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Comprehensive Water Use and Customer Characterization for Efficiency and Shortage Planning

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Overview

- Define objectives of Phoenix's Water Demand Management Plan
- Summarize informational needs and data sources
- Discuss selected analyses and water use characterizations
- Offer some lessons learned and a look forward

Demand Management Plan: Overview and Purpose

■ Water Resources Challenges

- Growth
- Rising costs
- Supply Shortage

■ Purpose of Demand Management Planning

- 2005 Water Resources Plan Directive: “Sharpen focus of Demand Management Efforts”
 - ▶ Long-term “lifestyle” conservation
 - ▶ Curtailment due to drought or other system emergency
 - ▶ **Adapt to changes in system dynamics**

■ Objectives of DMP

- Integrate elements of existing *Plans*
- Review and update philosophy (concepts, principles, approaches)
- **Describe and analyze current water use profile and trends**
- Identify demand-side strategies

Informational Needs

- Understanding demand dynamics
 - How does water use vary currently and why?
 - How has water use changed over time and why?
 - What trends are operating to shape future demands?
- Dimensions of demand dynamics
 - Sectors (user types)
 - Time periods (monthly, seasonal, annual)
 - Geographies (demand zones and planning areas)

Data Collection and Management

- Available (secondary) data
 - Account-level water billing database
 - ▶ Monthly meter reads 1995-2008
 - ▶ Multiple useful tables and fields
 - Type user category (32 type users)
 - Meter install date(s)
 - Sewer charge code
 - Demand zone
 - Parcel number

Data Collection and Management

- Available (secondary) data (continued)
 - Maricopa County Assessor's data
 - Pool permit database
 - Weather data
 - Water and sewer rate schedules

Primary Data Collection

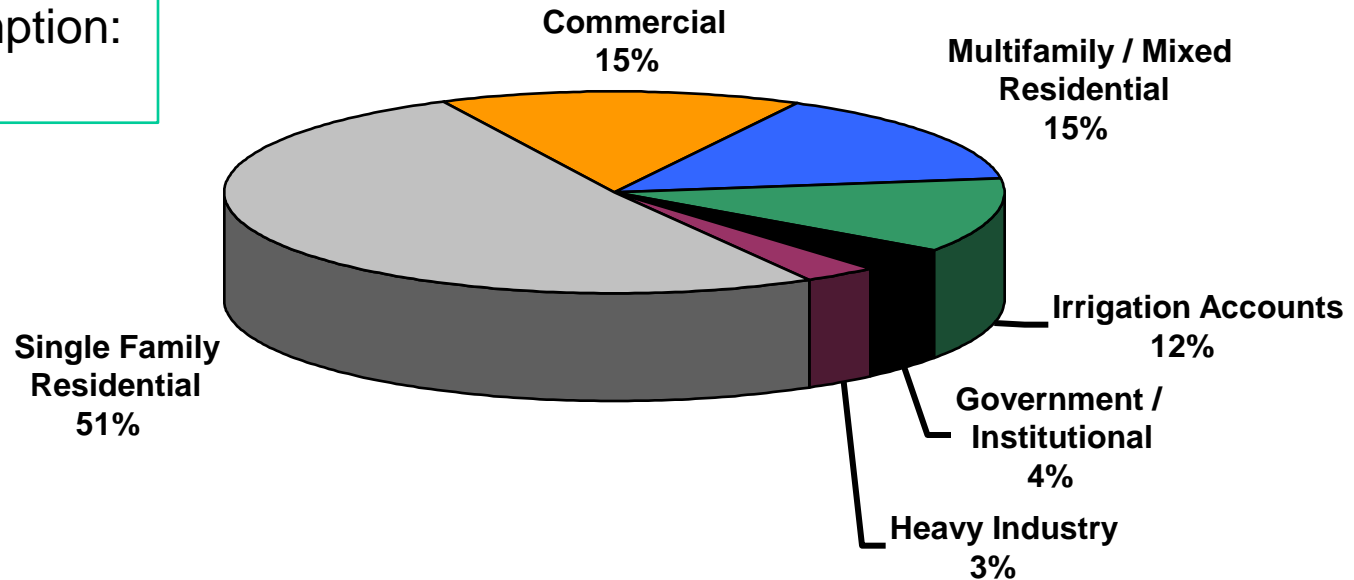
- Customer surveys
 - Single-family
 - Multifamily
 - Commercial General
 - Restaurants
 - Hotels



ANALYSIS OF DEMAND PATTERNS AND TRENDS

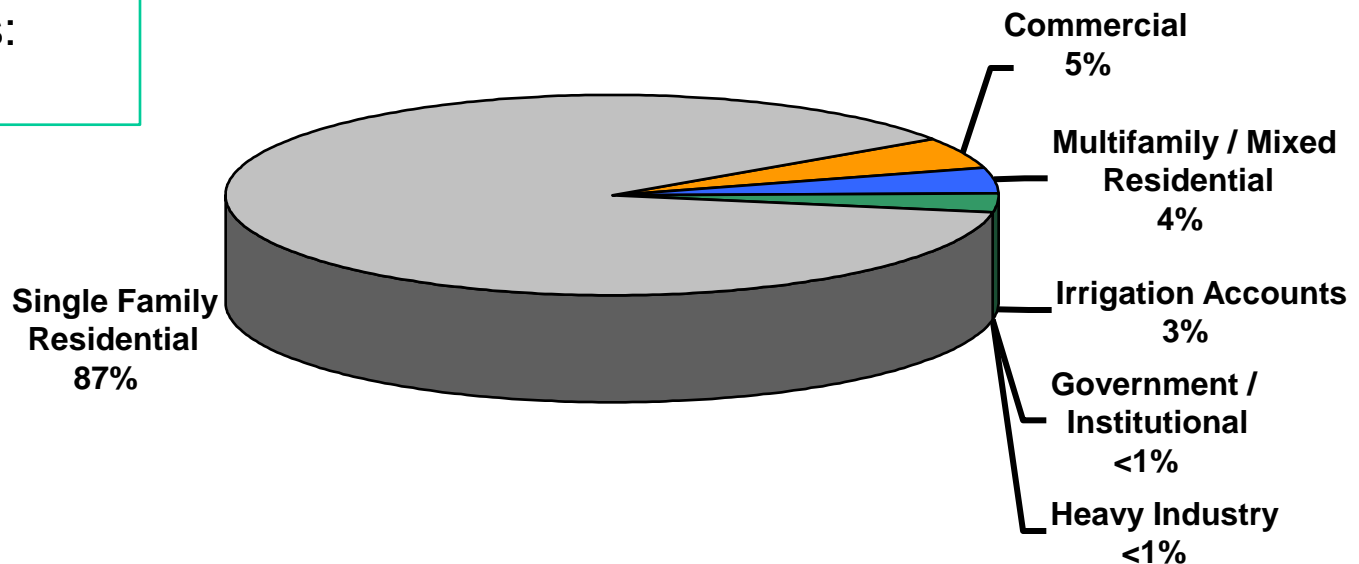
Distribution of Water Consumption (2008)

Total Consumption:
289,974 AF



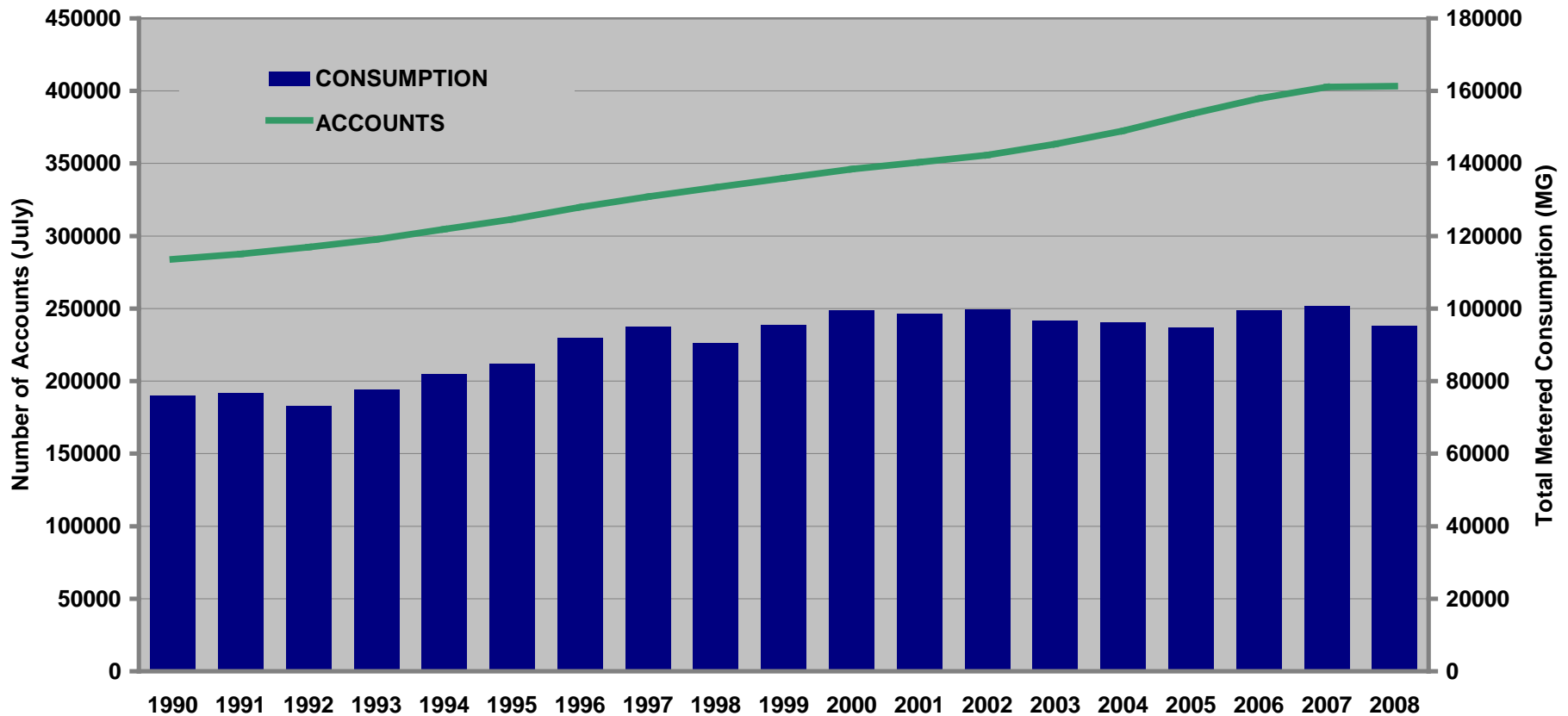
Distribution of Water Accounts (2008)

