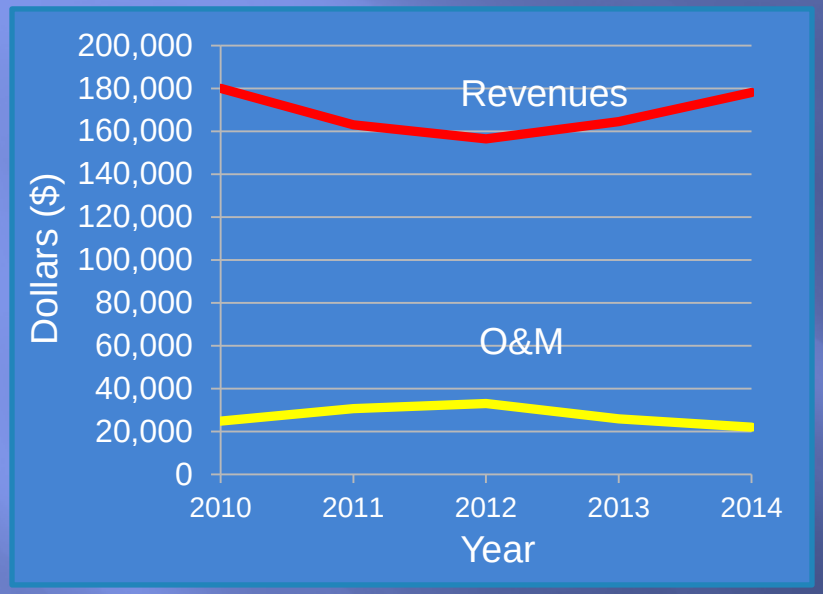


Water Rights:
Large municipal provider
Regional recovery

Isolated Systems - Value

- Revenues
- O&M Costs
- Capital Costs
- Area Development Fees (Diamond Bell Ranch & Santa Rita Bel Air)
- Asset Value
- Projected Market Value

Vista Catalina



Year	Annual Revenues **($)**	Operations and Maintenance Costs **($)**
2010	180,021	24,853
2011	163,031	30,745
2012	156,460	33,037
2013	164,454	25,974
2014	178,101	21,995

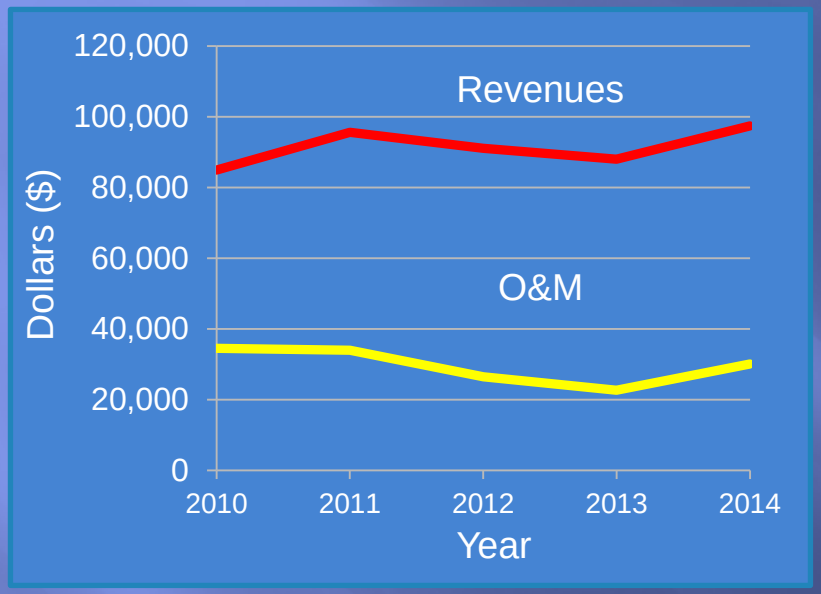
Purchase & Capital Costs to Date: $2,337,896

Projected Capital Cost in 5 yr CIP: $ 0

Asset Value: $1,295,796

Projected Market Value: $1,160,000

Diamond Bell Ranch



Year	Annual Revenues **($)**	Operations and Maintenance Costs **($)**
2010	84,926	34,543
2011	95,619	33,980
2012	91,083	26,491
2013	88,007	22,652
2014	97,384	30,083

Area Development Fees Collected $12,315/5 yrs.

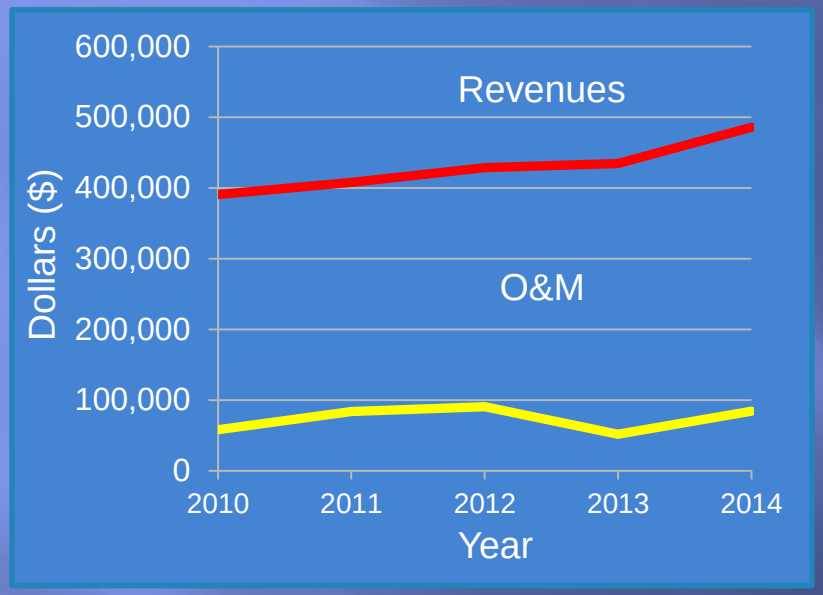
Purchase & Capital Costs to Date: $1,588,041

Projected Capital Cost in 5 yr CIP: $ 0

Asset Value: $1,284,332

Projected Market Value: $ 680,000

Rancho Del Sol Lindo



Year	Annual Revenues **($)**	Operations and Maintenance Costs **($)**
2010	390,789	58,240
2011	407,760	84,011
2012	428,502	90,562
2013	434,502	51,941
2014	485,596	84,322

Purchase & Capital Costs to Date: $1,046,962

Projected Capital Cost in 5 yr CIP: $1,190,000

Asset Value: $ 686,965

Projected Market Value: $3,083,000

Santa Rita Bel Air

Year	Annual Revenues **($)**	Operations and Maintenance Costs **($)**
2010	1,213,076	351,390
2011	1,195,841	611,501
2012	1,234,260	417,921
2013	1,303,798	328,123
2014	1,466,901	351,681

Area Development Fees Collected $1,740,583/5 yrs.

