WATER CONSERVATION EVALUATIONS WITHIN THE CONTEXT OF REGIONAL WATER SUPPLY PLANNING IN FLORIDA

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Proc. FSAWWA Fall Conference
Orlando, FL
November 29, 2010

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Introduction

- EZ Guide 2.0 (EZG) generates an optimal mix of water conservation BMPs that meets target goals such as:
  - Maximize total benefits minus total costs
  - Minimize the cost of achieving a specified maximum gallons per capita per day
  - Maximize water savings for a given budget
- EZG includes a water budget that is calibrated against measured water use data to explain the causes of trends in water use
- EZG can be used to help utilities and water management districts develop regional water supply plans that are based on a parcel-level bottom-up assessment with consistent assumptions across utilities in the study area

Water Planning Agencies in Florida

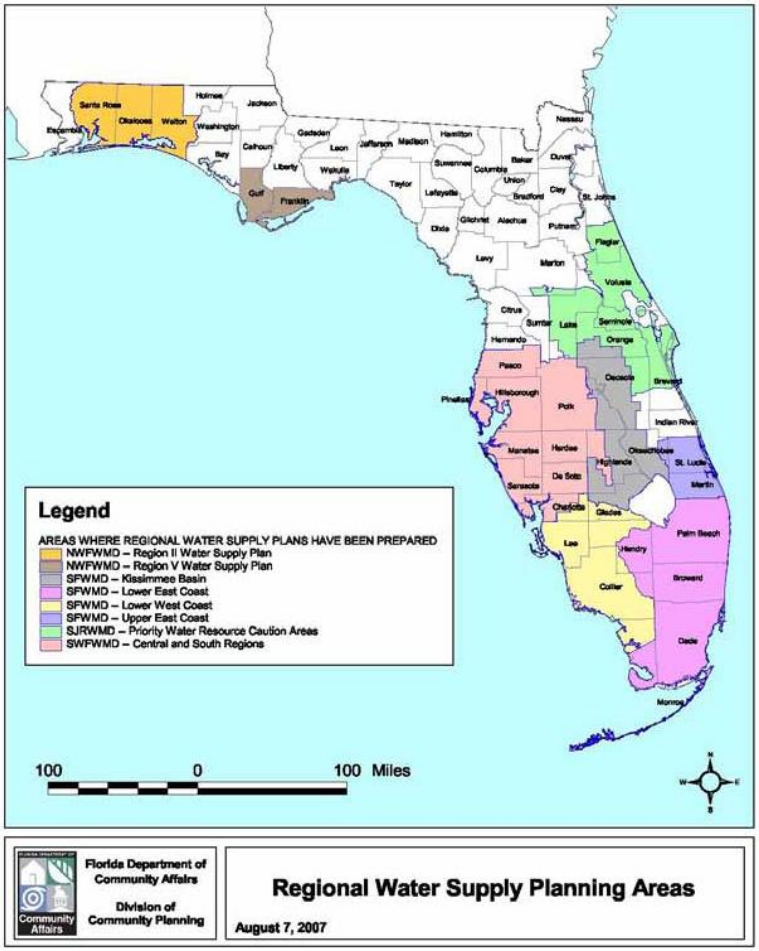
- State Agencies
  - Department of Community Affairs
  - Department of Environmental Protection
- Five Water Management Districts
- County Agencies
- Regional Water Supply Authorities
- Cities
- Water Utilities

EVOLUTION OF REGIONAL WATER SUPPLY PLANNING IN FLORIDA

- State legislative actions in 1997 launched regional water supply planning initiatives
- Water management districts (WMDs) were charged to conduct water supply assessments(WSA's) and identify areas of concern in terms of undesirable impacts of water development activities
- Regional water supply plans (RWSPs) need to be developed for identified areas of concern identified in the WSAs
- Local governments within RWSP areas need to develop 10-year water supply facilities work plans that include alternative water supplies, water reuse and conservation programs. These work plans are incorporated into the local government's comprehensive plans.
- Initial RWSPs were developed in 1998 and have been updated about every five years. WMDs have divided their service areas into planning regions and RWSPs have been developed for these regions as needed.

2007 Map of Regional Water Supply Planning Areas

(http://www.dca.state.fl.us/fdcp/dcp/publications/Files/finalguidelines.pdf)



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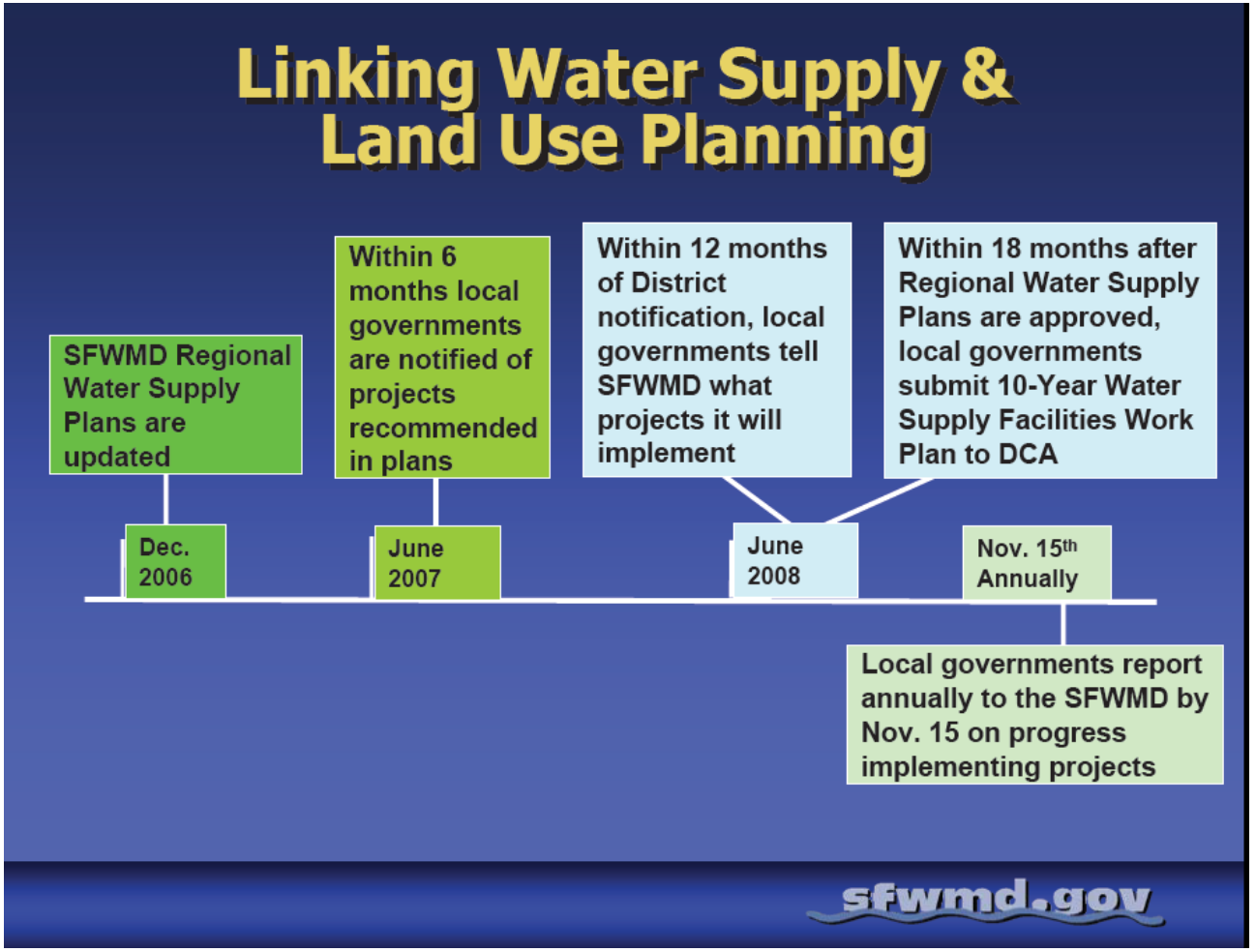
Sample SFWMD Time Table for Water Supply Planning

Jackson (2006)



Role of the Florida Department of Community Affairs (FDCA)

- FDCA, the State's land planning and community development agency, ensures that new growth and established communities comply with the State's growth management laws
- The Division of Community Planning within FDCA evaluates whether communities have adequate roads, schools, **water**, parks and sewer facilities for their residents. Water Supply Planning is one program within the Division of Community Planning.
- Since July 2005, FDCA has required local governments to submit comprehensive plan amendments include data and analysis to demonstrate that water supplies are sufficient to support anticipated growth