Total Accounts:
413,783



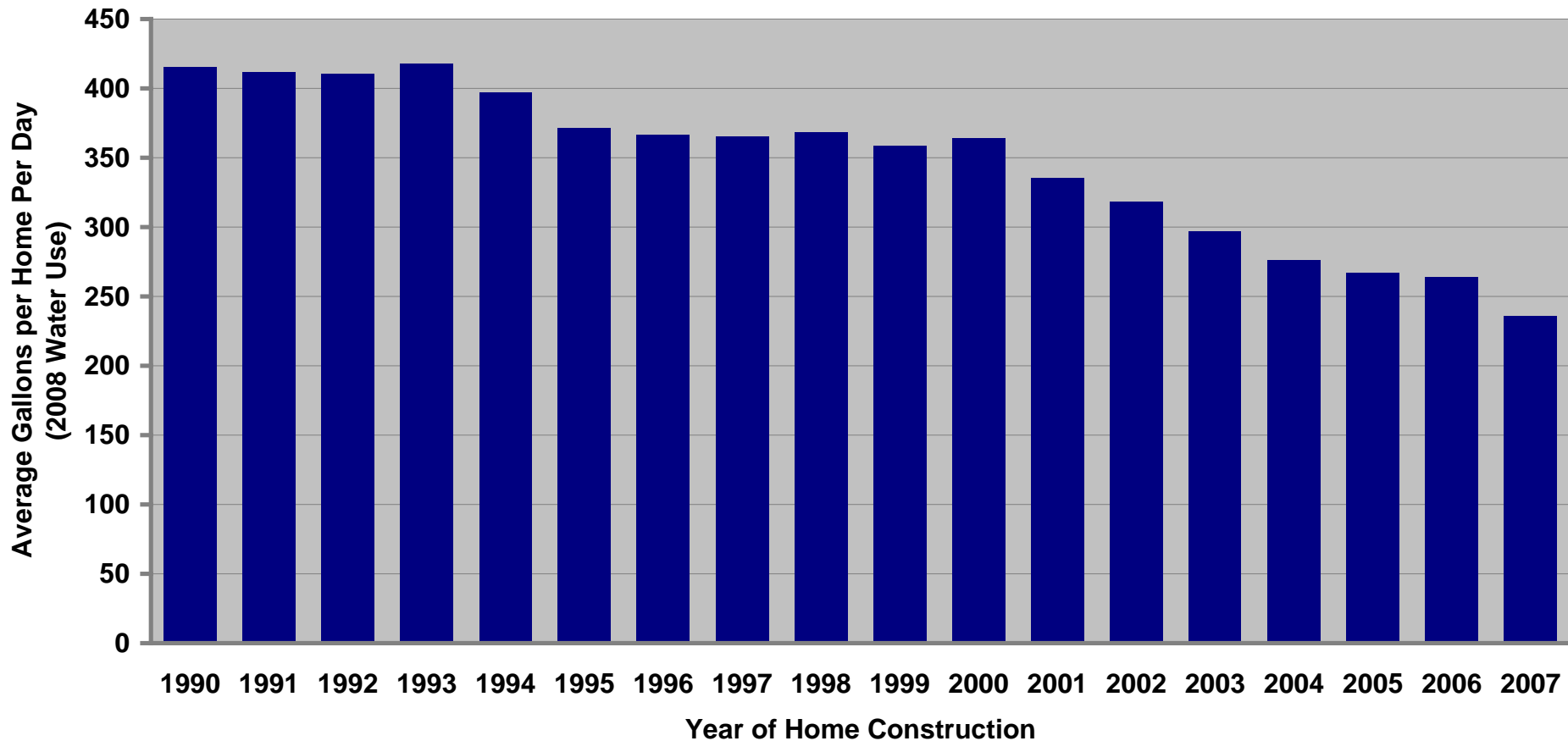
Historical Trends

Account Growth and Total Water Consumption



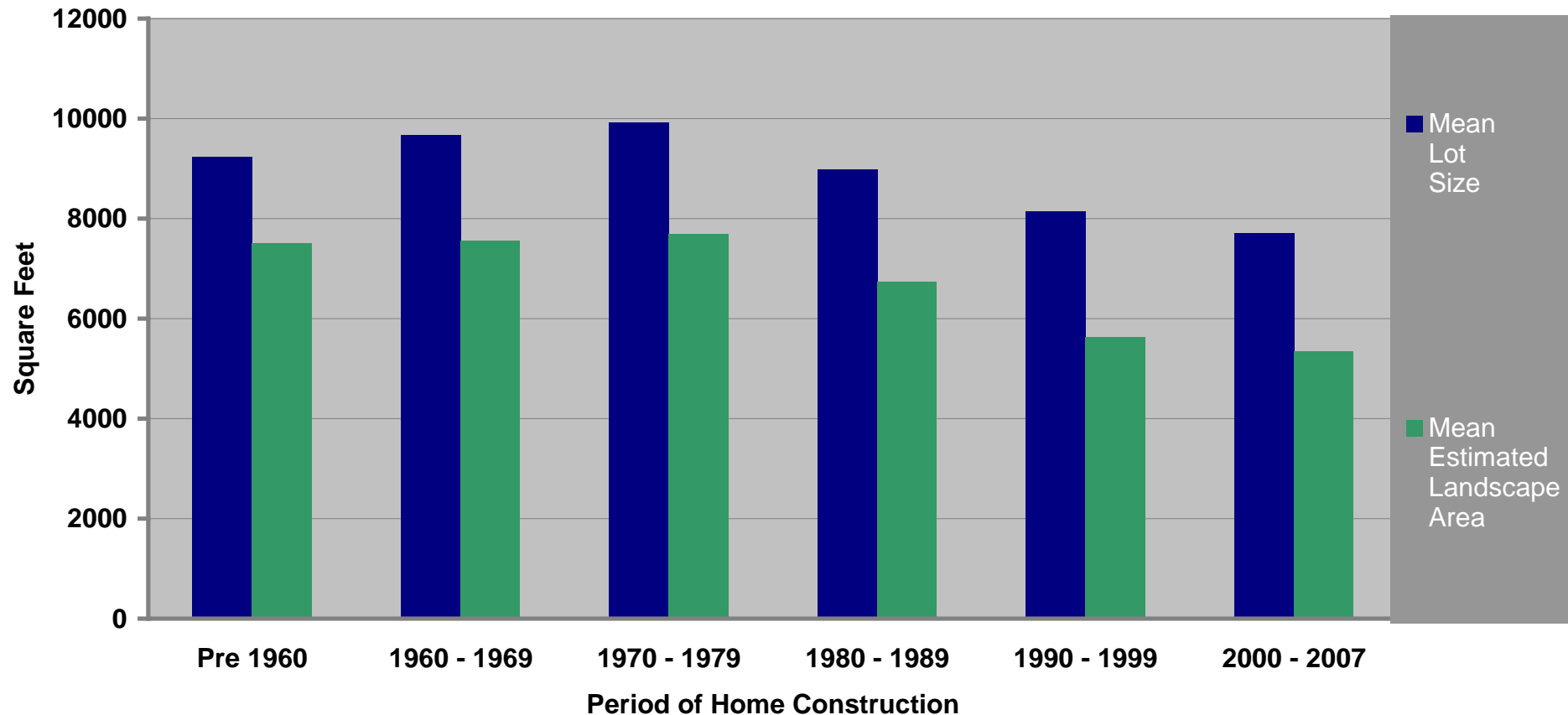
New Development

Average Daily Water Use (2008) by Year of Home Construction



Construction Characteristics

Trends in Lot Size and Landscape Area



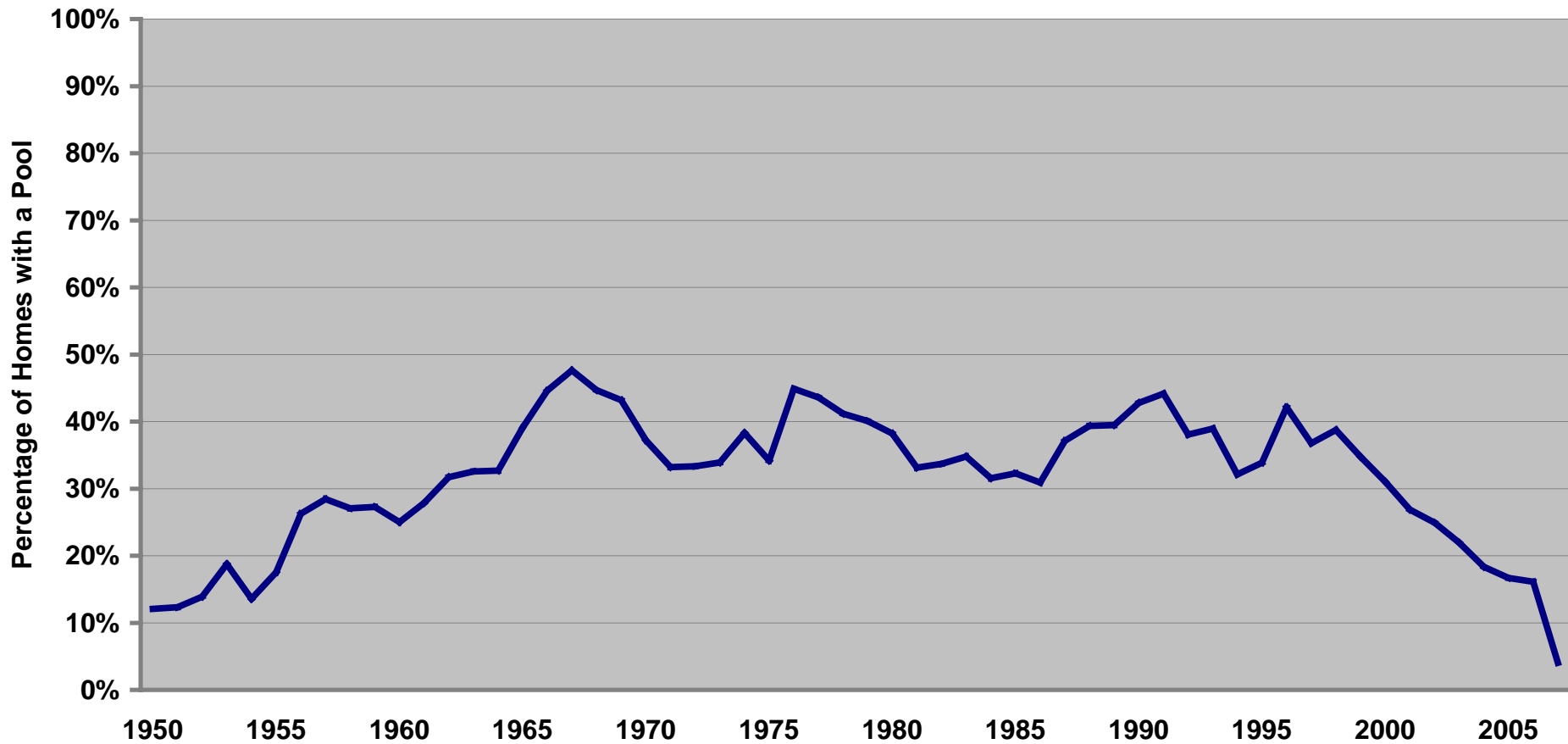
Lifestyle and Attitudes

Trends in Landscape Characteristics

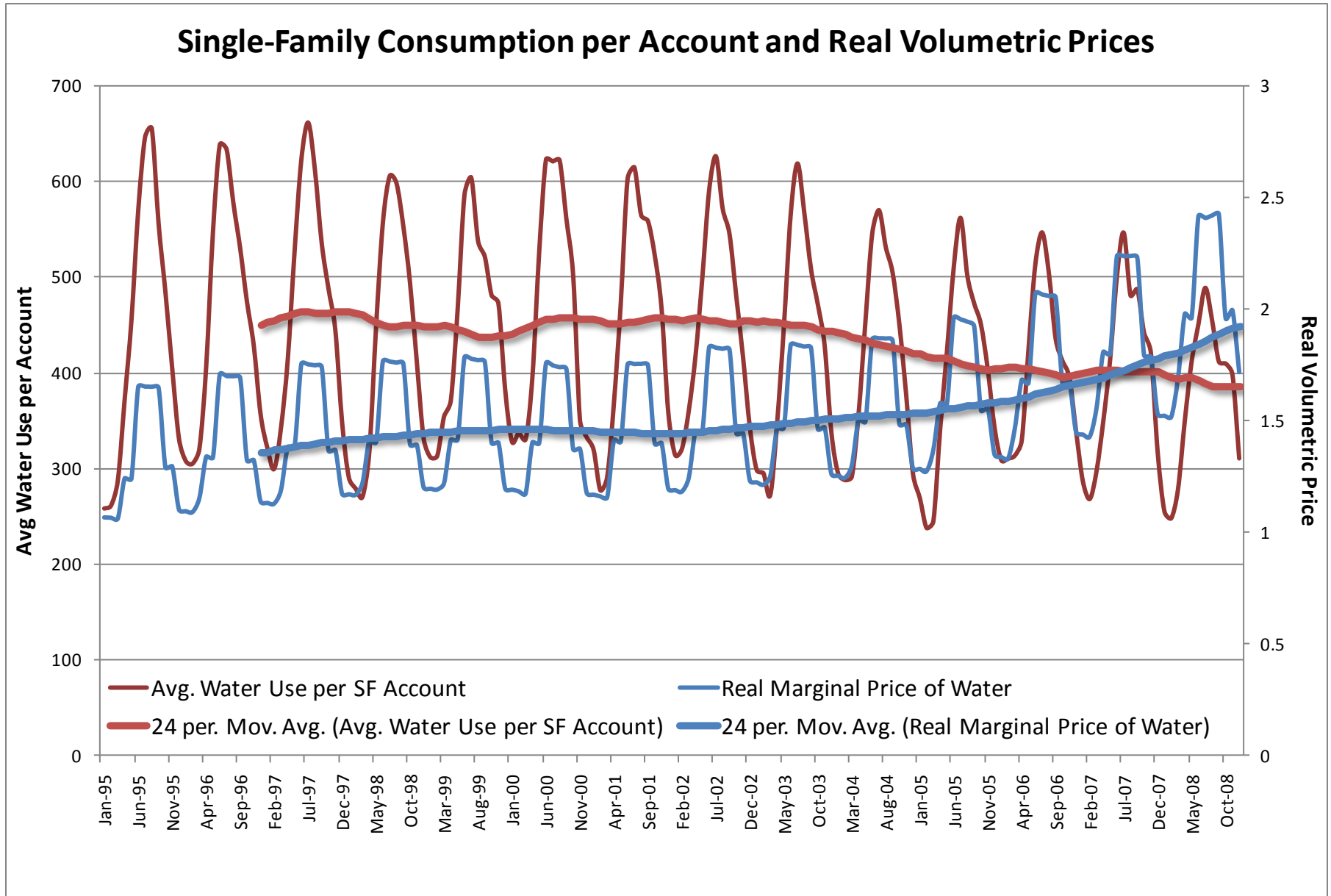
Landscape Type	Year of Construction		
	Pre-1995	1995 - 2000	2001 - 2007
Grass	35%	19%	11%
Mixed	48%	53%	61%
No Grass	17%	28%	29%