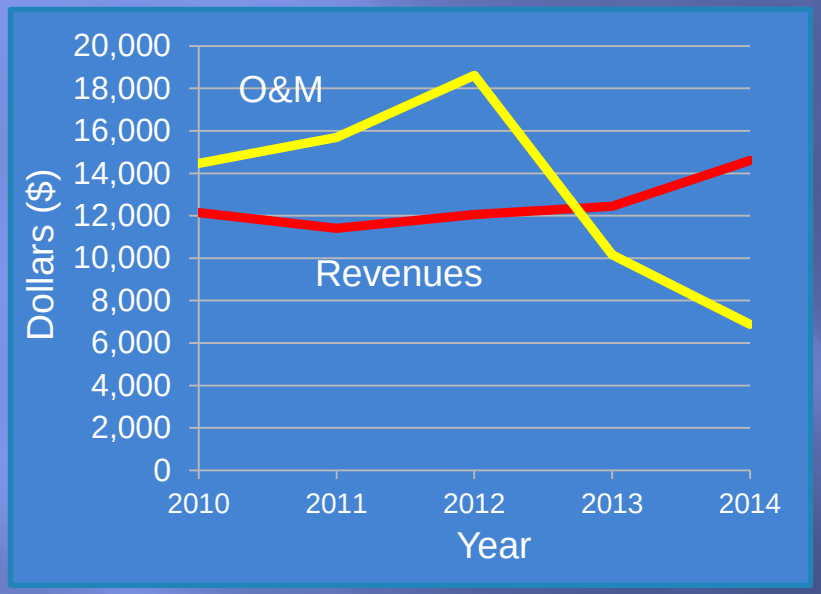
Purchase & Capital Costs to Date: $5,823,052

Projected Capital Cost in 5 yr CIP: $ 0

Asset Value: $4,828,215

Projected Market Value: $8,195,000

Sierrita Foothills Estates



Year	Annual Revenues **($)**	Operations and Maintenance Costs **($)**
2010	12,149	14,462
2011	11,401	15,686
2012	12,050	18,611
2013	12,445	10,163
2014	15,174	6,888

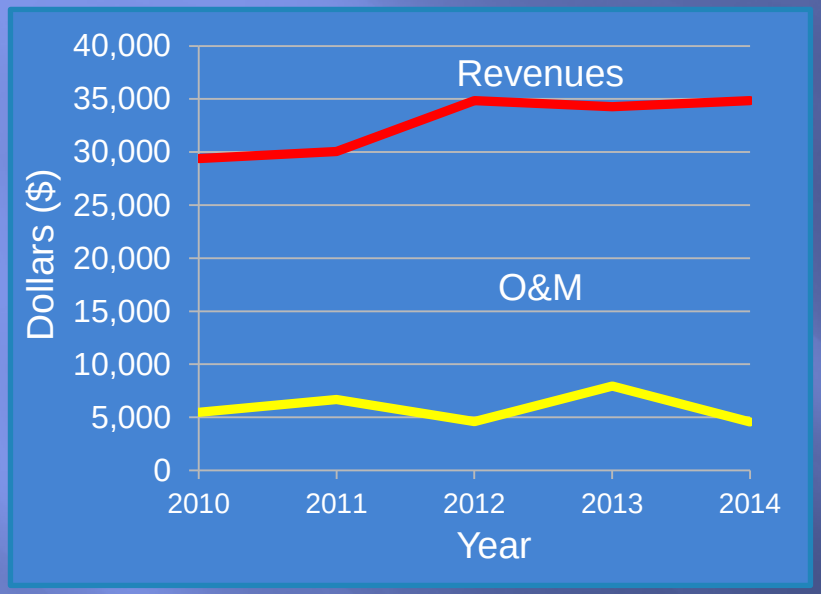
Purchase & Capital Costs to Date: $373,048

Projected Capital Cost in 5 yr CIP: $ 0

Asset Value: $317,905

Projected Market Value: $ 87,000

Silverbell



Year	Annual Revenues **($)**	Operations and Maintenance Costs **($)**
2010	29,385	5,468
2011	30,061	6,687
2012	34,844	4,602
2013	34,271	7,945
2014	34,855	4,558

Purchase & Capital Costs to Date: $484,812

Projected Capital Cost in 5 yr CIP: $ 0

Asset Value: $370,597

Projected Market Value: $256,000

Thunderhead Ranch

Year	Annual Revenues **($)**	Operations and Maintenance Costs
2010	29,537	50,653
2011	32,226	35,667
2012	30,265	5,648
2013	35,051	10,552
2014	36,361	11,352

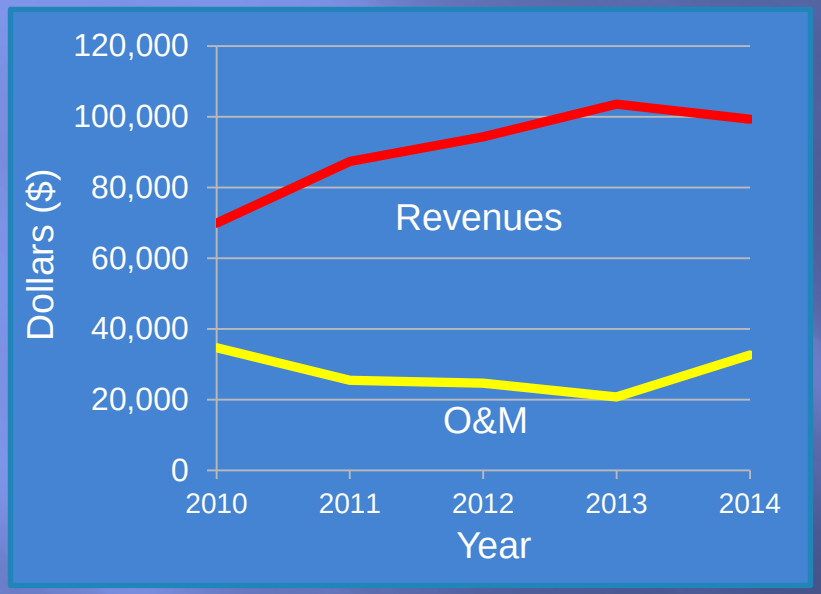
Purchase & Capital Costs to Date: $190,823

Projected Capital Cost in 5 yr CIP: $ 0

Asset Value: $150,688

Projected Market Value: $178,000

Valley View Acres



Year	Annual Revenues **($)**	Operations and Maintenance Costs **($)**
2010	69,931	34,697
2011	87,369	25,445
2012	94,343	24,667
2013	103,547	20,769
2014	99,273	32,658