FDCA Requirements for Local Governments

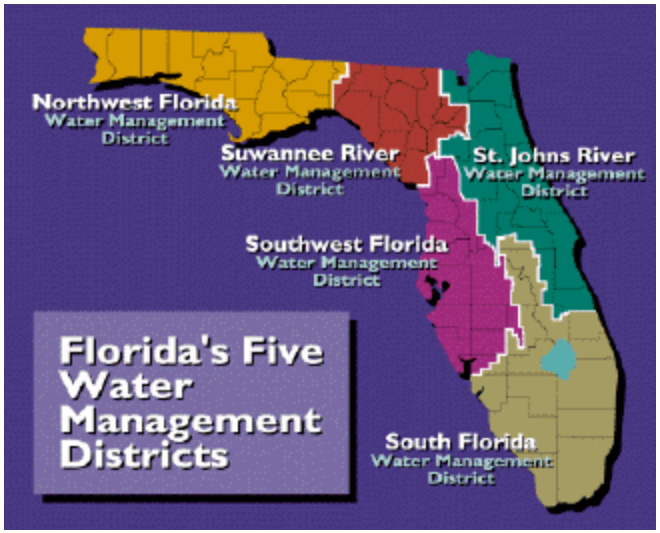
- Each local government must adopt an evaluation and appraisal (EAR) report every 7 years that assesses progress in implementing the local comprehensive plan. The content of these plans is as follows:
- Not subject to a regional water supply plan
  - Develop a 5 year schedule of capital improvements
  - Update the Conservation Element of the land use plan
  - Update the Intergovernmental Coordination Element
- Subject to a regional water supply plan
  - Do the above three items
  - Indicate status of implementation of the Infrastructure Element
  - **Indicate extent of identifying alternative water supply projects and conservation and reuse programs**
  - Update the comprehensive plan as needed

Role of Florida Department of Environmental Protection (FDEP)

- The Office of Water Policy (OWP) in FDEP is responsible for regional water supply planning
- OWP provides guidance to the water management districts as they develop their regional water supply plans
- FDEP regulates the operating capacity of each water treatment facility that processes the raw water and monitors water quality
- FDEP works directly with the public water utilities
- FDEP is also responsible for water and stormwater reuse that have a direct impact on urban water supply options

Florida's Five Water Management Districts

http://www.dep.state.fl.us/water/waterpolicy/districts.htm



- Responsibilities
  - Flood control
  - Water supply planning
  - Stormwater management
  - Compliance of local government water elements with comprehensive plans

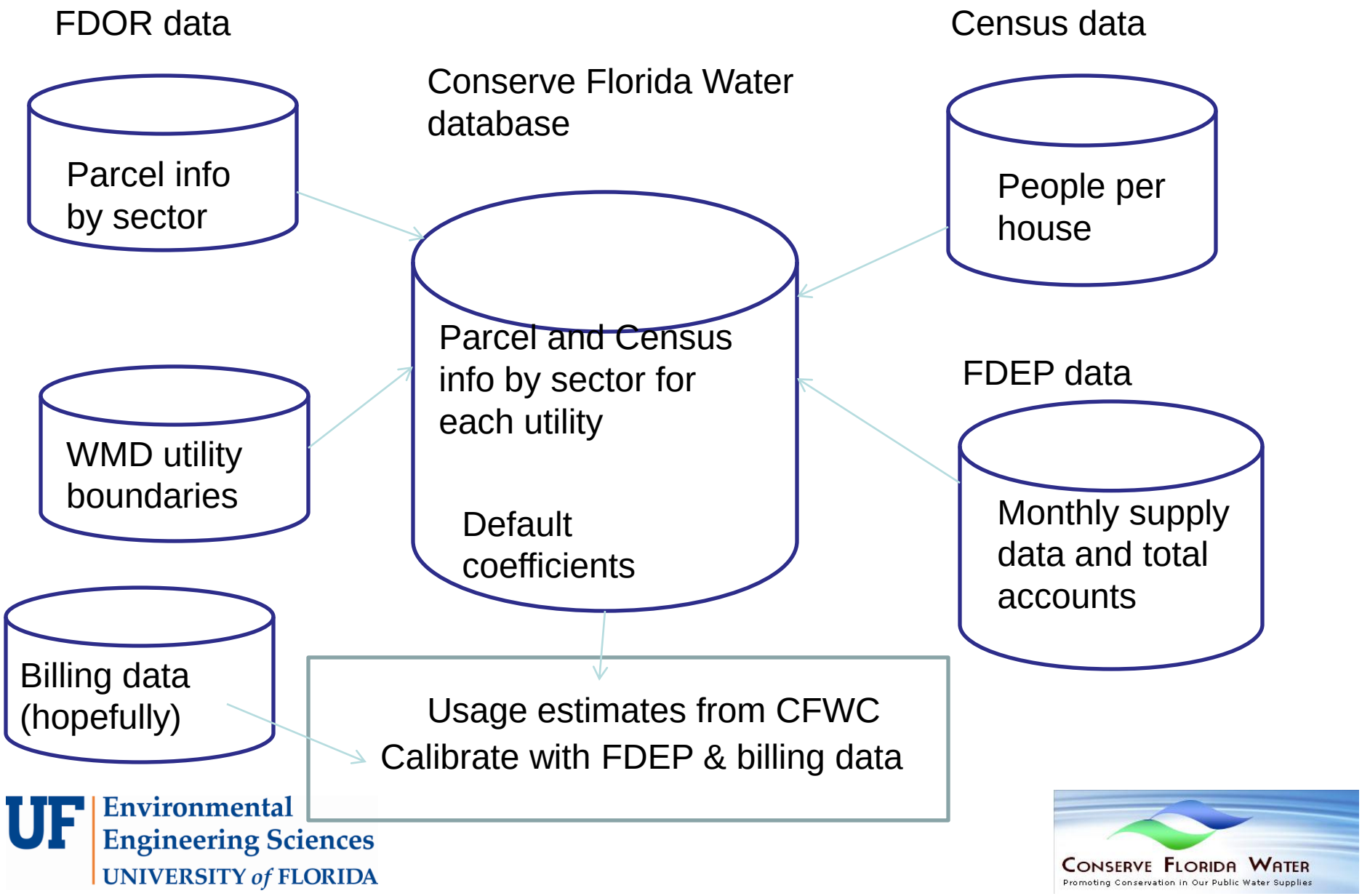
Role of the Water Management Districts

- Regulate the amount of raw water that can be withdrawn from a water source through the consumptive use permit process
- Prepare the Regional Water Supply Plans

EZ GUIDE EVALUATIONS OF SELECTED FACTORS IN REGIONAL WATER SUPPLY PLANNING

- Population estimates to calculate gallons per capita per day
- Inventory of reuse and private irrigation wells
- Residential water use
- CII water use
- Nature of changes in water use patterns
  - Exogenous impacts of climate, number of accounts, economy, etc.
  - Endogenous impacts of plumbing code changes, lawn watering restrictions, switching to alternative sources of irrigation water, utility retrofits, etc.