Lifestyle and Attitudes

Percentage of Homes with Pools by Year of Home Construction

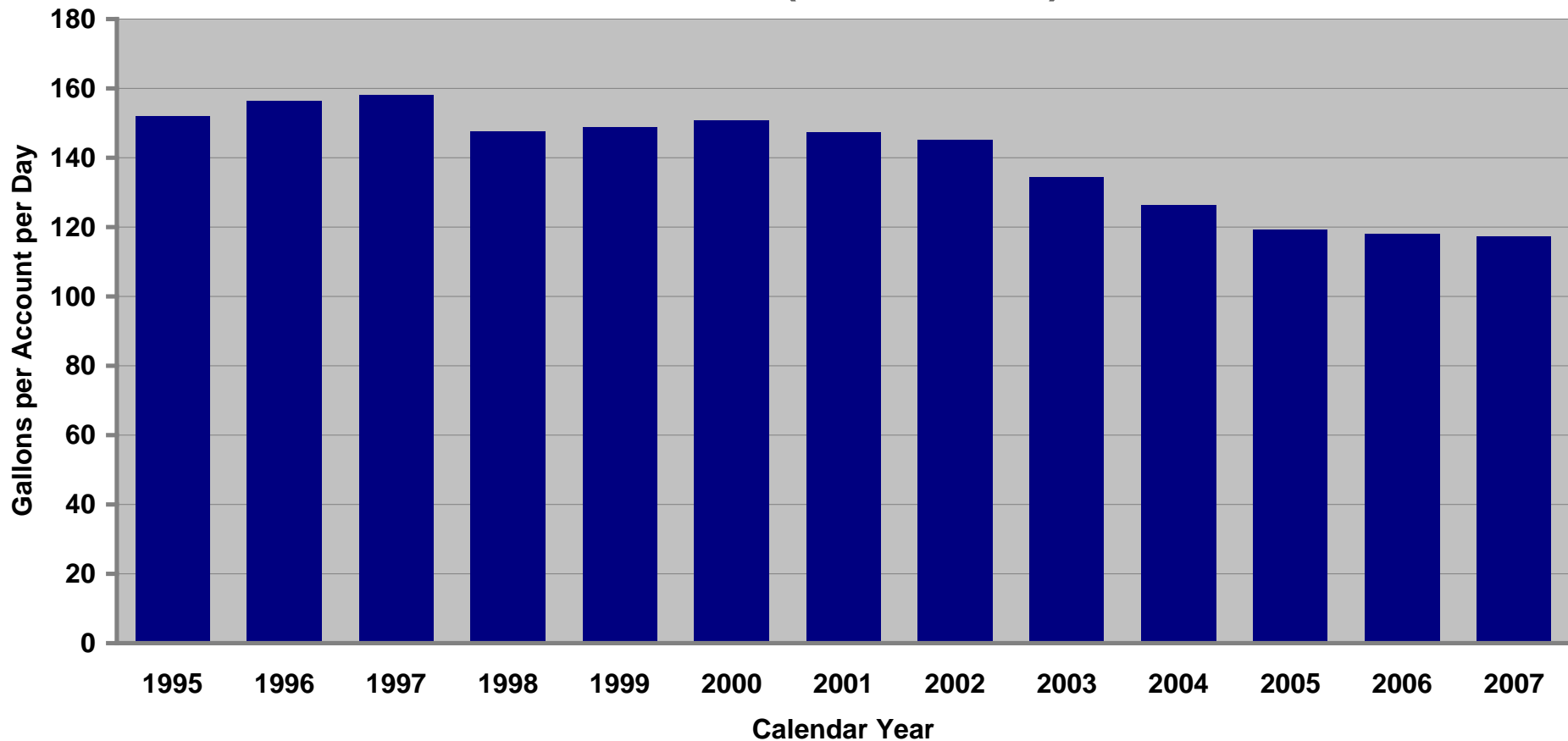


Water Pricing Impacts

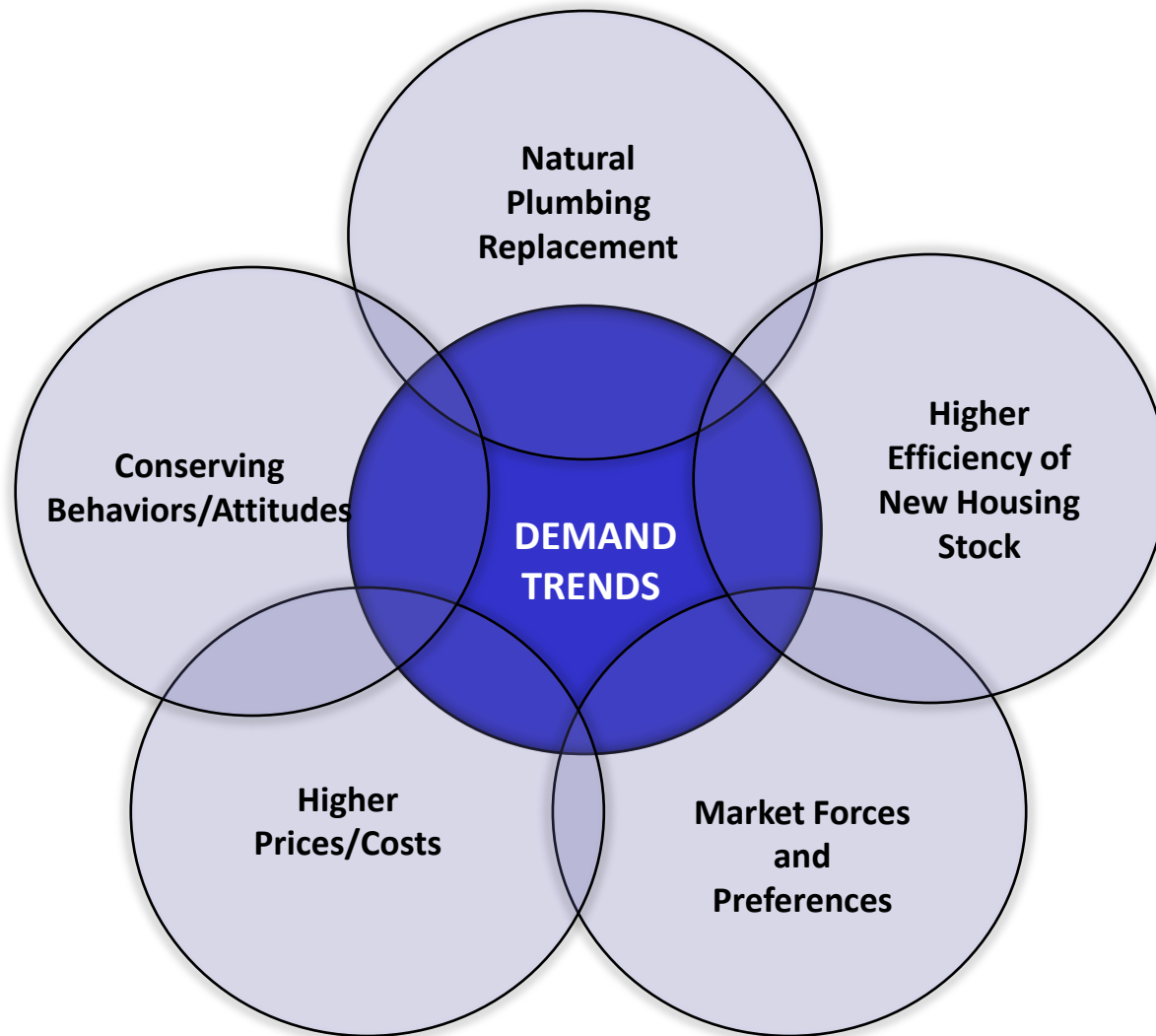


Evidence of Indoor Efficiency

10th Percentile Annual Water Use per Single Family Account (1995 – 2007)



