A Tool for Urban Water Efficiency – Smart Metering for Detailed Analysis of Long-Term Diurnal Water Use Patterns

Department of Civil and Environmental Engineering University of South Florida	Caryssa Joustra, PhD
Public Works and Utilities Department Water Division, City of Dunedin	Paul Stanek
Department of Civil and Environmental Engineering University of South Florida	Pacia Diaz
Department of Civil and Environmental Engineering University of South Florida	Daniel Yeh, PhD

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Introduction

Utility operations include demand-side management

- Cost effective
- Need for economic data recording, collection, interpretation

Water metering links customer to utility

- Shared benefits
- Individual water use monitoring

Customers exert unique dynamic water demands

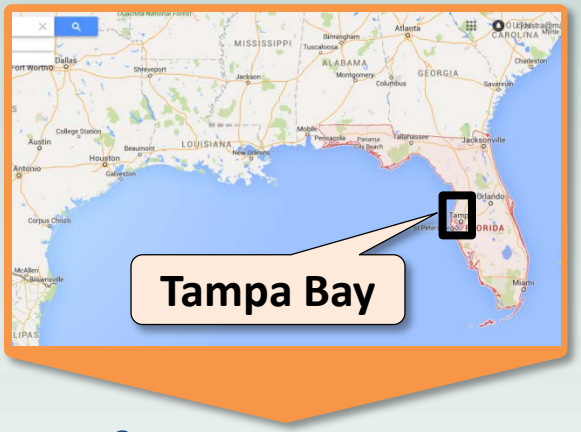
- Building and microsystem demands not captured with regional monitoring
- Tradeoffs between resolution and duration in previous water demand studies

Research objectives

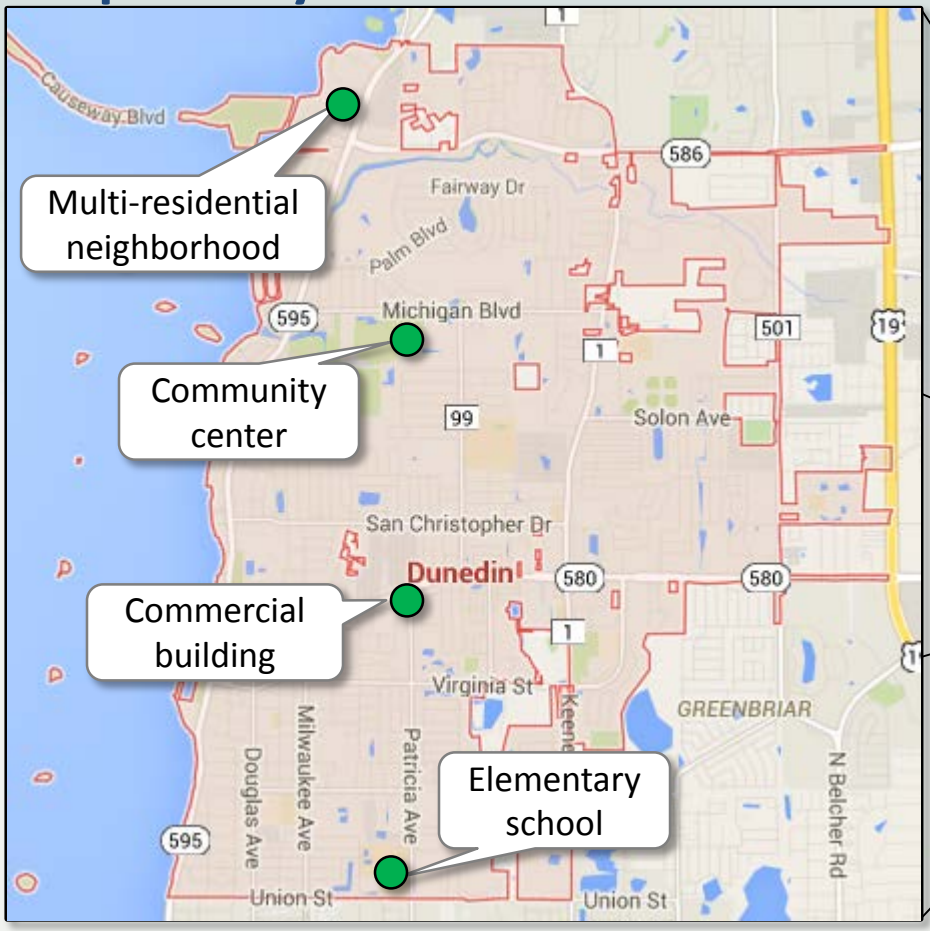
- Determine validity of smart meters to capture long-term diurnal water use profiles
- Evaluate diurnal water use patterns over time using attributes that describe curve features

