



City of Phoenix

WATER SERVICES DEPARTMENT
Quality. Reliability. Value.

DE-CONSTRUCTING RESIDENTIAL WATER USE

AZ WET ADVANCED TEACHER WORKSHOP

THE DECISION CENTER FOR A DESERT CITY, ASU

7.15.14

Adam Miller and Jamie Campbell

De-Constructing Residential Water Use

Presentation Summary

- ▣ Context of Water Demand Research
- ▣ Overview of Demand Trends
- ▣ Indoor Water Use
- ▣ Outdoor Water Use
- ▣ Applying Research to Demand Forecasting



Supply Considerations

Typical Year Water Supplies

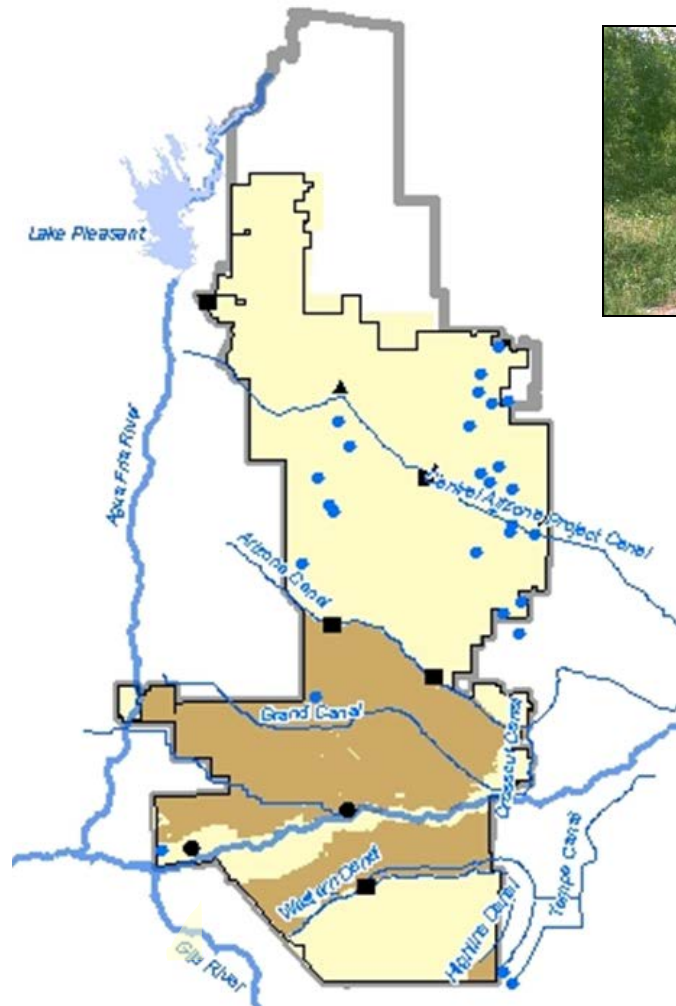
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Central Arizona Project (CAP)
Colorado River (43-45%)



Reclaimed Wastewater (?%)
•Palo Verde NGS
•Turf and Agriculture Irrigation



Salt River Project (SRP)
Salt/Verde River (49-51%)



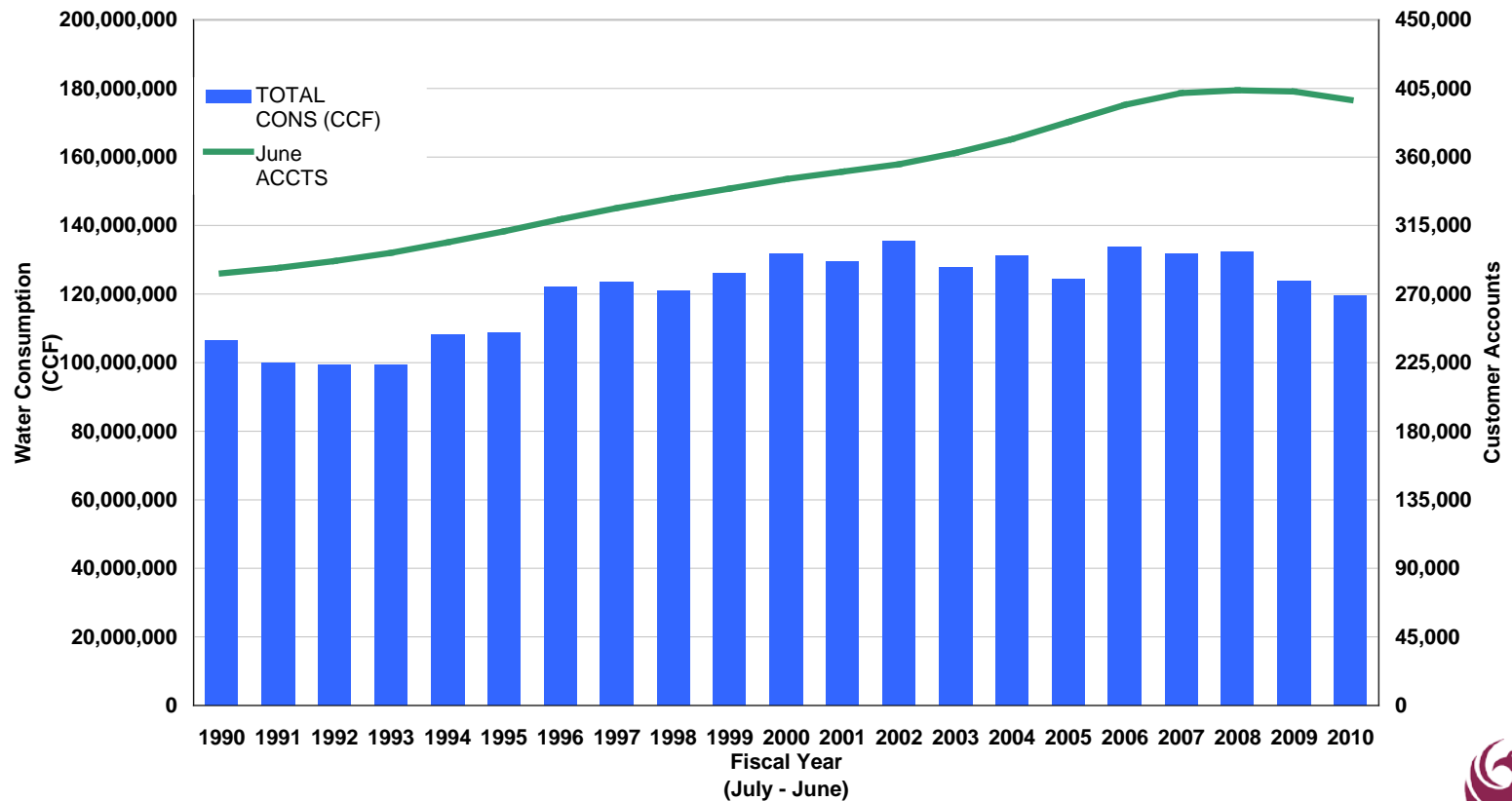
Groundwater (2-3%)



Demand Trends

Stable Demand Despite Growth

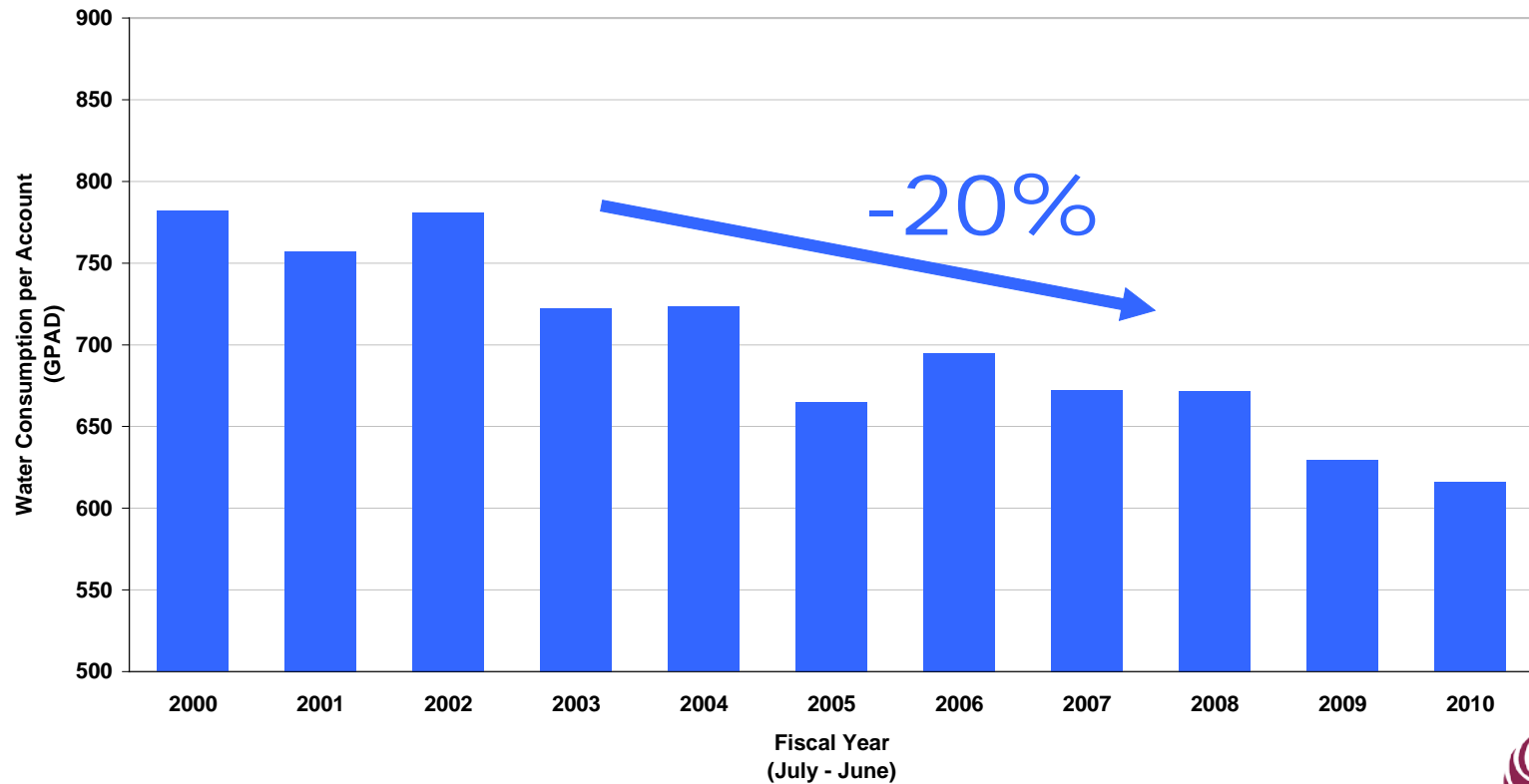
Trends in Water Account Growth and Metered Water Use
(1990 - 2010)



