This presentation premiered at WaterSmart Innovations

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What Savings, Where?

SCOTT WINTER
LEAD CONSERVATION SPECIALIST
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Colorado Springs Utilities
It's how we're all connected

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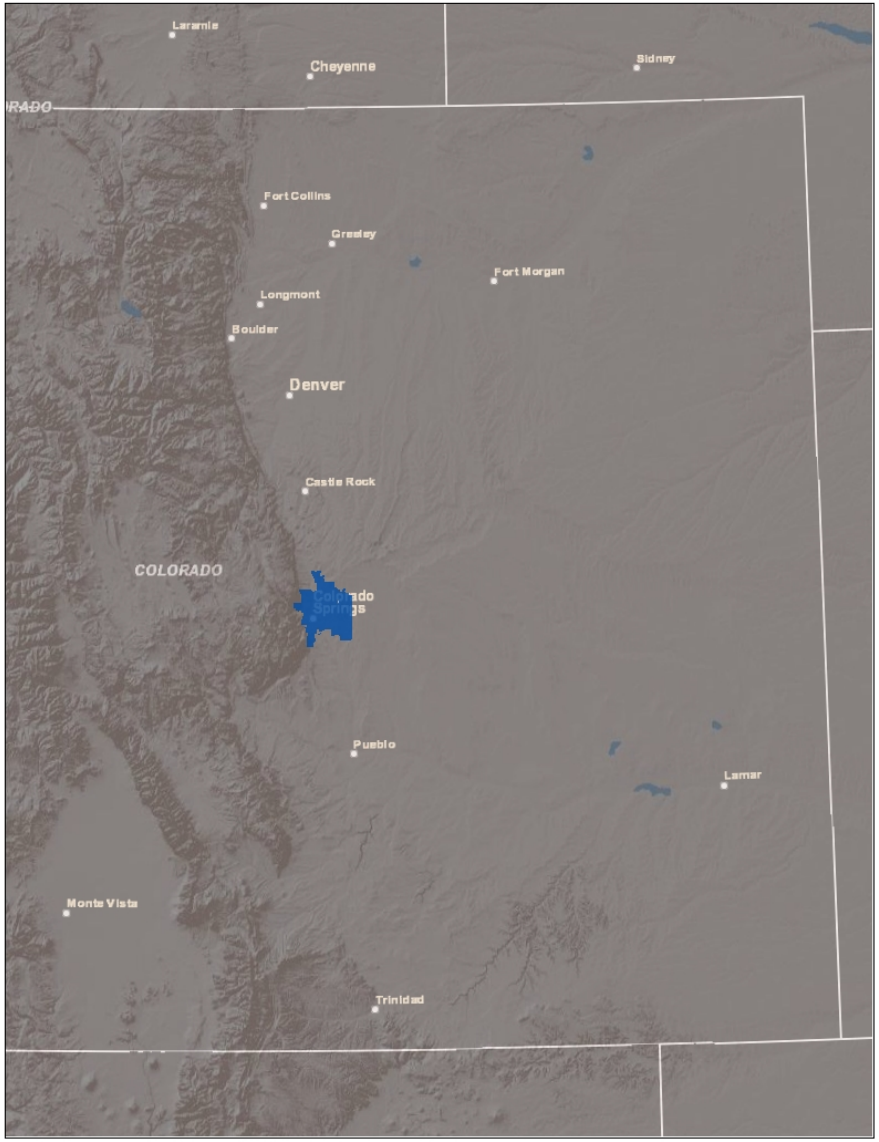
Objectives

- Describe purpose of study
- Profile water use
- Review demand modeling process
- Illustrate factors influencing water use
- Highlight potential demand management issues/ opportunities
- Discuss next steps

Colorado Springs Utilities

- The state's 2nd largest city
  - More than 420,000 residents
  - Employment of 230,000
- Only large city not on a major river
- Majority of water comes from Colorado River basin 200 miles away

