Analysis of Non-Residential Urban Water Use Through Property Appraiser and Water Billing Databases

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Conserve Florida Water

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Motivation

Significant contributors to public water demand. Non-residential (NR) sectors (commercial, industrial, and institutional establishments) account for approximately 29% of total water supplied in the United States (USGS, Solley et al. 1998).

Heterogeneous nature of water use. The primary challenge in evaluating NR water use is that use patterns vary widely because of the diversity within the NR sectors, which range from small convenience to regional shopping malls. The US Environmental Protection Agency (2009) cites a lack of customer-specific data (such as water use by facility and end use) and existing benchmarks by which to set targets.

Limitations of past methods. To estimate NR water use, utilities historically relied on similar customers within their service area or on water use coefficients normalized by number of employees developed from studies in other areas. Employment data are available from the US Census Bureau or from private surveys. US Census data are limited by spatial and customer classification aggregation required to ensure anonymity, and private surveys must be purchased.

Water conservation commands a new approach. Benefit-cost analysis of water conservation options requires water use evaluation at the end use level. Property appraiser databases make this possible by providing attribute and spatial parcel-level information allowing for both standardized classification of NR customers and normalization of water use via heated building area (Morales et al, 2011). This new approach is powerful, allowing analysis across spatial scales: macro (state, water management district, or county), meso (city or utility), micro (parcel), and nano (end use such as toilets) as shown in Figure 1.
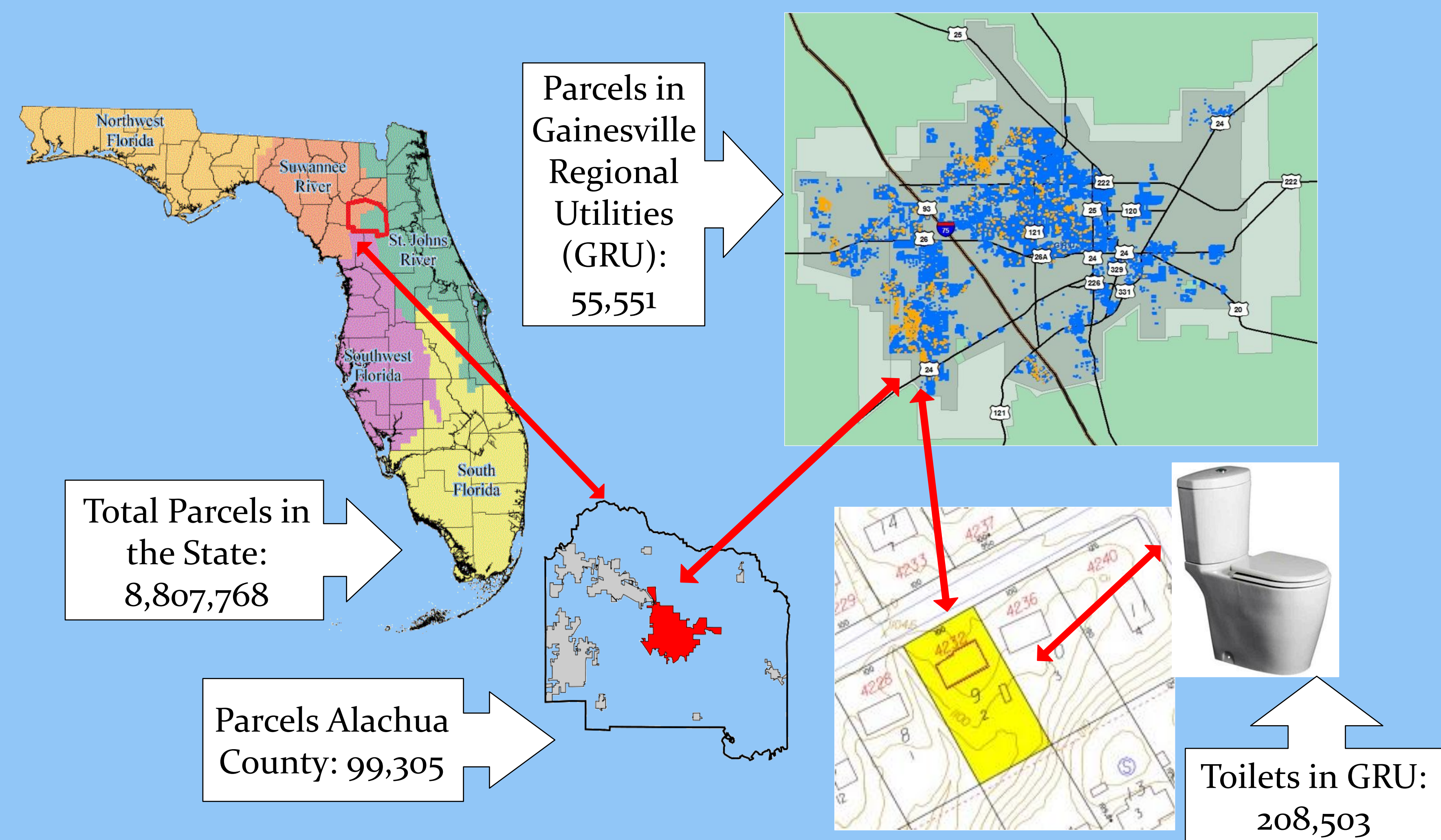