Demand Trends

Reduction in Use per Customer

Annual Mean Daily Water Use per Account
(2000 - 2010)



Determinates of Single Family Water Use

Attribute	Data Type	Source
Age of home	Property Tax Data	MCAO
Size of lot	Property Tax Data	MCAO
Household size	Census	USCB
Income	Census	USCB
Location	Customer Records	WSD
Landscape composition	Survey	WRDP
Device efficiency	Survey	WRDP

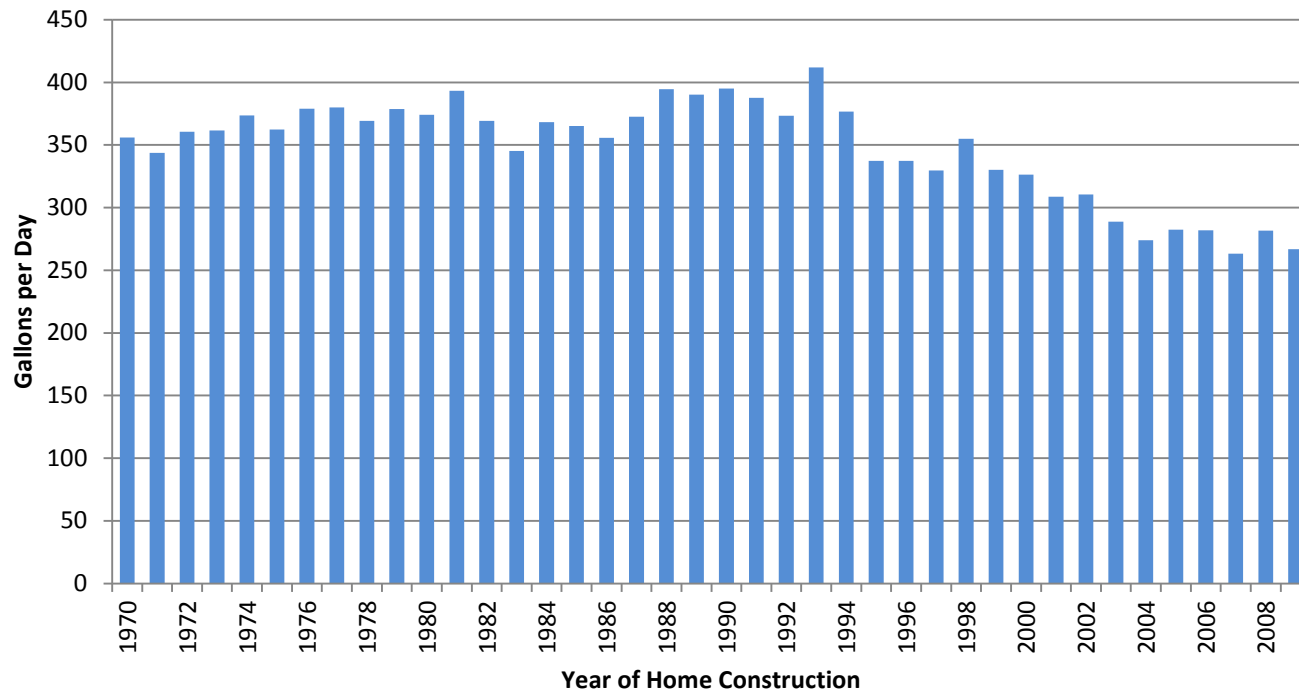


Demand Trends

New Homes are Using Less

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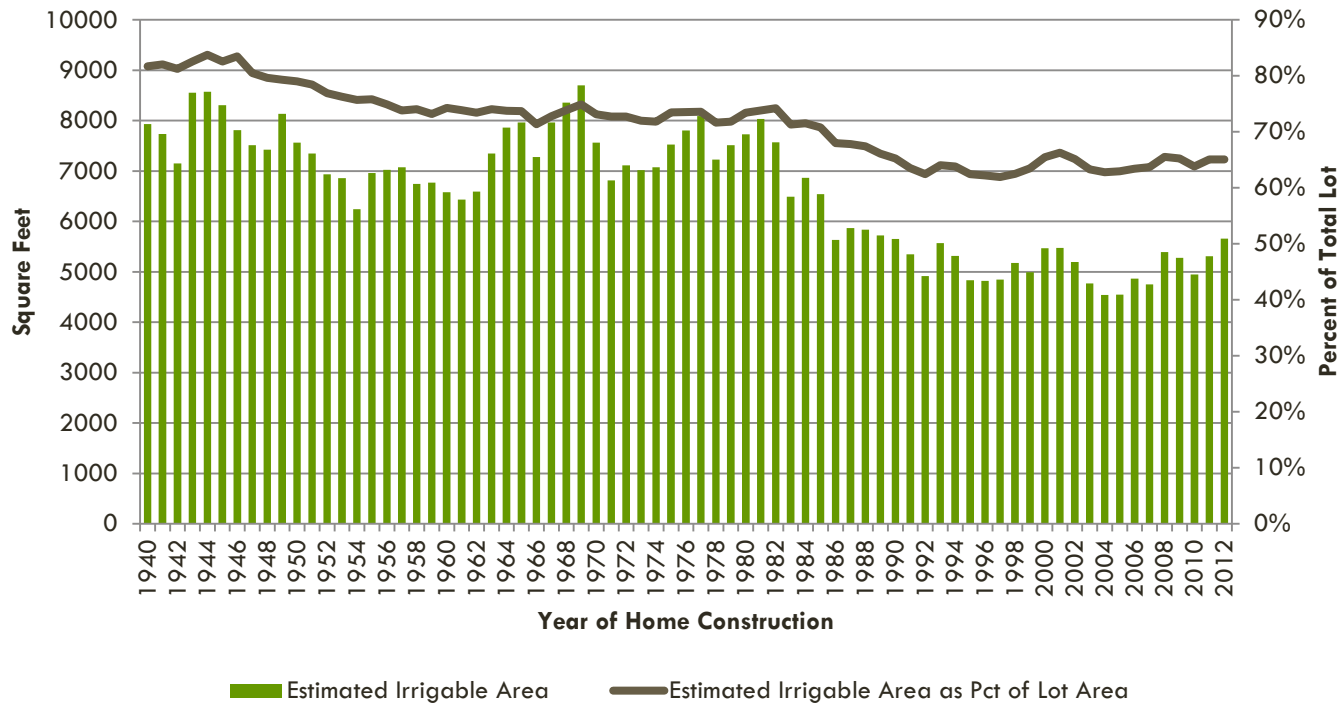
**Average Daily Water Use (2010 - 2012) by
Year of Home Construction**