Study Sites

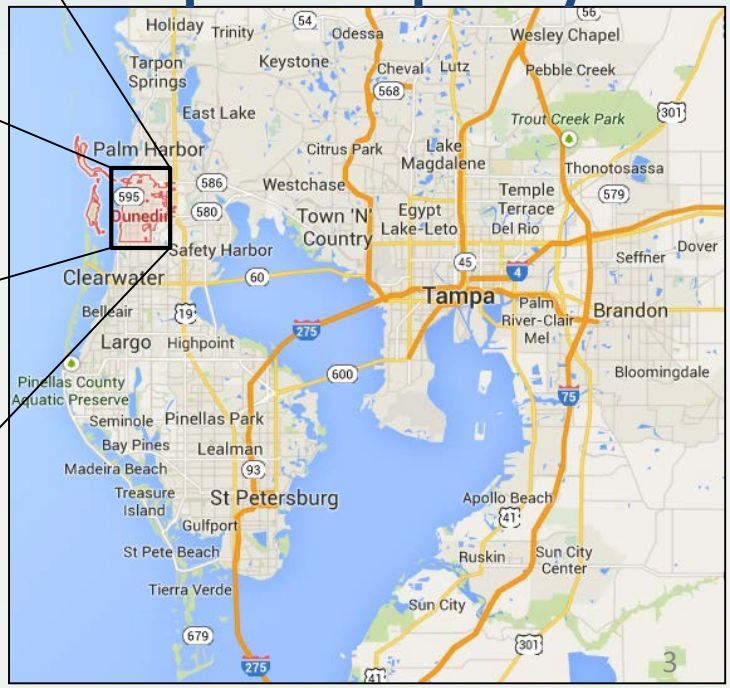
SE United States



Map of City of Dunedin



Map of Tampa Bay Area



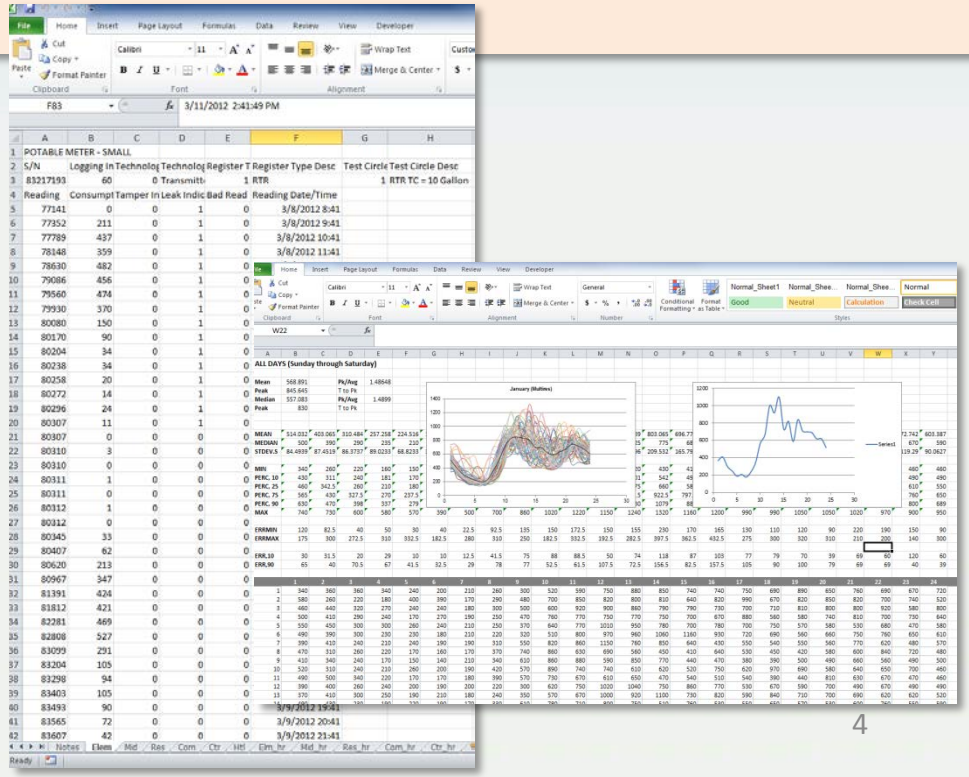
Methodology
Data Mining

Data Collection

- Trimble Ranger handheld
- **Infrared data transmission** at meter site
- 7 total meters for 4 sites
- 21,434 data points/meter x 7 meters = 150,038 data points
- Meter resolution 1-100 gal