EZ Guide 2.0 Databases



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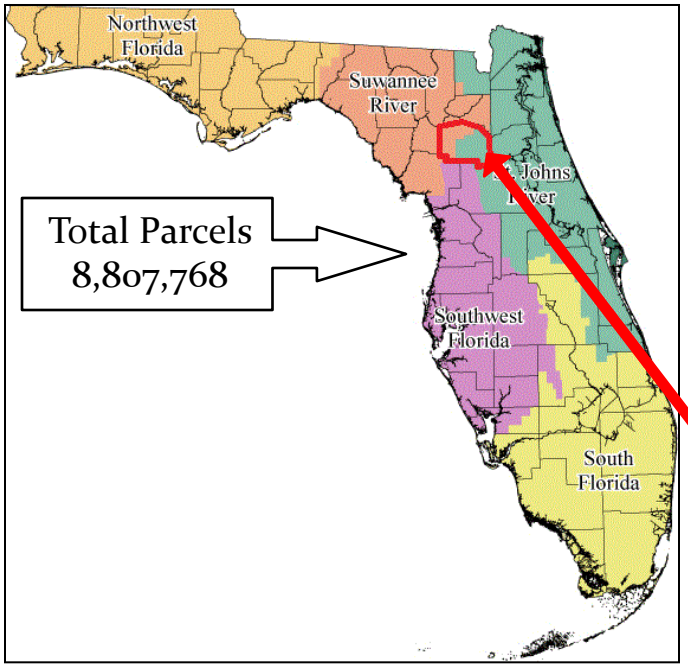
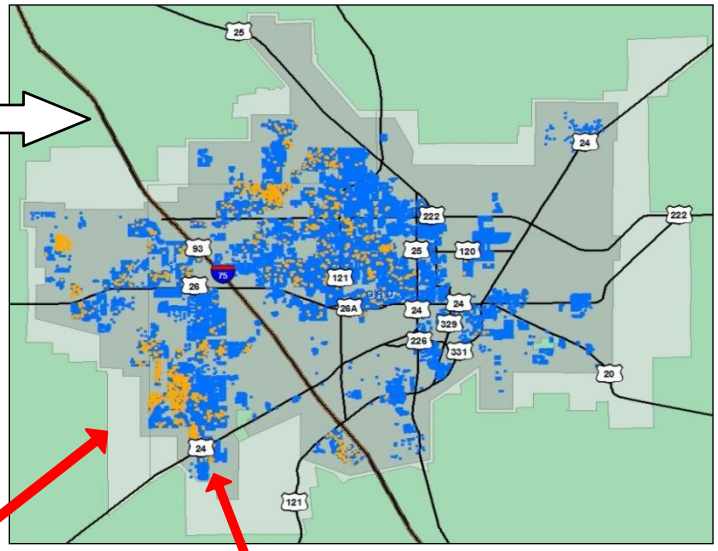
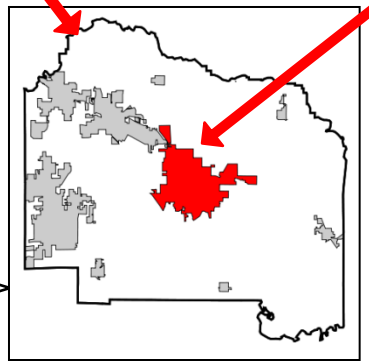


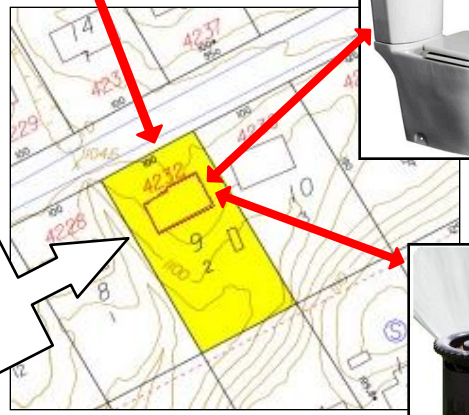
Total Parcels
8,807,768

Total Parcels GRU
55,551





Parcels Alachua
99,305



SFR parcels GRU
30,910

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Public Water Supplies in Florida

(Marella 2009)

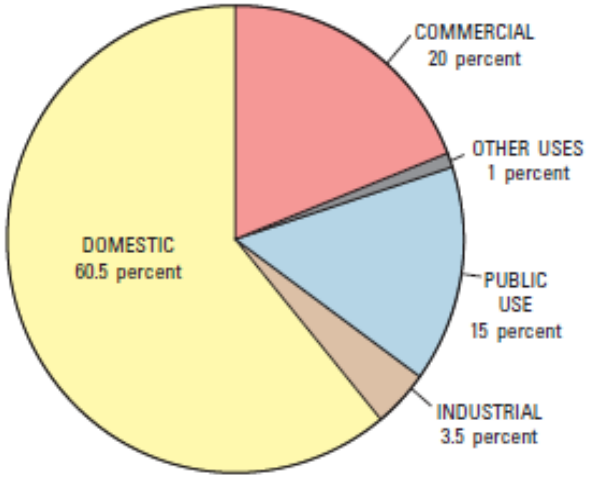

Figure 10. Public-supply water-use deliveries in Florida, 2005.

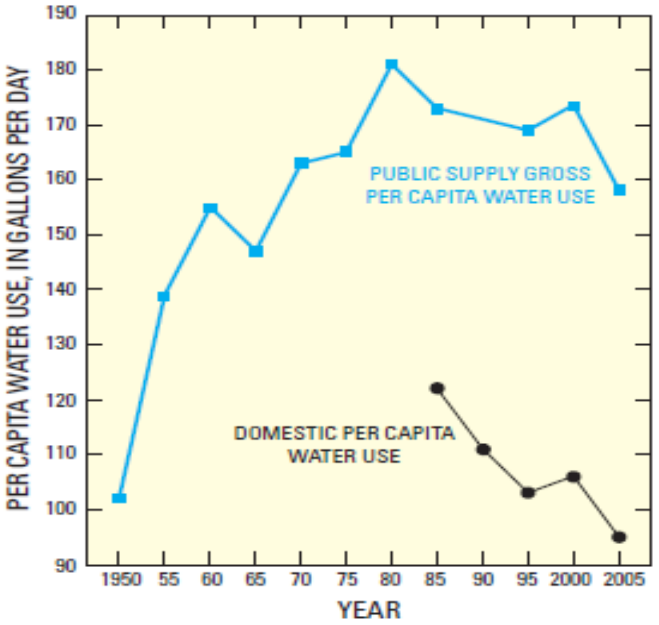

Figure 11. Historical public-supply gross and domestic per capita water use in Florida, 1950-2005. Domestic per capita data was not available prior to 1985. Modified from Marella (2004).

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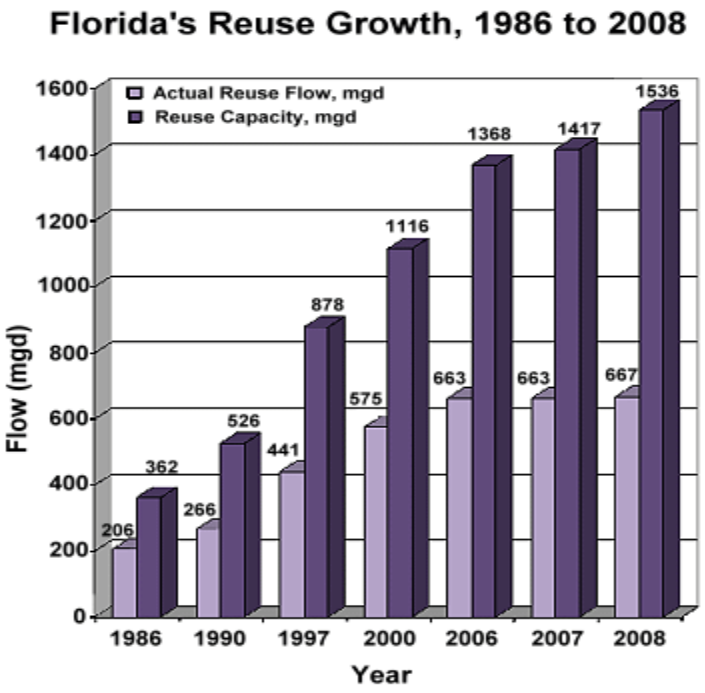
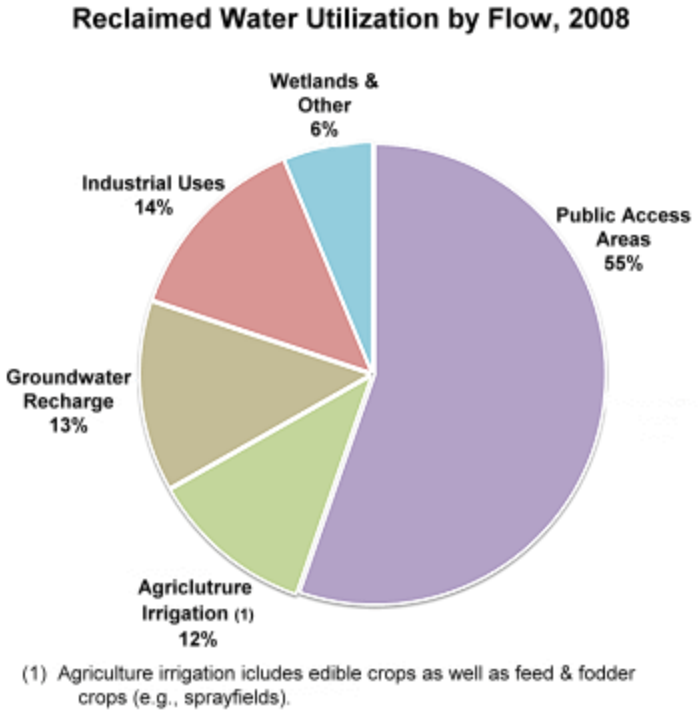
Reuse in the Selected States in the United States

http://floridadep.org/water/reuse/inventory.htm

State	Population (2006 est)	Reported Reuse[1] in Millions of Gallons per Day	Reuse per Capita in Gallons per Day per Person	Rank
Florida	18,019,093	663	36.79	1
California	36,121,296	87	2.41	2
Virginia	7,628,347	11.2	1.46	3
Texas	23,367,534	31.4	1.34	4
Arizona	6,178,251	8.2	1.33	5
Colorado	4,751,474	5.2	1.09	6
Nevada	2,484,196	2.6	1.03	7
Idaho	1,461,183	0.7	0.5	8
Washington[2]	6,360,529	0	0	9