Figure 1. Macro to nano-scale evaluation of urban water use in Florida.

Parcels in Gainesville Regional Utilities (GRU): 55,551

Total Parcels in the State: 8,807,768

Parcels Alachua County: 99,305

Toilets in GRU: 208,503

References

Dziegielewski, B., Kiefer, J., Opitz, E., Porter, G., Lantz, G., DeOreo, W., Mayer, P., and Nelson, J. (2000). *Commercial and Institutional End Uses of Water*, AWWARF, Denver, CO.

Morales, M., Heaney, J., Friedman, K., and Martin J. (2011). "Estimating Commercial, Industrial, and Institutional Water Use on the Basis of Heated Building Area." *Journal American Water Works Association*, Vol. 103, No. 6.

Solley, W., Pierce, R., and Perlman, H. (1998). *Estimated Water Use in the United States in 1995*. USGS Circular 1200.

U.S. Environmental Protection Agency. (2009). *Water Efficiency in the Commercial and Institutional Sector: Considerations for a WaterSense Program*. US EPA WaterSense Program, Washington, D.C.

Database-Driven Approach

Property Appraiser Databases. The Florida Department of Revenue (FDOR) database, in conjunction with Florida County Property Appraisers (FCPA), provides legal, physical, and economic property-based information for each of the 8.8 million parcels in the state of Florida; of which 326,000 are NR (215,000 commercial, 69,000 industrial, and 42,000 institutional). The FDOR database is audited and updated annually and is available free of charge from the FDOR file transfer protocol website (ftp://sdrftp03.dor.state.fl.us/). The FDOR data are provided by each of the 67 FCPA.

Attributes of interest include:

Land Use Code: FDOR partitions parcels on the basis of their land use into 100 subsectors. This standardized classification system allows for various degrees of disaggregation shown in Figure 2.

Year Built: Actual year built or of major improvement to buildings on a parcel, provides valuable time series information to estimate trends and forecast number of accounts and other attributes.