Demand Trends

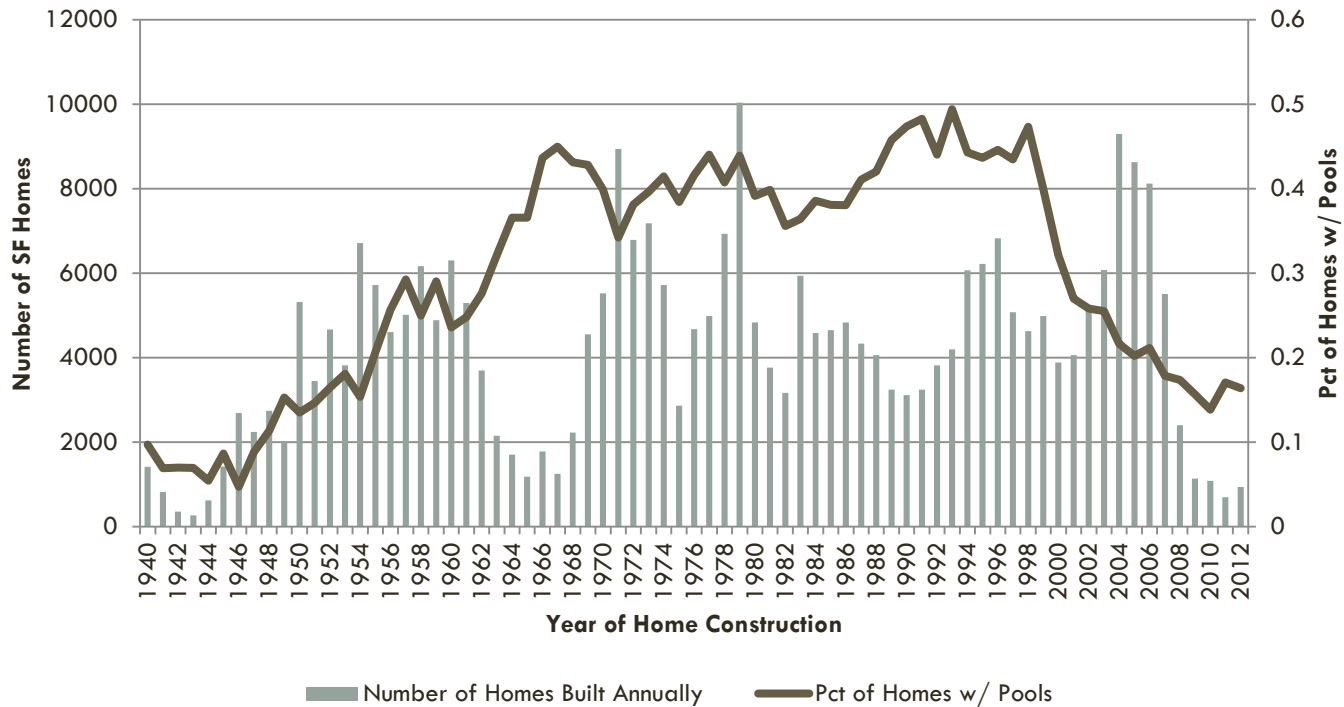
New Homes have Less Landscaping

Historic Comparison of Estimated Irrigable Area for Single Family Lots



New Homes have Fewer Pools

The Presence of Pools at Single Family Lots by Year of Home Construction



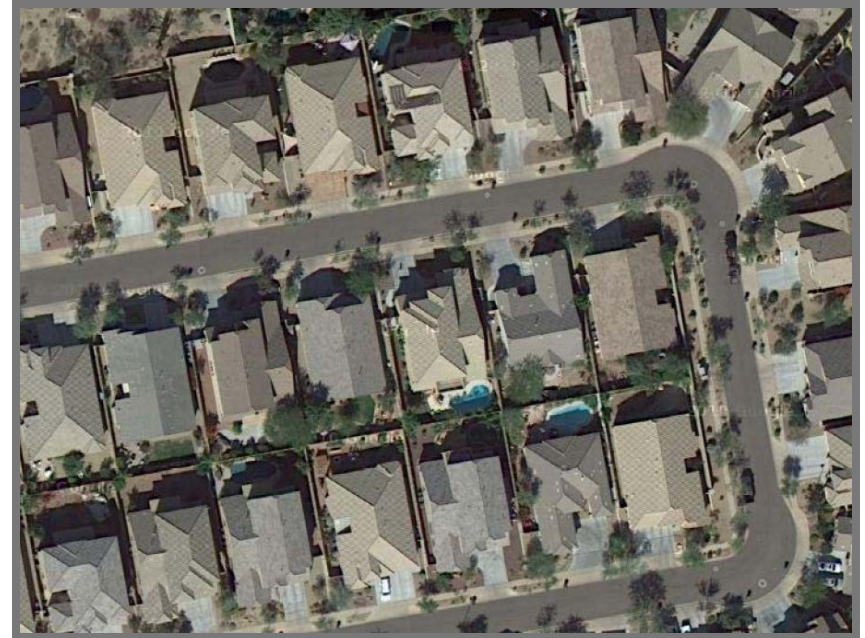
Demand Trends

New Homes w/ Desert Adapted Landscaping

Subdivision Built in 1940's



Subdivision Built post-2000



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Demand Trends

All Homes are Using Less

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- Water use by single family homes decreased 12 – 15% during the first decade of the 21st Century

TREND IN SINGLE FAMILY AVERAGE DAILY WATER USE FOR VARIOUS PERIODS OF HOME CONSTRUCTION		
Home Vintage	Consumption Period	
	1997 - 1999	2007 - 2009
pre - 1960	437 gpd	367 gpd
1960 - 1975	478 gpd	409 gpd
1975 - 1990	473 gpd	412 gpd
1990 - pres	436 gpd	368 gpd

Results displayed in average gallons per account per day (GPAD)



Demand Research Objectives

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- Quantify the Potential for Change
 - Current Baseline Efficiency
 - Efficient Future
- Determine the Basis of Change
 - Inform rate of change

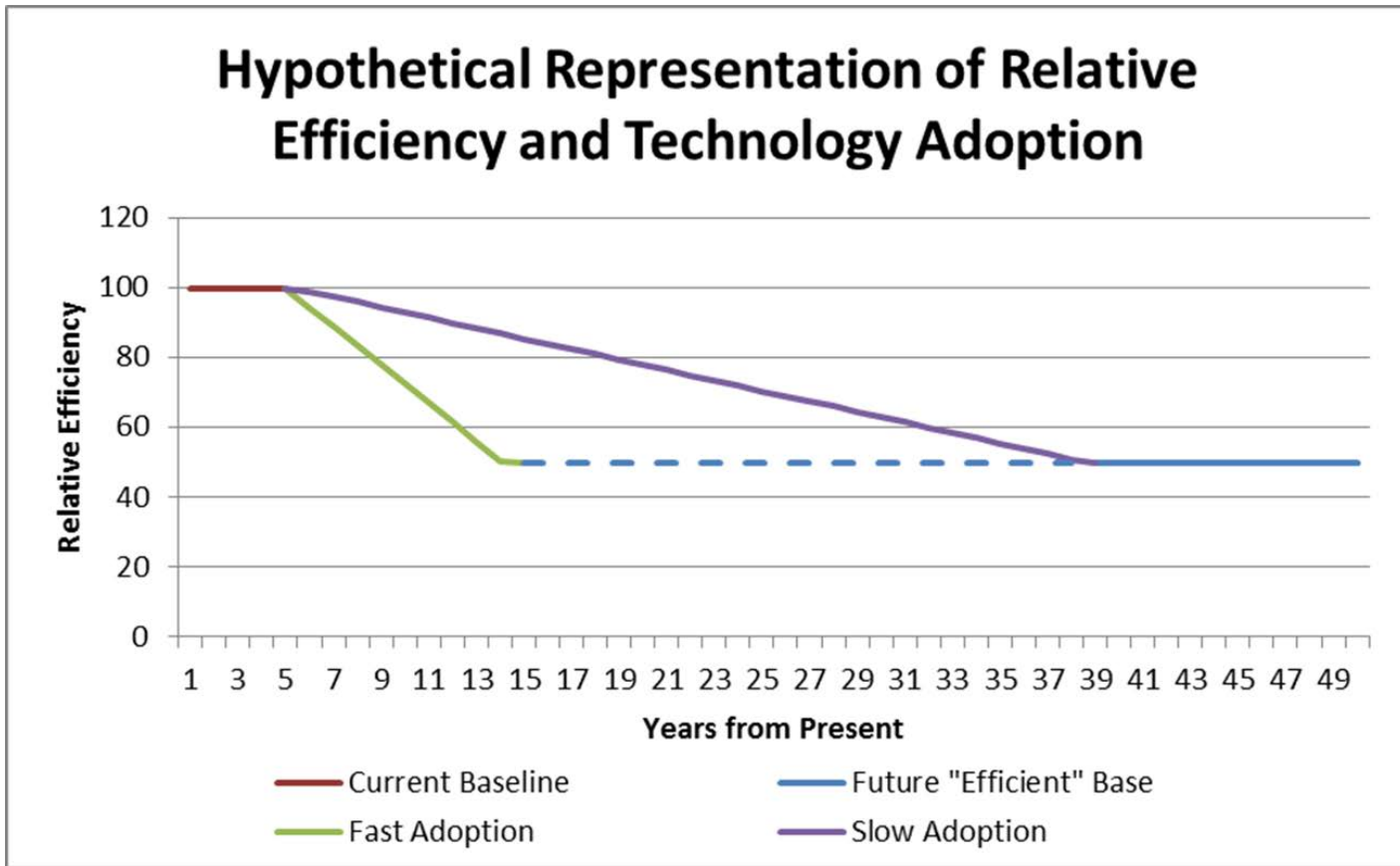


How low can you go?