Florida Reuse





- Florida has the largest reuse program in the United States

Population Estimates

- According to 2007 DCA guidelines, local governments must base their population projections on the mid-range population projections developed by the University of Florida Bureau of Economic and Business Research (BEBR) unless an alternative method has been approved
- The projections are made for 20 years with 5 year reporting increments. BEBR population projections are made for counties and cities, not public utilities.
- Water use data is available for utilities, not cities
- Thus, it is necessary to apportion BEBR projections down to the utility level

EZG 2009 Bottom Up Population Estimate for Florida

DORUC	FDOR stratum	FDOR description	Total parcels	Dwelling units/ parcel	Dwelling units	Persons/ dwelling unit	2009 Population
1	Single family res.	Single Family Residential	4,860,912	1.00	4,860,912	2.5	12,152,280
2	Single family res.	Mobile Homes	445,582	1.00	445,582	2.5	1,113,955
3	Multi-family res.	Multi-family – 10 units or more	14,064	53.04	746,022	2	1,492,044
4	Single family res.	Condominiums	1,568,927	1.00	1,568,927	2	3,137,854
5	Single family res.	Cooperatives	40,759	1.00	40,759	2	81,518
6	Multi-family res.	Retirement Homes	576	40.45	23,297	2	46,594
7	Multi-family res.	Miscellaneous residential	26,972	1.00	26,972	2	53,944
8	Multi-family res.	Multi-family – less than 10 units	161,698	1.88	304,058	2	608,116
28	Commercial	Mobile home parks	15,481	4.66	72,105	2	144,210
		Total	7,134,971	1.13	8,088,634		18,830,515

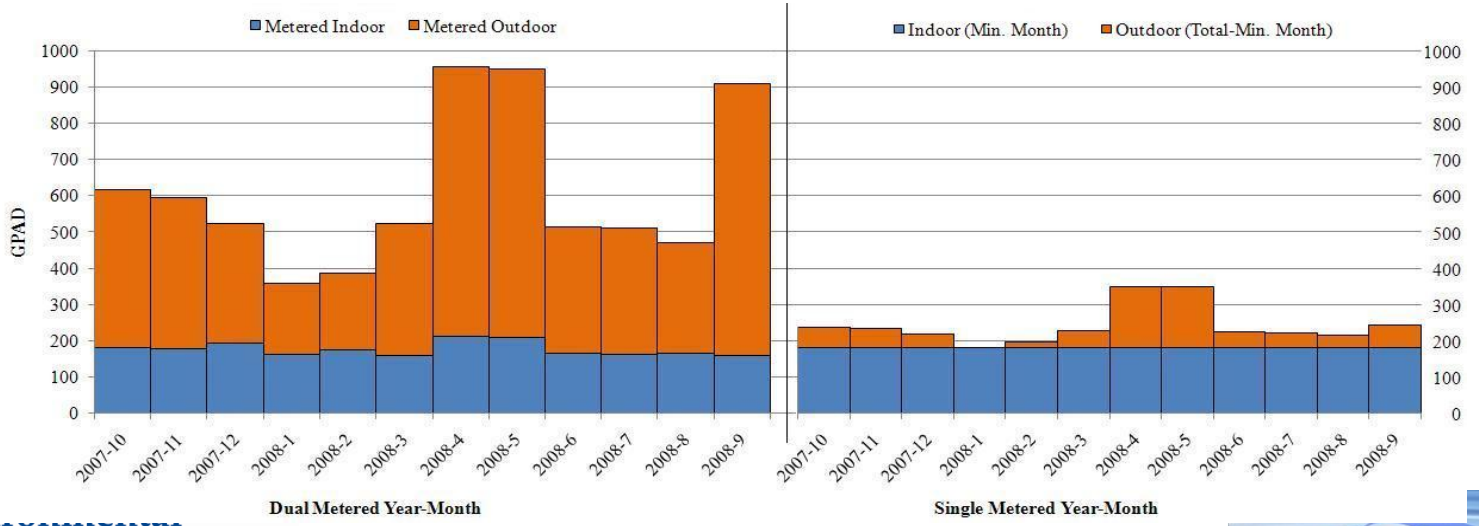
- U.S. Census estimate of 2009 Florida population is 18,537,969. Adjust persons/dwelling unit to calibrate the estimate
- This method is used in EZG and is used by SJRWMD and SWFWMD for RWSP (GIS Associates)
- Friedman et al. (2010) describe how the MFR estimates are developed

Parcel Estimates for Individual Utilities

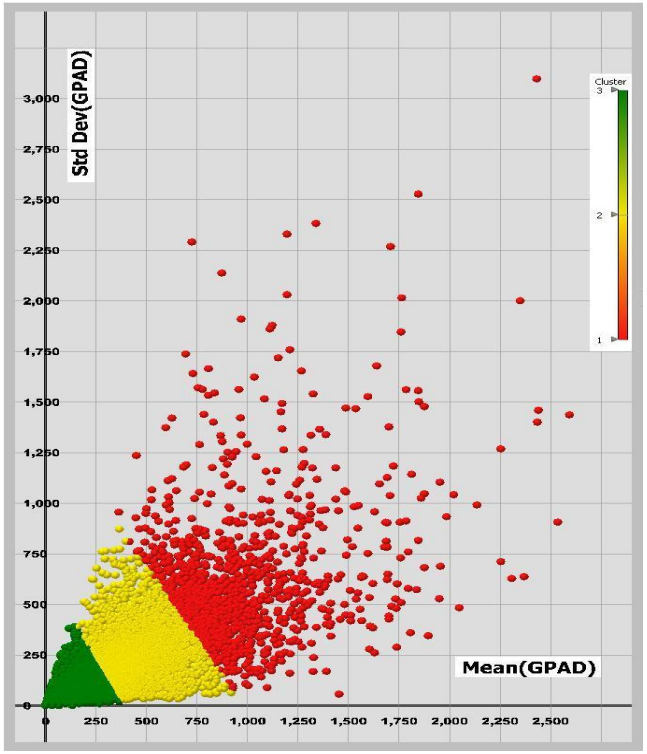
- WMDs and utilities can provide GIS files that estimate utility boundaries
- Files may not be current and parcels within the boundaries may not be connected to the utility
- GIS files from WMDs that are using the bottom up approach should be very good

Classification of Customers

- Parcels in the utility boundaries that are not served by the utility-need to cross check utility and parcel data
- Parcels on reuse water-available on a case by case basis
- Parcels with private irrigation wells-hard to get this information. Whitcomb (2005) found that 28% of his residential sample use private wells with a range from 0 to 74%.
- Billing data can be used to determine which customers are using public water supply for irrigation. Results for 1,402 dual meter and 29,504 single metered GRU customers are shown below.