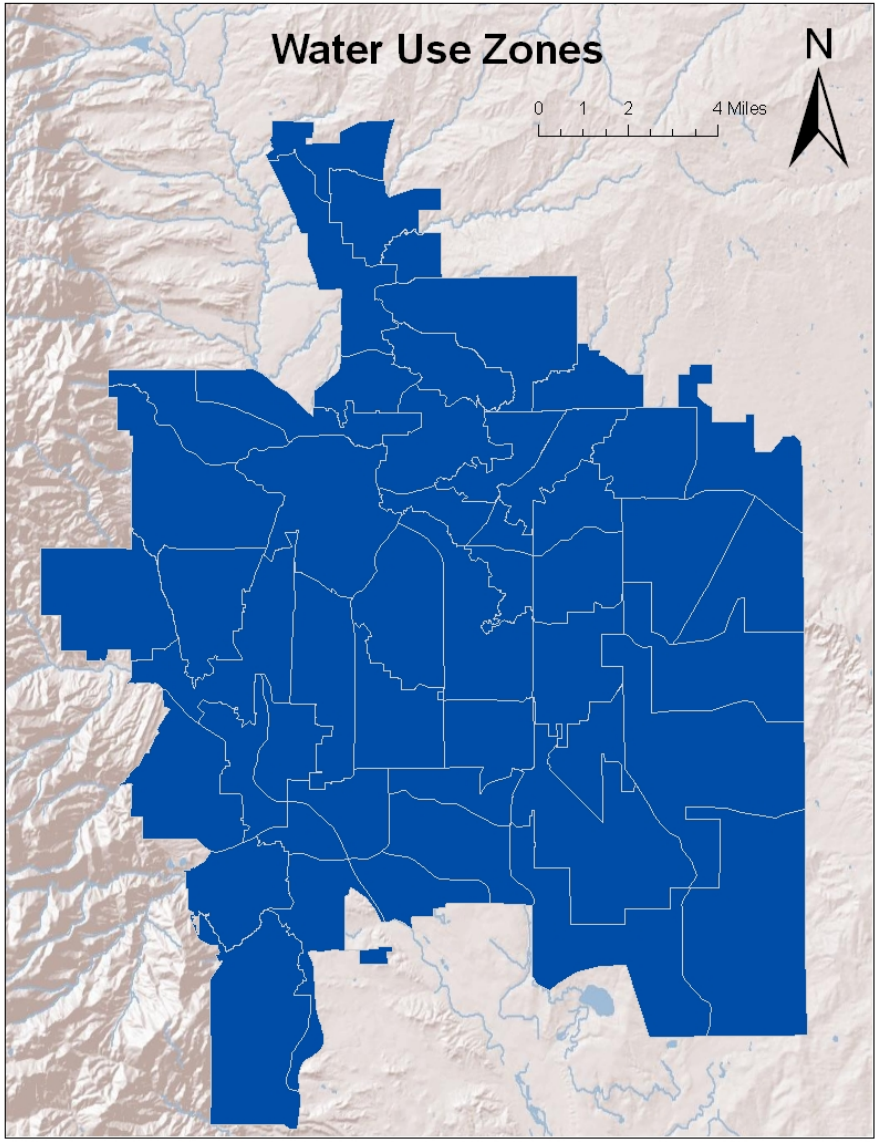


Study Purpose

- Examine the spatial and temporal variation of water use in Colorado Springs
  - What factors influence water use in Colorado Springs?
  - What are the spatiotemporal patterns of use?
- Develop a predictive model of water use
- Explore, analyze and interpret model results
  - How does the influence of various factors vary spatially?
  - Are there apparent neighborhood influences on water use?
- Develop water demand scenarios
- Identify high level demand management opportunities
  - How does the potential to conserve vary spatially?
  - Identify information gaps