And... How quickly will you get there?

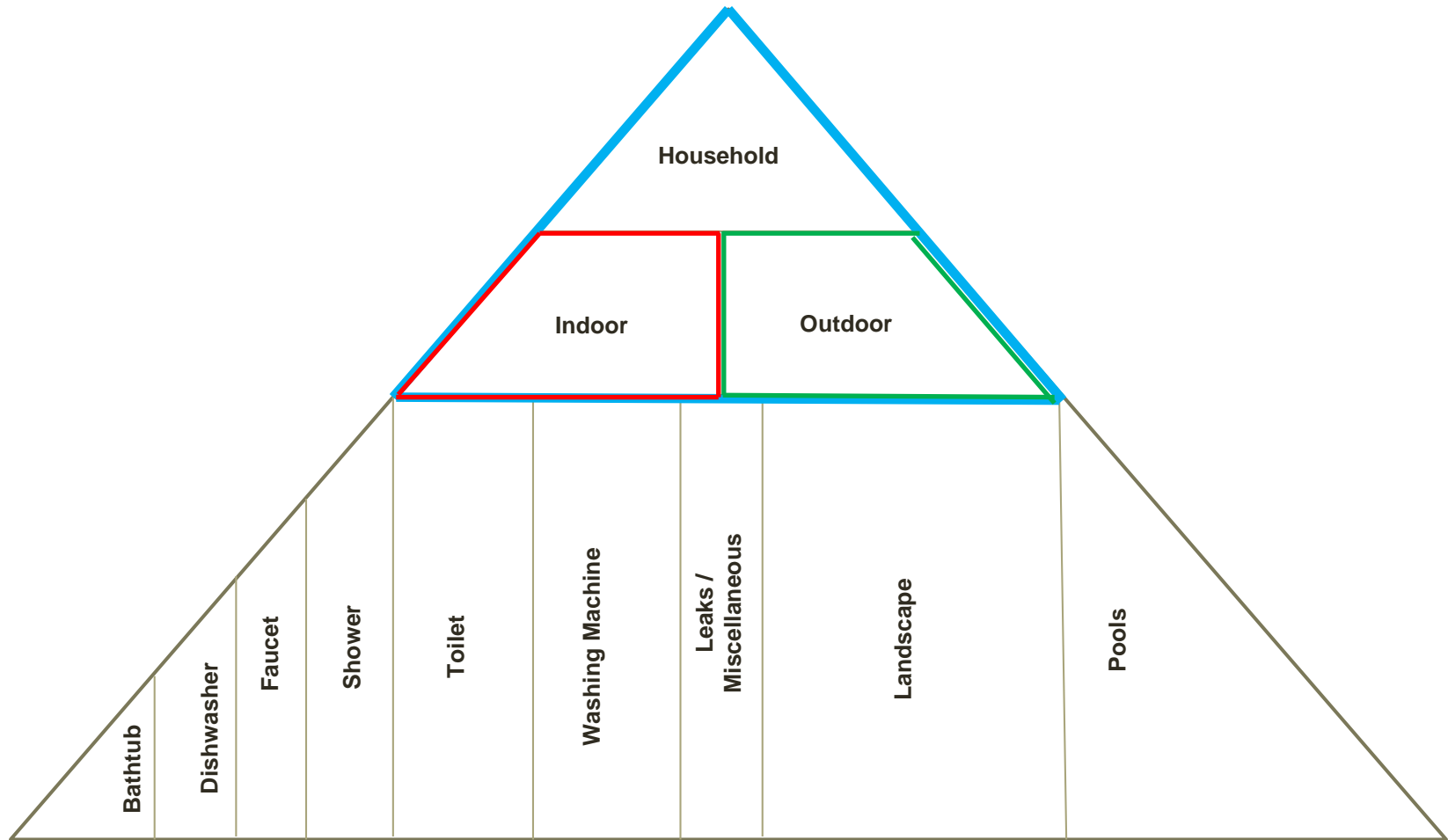


Demand Research Objectives



Data Analysis

Building Blocks of Household Water Use



Primary Data Collection Methods

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1. Flow Trace Analysis
2. Landscape Inventory
3. Surveys & Site Visits
4. Sewer Flow Analysis

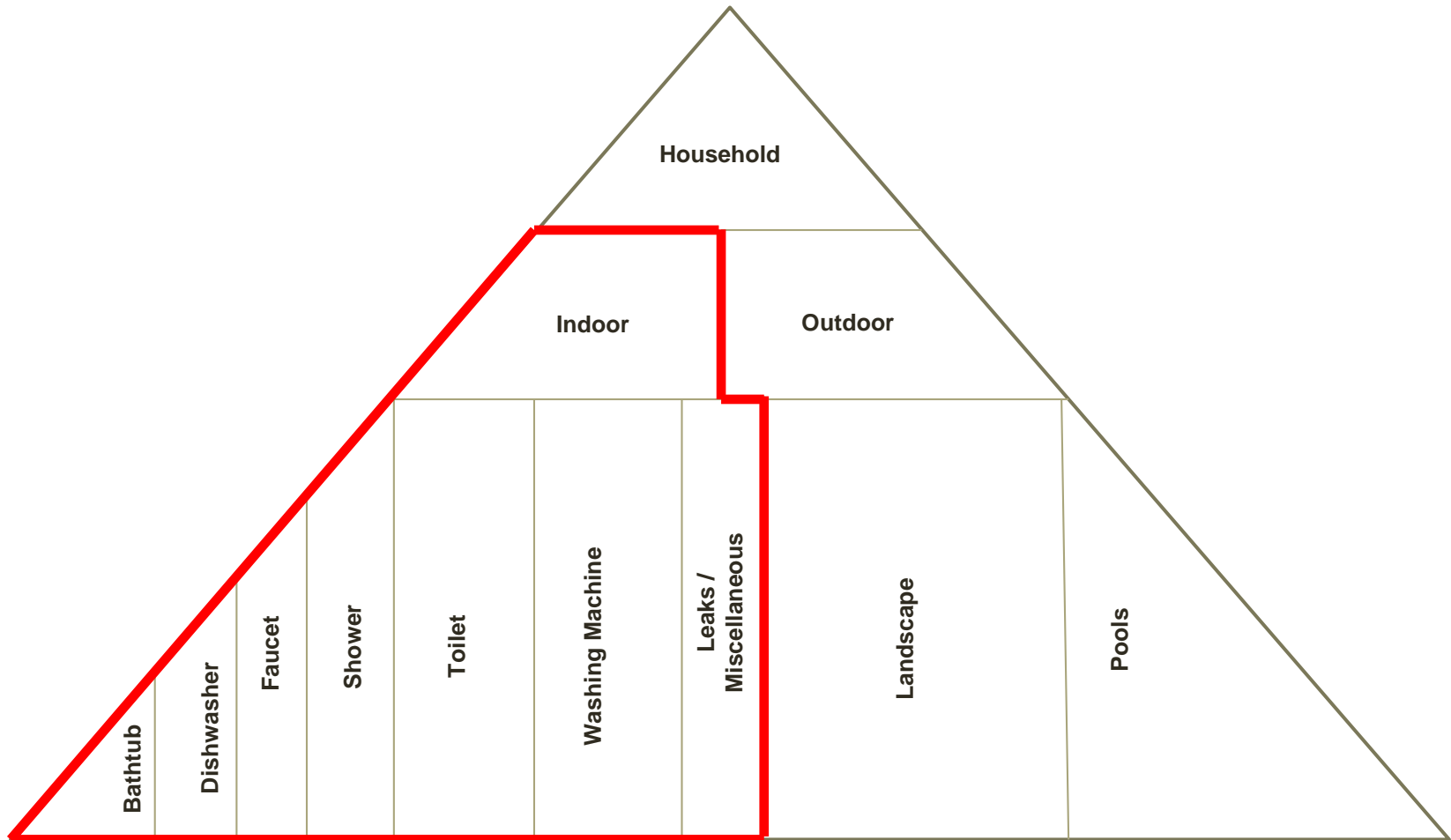


Data Collection



Data Collection

Indoor Building Blocks



Data Collection

Quantify Baseline Efficiency

PENETRATION RATES FOR *EFFICIENT* RESIDENTIAL DEVICES

Low-Flow Toilets (ULFT)	74.31%
Shower Heads (ULFS)	88.74%
Bathroom Faucets (ULFF)	58.58%
High Efficiency Clothes Washers	22.86%
High Efficiency Dish Washers	22.51%