Recent and Future Demand Trends



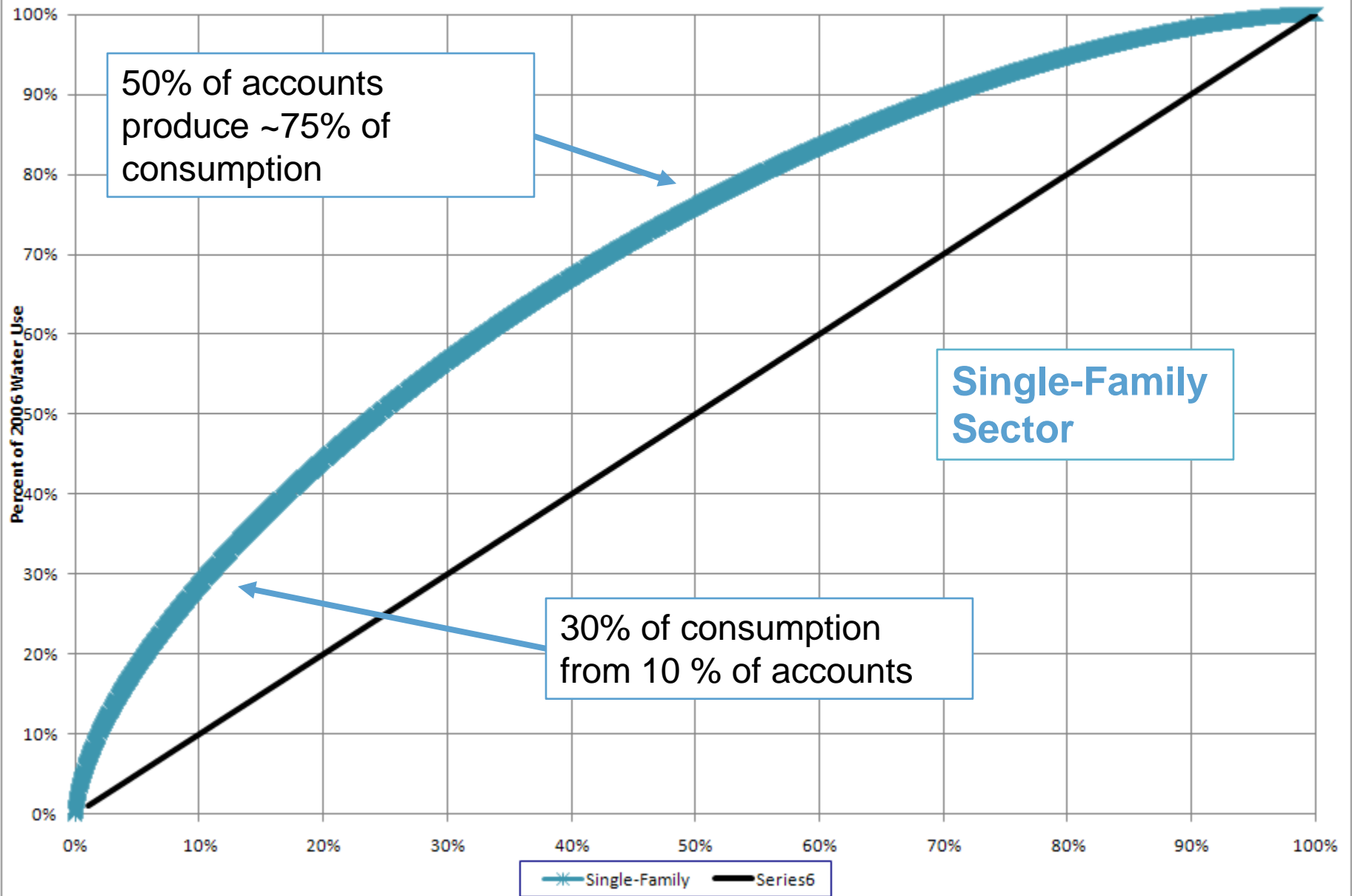


EVALUATION OF SECTORAL WATER USE VARIABILITY AND END USES

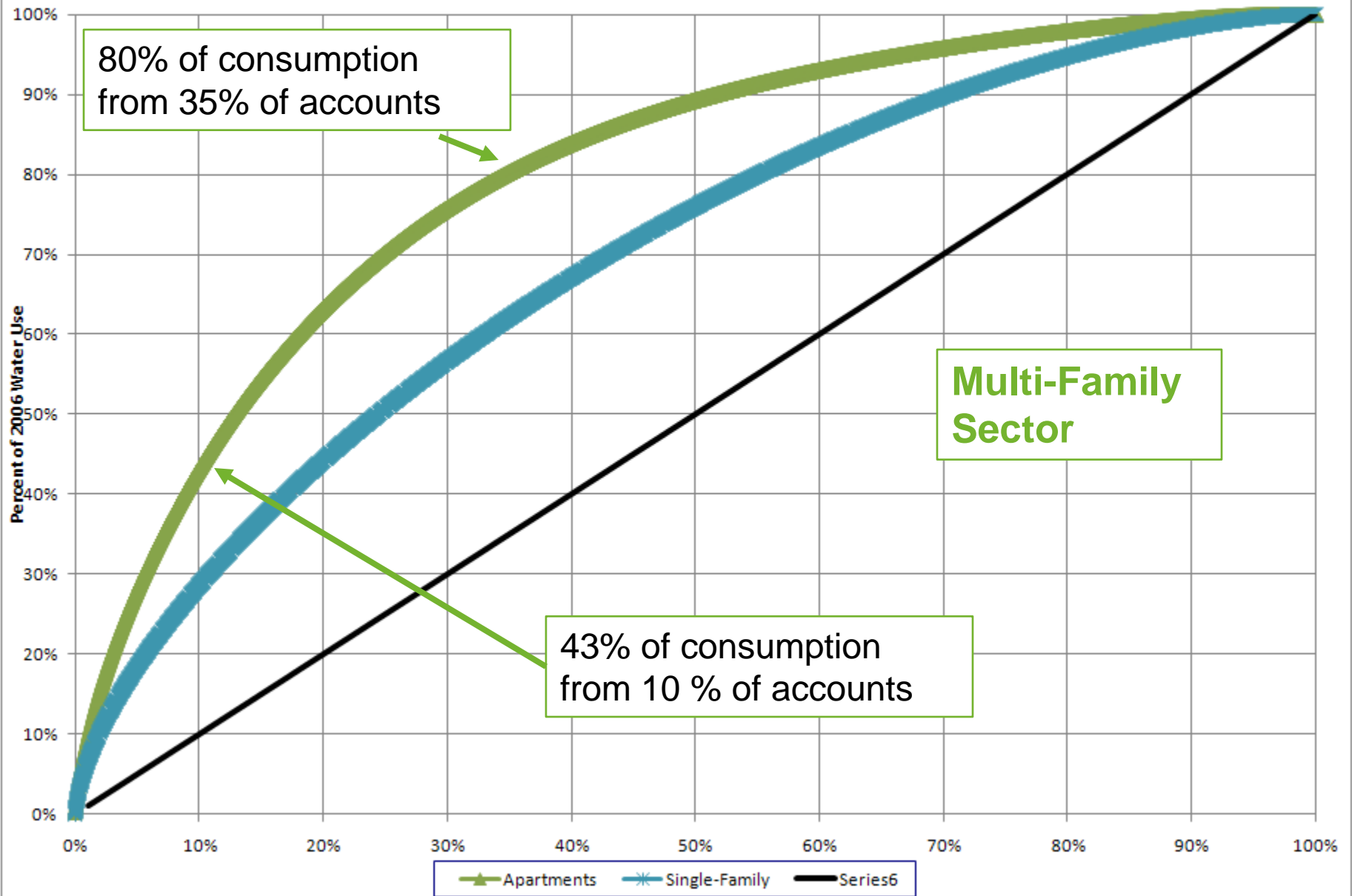
Sector Demand Analysis

- Demand disaggregation is fundamental for understanding variability in water use
- Understanding how and why water use varies assists in the formulation of planning alternatives
- Variability in water use differs across sectors
 - Relative homogeneity of customers
 - Scale of operations
 - End uses of water
 - Sensitivity to weather
- Developed concentration curves and random sample surveys

Comparison of Water Use Concentration among 5 Type User Classes