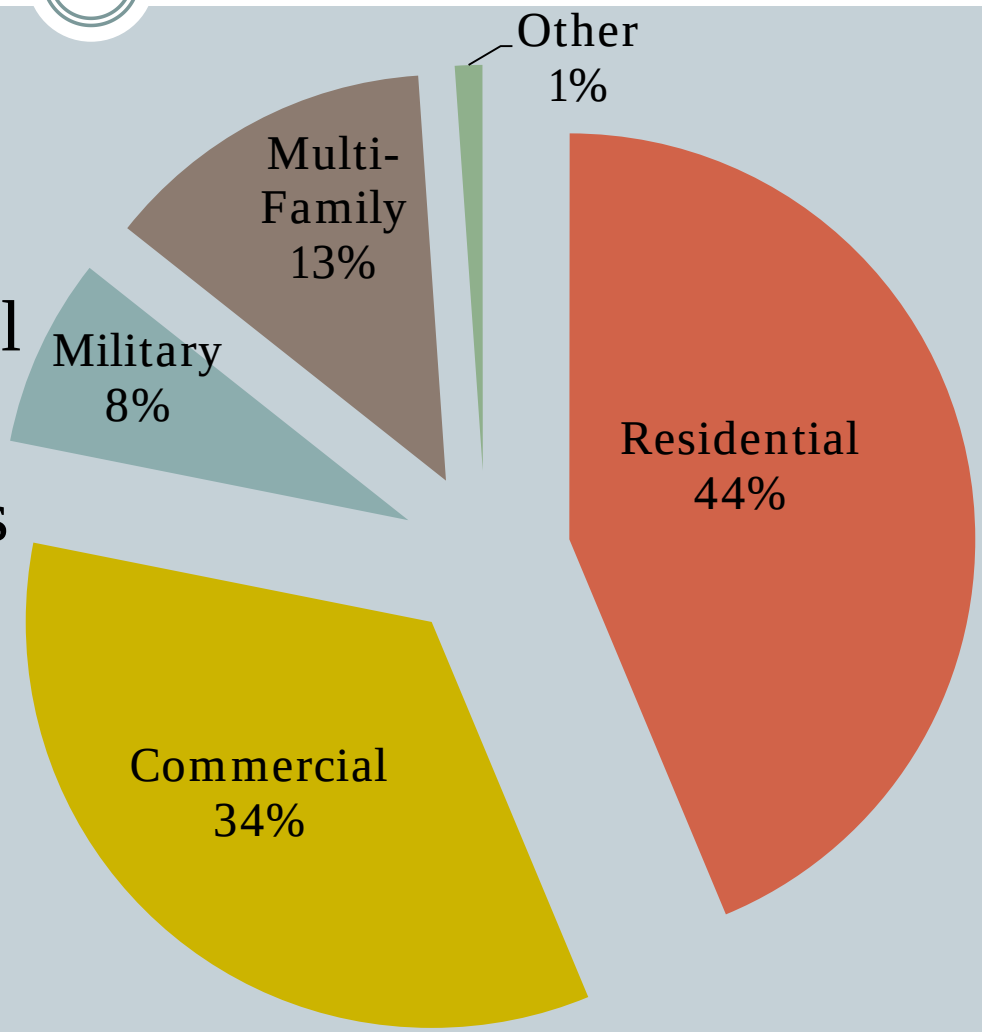
Water Use Profile

- City sub-divided into 50 “water use zones”
  - Population and employment estimated based on traffic analysis zones
  - Boundaries correspond to major pressure zone