City of Phoenix Single Family Site Visit Results 2009-10; n = 510

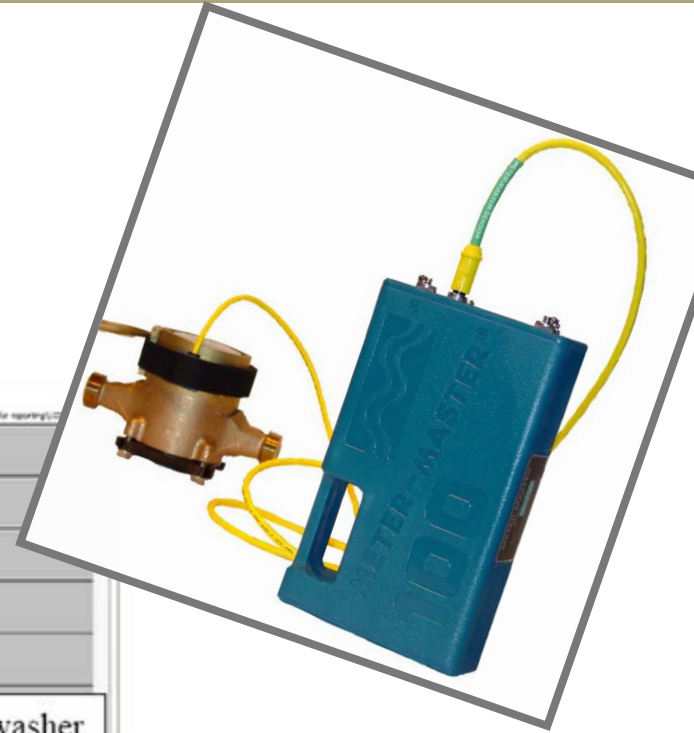
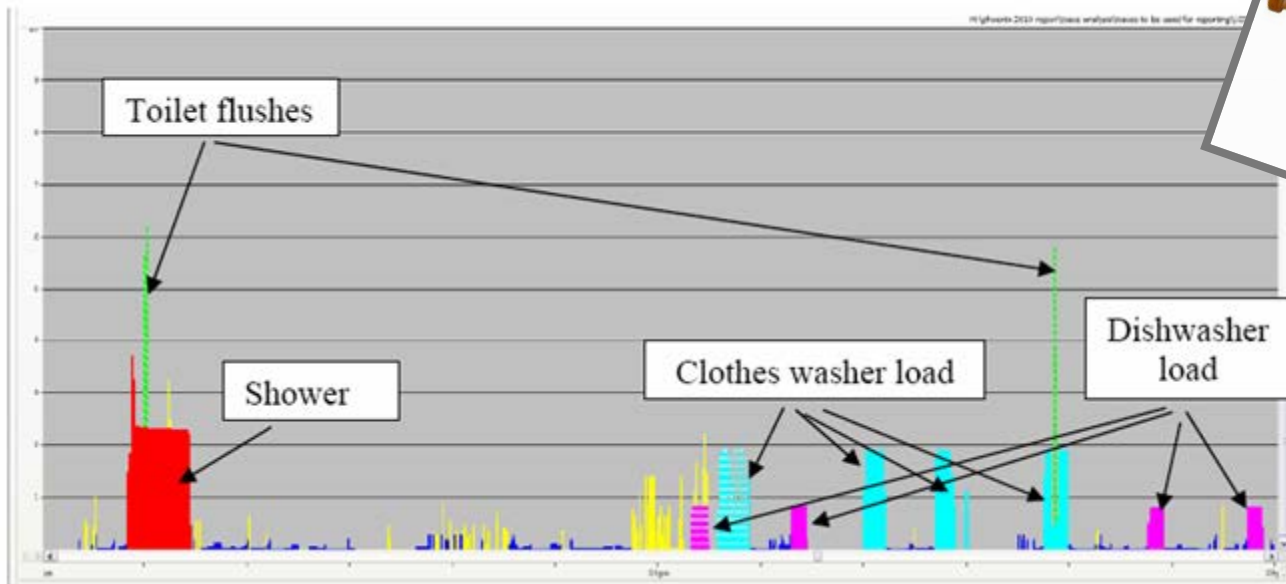


Flow Trace Analysis

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End-Use Data

- Presence and Efficiency
- Frequency and Intensity



Example of trace analysis from City of Phoenix, Re-Log Study 2009



Re-Log Study Results

- Major efficiency improvements have been achieved for toilets and clothes washers

TREND IN USAGE RATES FOR RESIDENTIAL DEVICES		
Pre-1996 Homes		
Fixture / Appliance	1999 Use Rate (gal/day)	2009 Use Rate (gal/day)
Toilet	48.3	35.2
Clothes Washer	43.5	27.9
Shower	33.3	31.3
Faucet	24.7	28.0
Leak¹	14.1	15.1
Other	10.1	11.7
Dish Washer	2.2	1.0
Bathtub	3.0	1.8
Total	179.2	152.0

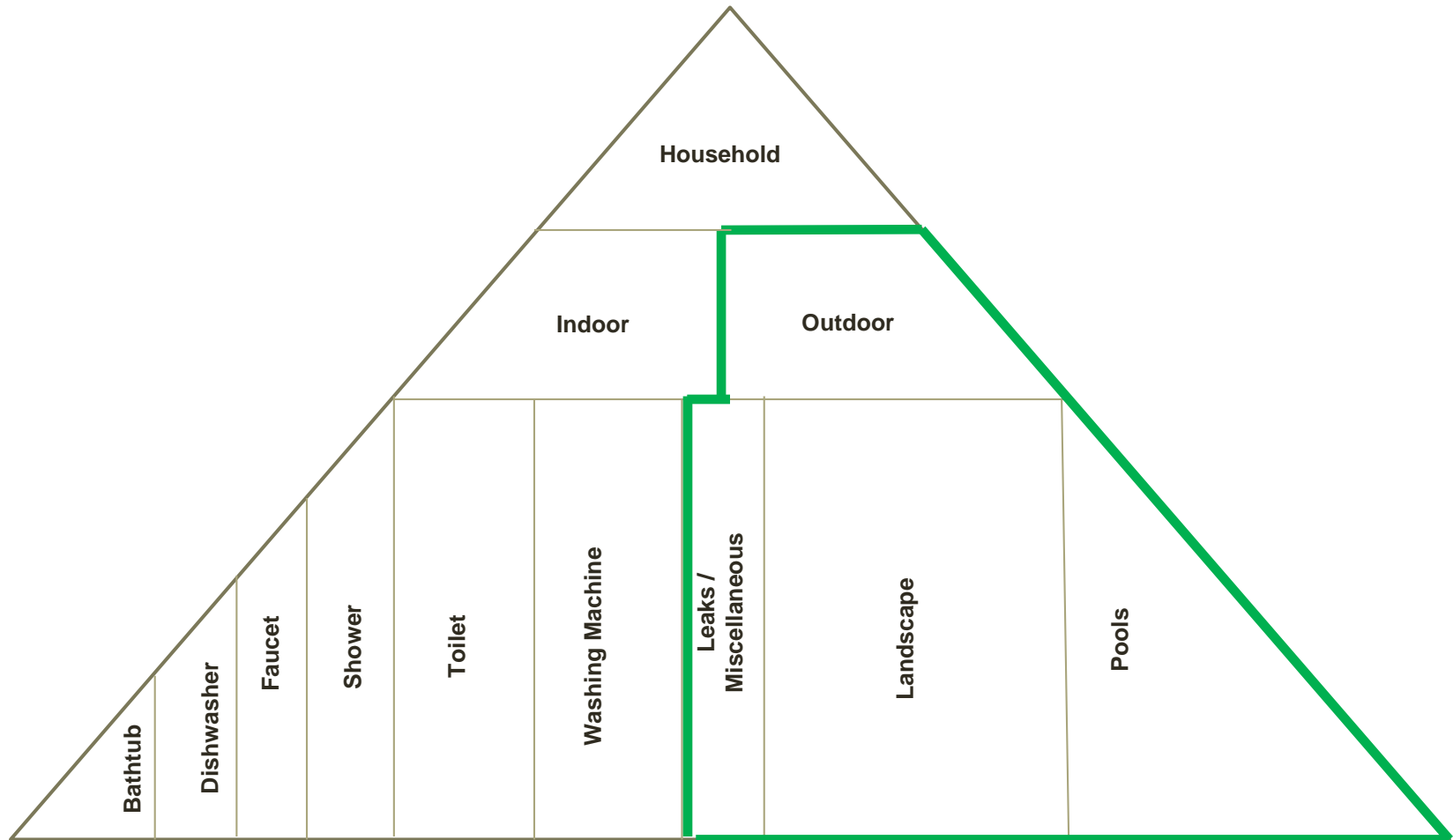
Data from the 1999 REUWS and the 2009 city of Phoenix ReLog Study

1. Data shown is mean daily use (gallons) except Leak data is median due to right-hand skew.



Data Collection

Outdoor Building Blocks



Data Collection

- Landscape classification
 - Use of GIS and aerial imagery to determine landscape characteristics of single family residence to determine outdoor water demand