Cluster Analysis Using Parcel Data



Irrigation Group	Mean GPAD	Standard Deviation GPAD	% of SFR Customers	% of SFR Water Use
Minimal/Offline	156	65	70.6%	42.5%
Mid-range	434	233	25.3%	42.4%
Upper	949	598	4.1%	15.1%
Total			100.0%	100.0%
Average	259			

- Cluster analysis indicates that only about 30% of SFR customers irrigate using utility water

Statewide CII Water Use

Description	Sample Size	HA/EA	q_j (gallons/ heated ft^2/ day)	State Parcel Count	State Total Heated Area (acres)	State Total Water Use (MGD)	% CII Heated Area in State	% of CII Water Use in State
Commercial	2,191	0.941	0.1304	230,881	48,009	282.68	46.75%	63.49%
Industrial	299	0.942	0.0496	93,264	30,851	77.86	30.04%	17.49%
Institutional	682	0.963	0.0781	107,853	23,826	84.73	23.20%	19.03%
Total CII	3,172	0.948	0.1015	431,998	102,686	445.27	100.00%	100.00%

- Above table shows estimated statewide CII water use using EZG
- Similar sums can be done for any combination of utilities within the state

Analysis of Nature of Changes

- Time series and regression analysis to remove the non-water conservation factors and then do a final cause-effect analysis of the residual time series
- Process simulation and optimization model that provides a daily time step simulation of water demand over multiple years using a water budget approach that incorporates cause-effect relationships

Watershed Modeling-Evaluation of Streamflow Time Series (Bedient & Huber 2002)

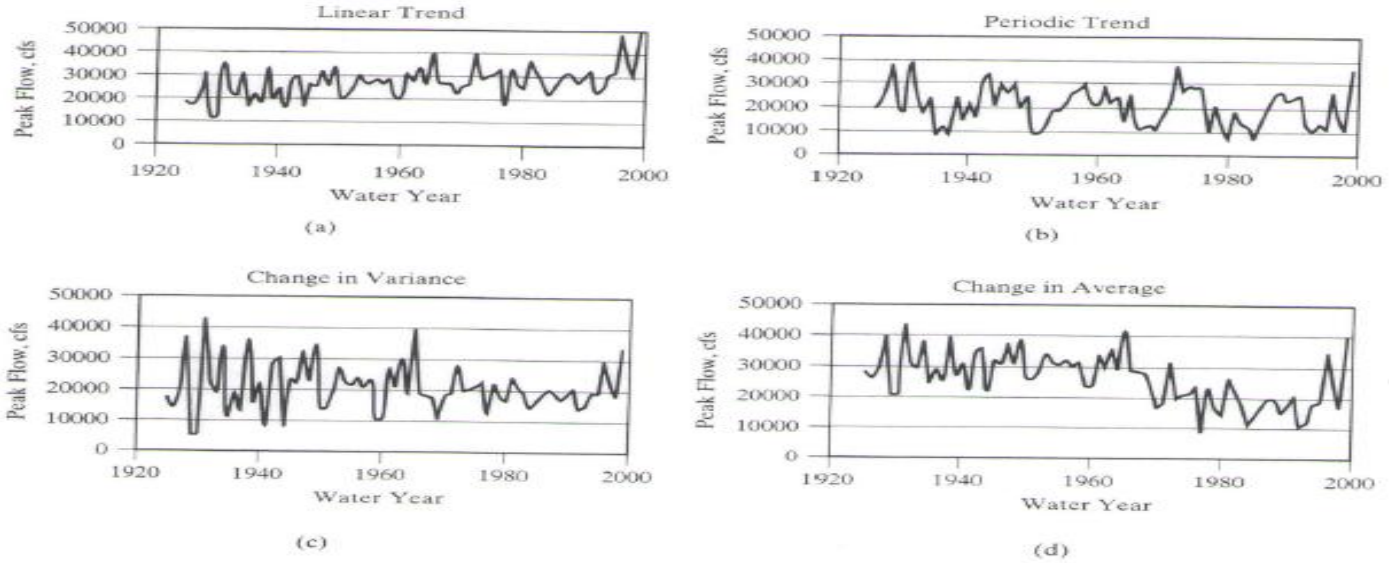


Figure 3.3 Hypothetical examples of nonstationary time series. (a) Linear trend. (b) Periodic trend. (c) Change in variance. (d) Change in average.

a) increased flow due to urbanization

b) longer term cycles due to climate change?

c) decreased variability due to a dam

d) decreased mean flow due to a diversion of water

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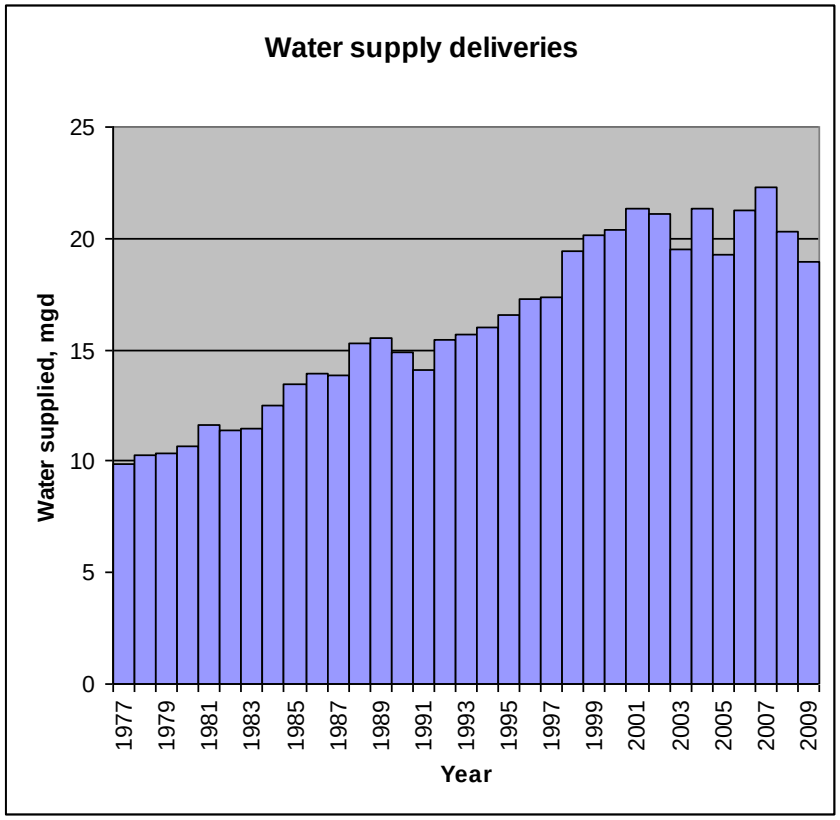
Water Use Modeling Problem- Nature of Water Use for this Utility?



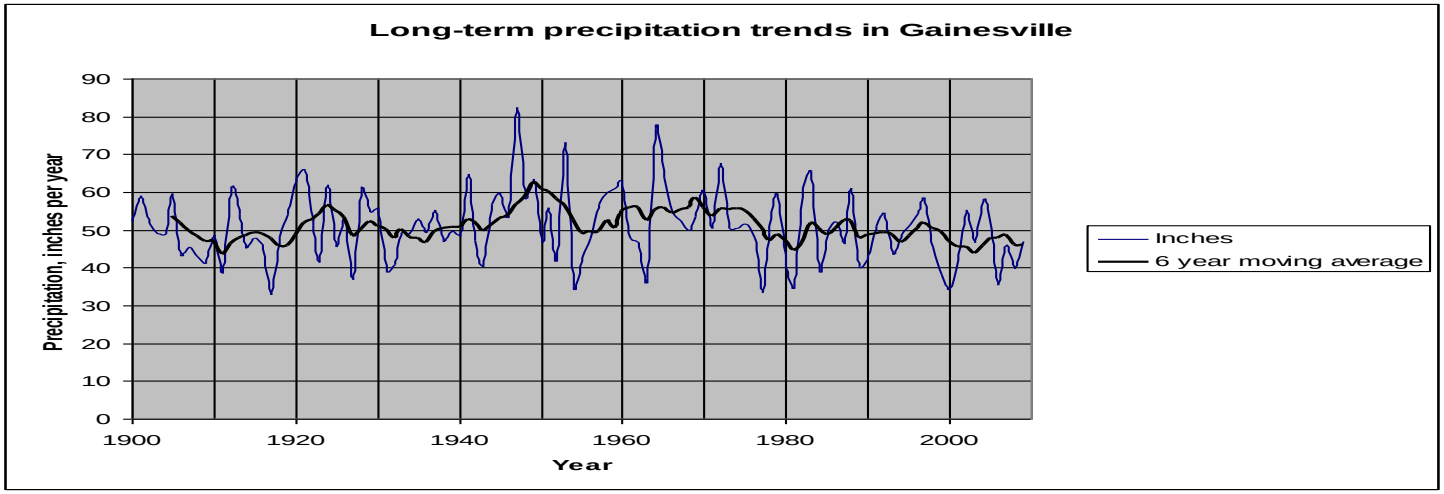
- Quantify effects of:
  - Population
  - Climate
  - Plumbing code changes
  - Irrigation systems
  - Wastewater reuse
  - Economy
  - Etc.
- Have monthly water use data for each customer for 2007 and 2008

Long-term Precipitation Trends, Gainesville, Florida
Below average precipitation trend since 1977

Data from http://coaps.fsu.edu/climate_center/data/precip_gainesville.shtml

Decade		Avg.	11 year Averages		Avg.
From	To	Inches	From	To	Inches
1900	1909	49.48	1900	1910	49.41
1910	1919	47.79	1911	1921	50.78
1920	1929	53.60	1922	1932	49.30
1930	1939	48.90	1933	1943	50.48
1940	1949	57.70	1944	1954	57.12
1950	1959	52.18	1955	1965	54.91
1960	1969	54.62	1966	1976	53.64
1970	1979	52.21	1977	1987	48.54
1980	1989	49.30	1988	1998	50.14
1990	1999	48.82	1999	2009	44.84
2000	2009	45.49			
1900	2009	51.46			

Conclusion-1999-09 is driest 11 year period by a significant amount.