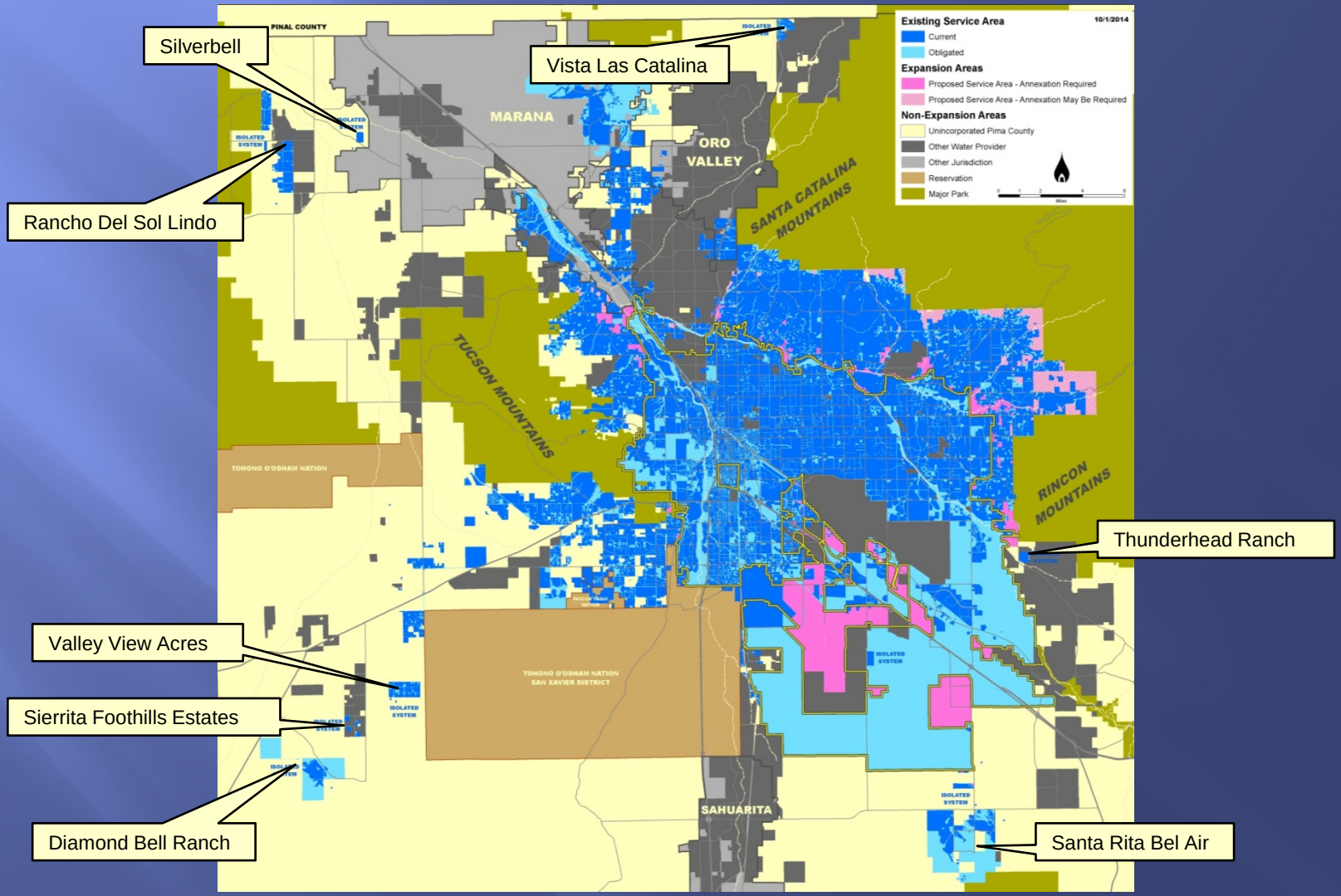
Purchase & Capital Costs to Date: $6,768,841

Projected Capital Cost in 5 yr CIP: $ 0

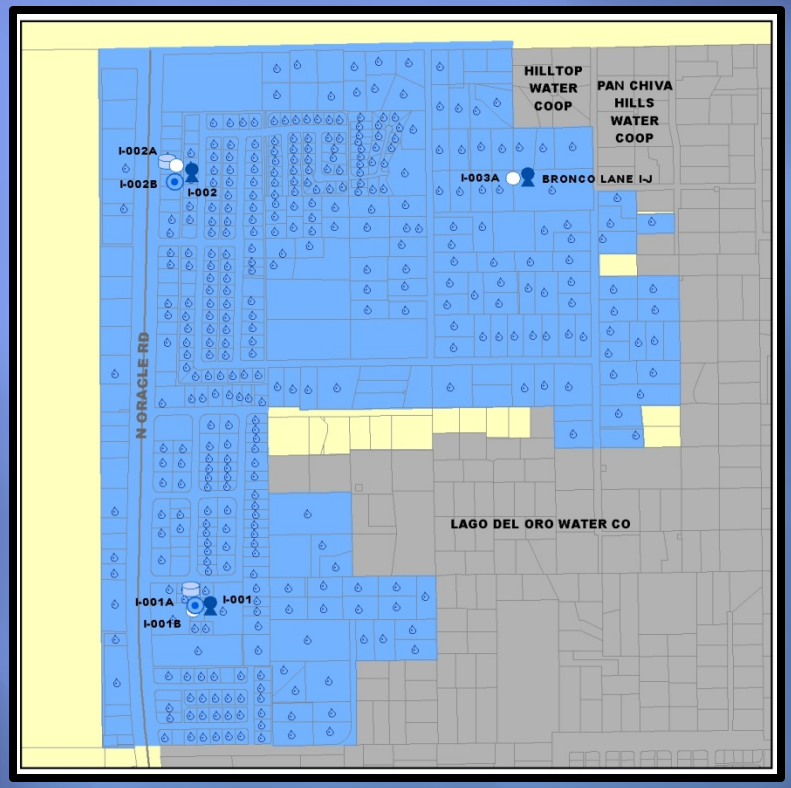
Asset Value: $4,821,540

Projected Market Value: $ 474,000

What is The Future of Our Isolated Water Systems?



Vista Las Catalina



Does System Pay for Itself? (Revenues > O&M) *Yes*

Can System Reasonably be Connected to the Central System? *No*

Who Might We Sell it to?

Lago Del Oro Water Co.
Pam Chiva Hills Water Coop
Hilltop Water Coop

Remarks:

Diamond Bell Ranch

Does System Pay for Itself? (Revenues > O&M) *Yes*

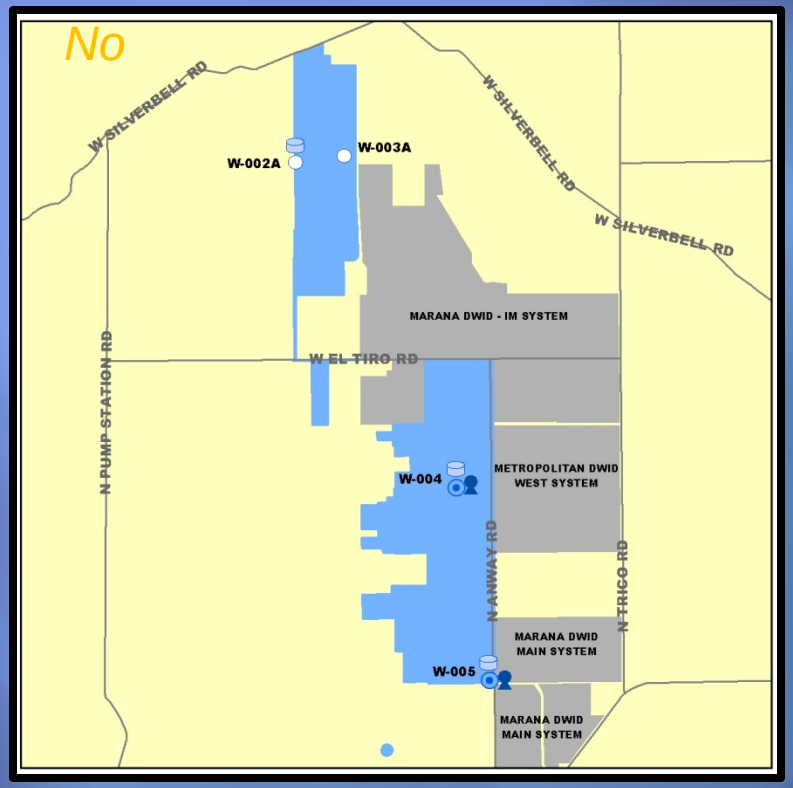
Can System Reasonably be Connected to the Central System? *No*

Who Might We Sell it to?