Data Collection

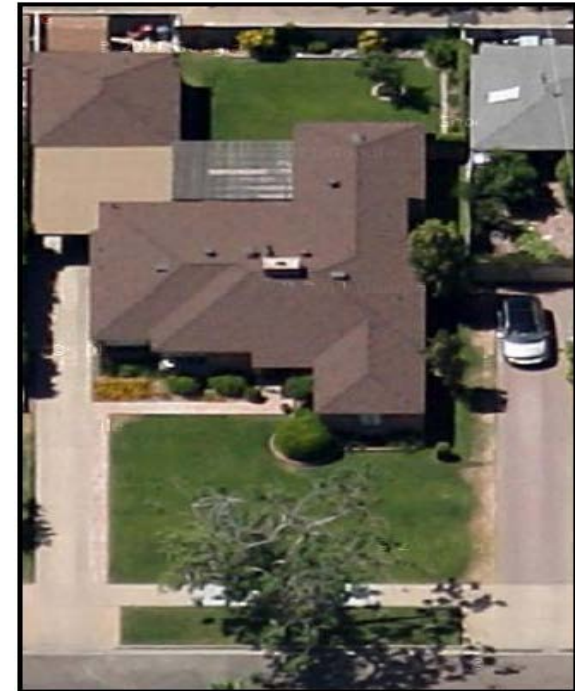
- Landscape classification – based on the amount of vegetation



Turf Front



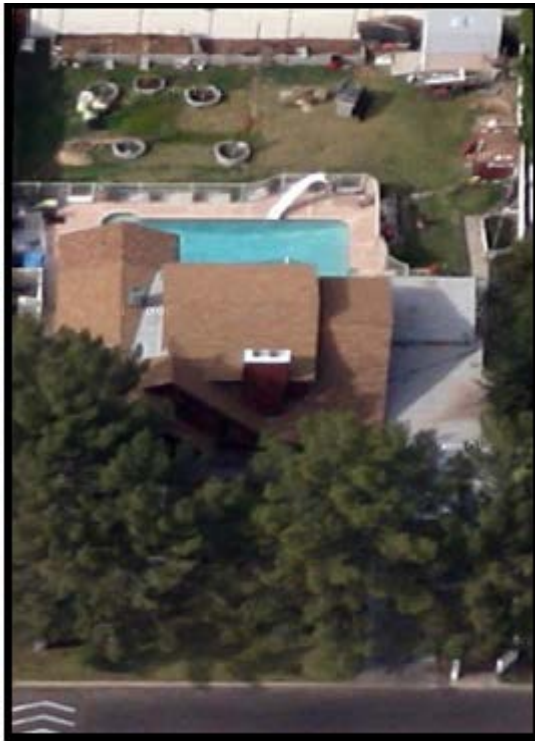
Turf Back



Turf Overall

Data Collection

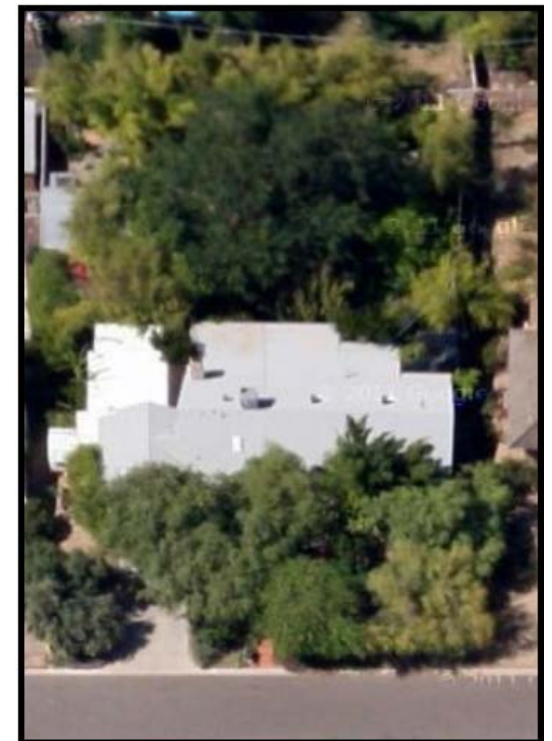
- Landscape classification – based on the amount of vegetation



Extensive Front



Extensive Back



Extensive Overall

Data Collection

- Landscape classification – based on the amount of vegetation



Moderate Front



Moderate Back



Moderate Overall

Data Collection

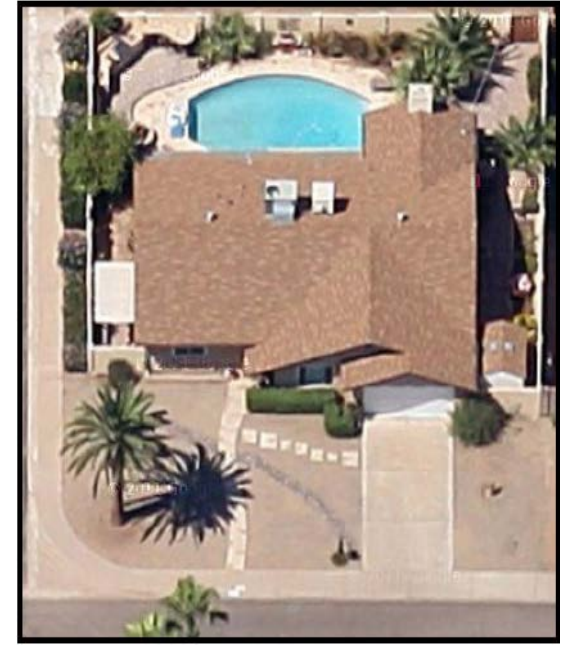
- Landscape classification – based on the amount of vegetation