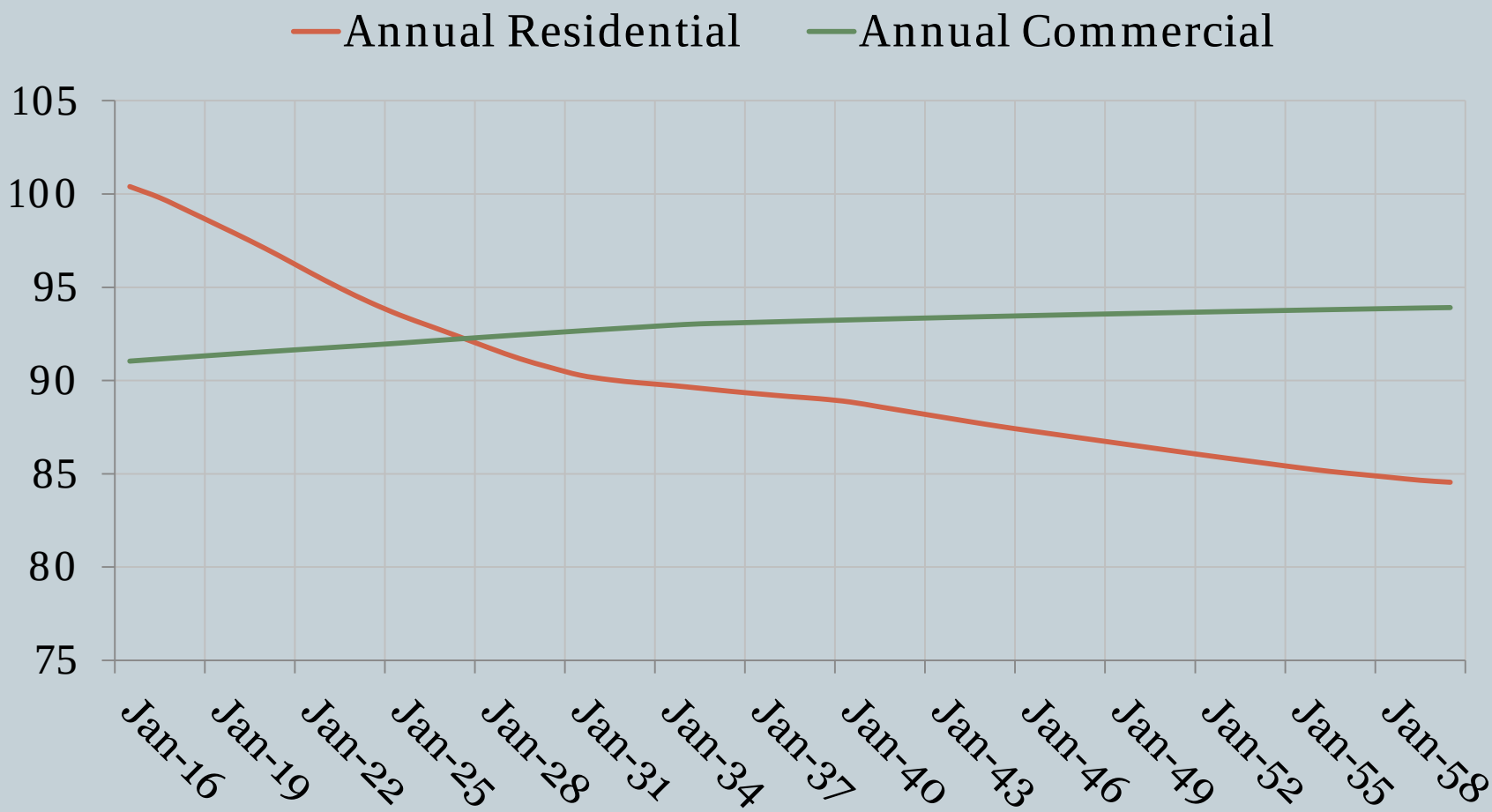


Water Use Profile

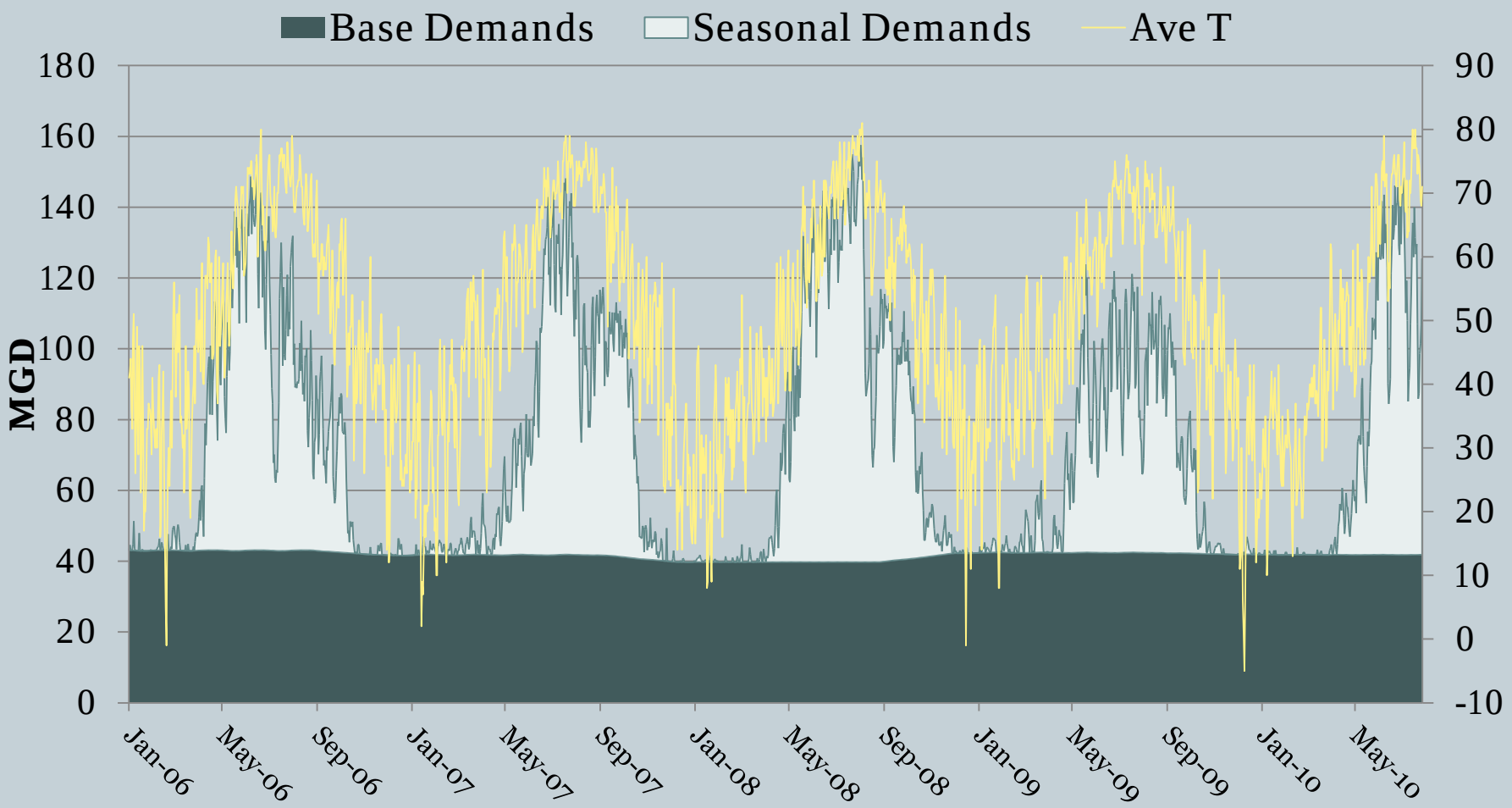
- Majority of total use is residential
- Substantial commercial and military use
- Per person usage ratios are slowly shifting toward commercial