Data Analysis

- March 11, 2012 – August 16, 2014
- Separate water use for each 24-hour day
- 889 daily diurnal curves per site
- Track curve attributes and changes
- Trends by day of week and seasonally



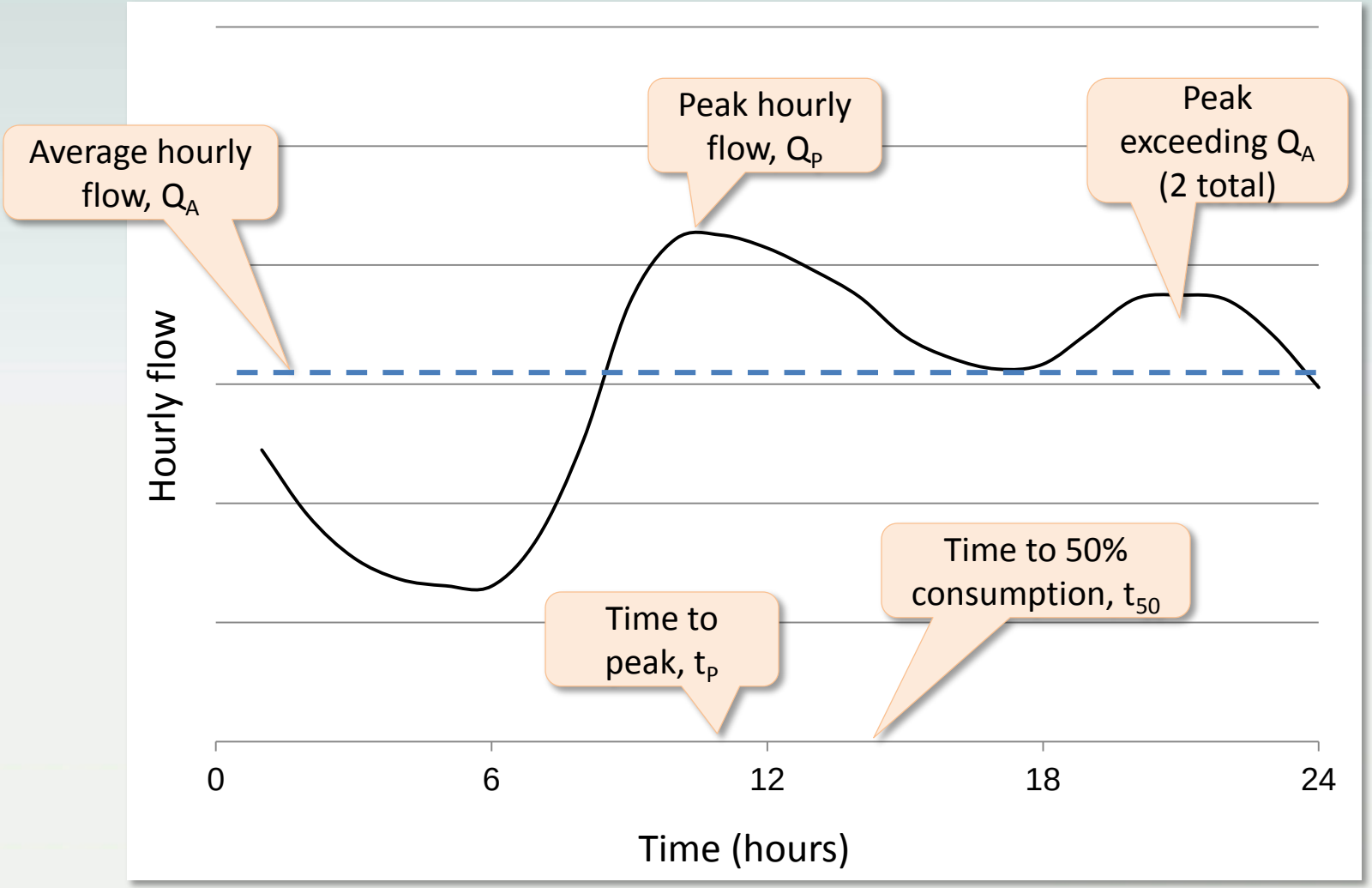
Methodology

Data Analysis

Characteristic	Notation	Units	Definition
Average hourly flow	Q_A	gph	Average flow over a 24-hour day
Peak hourly flow	Q_P	gph	Maximum flow observed in a one-hour period over a 24-hour day
Peak factor (peak to average factor)	$F_{P/A}$	-	Ratio of maximum one-hour flow to average hourly flow