- *Metro Water*
- *Mirabell Water Co.*
- *Ranch Sierrita Well Assoc.*
- *Thim Utility Co*

Remarks:

Rancho Del Sol Lindo



Does System Pay for Itself? (Revenues > O&M) *Yes*

Can System Reasonably be Connected to the Central System? *No*

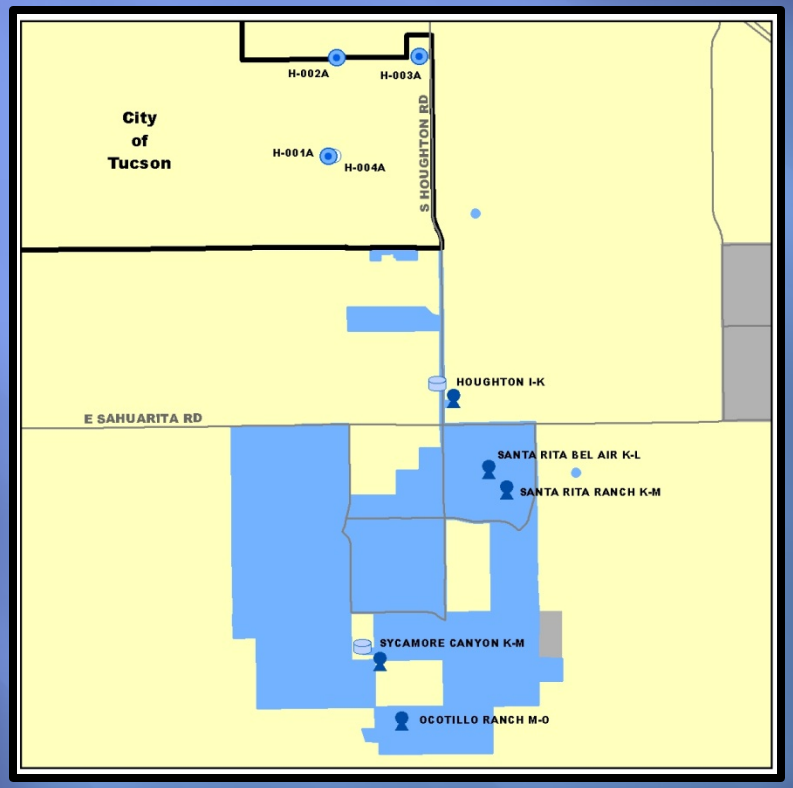
Who Might We Sell it to?

Marana DWID

Metro Water

Remarks:

Santa Rita Bel Air



Does System Pay for Itself? (Revenues > O&M) *Yes*

Can System Reasonably be Connected to the Central System? *Yes*

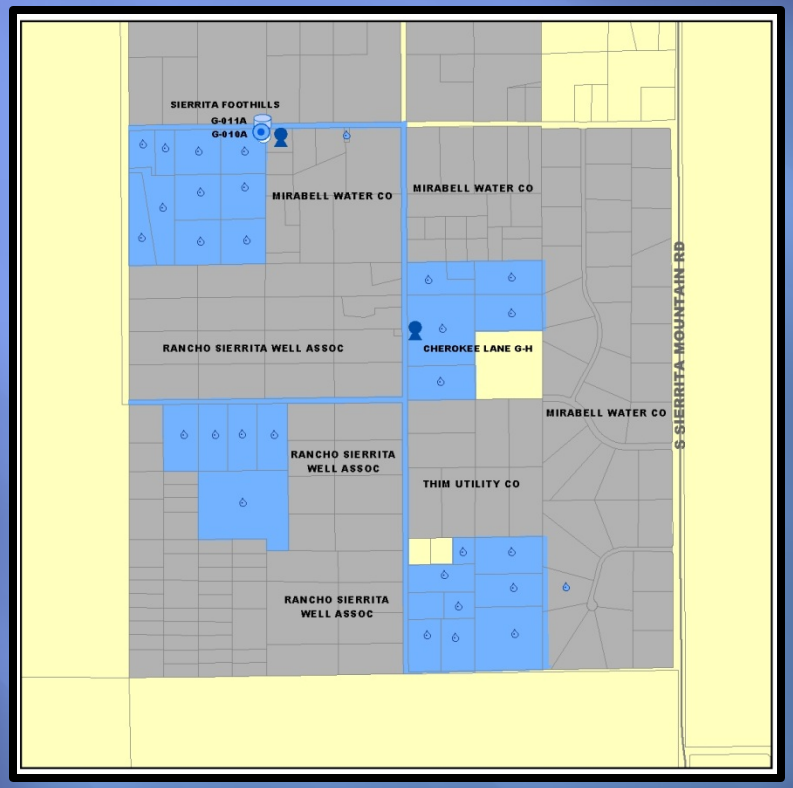
Who Might We Sell it to?

N/A

Remarks:

Connect to Central System

Sierrita Foothills Estates



Does System Pay for Itself? (Revenues > O&M) *Sometimes*

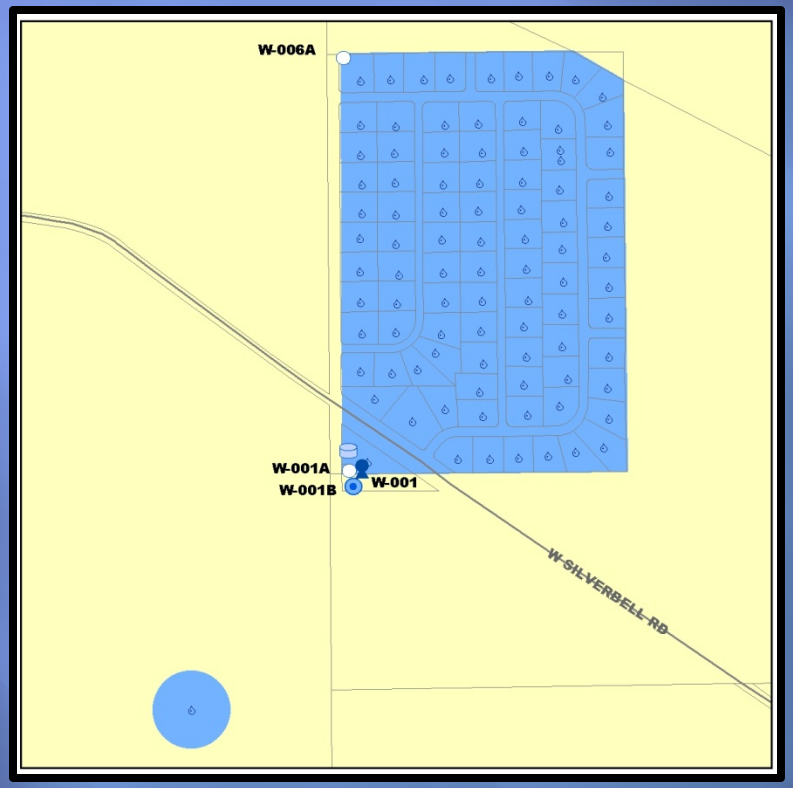
Can System Reasonably be Connected to the Central System? *No*

Who Might We Sell it to?