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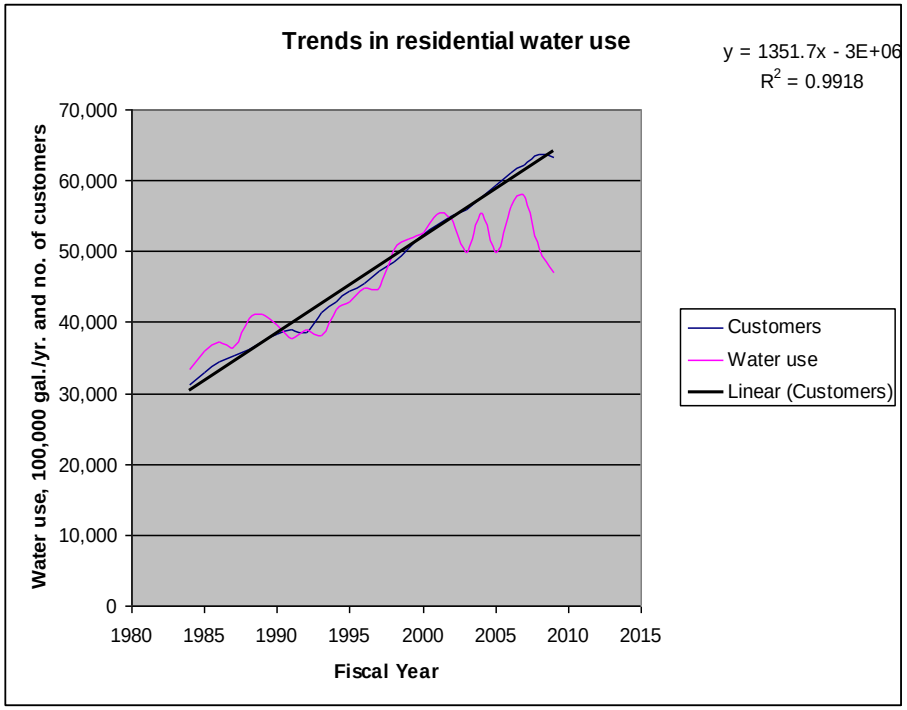
Trends in Residential Water Use Since 1984



- Linear increase in residential customers of about 1,350 per year until 2009 when utility lost 281 customers
- Why has water use leveled off after 2000?

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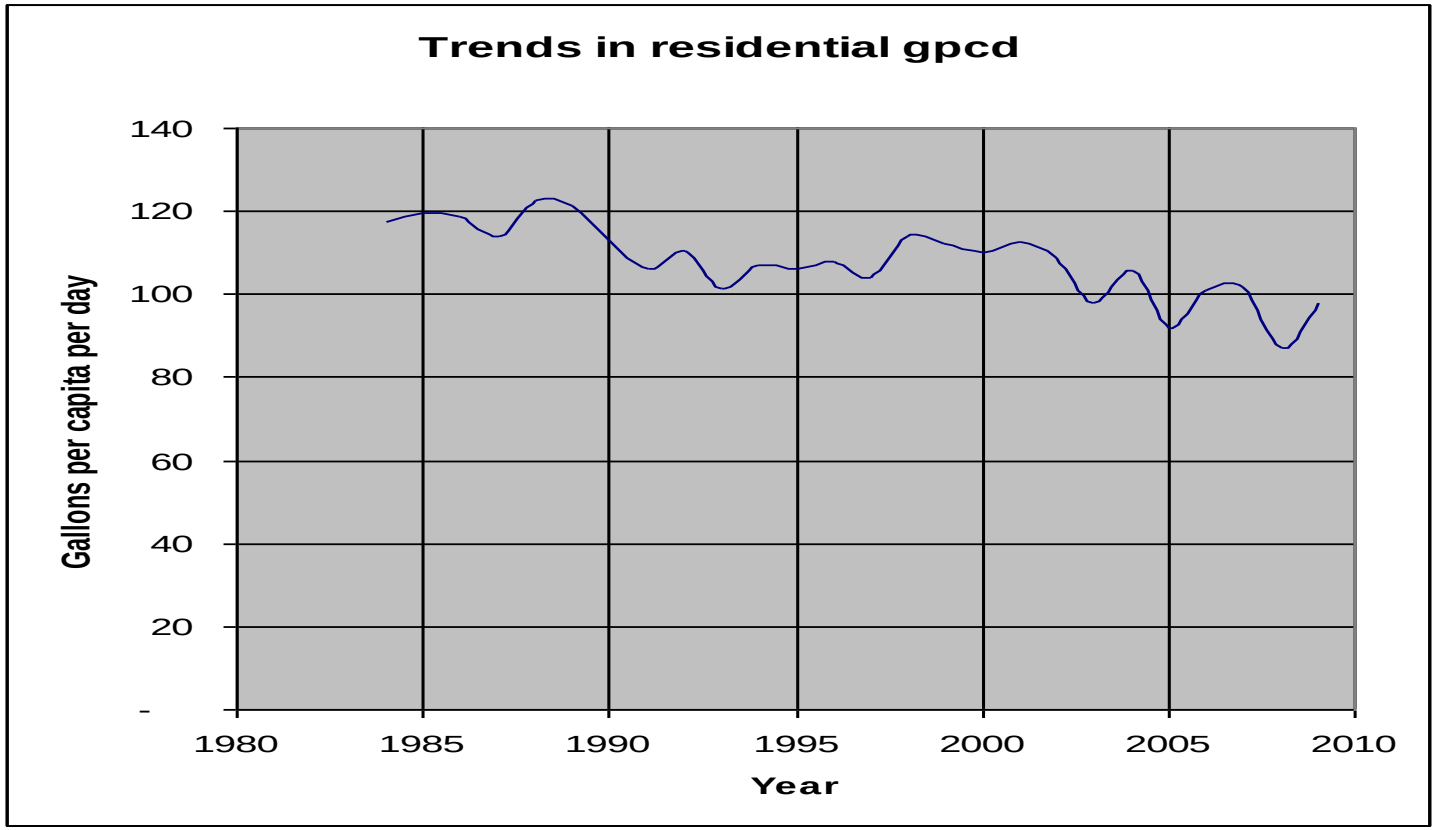
Residential Gpcd Has Declined By About 18% Since 1984



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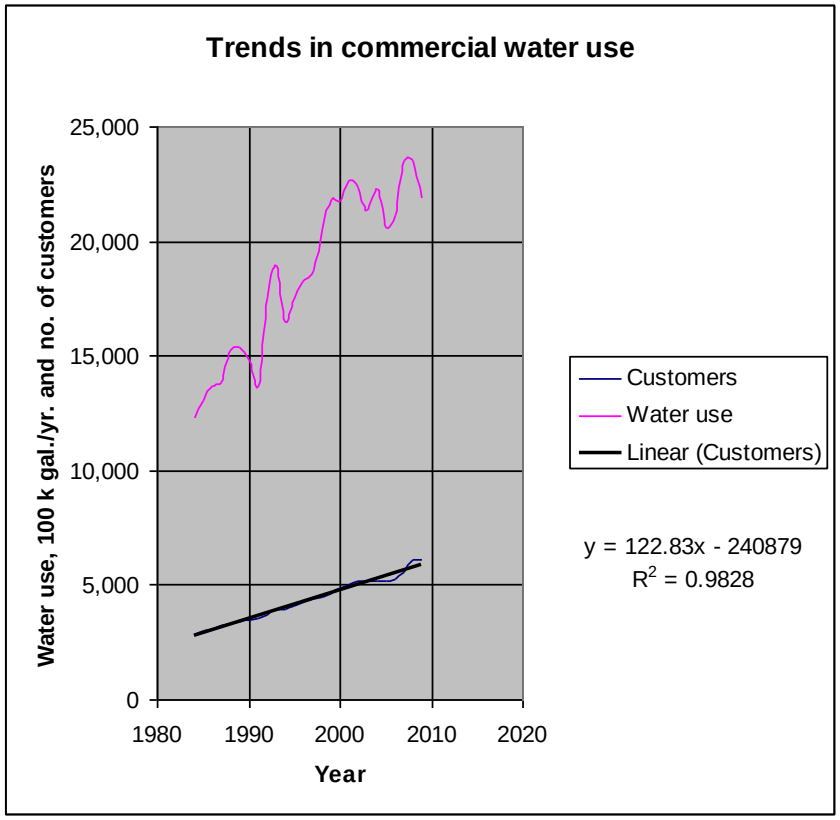
Trends in Commercial Water Use Since 1984