Time to peak flow	t_p	hr	Hour at which the PHF first occurs
Time to 50% consumption	t_{50}	hr	Time in hours that it takes to reach half of the daily water use
Duration that hourly flow is greater than Q_A	$T_{Q>QA}$	hr	Duration in non-consecutive hours when the hourly flow exceeds the MHF
Number of peaks exceeding Q_A	N_P	-	The number of events in which a peak flow occurs and exceeds the MHF

Methodology

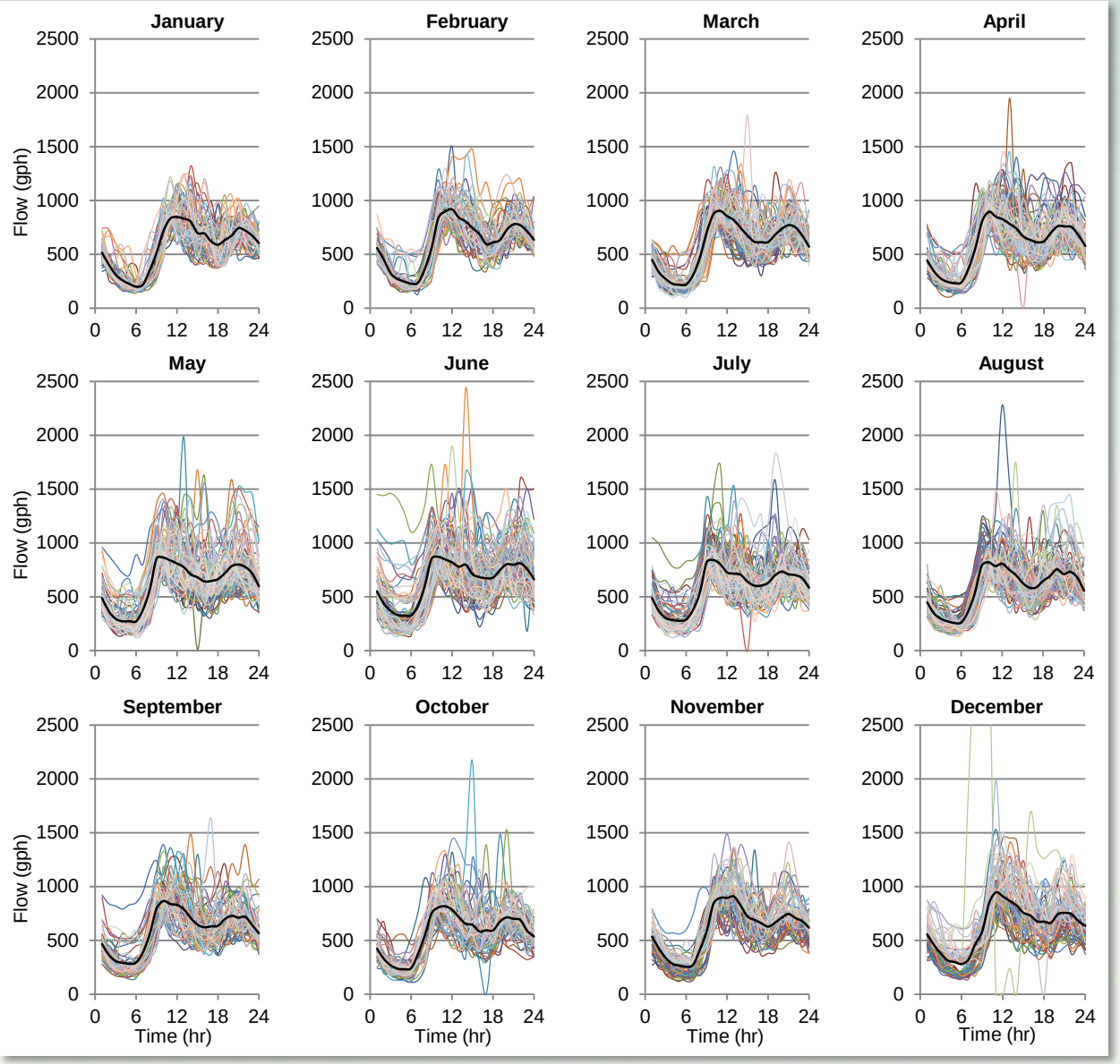
Data Analysis



Results

Diurnal Water Use Curves

Data from Multi-residential Site (889 diurnal curves)