Heated Building Area: Area under climate control of all buildings on a parcel, allows for normalization of water use given its availability through property appraiser databases and strong correlation to water use (Dziegielewski et al, 2000, Morales et al, 2011).
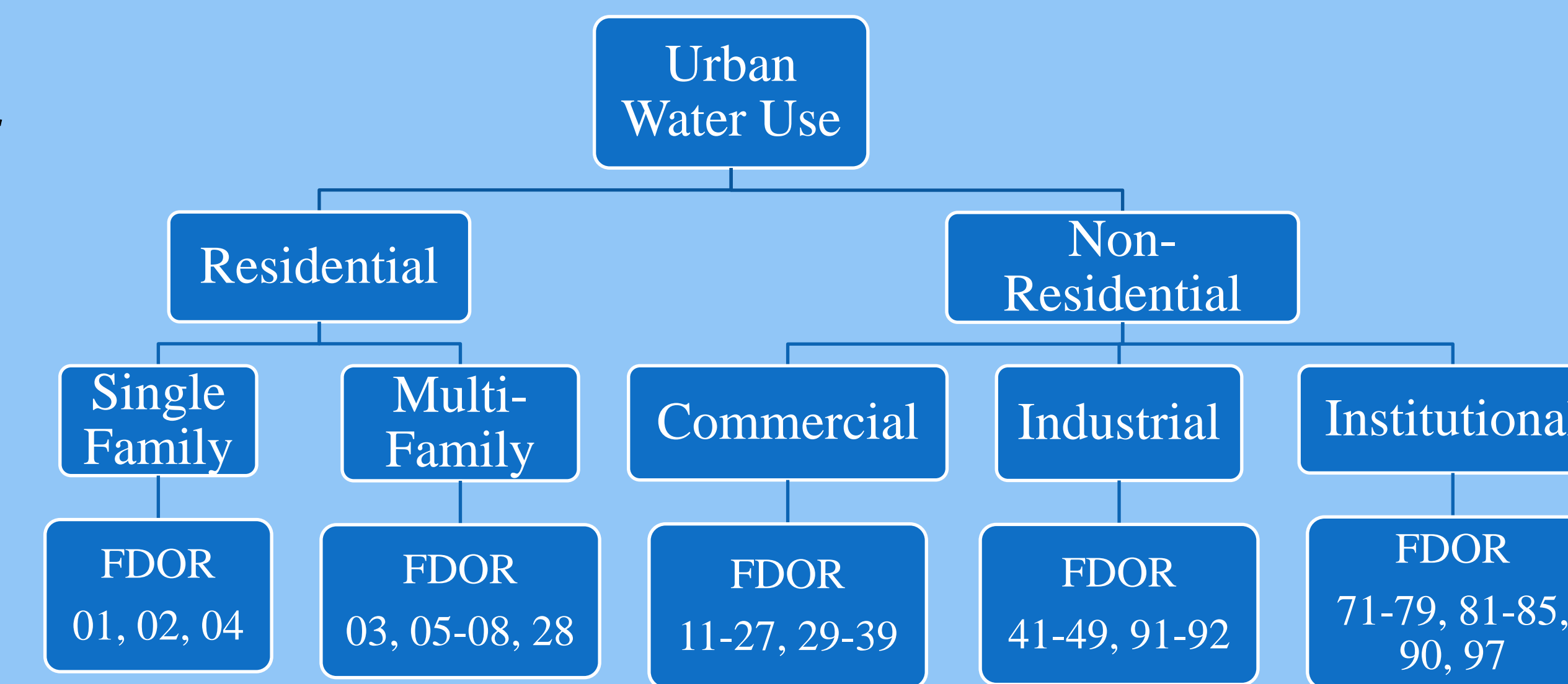

Figure 2. Levels of FDOR land use disaggregation into 9 residential and 55 non-residential sectors.

Water Billing Databases. For this study, parcel-level land use characteristics from the FDOR and FCPA databases were linked with historic water billing data for 3,172 NR parcels in Hillsborough County Water Resources Services (HCWRS) and Gainesville Regional Utilities (GRU). The characteristics of the two water billing databases analyzed are presented in Table 1. The water billing time series is shown in Figure 3.

Table 1. Description of water billing databases.