- *Metro Water*
- *Mirabell Water Co.*
- *Ranch Sierrita Well Assoc.*
- *Thim Utility Co.*

Remarks:

Silverbell



Does System Pay for Itself? (Revenues > O&M) *Yes*

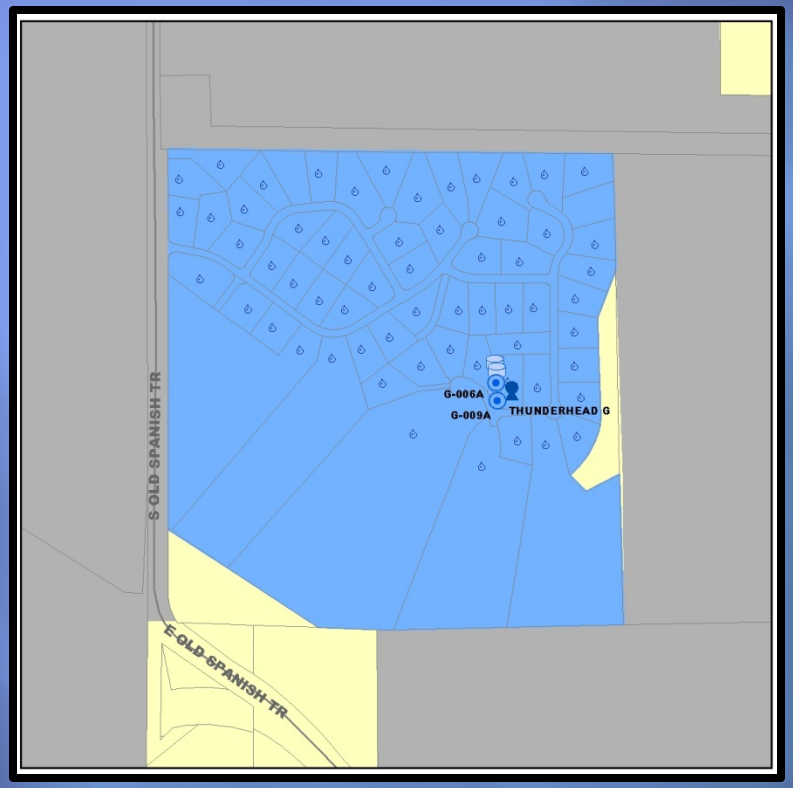
Can System Reasonably be Connected to the Central System? *No*

Who Might We Sell it to?

Marana Water

Remarks:

Thunderhead Ranch



Does System Pay for Itself? (Revenues > O&M) — *Yes (Now)*

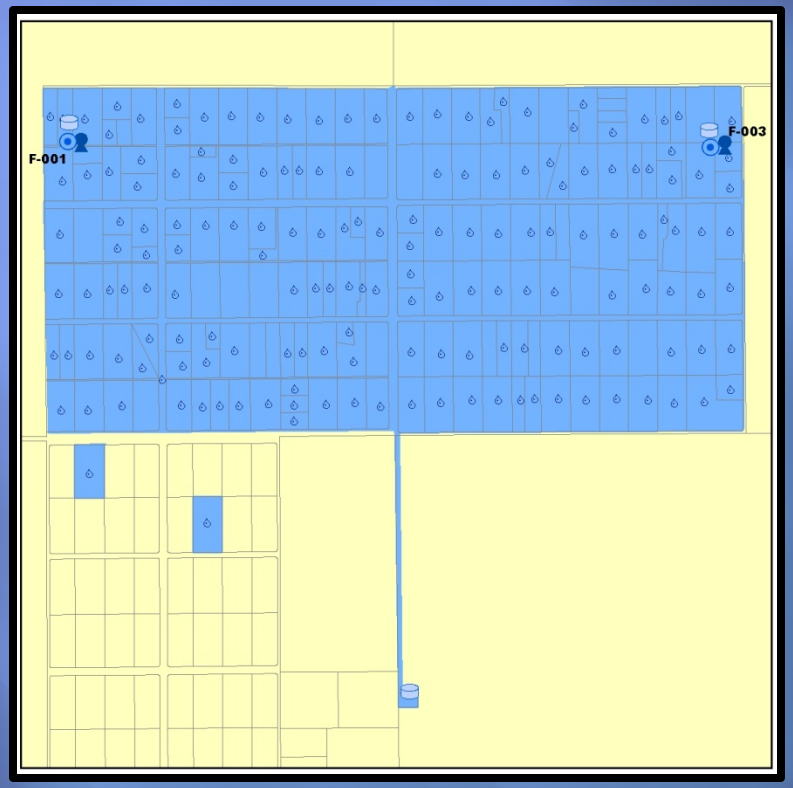
Can System Reasonably be Connected to the Central System? — *Maybe*

Who Might We Sell it to?

Spanish Trail Water Co.

Remarks:

Valley View Acres



Does System Pay for Itself? (Revenues > O&M) *Yes*

Can System Reasonably be Connected to the Central System? *Maybe*

Who Might We Sell it to?

- *Metro Water*
- *Mirabell Water Co.*
- *Ranch Sierrita Well Assoc.*
- *Thim Utility Co.*

Remarks:

How Much Revenue is Attributed to Isolated Systems Versus Total Revenue?

- Revenue From Isolated Systems $2,418,923
- Total Tucson Water Revenue $176,411,669
- % Contribution From Isolated Systems 1.4%

* Note: Values Reflected Fiscal Year 2014

How Much Water Use is Attributed to Isolated Systems Versus Total Water Use?

- Isolated Systems Water Use — 1,191 AF/Yr
- Total Tucson Water Use — 112,000 AF/Yr
- % of Total System Use — 1.06%

* Note: Values Reflected Fiscal Year 2014

How Do Isolated Systems Affect Our Non-Renewable Water Resource?