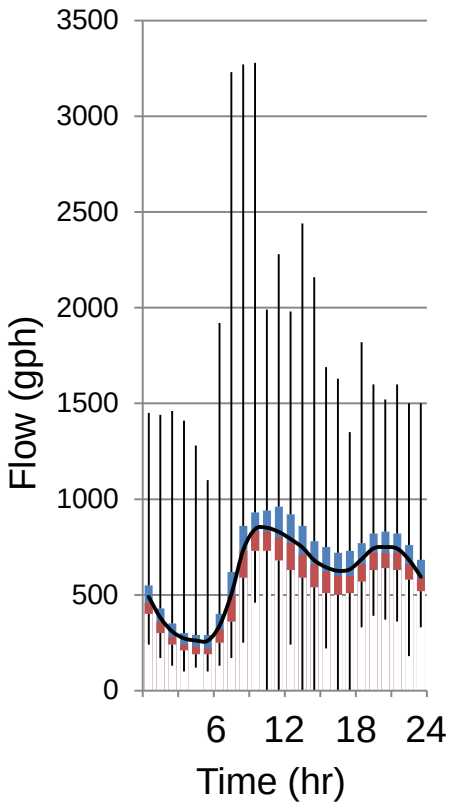


Results

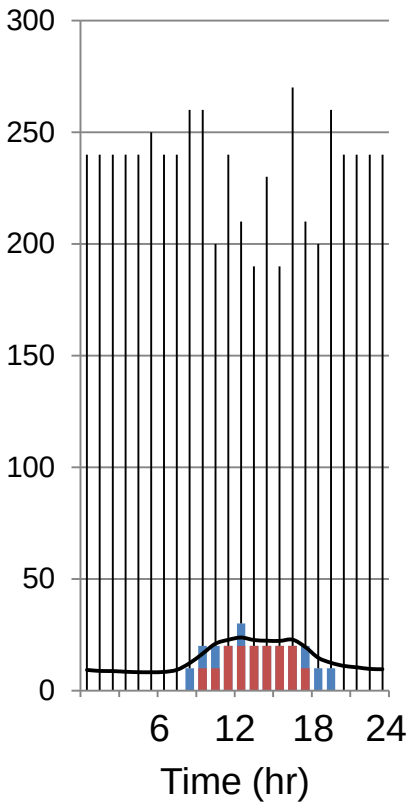
Distribution of Flows by Hour

Above 75th percentile
50th – 75th percentile
Median
25th – 50th percentile
Below 25th percentile