Forecast Annual per Person Use

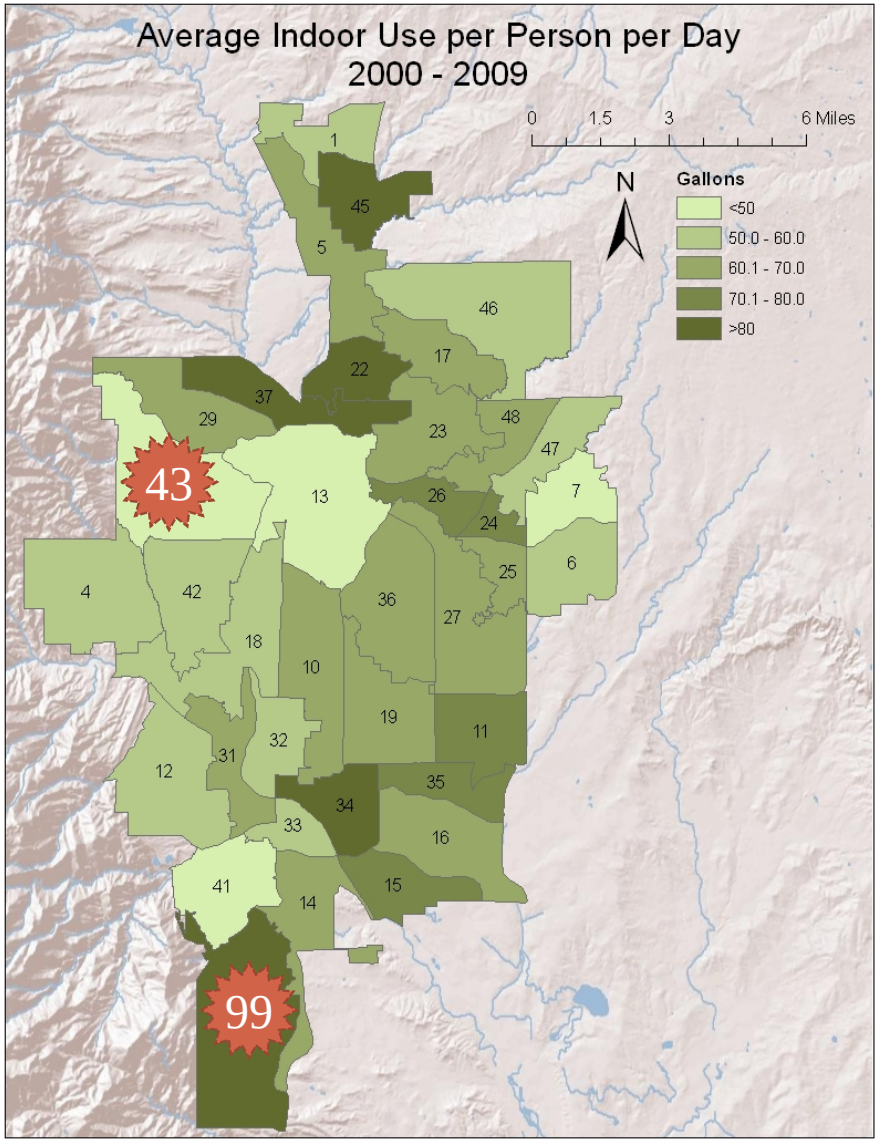


Base and Seasonal Demands



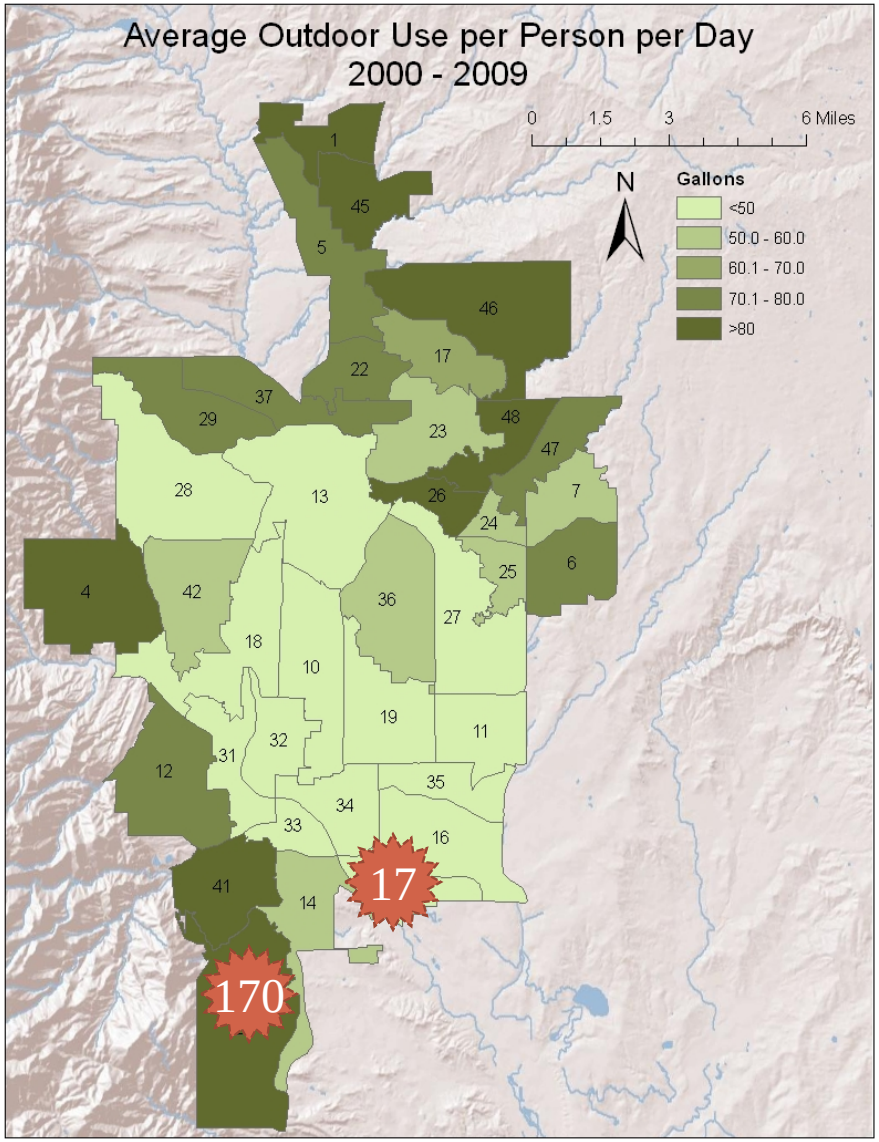
Residential Indoor Use

- Primarily associated with fixture and appliance efficiency
- Highly variable from 43 to 99 gpcd
- Variability indicates other factors at play
- Moderately clustered
- Not clearly correlated with income or house age



Residential Outdoor Use

- Primarily associated with lot size which is a function of socioeconomics
