MULTIFAMILY
PAST, PRESENT
AND FUTURE RESEARCH
Overview

1. Background

2. Research
   a. Past
   b. Present
   c. Future
Multifamily Developments
Multifamily Unit Size

Recent (Post 1998) City of Phoenix Multifamily Developments
By Average Size of Units in Square Feet

Traditional Multifamily Size
Recent (Post 1998) City of Phoenix Multifamily Developments
By Average Number of Fixture Units

Expected Single Family Count

Old Expected MF Count
Potential Multifamily Subsectors

ICI sectors have similar end use characteristics

- Hospitality (extended stay)
- Retirement Communities
- Timeshare
- Dormitories
- Correctional Facilities
- Mixed-use (residential/retail)
Previous Research

2008 Hazen and Sawyer
- Demand management plan update
- Goals:
  - Begin to disaggregate sector
  - Characterize presence and efficiency of end uses
  - Quantify curtailment potential
- Method: mail survey
  - Site level data
  - Water use matched to properties using address and customer characteristics
    - Attempted to match landscape meters to properties

2014 BBC/Keen
- ICI Phoenix research initiative
- Goal: Assessing structural changes in demand property characteristics
- Method: GIS
  - Water use spatially join to parcel
  - Enhanced data with Hazen and Sawyer site level data
Indoor Use = 166 - 169 g/u/d

• Majority of water use indoor
• Major indoor uses
  • Toilets, showers, faucets
  • Clothes washers
    • In-unit laundry, common area, no laundry facilities

Comparing water use in multifamily properties by laundry condition, 2012

<table>
<thead>
<tr>
<th>Laundry condition</th>
<th>Gallons per unit per day</th>
<th>Gallons per ksf per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Properties with in-unit laundry facilities</td>
<td>219</td>
<td>265</td>
</tr>
<tr>
<td>Properties with common area laundry facilities</td>
<td>195</td>
<td>281</td>
</tr>
<tr>
<td>Properties with no laundry facilities</td>
<td>150</td>
<td>250</td>
</tr>
</tbody>
</table>

Note: ANOVA reveals significant differences at p < .01 for g/u/d, but no significant difference for g/ksf/d. Source: Keen Independent calculations.
Outdoor use = 43 - 46 g/u/d, less than ¼ total use

- 125 developments (98% had irrigable landscape, 78% at least one pool)
- Lower water use than single family – shared common area
- Not all properties have dedicated irrigation meters
- Variation of landscape types within and among developments
Developed landscape categories based on City’s single family landscape classification

Share of landscaped area for Phoenix multifamily properties, 2014

Source: BBC/Keen Independent Multifamily Report
Average water use for sample properties, 2002-2012

Source: Keen Independent Calculations
Current Research
Multifamily Inventory

• Creating a more expansive multifamily inventory (5+ unit developments)

• Data Acquisition
  • Multiple sources
    • Maricopa County Database
    • COP water consumption
    • COP water meter shapefile
    • Maricopa County Parcel shapefile
  • Using aerial imagery to identify pools and cooling towers

• Data Complexity
  • Multiple sources – different structures and formats
  • Association between parcels, water meters and multifamily developments
Inventory Creation
Data Complexity

One to one relationship (meter to parcel/development) similar single family
Inventory Creation

Data Complexity

Many to one relationship (meter to parcel/development)
Inventory Creation
Data Complexity

Many to many relationship (meter to parcel)
Current Research
Overcoming Data Obstacles

• Identifying and correcting the locations of incorrectly placed water meters in GIS Layer

• Applying spatial analysis to more accurately associate multifamily developments with water meters and property characteristics
  • Creating multifamily developments from Maricopa County parcel shapefile
  • Spatial selection of all water meters which fall into multifamily development polygons
Inventory Database

- 1348 multifamily development polygons (5+ unit complexes)

- Database includes:
  - Building characteristics
  - Water consumption data
  - Unit counts for each multifamily development
  - Presence of pools (using GIS/assessor data)
  - Presence of cooling towers (using GIS)

<table>
<thead>
<tr>
<th>Properties (Polygons)</th>
<th>Total Number Polygons (PUC 035-039)</th>
<th>Total Number Parcels</th>
<th>Unit Count</th>
<th>Water Meter Count</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,348</td>
<td>1,878</td>
<td>115,683</td>
<td>4,319</td>
</tr>
</tbody>
</table>
Multifamily Developments (5+ units) by Build Year

Number of Apartment Complexes

Build Year

Top-down Data Analysis

Distribution of Multifamily Developments (5+ units) by unit count
Water Use Trend Comparison

Water Use for Multifamily Development (5+ units) 2002-2012

Gallons Per Day/Unit

Year

City of Phoenix
BBC/Keen (sample)
Future Research

• Include site specific data for bottom-up analysis
  • Site visits/audits
    • occupancy rates, number of residents, types of fixtures, amenities (pools, laundry, etc.)
  • Datalogging
    • Differentiate fixture types
• landscape characteristics
  • landscape classification
    • Imagery analysis/coding system

• Expand inventory for multifamily subsectors

• Refine water demand forecasts
Landscape

Variation of landscape within multifamily developments
# Projected End Uses and Average Use

Projected end uses for multifamily based on sample properties, 2032

<table>
<thead>
<tr>
<th>Metric</th>
<th>Estimated outdoor water use</th>
<th>Estimated indoor water use</th>
<th>Estimated cooling tower water use</th>
<th>Estimated leakage water use</th>
<th>Average total water use for sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gallons per unit per day</td>
<td>63</td>
<td>86</td>
<td>21</td>
<td>25</td>
<td>196</td>
</tr>
<tr>
<td>Gallons per ksf per day</td>
<td>76</td>
<td>105</td>
<td>26</td>
<td>31</td>
<td>237</td>
</tr>
</tbody>
</table>

Source: Keen Independent calculations.

Projected end uses for multifamily based on all properties, 2032

<table>
<thead>
<tr>
<th>Metric</th>
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<th>Estimated indoor water use</th>
<th>Estimated cooling tower water use</th>
<th>Estimated leakage water use</th>
<th>Average total water use for all properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gallons per unit per day</td>
<td>55</td>
<td>73</td>
<td>18</td>
<td>22</td>
<td>169</td>
</tr>
<tr>
<td>Gallons per ksf per day</td>
<td>76</td>
<td>106</td>
<td>26</td>
<td>31</td>
<td>239</td>
</tr>
</tbody>
</table>

Source: Keen Independent calculations.
MULTIFAMILY

Past, Present and Future Research

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