Total Isolated Systems Non-Renewable Use: 584 AF

Total Tucson Water Non-Renewable Use: 9125 AF

% Attributed to Isolated Systems: 6.4%

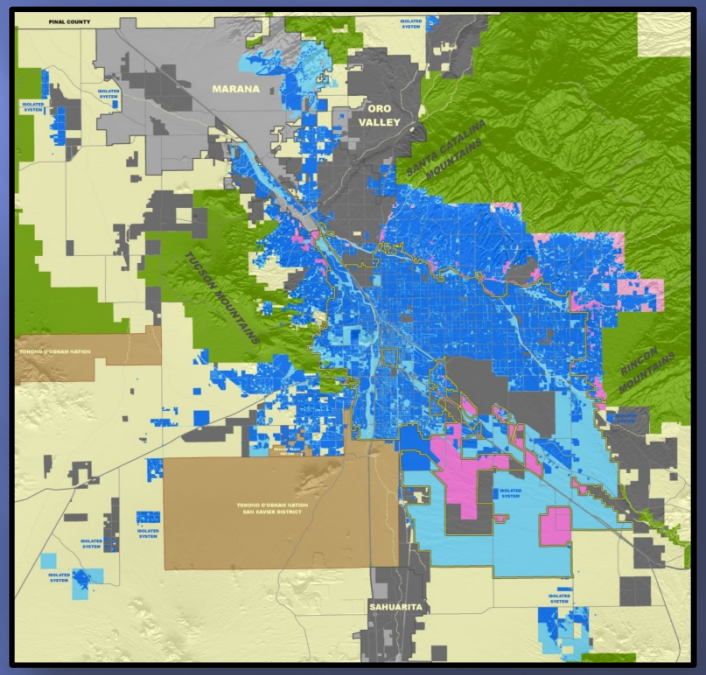
* Note: Values Reflect Calendar Year 2014

Water System Buy/Sell Policy

- Established policies and procedures exist for water system acquisition
- Draft policy for water system divestment encompasses:
  - Isolated System evaluation criteria and procedures
  - Evaluation-based actions and procedures for Isolated System divestment or modification