- Neighborhood-level influences are also important
  - HOAs



Data Preparation

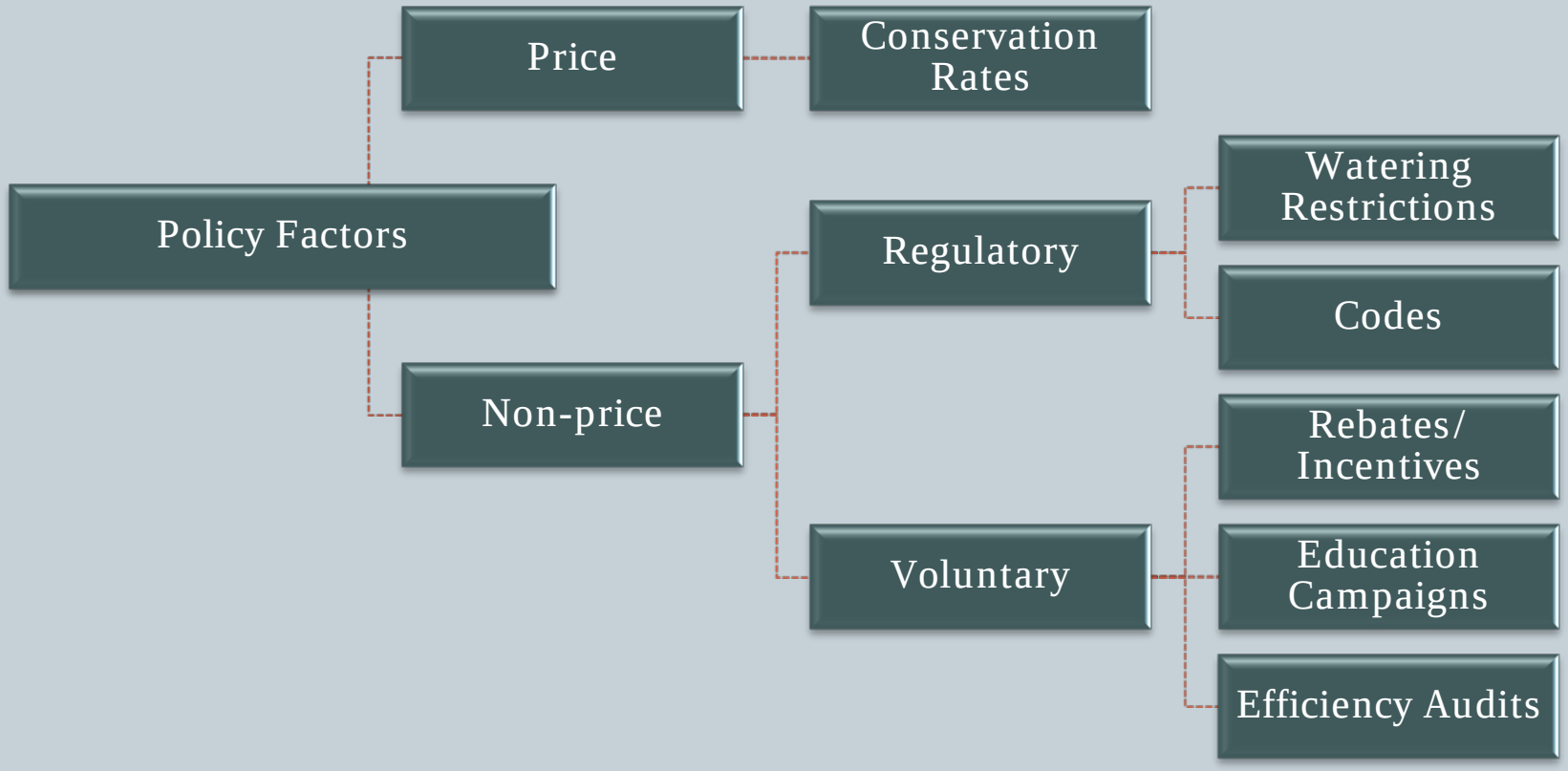
- Water use data are derived from a Colorado Springs Utilities water use database
- Customer-level monthly billing data
- Use is segregated into residential and commercial indoor and outdoor
- Majority of housing and socioeconomic data are added at the customer level
- Use, housing and socioeconomic data are aggregated monthly by demand zone
- Additional demand-zone level data are added to aggregated monthly data