Comparison of Water Use Concentration among 5 Type User Classes

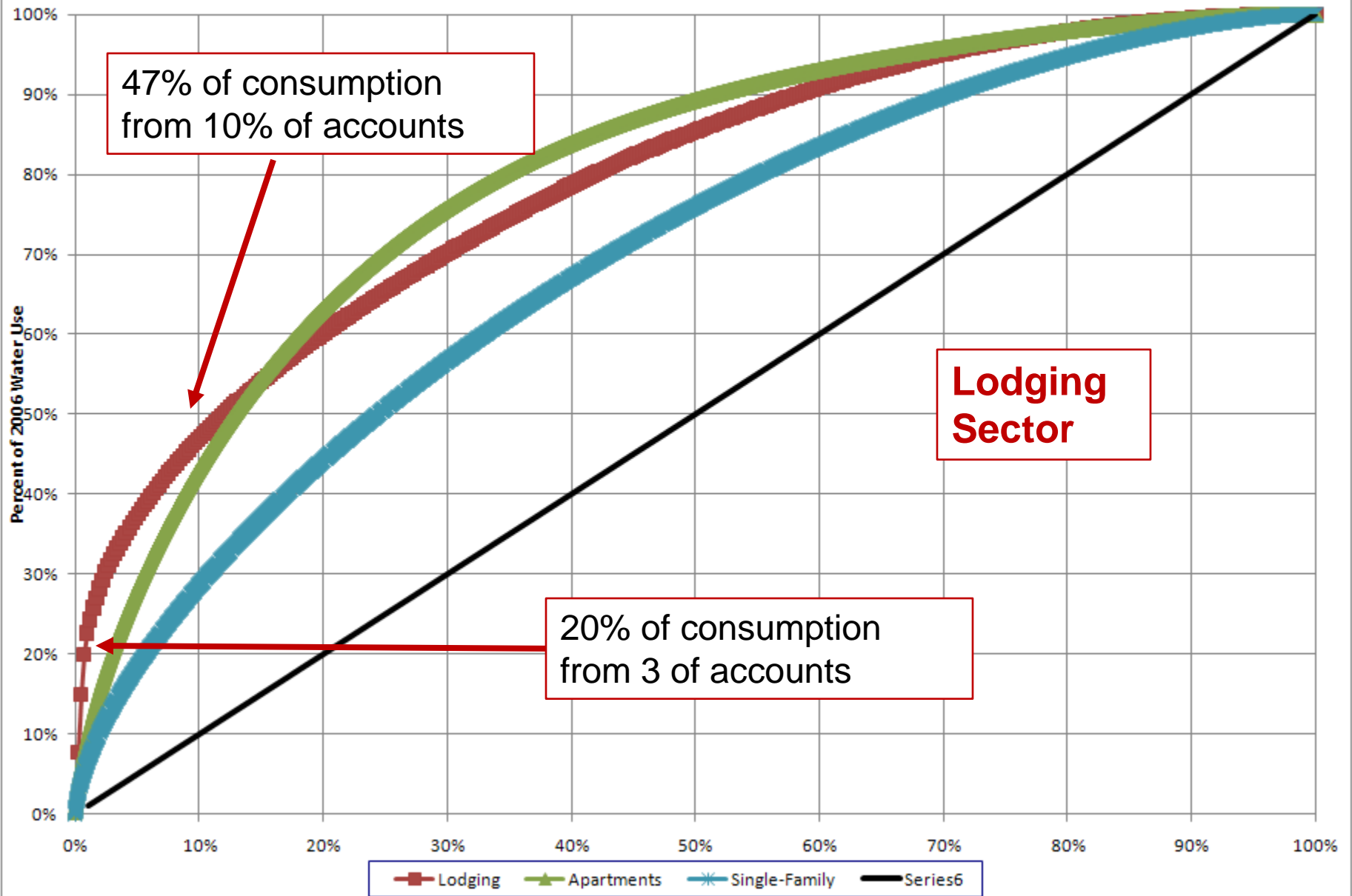


Apartment Survey

- Sample of 346 apartment *properties*
- Discriminators between high and low users
 - Scale/Number of units
 - Presence of outdoor end uses
- Water use per unit
 - Sample mean: 257 gpd
 - Newer properties: 156 gpd
 - Fewer common laundries
 - Less turf/irrigation

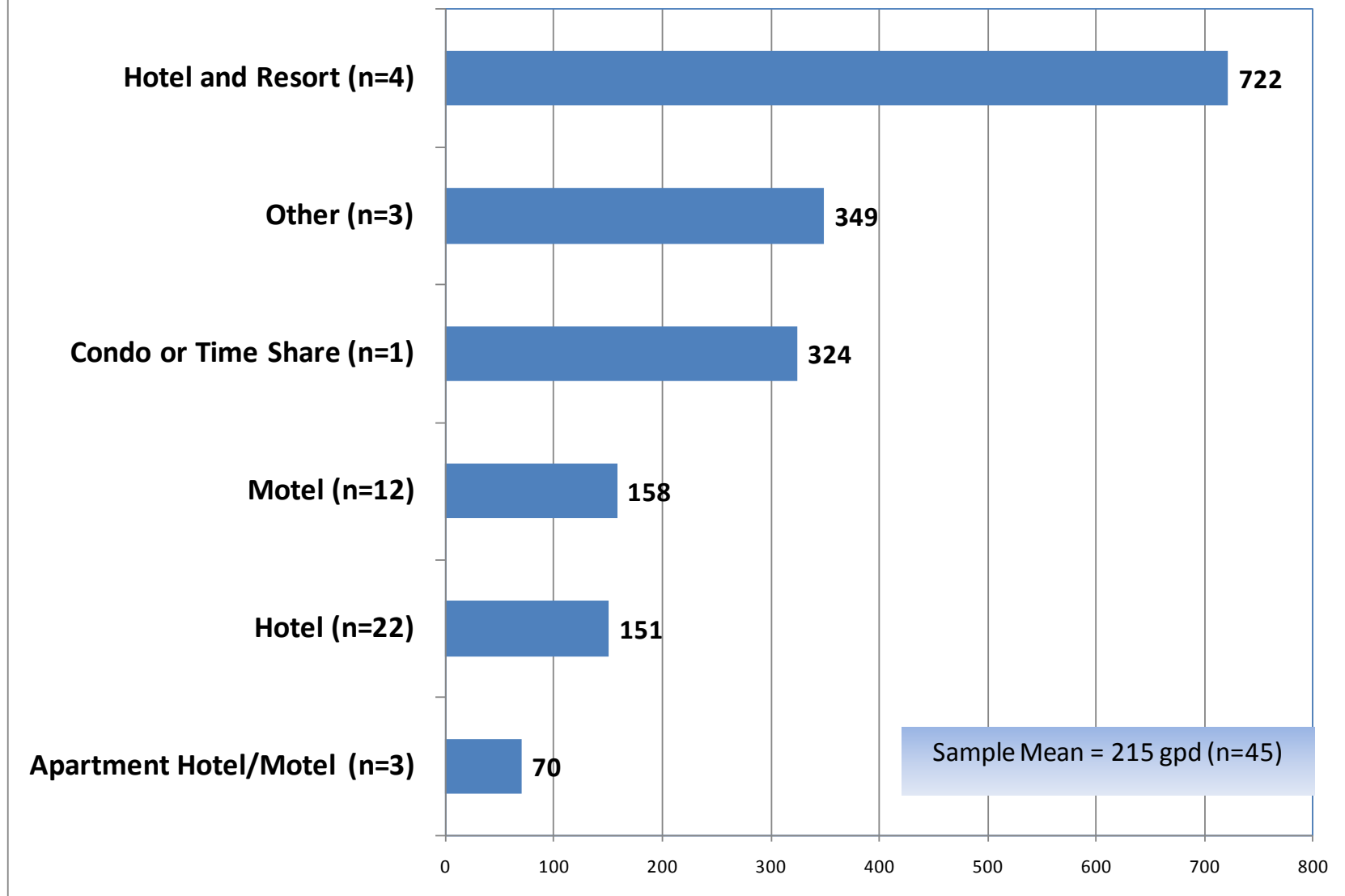
End Use	% Sample
Swimming Pool	66%
In-ground Sprinklers	69%
Evaporative Coolers	19%
Cooling Tower(s)	14%
Common Laundry	60%
Washing Machine Hookups (all units)	27%
Dishwasher Hookups (all units)	45%