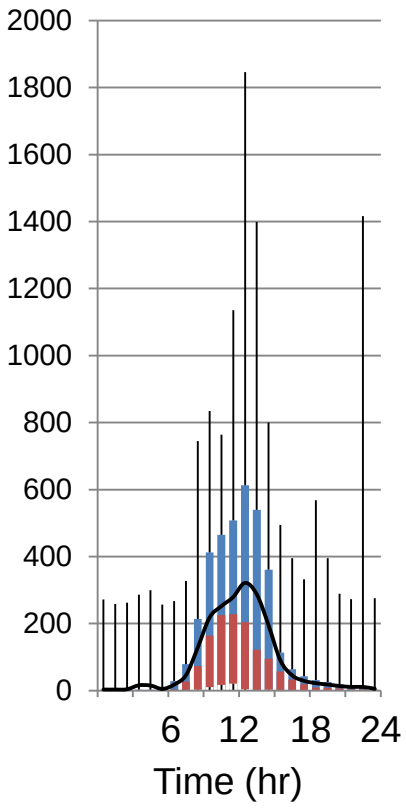
Multi-residential



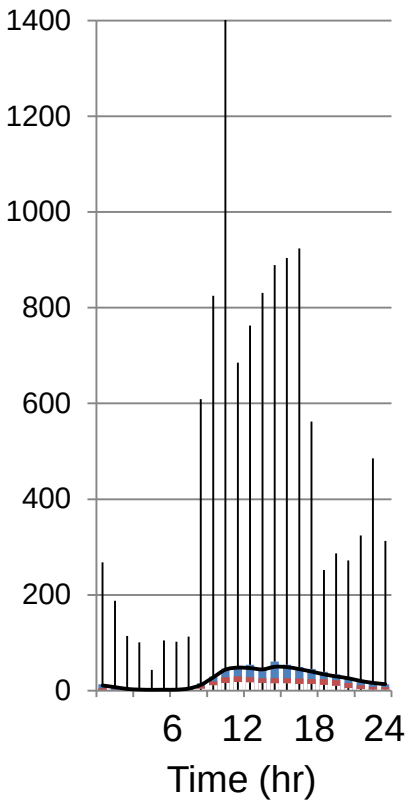
Commercial building



Elementary school

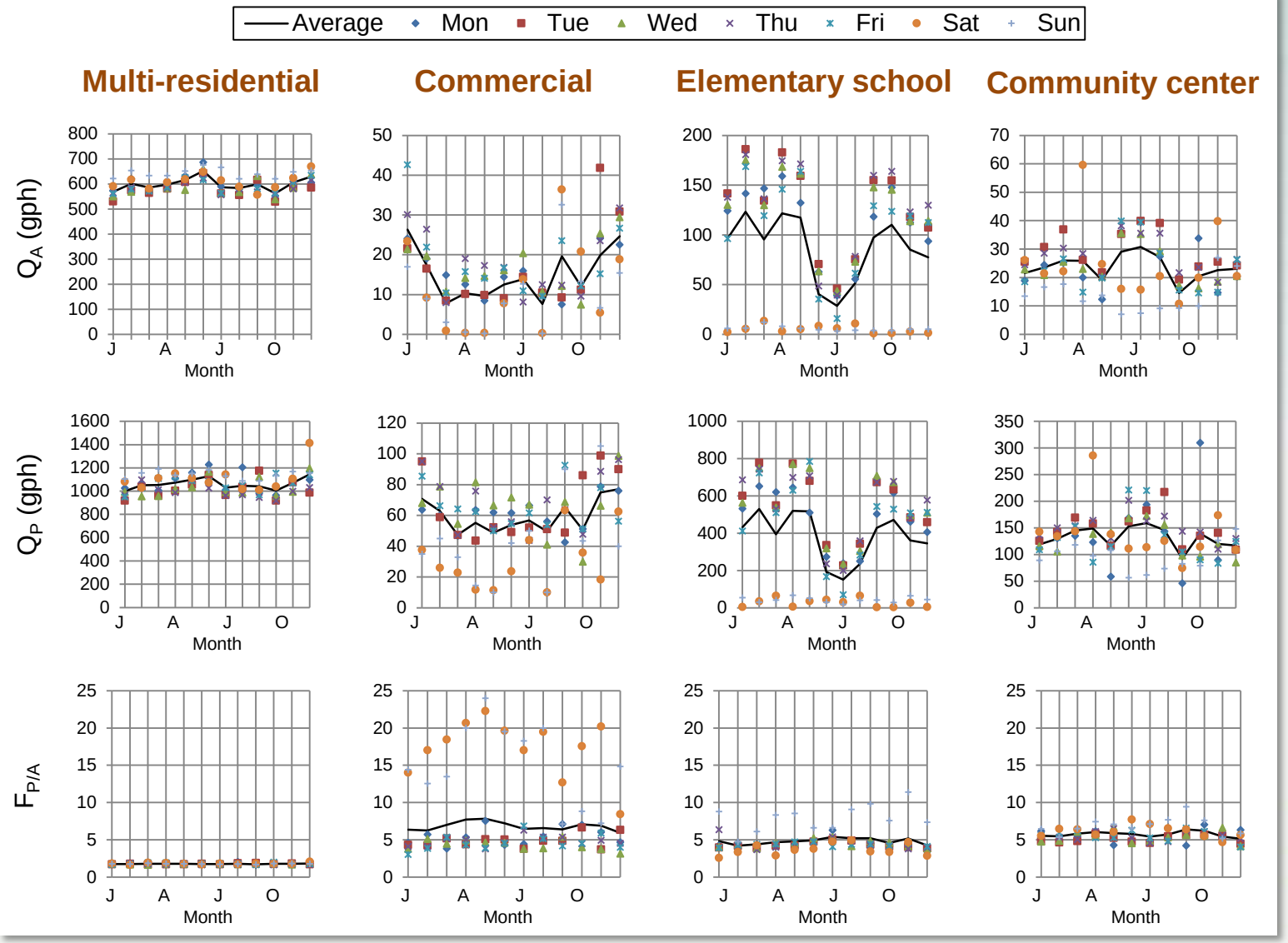


Community center



Results

Trends Over Time



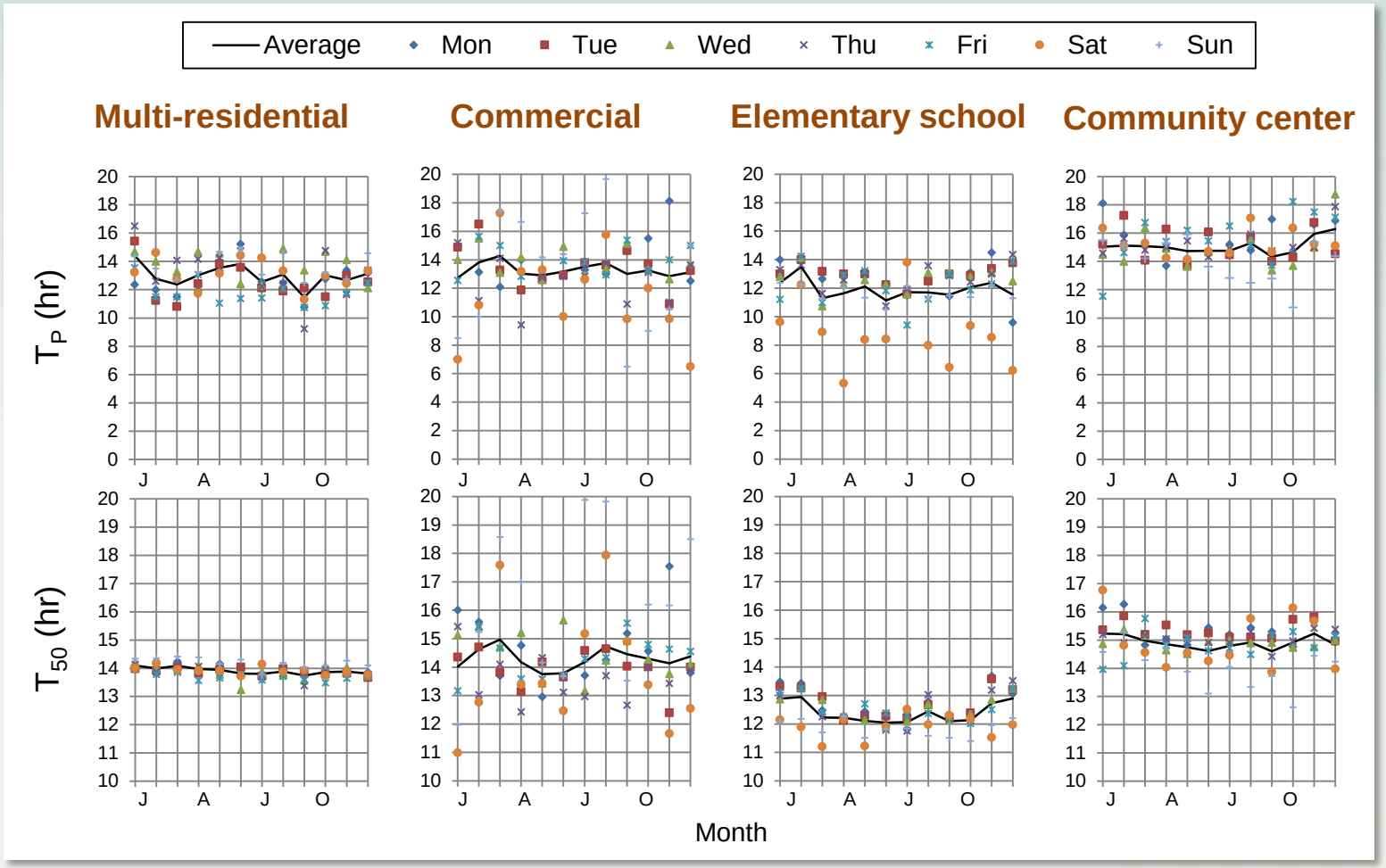
Average hourly flow

Peak hourly flow

Peak to average factor

Results

Trends Over Time