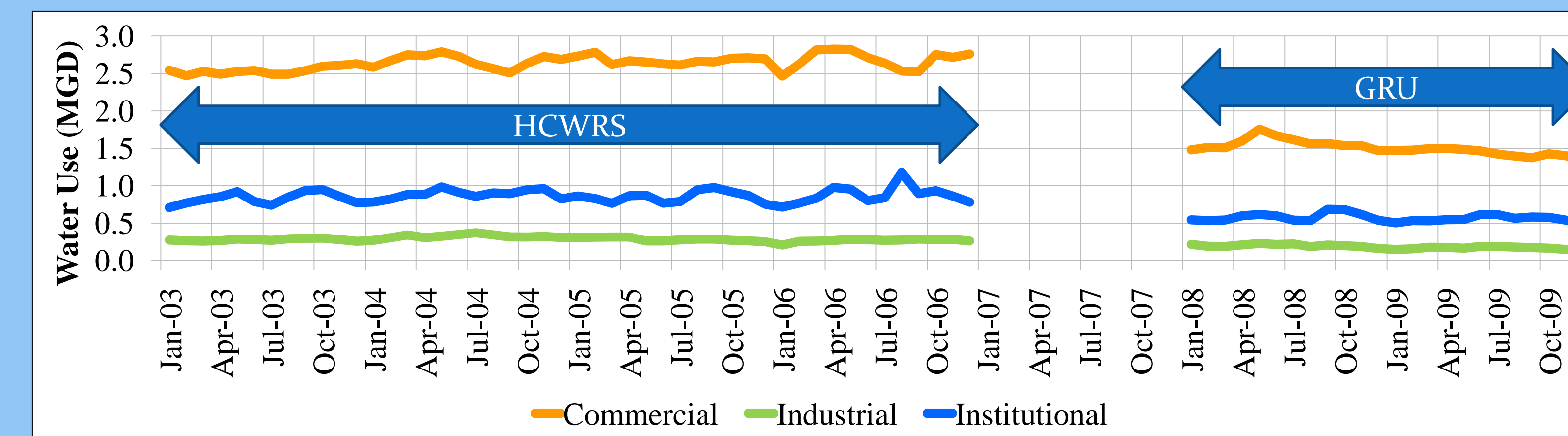|	HCWRS	GRU
Years of billing	2003-07	2008-09
CII parcels	1,770	1,402
Commercial	67%	72%
Industrial	9%	10%
Institutional	24%	18%

Figure 3. Water billing time series for NR parcels in HCWRS and GRU.

Through this database-driven approached, every utility in the state can determine the relative water use by different sectors of customers in their service area. A schematic of how databases are related to FDOR, along with particular attributes of interest, is presented in Figure 4.

U.S. Census
- People per home
- n = 362,499 blocks

Utility Service Boundaries
- PWSID; n = 2,623

Business Data
- SIC and NAICS classification
- Employment
- Annual sales
- n = 1.4 million

FDOR/FCPA
- Parcel ID
- Land use code
- No. of residential units
- No. of buildings
- Year built
- Total parcel area
- Total building area
- Impervious area
- Presence of automatic irrigation sprinklers
- Address
- n = 8.8 million