Comparison of Water Use Concentration among 5 Type User Classes

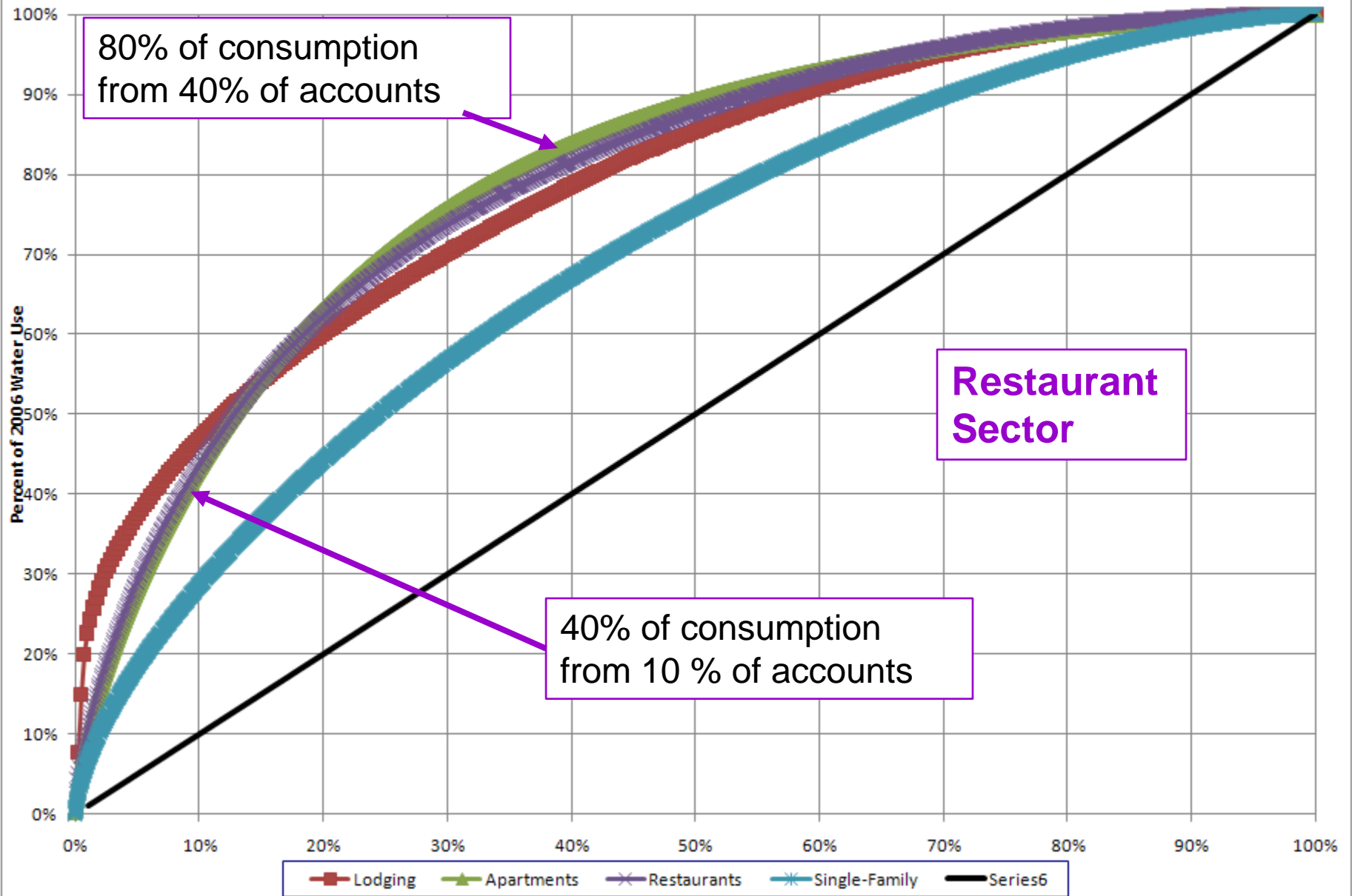


Lodging Survey

Water Use per Room per Day (Annual Average 2006)



Comparison of Water Use Concentration among 5 Type User Classes

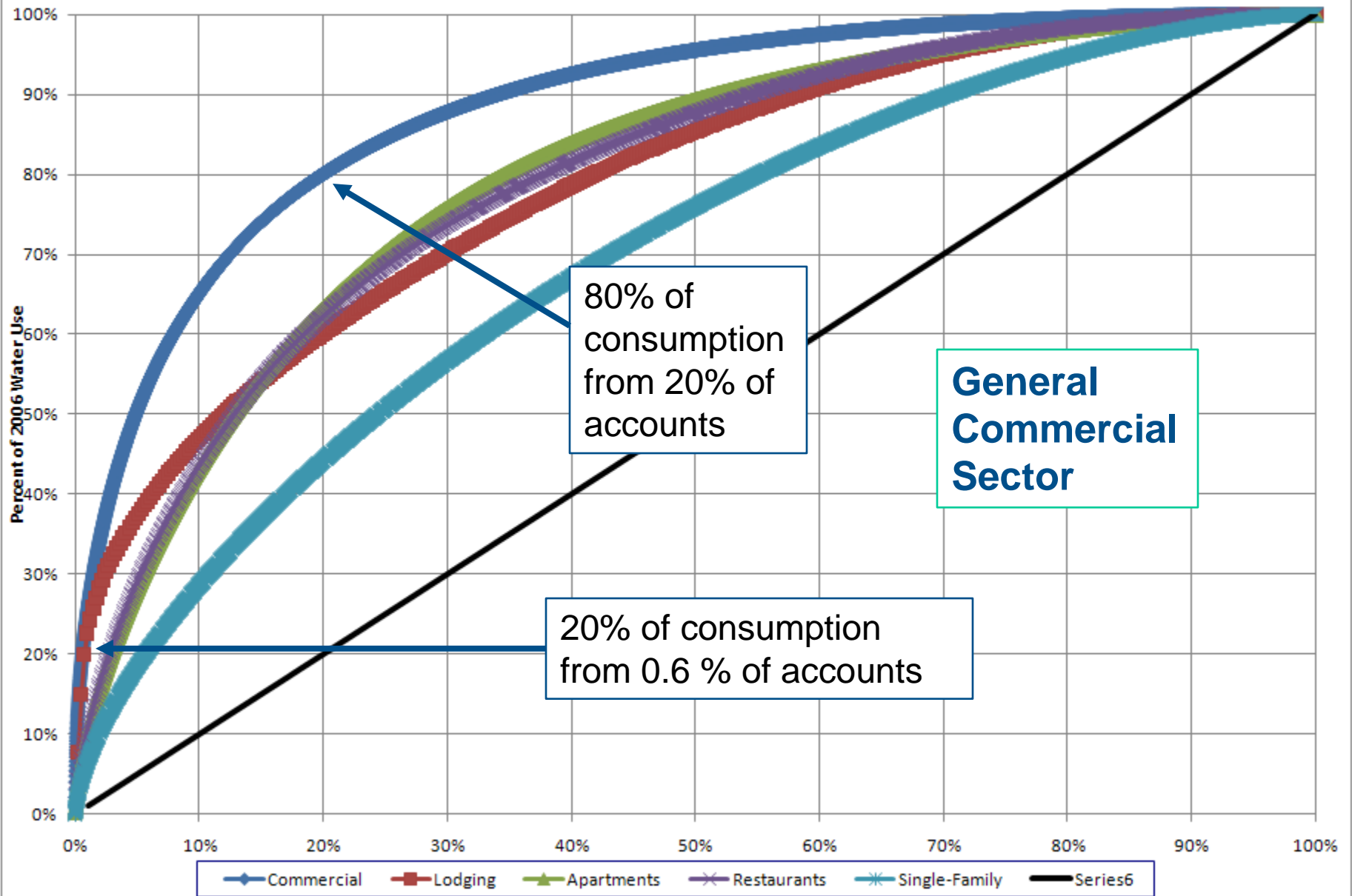


Restaurant Survey

- Sample of 247 restaurants
- Discriminators between high and low users
 - Scale of operations and capacity
 - Presence of cooling towers, landscape, and outdoor amenities
- Water use per meal served
 - Wide (largely unexplained) variation
 - Sample mean: 58 g/meal

End Use	% Sample
Landscaping	58%
In-ground Sprinklers	37%
Evaporative Coolers	55%
Cooling Tower(s)	11%
Misters	15%
Hot Water Boilers	66%
Pre-Rinse Spray Nozzle(s)	66%

Comparison of Water Use Concentration among 5 Type User Classes



Commercial Survey

- Sample of 443 properties
- Relatively undefined (catch-all) customer class
- Several properties with multiple business types
- Sub-sample of 299 single-business properties
 - Diversity in business types
 - Mean water use: 85 gallons per employee per day (ged)
 - ▶ Top users: 169 ged
 - ▶ Bottom users: 12 ged

End Use	% Sample
Landscaping	57%
In-ground Sprinklers	39%
Evaporative Coolers	39%
Cooling Tower(s)	8%
Ice Machine	17%
Laundry Facilities	10%
Flush-type Urinals	37%