- Linear increase of about 123 customers per year
- Net loss of 4 customers in 2009

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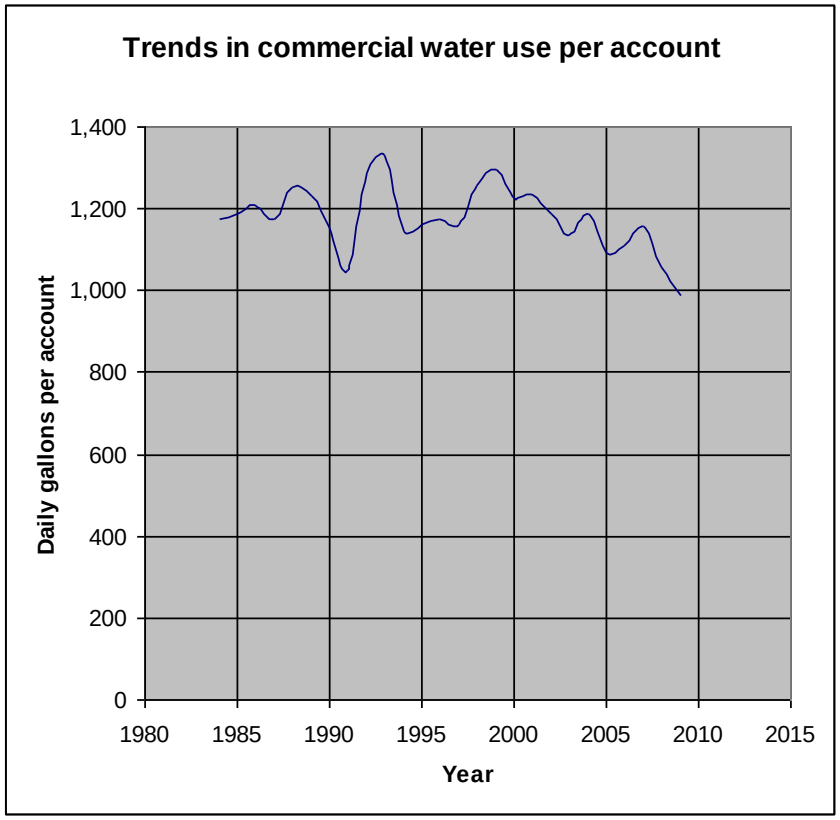
Annual Trends in Water Use per Commercial Account



- Stable from 1984 until about 2000 when it began to decrease from 1,200 to 1,000 gallons per account in 2009, a decline of about 17%
- Similar to decline in residential use rates

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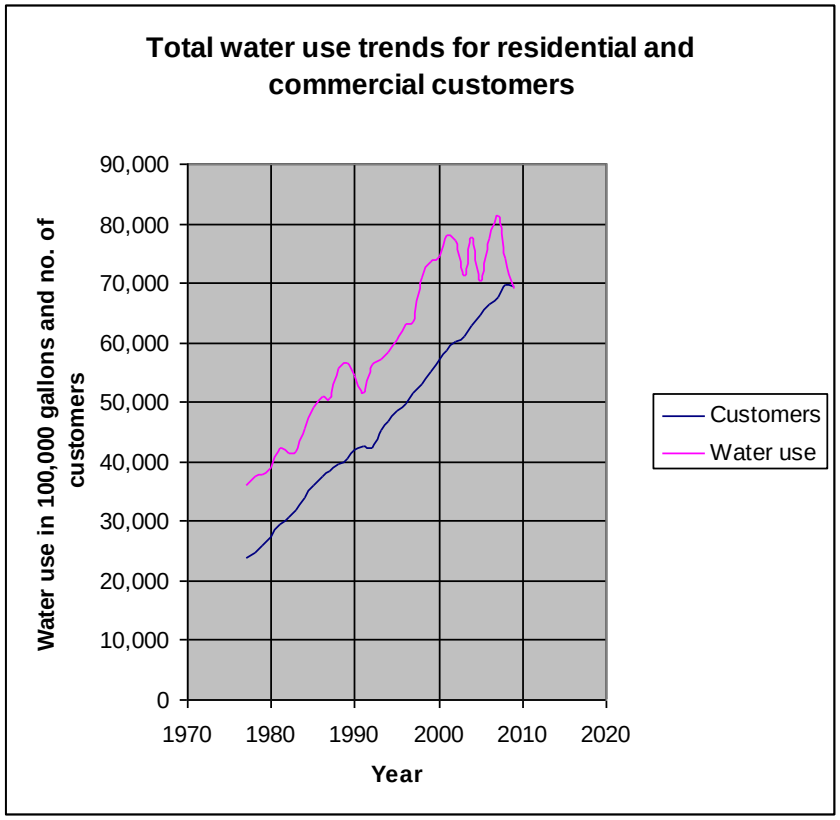
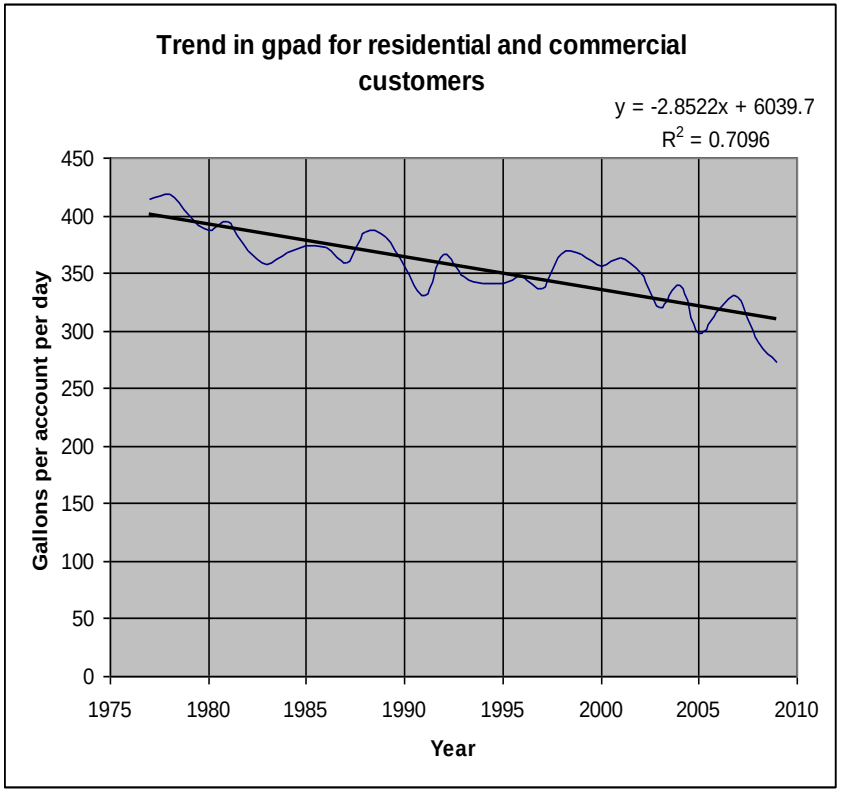
Combined Effect of Residential and Commercial Users Since 1977