Water Billing
- Parcel ID
- Monthly water use

FDEP (Water Supply)
- Monthly average and peak monthly water use
- Number of accounts
- Population served
- Population sold to
- n = 2,623
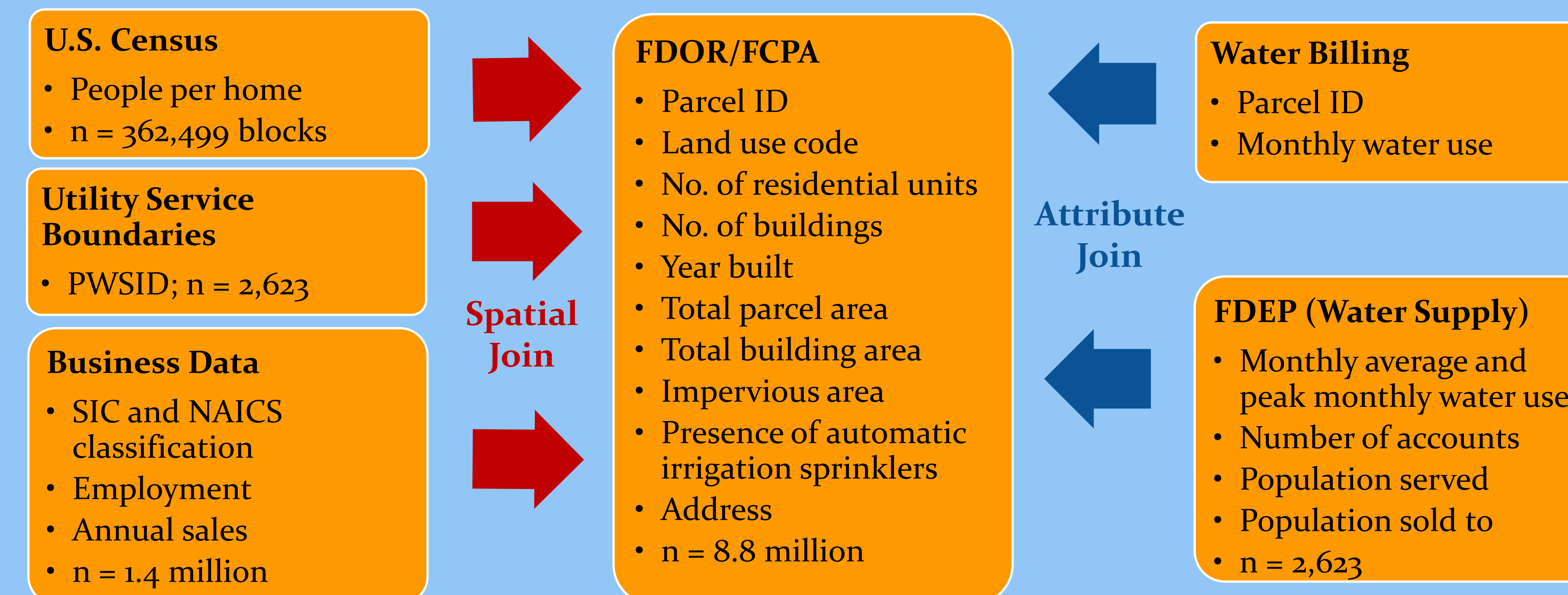
Spatial Join

Attribute Join

Figure 4. Relational databases for urban water systems in Florida.

Results

The linking of property appraiser and water billing databases allow for detailed water use evaluations. For example, community shopping centers in Florida (Table 2) are not only getting larger, but they are also using water at a higher rate.

Table 2. Community shopping center trends in Florida.

FDOR 16 - Community Shopping Centers				
Built Group	Sample Size	Avg. Year Built	Avg. Heated Area (ft²)	Avg. Water Use Coef. (gal/heated ft²/d)
Pre-1983	56	1975	27,289	0.068
1983-1994	115	1988	39,183	0.101
Post-1994	63	1999	47,372	0.108
Total	234	1988	38,541	0.097

For the evaluation of water conservation options, estimates on the number, efficiency, frequency of use, and cost of retrofit of water devices allow for BMP performance and marginal cost functions to be produced (Figure 5). Thus, customers can be targeted to maximize water conservation efforts.