Sparse Front



Sparse Back



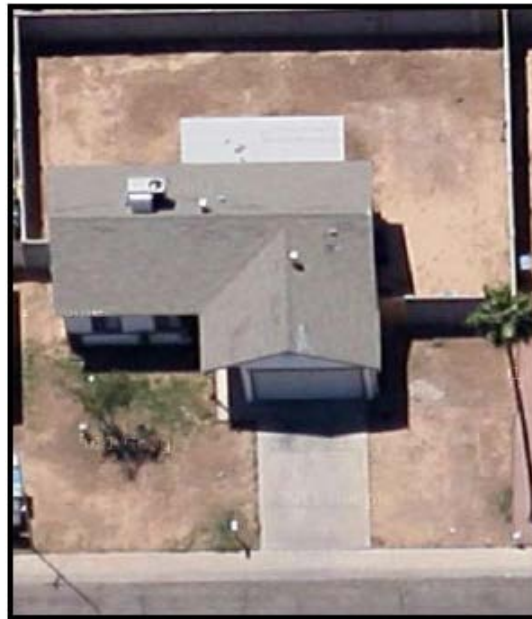
Sparse Overall

Data Collection

- Landscape classification – based on the amount of vegetation



Arid Front



Arid Back



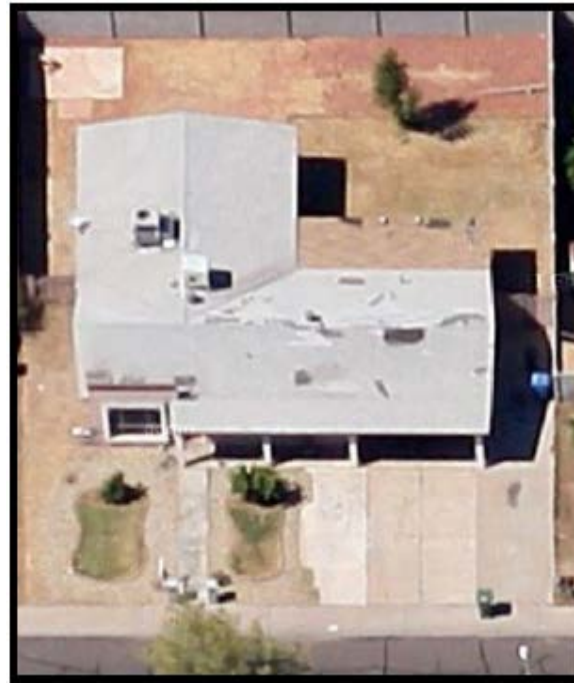
Arid Overall

Data Collection

- Landscape classification – based on the amount of vegetation



Transition Front



Transition Back



Transition Overall

Data Collection

□ Landscape classification – Pools

Full Pool



Empty Pool



Above Ground Pool



Small Pool or Large Water Feature



Filled in Pool



Data Collection

- Landscape Classification – Turf Quality

High Quality Turf



Medium Quality Turf



Low Quality or Dying Turf



Data Collection

□ Image Classification using GIS

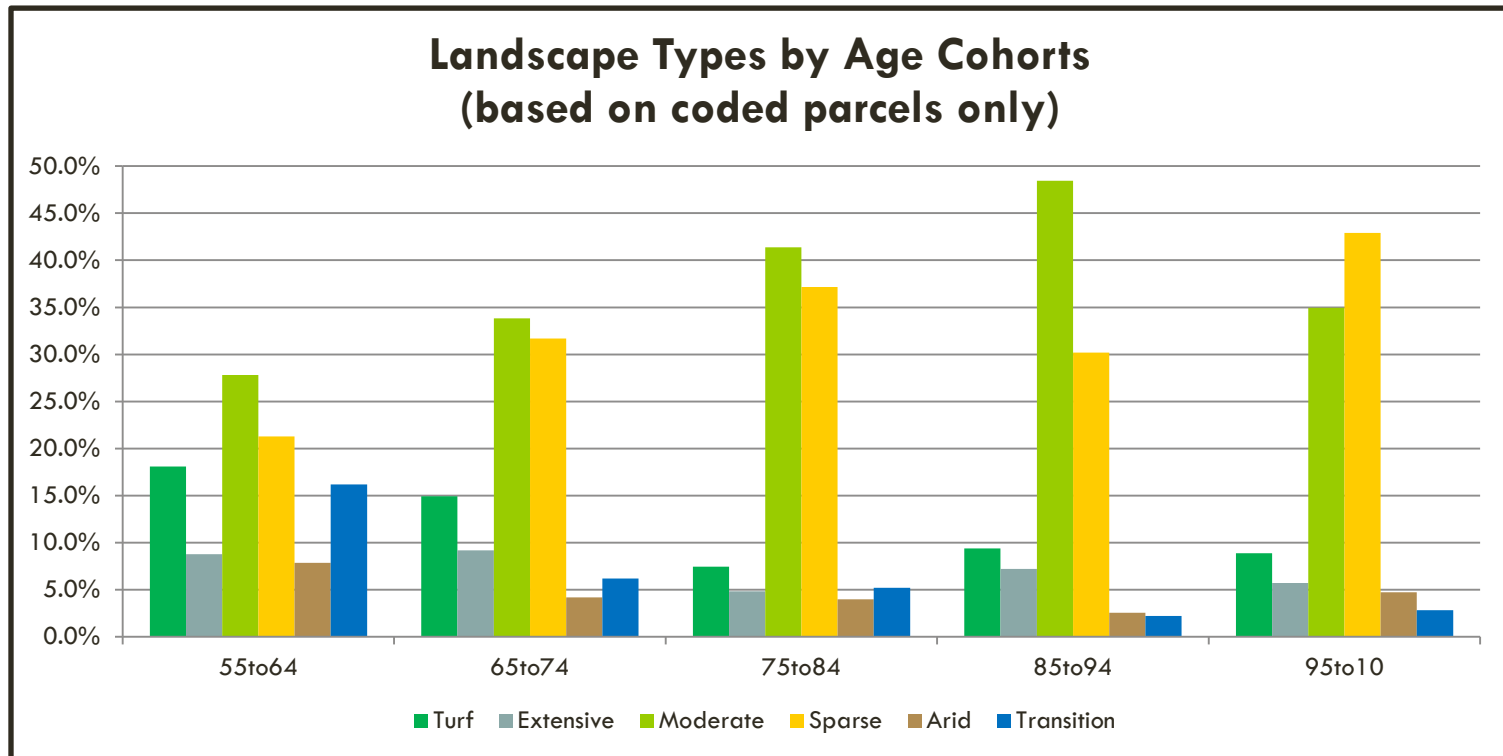
Aerial Imagery



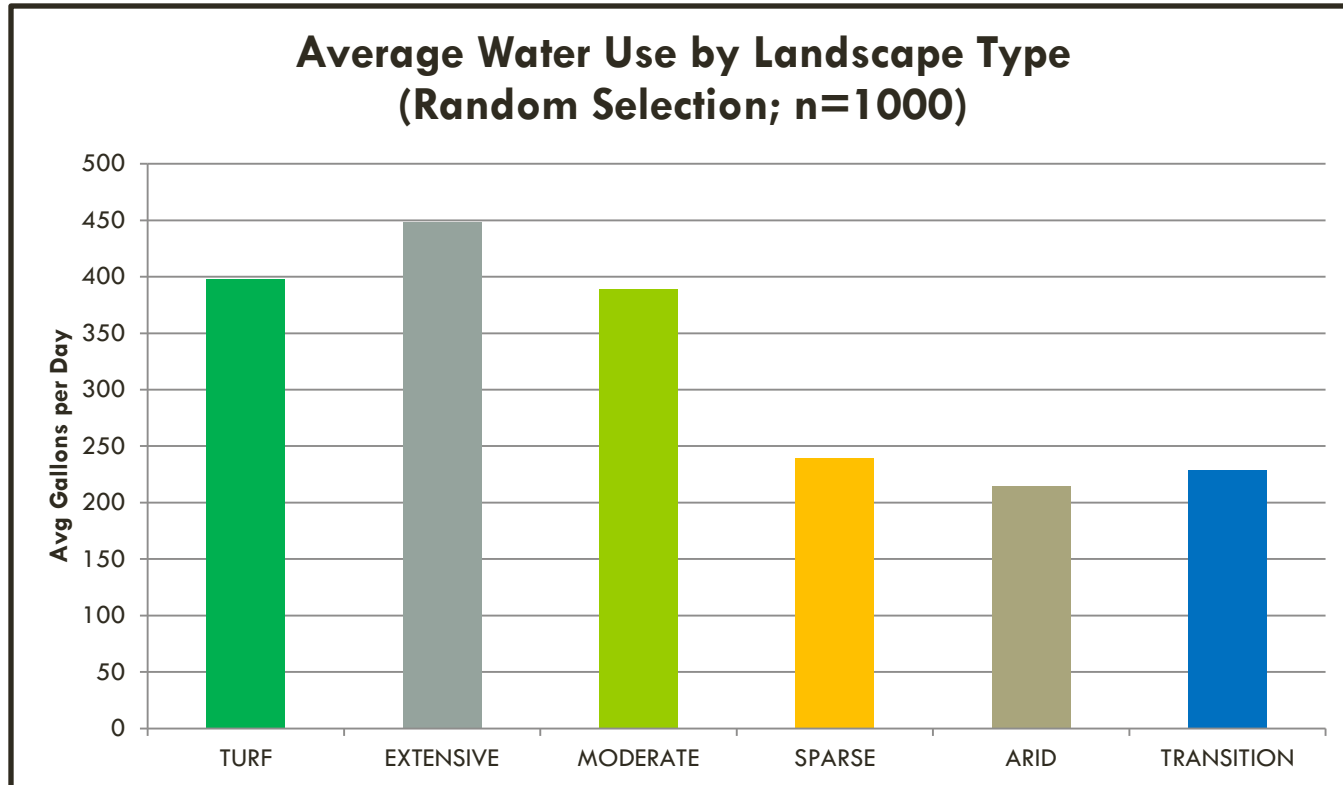
GIS classified Imagery



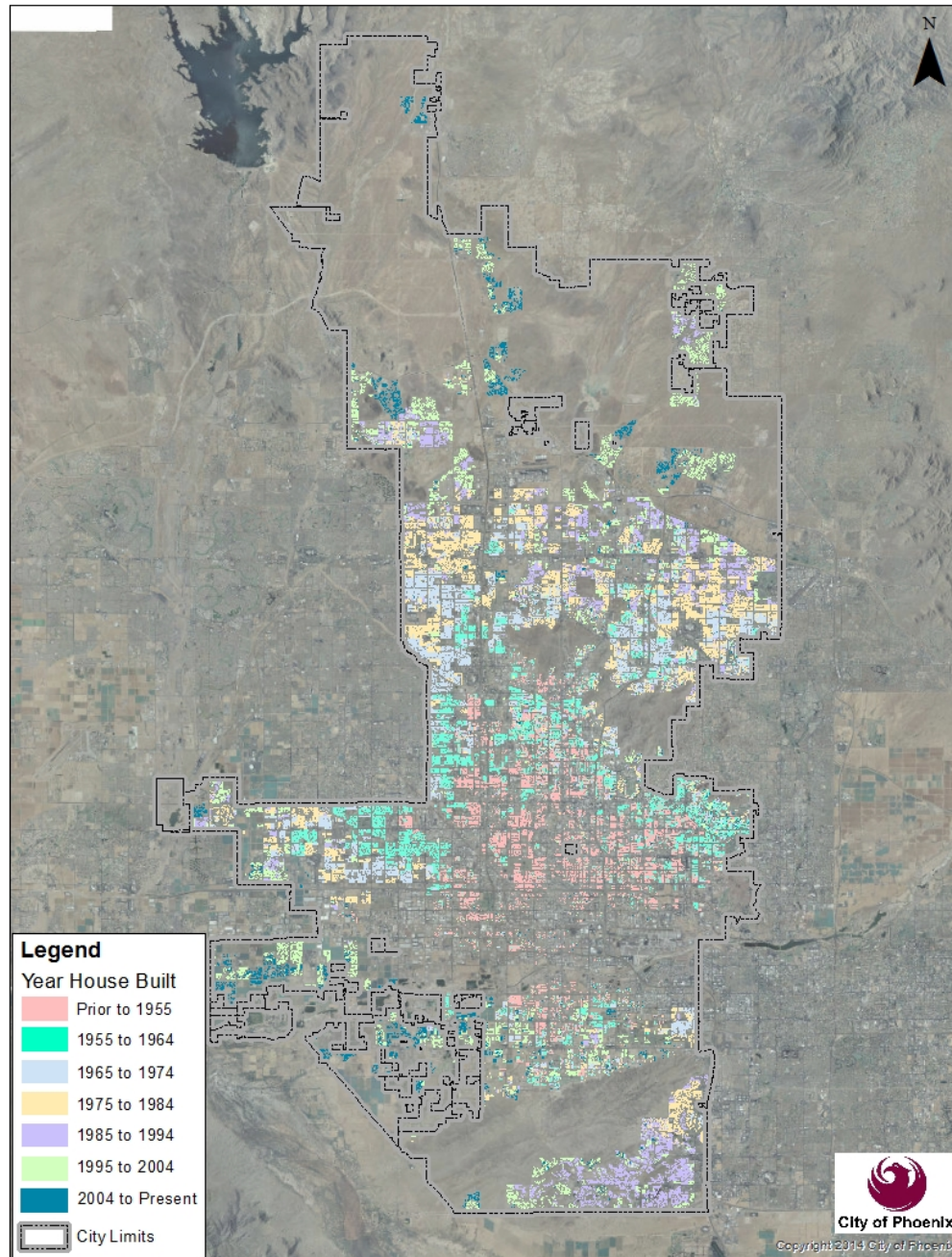
Data Analysis



Data Analysis



Spatial Distribution of Homes by Age Cohort



Demand Forecasting

Residential Demand Assumptions