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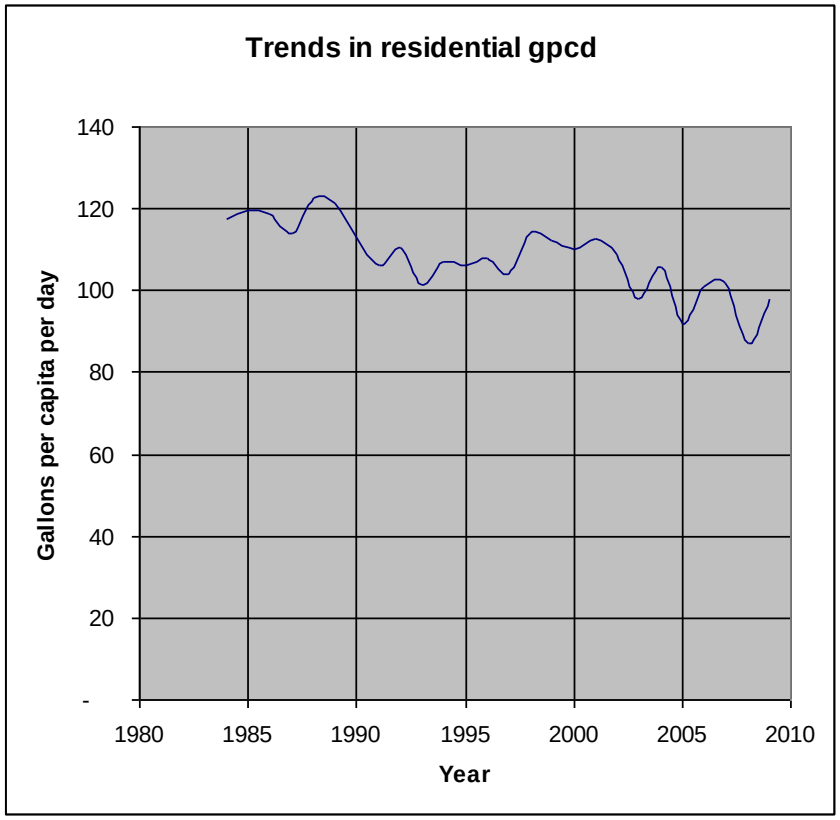
What is Causing these Changes?

- Toilet plumbing code changes in:
  - 1983 mandating the use of 3.5 gpf toilets instead of 5 to 7 gallons per flush
  - 1994 mandating the use of 1.6 gpf toilets
- Similar mandates for clothes and dish washers, faucets, and showerheads
- Less rainfall during this period implies an increase in gpcd
- Lawn watering restrictions
- Customers switching to reuse and private wells for irrigation
- Etc.

Recall that residential gpcd has declined by about 18% since 1984



- Decline of about 20 gpcd during since 1984
- Can this decline be accounted for because of the impact of plumbing changes?
- Calibrate EZG by finding the service life that provides the best fit

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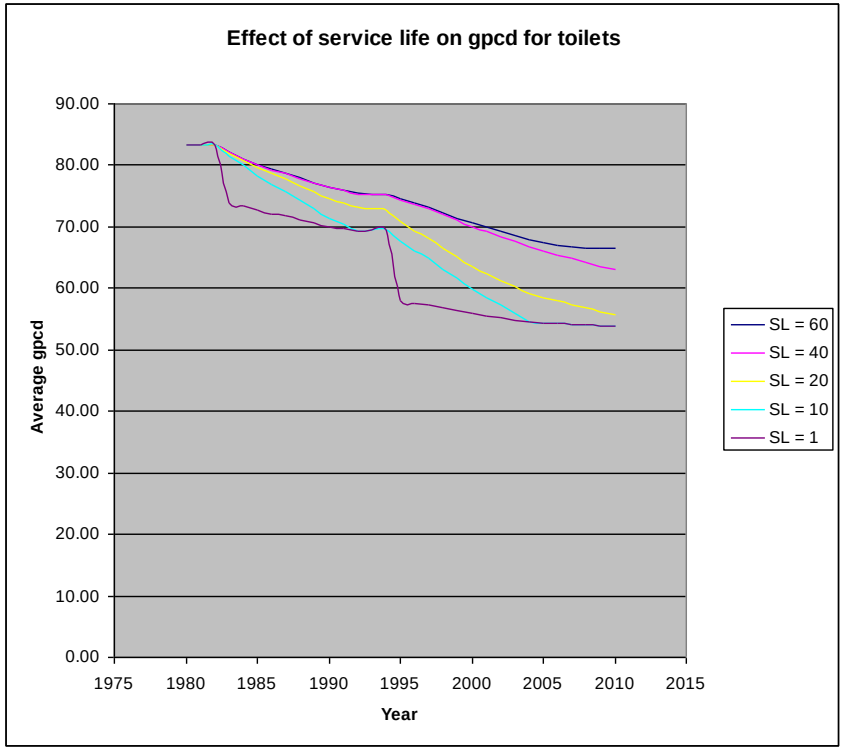
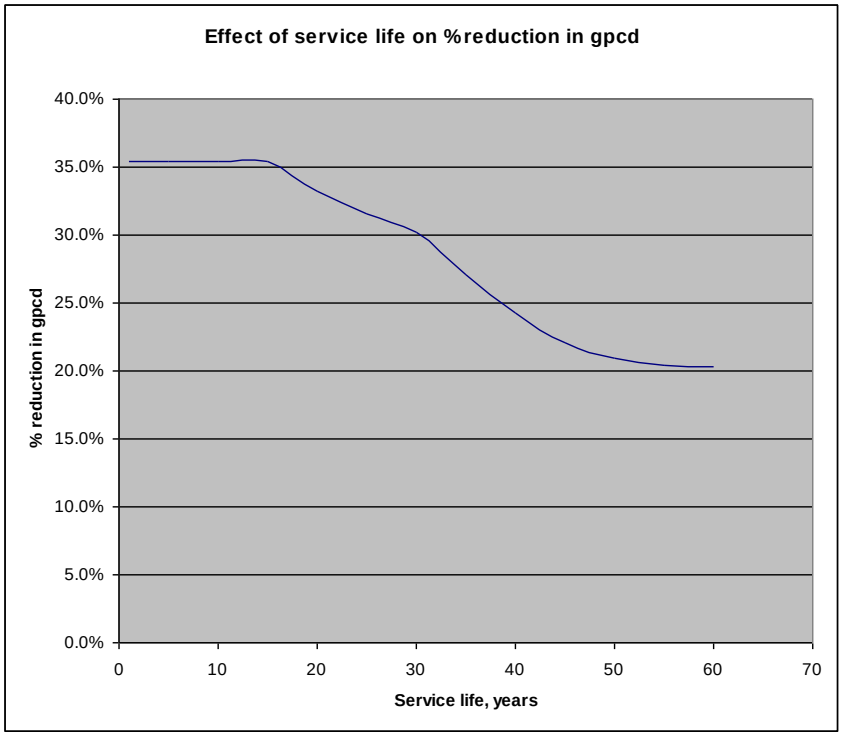
Improved toilets could account for a drop of about 20 gpcd
(EZG run on effect of assumed service life on indoor gpcd)





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Summary and Conclusions

- Water conservation analyses are done for a variety of applications including regional water supply planning (RWSP)
- EZ Guide 2 uses a bottom up approach based on data at the individual parcel level for every parcel in the state of Florida
- This information can be aggregated at any desired scale, e.g., WMD RWSP study area
- Illustrative applications to state-level water supply planning are described to demonstrate these capabilities
- Calibrated EZG model is very helpful in explaining cause-effect relationships

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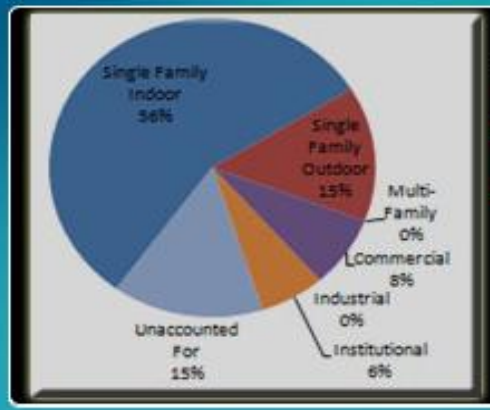

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A WATER CONSERVATION AND PLANNING TOOL

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This new tool is pre-populated for the utilities using water production, property appraiser, and census data. Check the new features of EZ Guide 2.0

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Mission: The mission of the Conserve Florida Water Clearinghouse is to develop collaborative relationships with related programs, and to collect, analyze, and make available reliable information and technical assistance to public water supply utilities and water managers for use in developing effective and efficient water conservation programs.

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