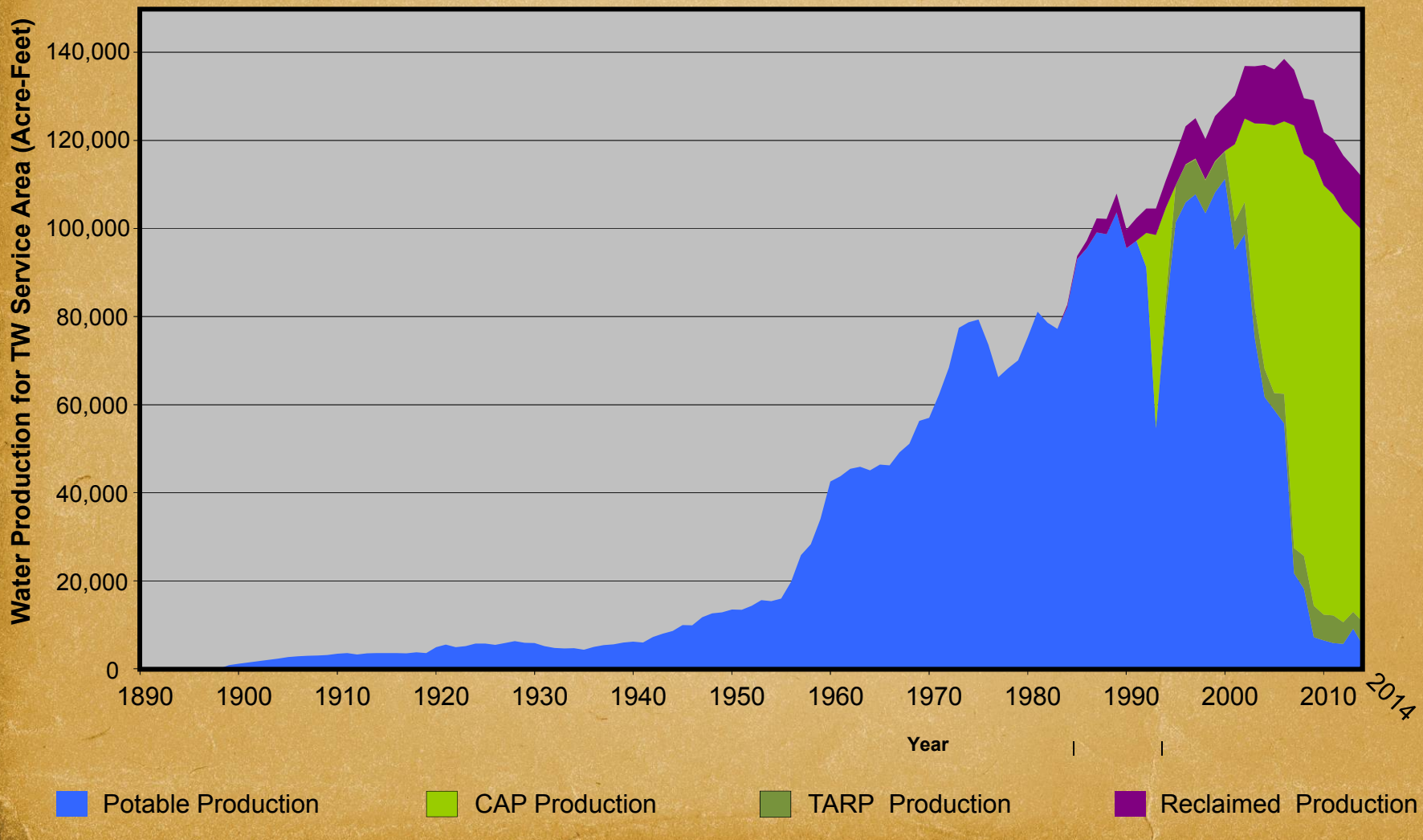
Impact of Isolated Water Systems

Presented By: Melodee Loyer

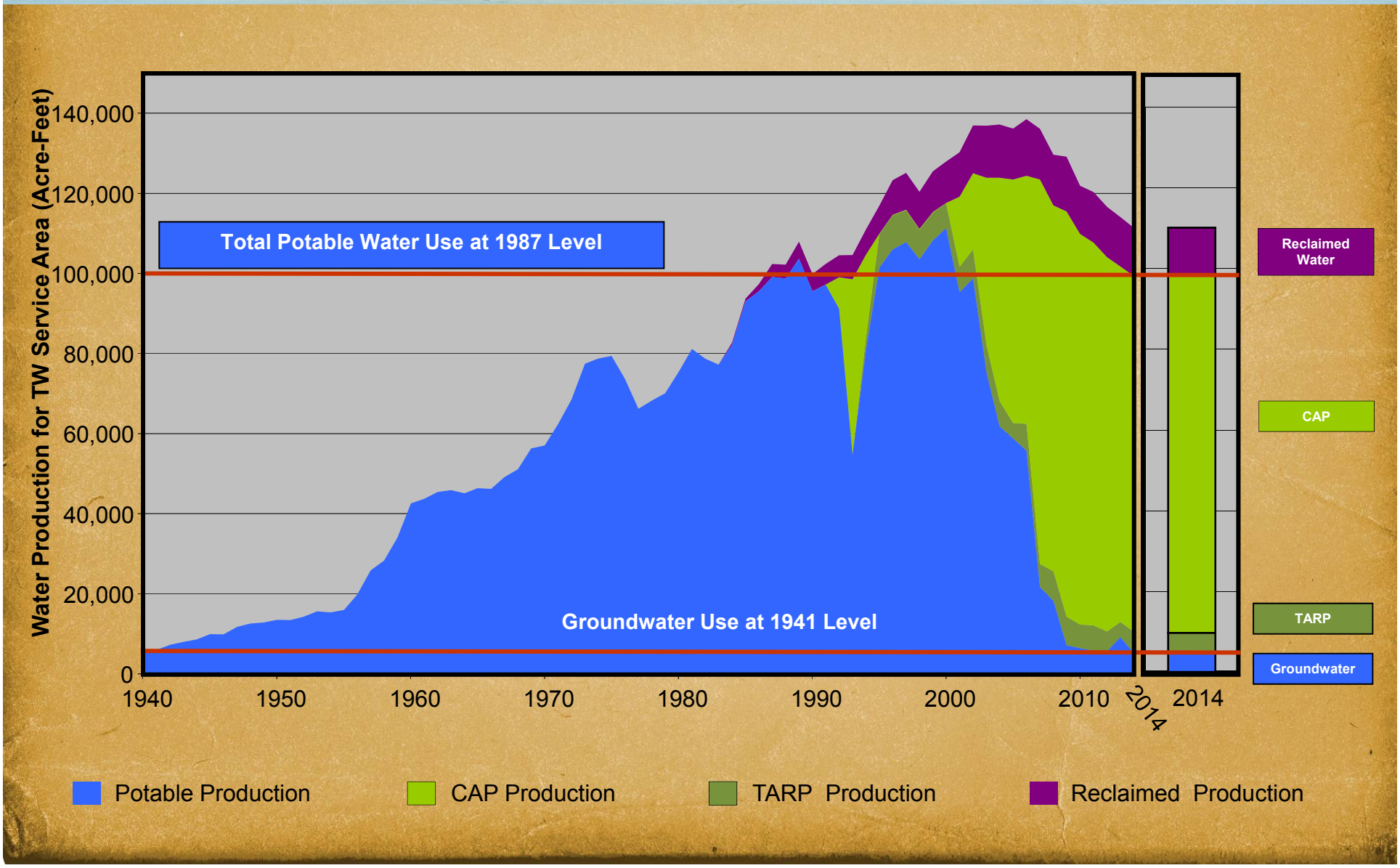


QUESTIONS

Water Production for Tucson Water Service Area 1899-2014

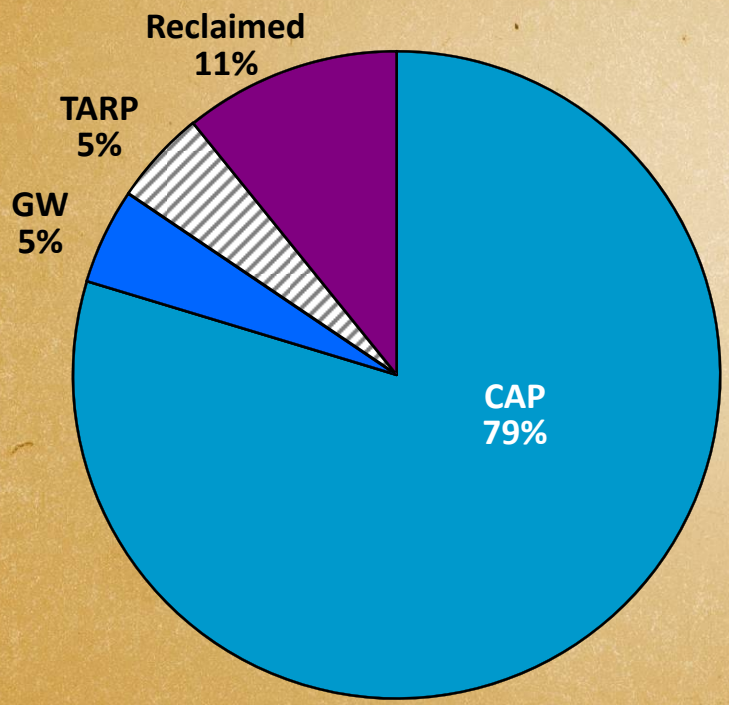


Water Production for Tucson Water Service Area 1940-2014

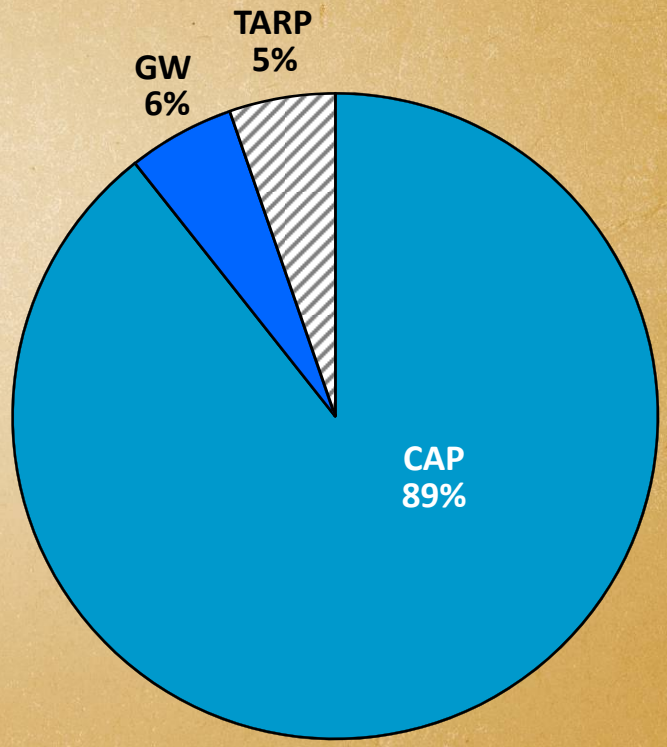


Water Production Type 2014

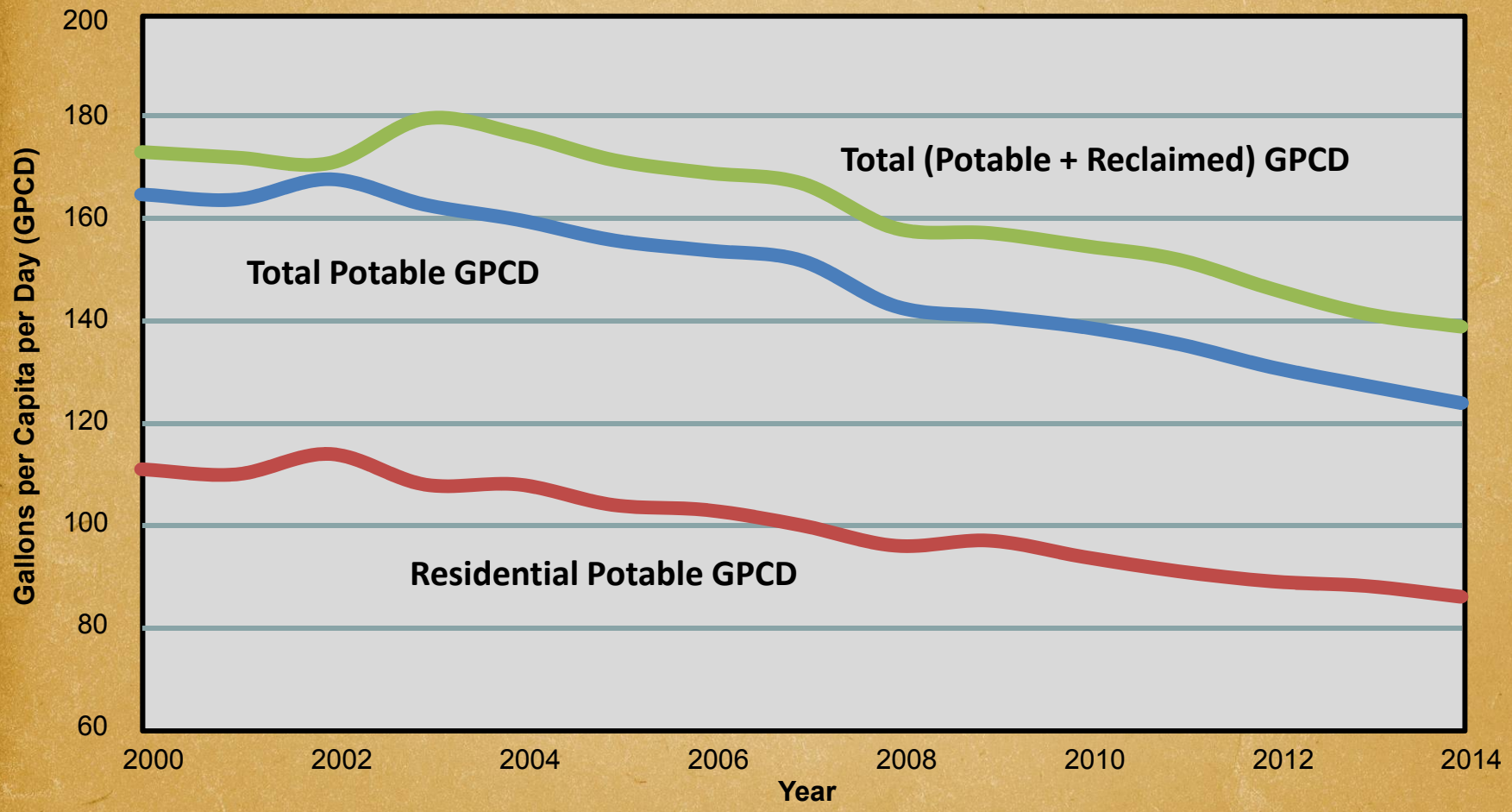
Total Water Production
111,459 AF



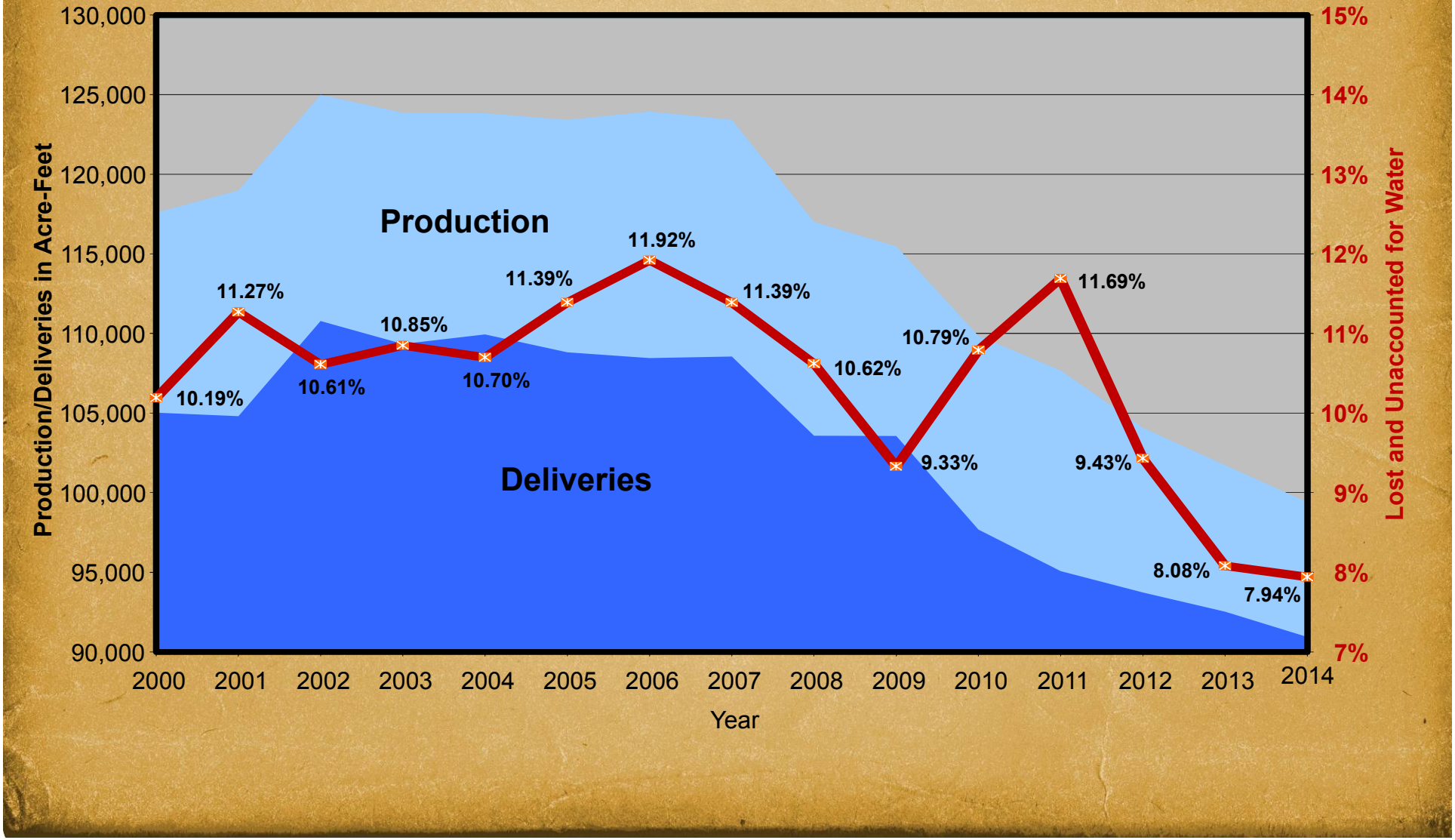
Potable Water Production
99,396 AF



Tucson Water Service Area GPCD Trend 2000-2014



Tucson Water Service Area LUW Trend 2000-2014



Citizens' Water Advisory Committee

Projected Agenda

May 6, 2015

- **WSA Policy Review/Water Checkbook Update (Melodee Loyer)**
- **Presentation/Discussion on PILOT – City Budget (pending confirmation)**
- **Consideration of Formation of By-Laws – Committee Discussion**

June 3, 2015

- **Mayor Rothschild on Water Perspectives**

Future Agenda Items without a Date:

-Green Streets Presentation
-Antibiotic resistant genes in the Wastewater system (J McLain)
-Effluent Sales and ground water use Analysis (P dos Santos)
-WaterSMART program
-PR Position/Strategy
-Public Engagement
-Utility Bill Re-design
-ADWR Director Presentation on the Plan for DWR (possibly regional)