Save an average of 5 gal/toilet/d

Save an average of 43 gal/toilet/d

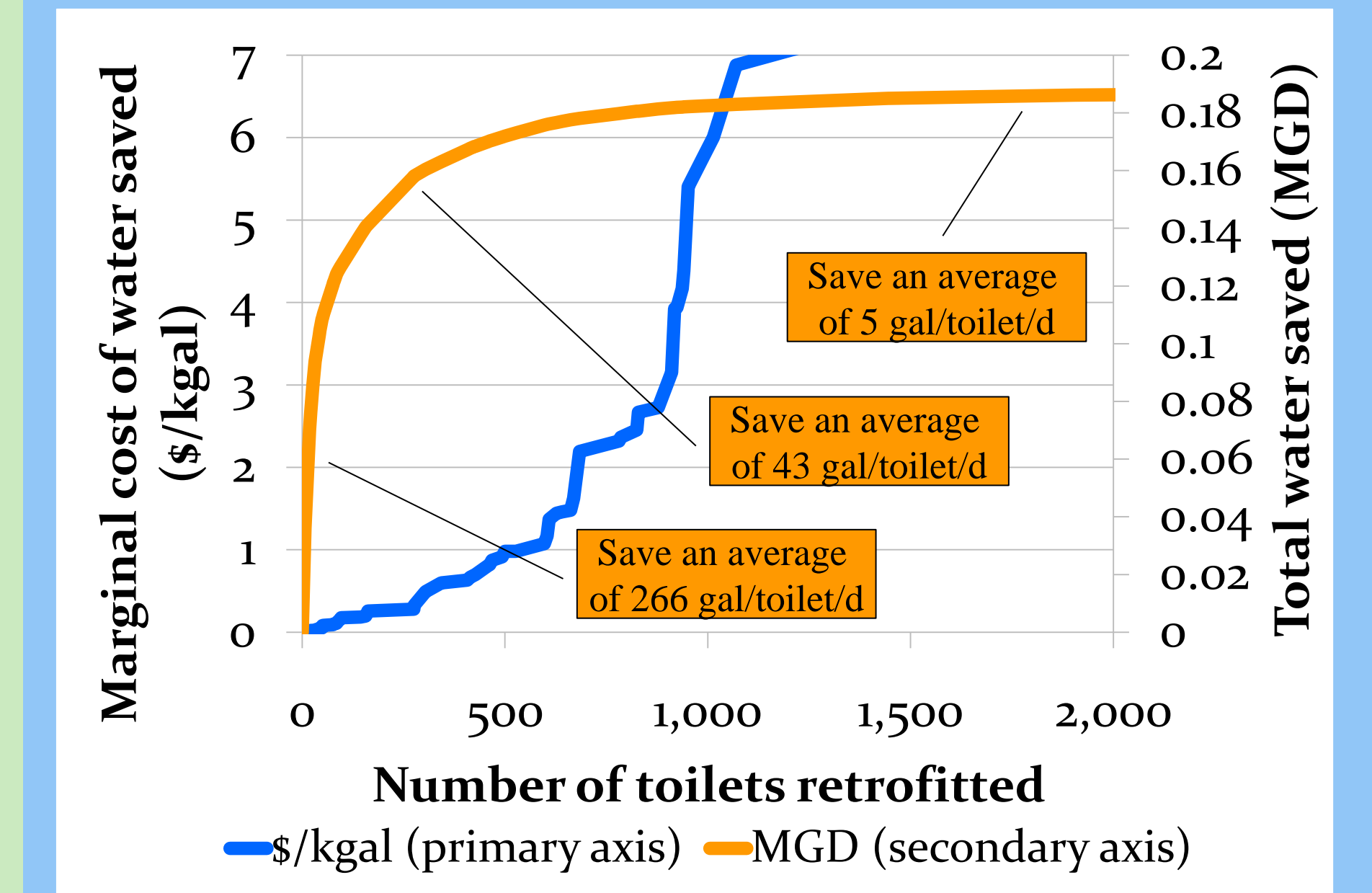Save an average of 266 gal/toilet/d

Figure 5. Toilet BMP performance and marginal cost functions for a utility in Florida.

Conclusion

This database-driven approach offers a significant improvement over existing methods of analyzing NR water use.

For more information please visit: http://conservefloridawater.org

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