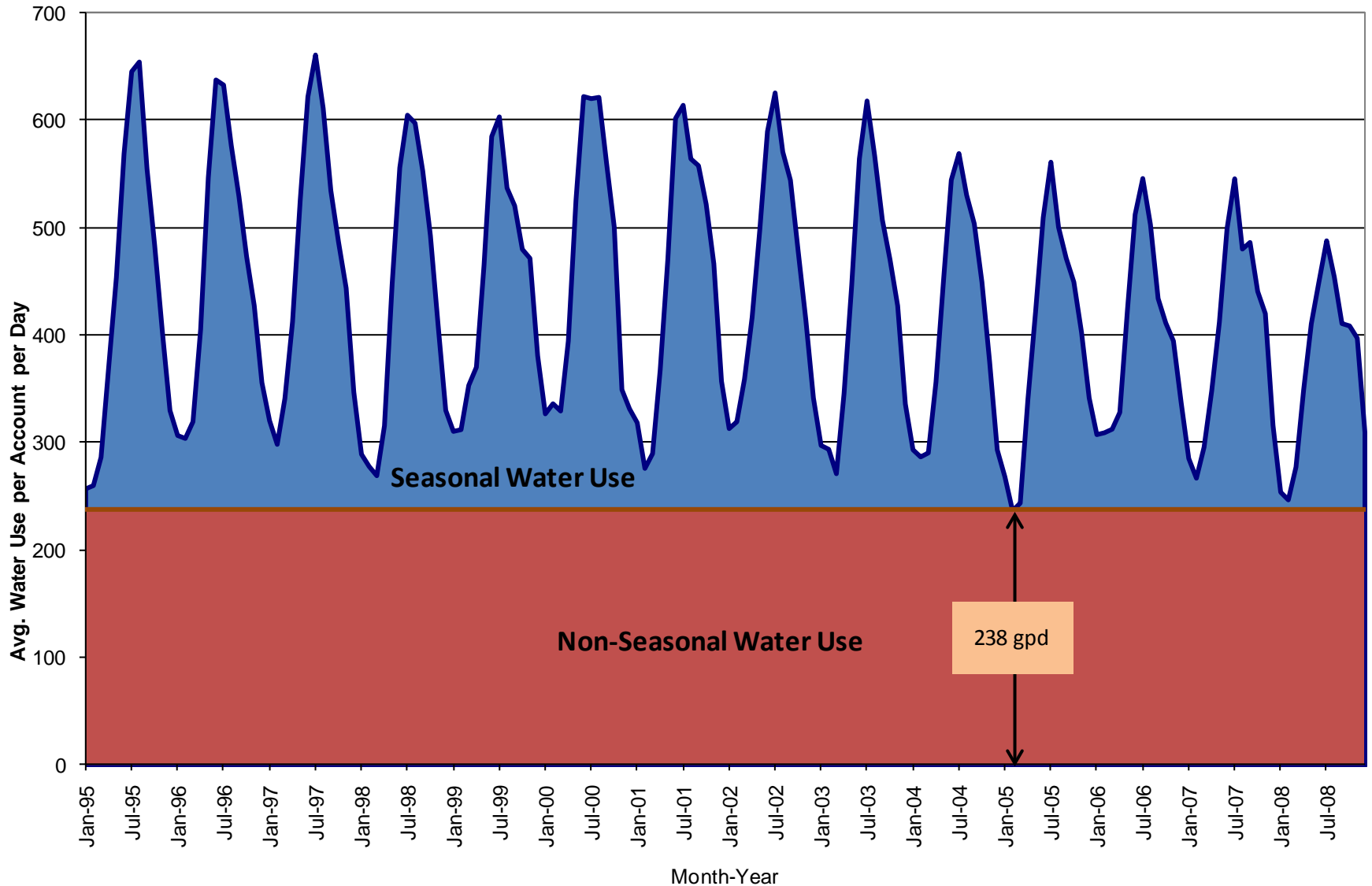


SEASONAL CONSUMPTION AND CURTAILMENT ANALYSIS

Seasonal Demand Components

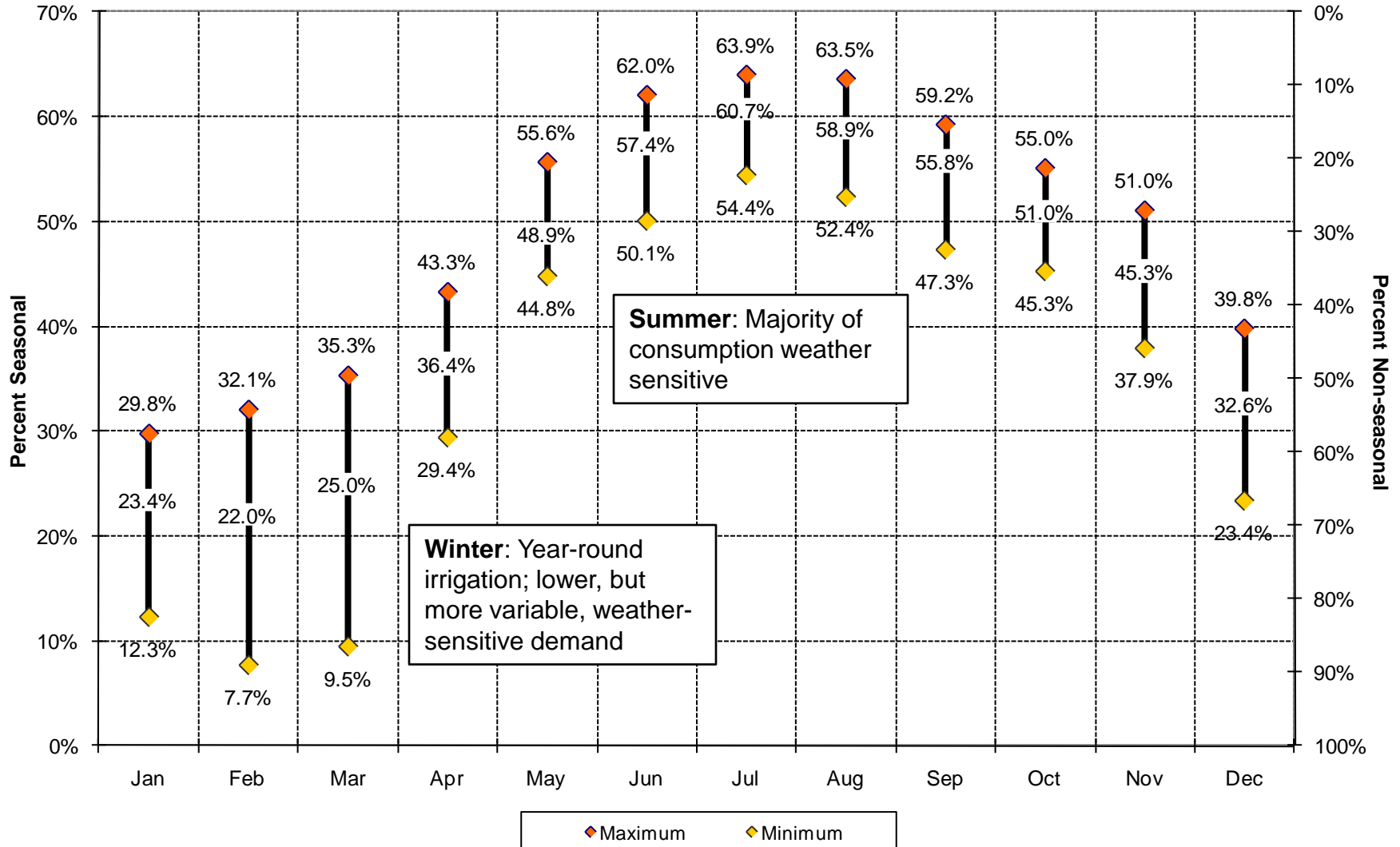
- Estimation of seasonal (or weather-sensitive) water use fundamental for estimating irrigation demands and curtailment potential
- Minimum-month estimation method
 - Can be applied to available monthly type user billing data
 - Yields conservative estimates of seasonal uses due to year-round irrigation
 - Modified method employed to increase precision of estimates

Modified Minimum-Month Method



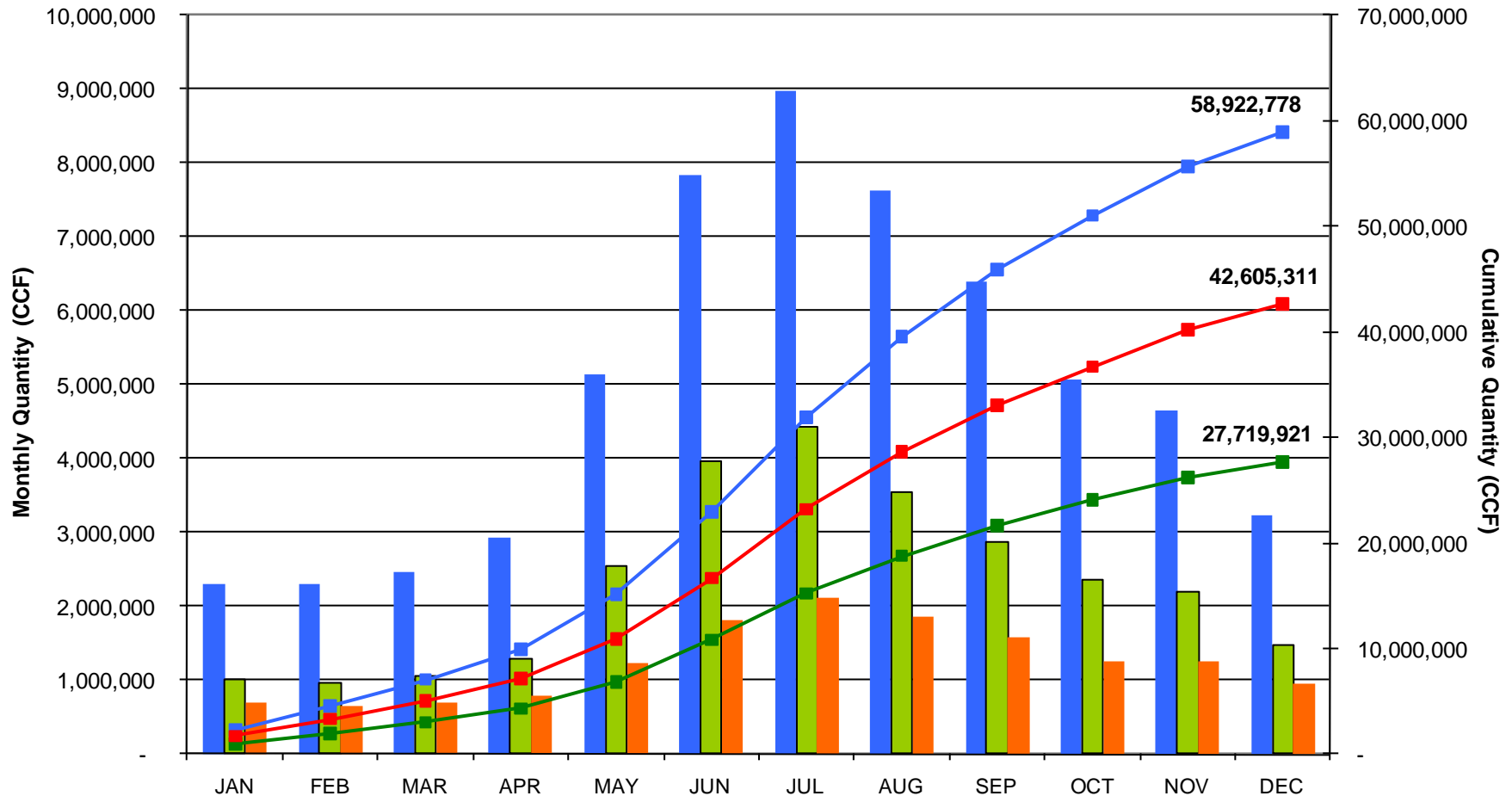
Variability in Weather-Sensitive Demand

Proportion of Total Phoenix Use Designated as Seasonal Consumption
(all accounts; 1995-2008)