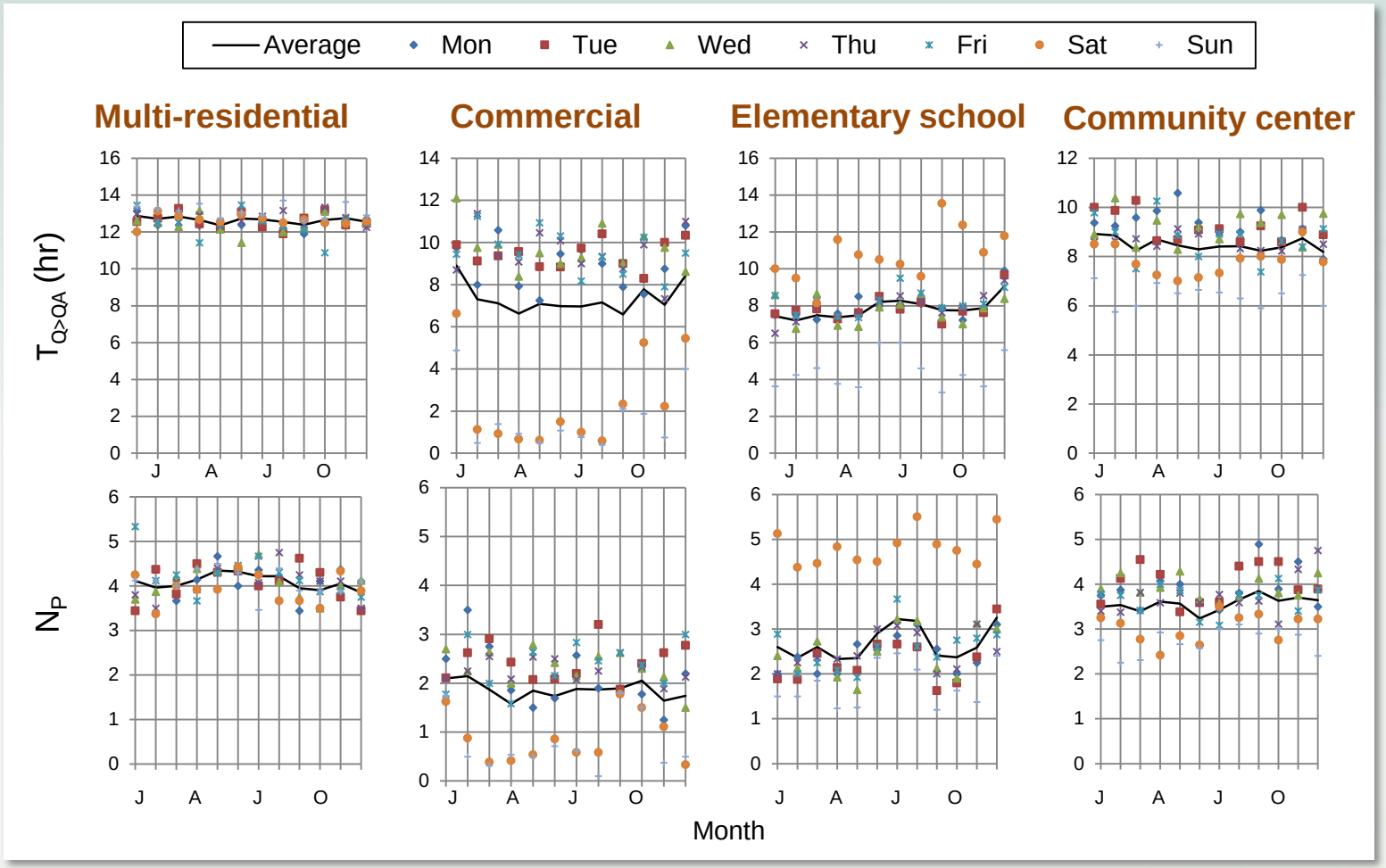


Time to peak

Time to 50% consumption

Results

Trends Over Time



Duration flow exceeds average hourly flow

Number of peaks above average hourly flow

Conclusion



Need for efficient collection and evaluation of high-resolution water data

- Smart meters collect, record, disseminate data
- Sufficient resolution for diurnal trends

Variation in water use

- Patterns and trends unique to each building
- Multi-residential – least variation; community center – highest variation

Smart meters provide data on location-specific water use patterns

- Component for integrated urban planning
- Land use planning may alter spatial and temporal demand patterns

Thank You

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