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SINGLE FAMILY COHORT (BUILD YEAR)	BASE DEMAND	HIGH SCENARIO¹	MEDIUM SCENARIO¹	LOW SCENARIO¹
PRE – 1955	7,254,224	-0.65	-1.21	-1.72
1955 – 1964	8,804,807	-0.77	-1.30	-1.81
1965 – 1974	9,691,721	-0.65	-1.21	-1.72
1975 – 1984	11,688,532	-0.60	-1.16	-1.66
1985 – 1994	9,727,535	-0.56	-1.11	-1.59
1995 – 2004	10,791,232	-0.40	-0.75	-1.06
POST – 2004	3,888,396	-0.27	-0.50	-0.71

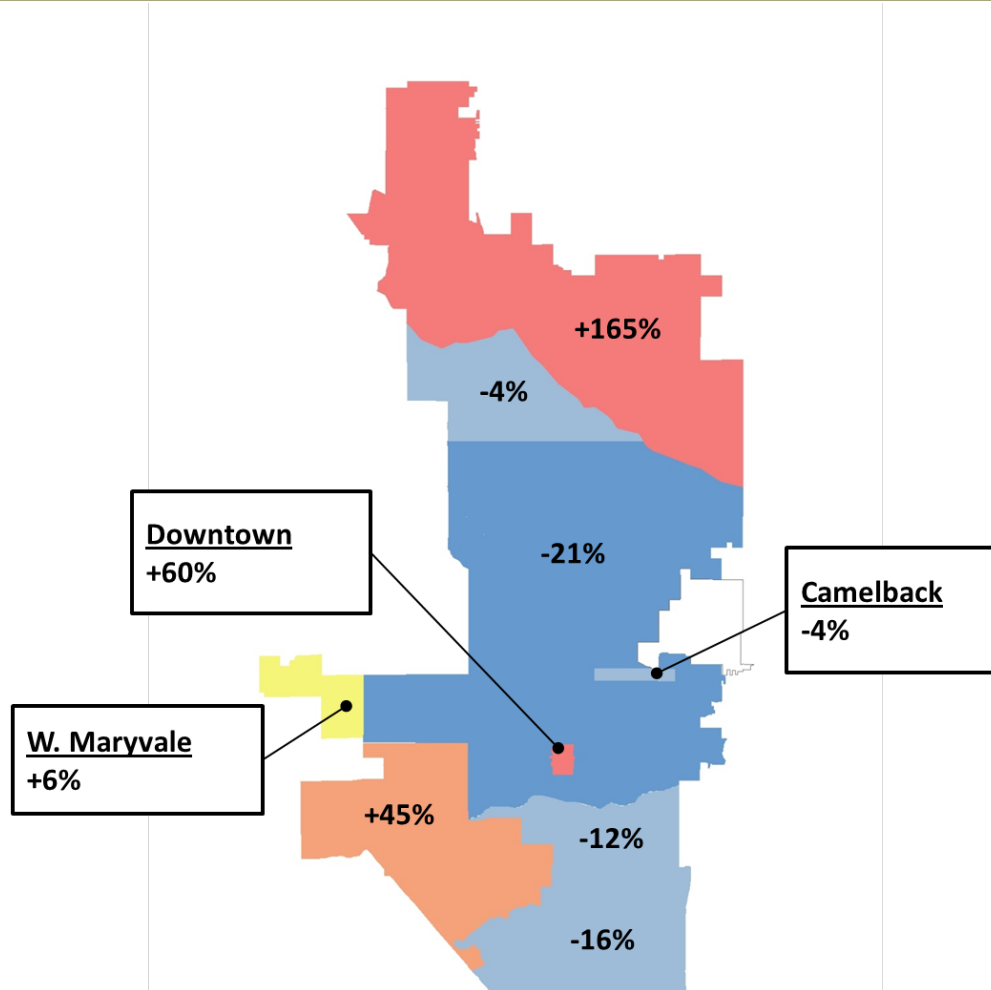
1) Reduction rates shown are for the first year of the forecast only. Subsequent years will have lower reduction rates as demand approaches the minimum limit.



Projected Change in Water Demand by City of Phoenix Area

Medium Scenario - 2030

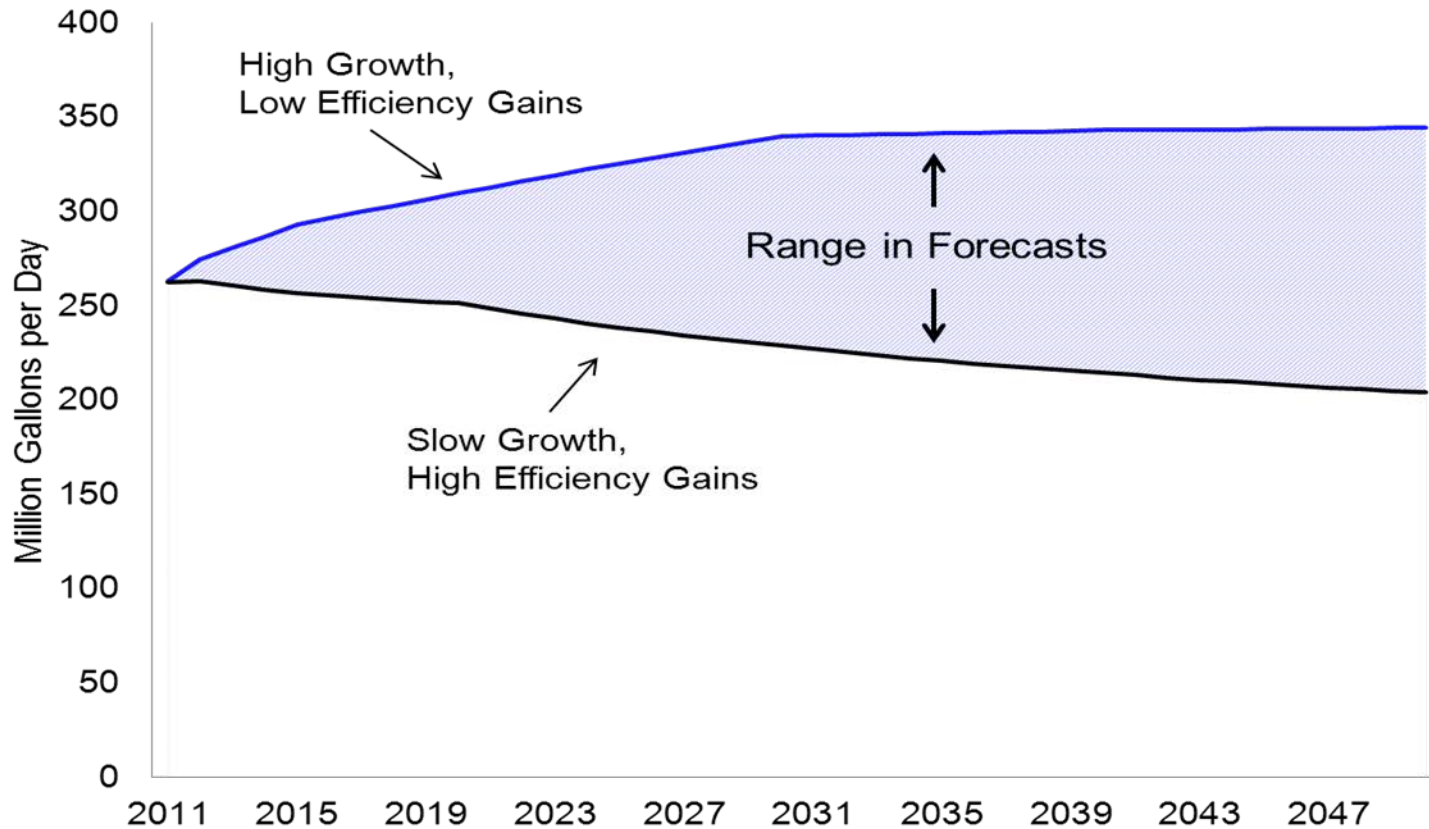
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Master Plan Forecast

Planning Under Uncertainty

Range in Water Demand Scenarios





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QUESTIONS?

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