Estimation of Seasonal Quantities

Monthly and Cumulative Estimates of Seasonal Water Use Quantities (2006) (CCF)



Monthly Seasonal Use

Irrigation Account Seasonal Use

Cumulative Single-Family Seasonal Use

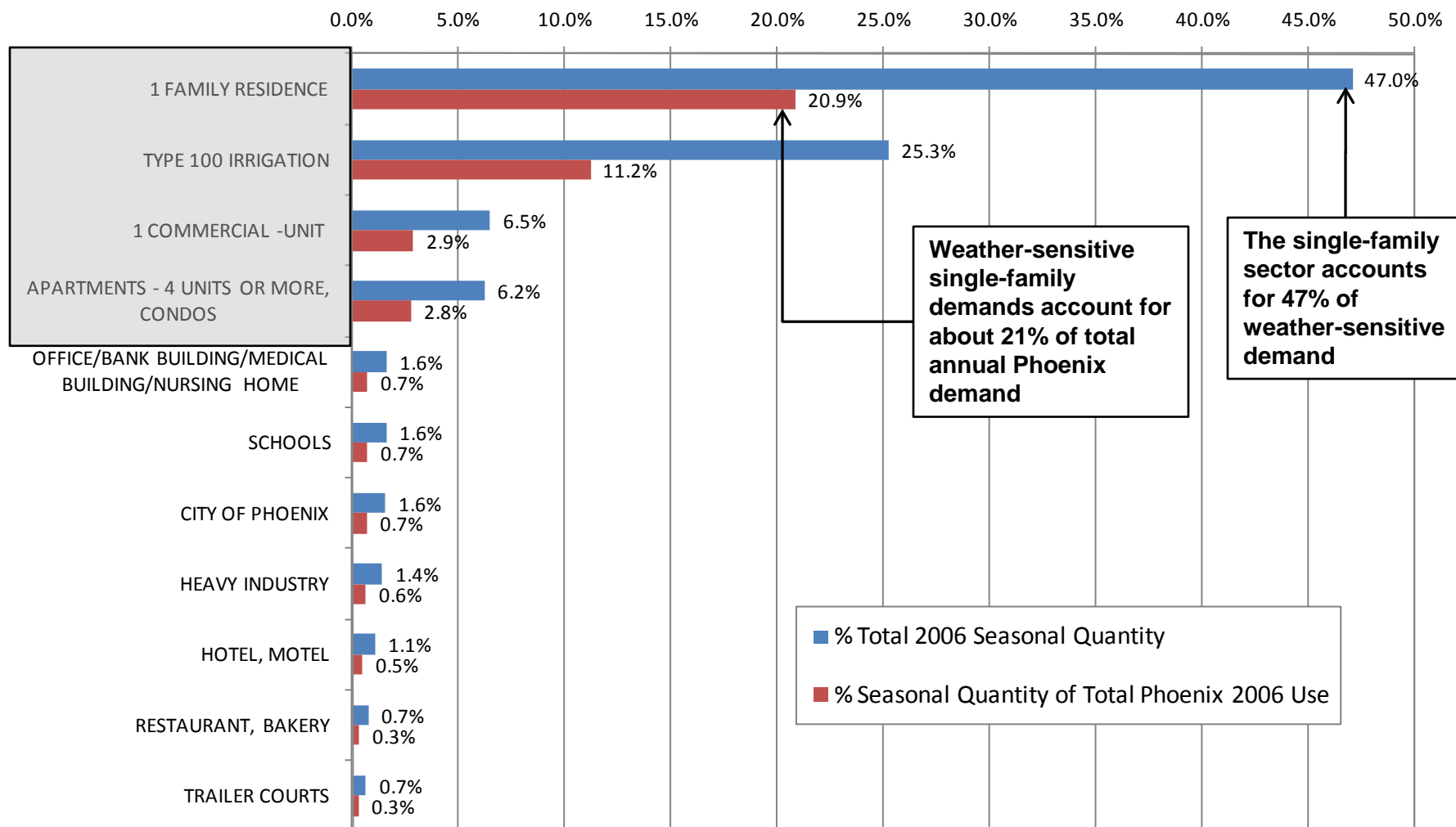
Single-Family Seasonal Use

Cumulative Total Seasonal Use

Cumulative Single-Family plus Irrigation Seasonal Use

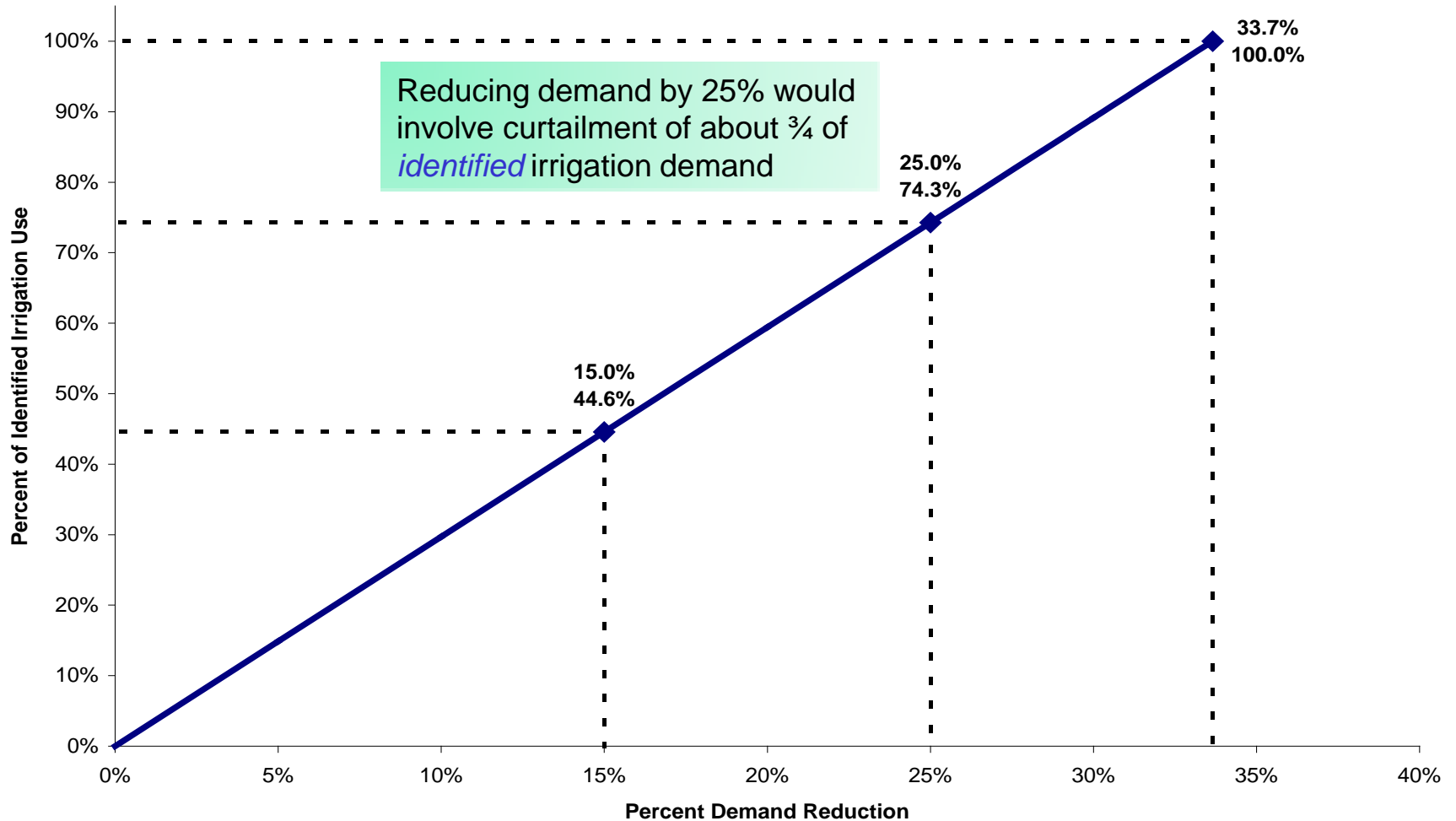
Ranking of Curtailment Potential

Type User Classes with Highest Seasonal Consumption



Estimation of Curtailment Potential

Percentage Demand Reduction and Identified Irrigation



Summary

- Demand management planning requires in-depth evaluation of water use patterns and trends
- Many (fundamental) characterizations of water use can be achieved with available data
- Characterizations can and should be supported by customer surveys to better understand variability in water use
- Caution: other interesting and cogent questions are certain to arise during the process

On-Going and Future Analyses

- Additional end use analyses
 - Data logging
 - Field visits
- Sharpening of curtailment potential
 - Estimation of cooling demands
 - Prioritization of targeted reductions
 - Coping costs

THANK YOU

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