GWR Analysis

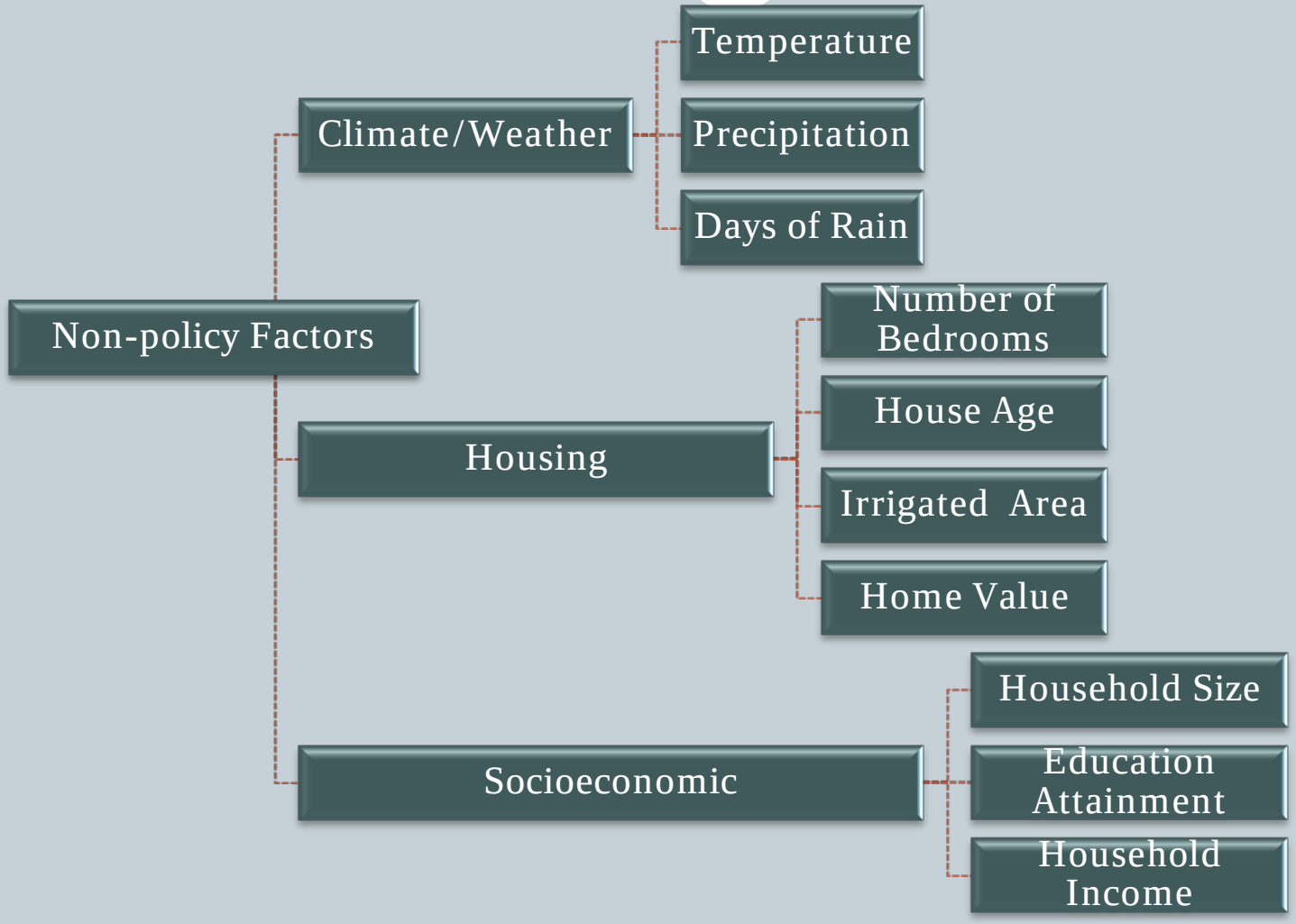
- Employs a spatial weighting scheme whereby near observations are considered to have more influence on the dependent variable than those further away
- Allows for spatial variability of parameter coefficients, coefficient significance, and model performance
- Written as:

$$y_i = \beta_0 (u_i, v_i) + \sum_k \beta_k (u_i, v_i) x_{ik} + \varepsilon$$

Policy Factors Influencing Use



Non-Policy Factors Influencing Use

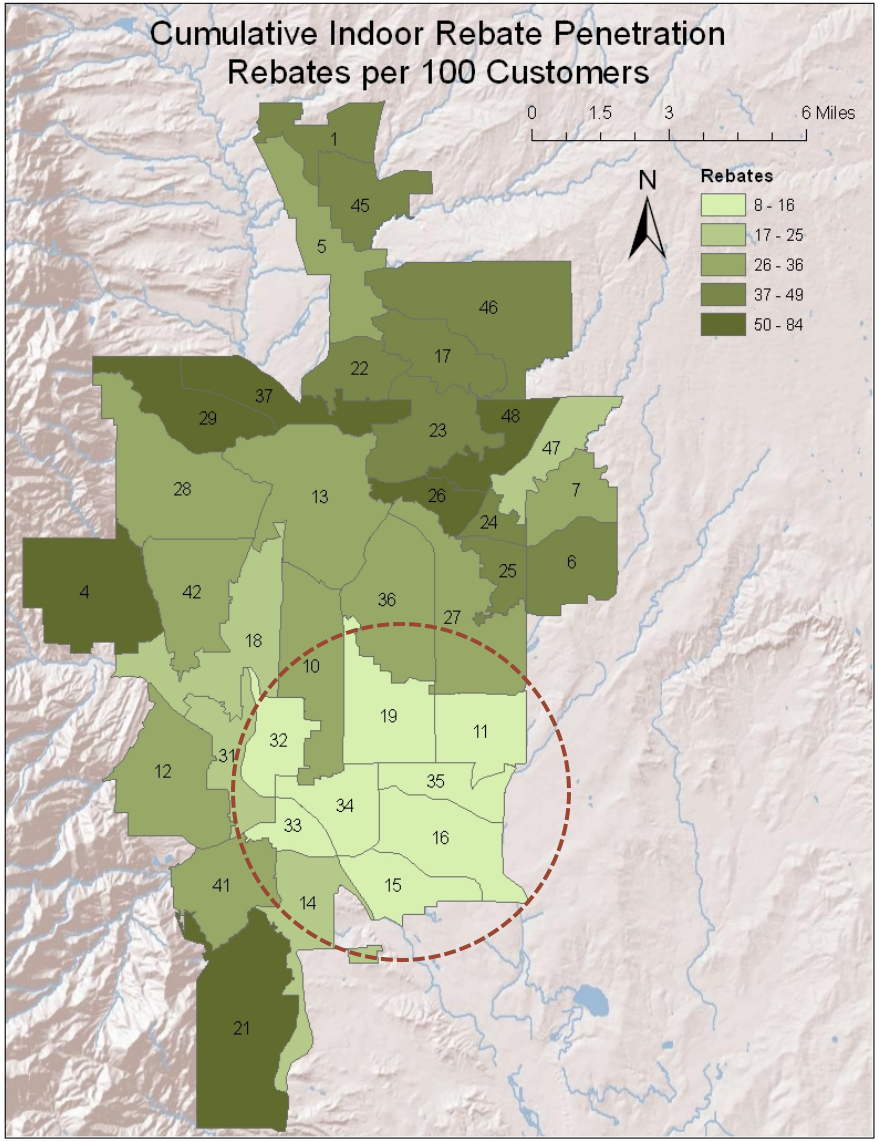


Residential Outdoor Model Parameters

- Ten independent variables chosen out of 49 tested
  - Days greater than 85˚F
  - Average maximum temp × days greater than 55˚F
  - Days less than 40˚F
  - Effective precipitation × days with greater than .02”
  - Prosperity Index
  - Average water price from previous month
  - House age
  - 1 day per month watering restrictions
  - 2 days per week watering restrictions
  - 3 days per week watering restrictions

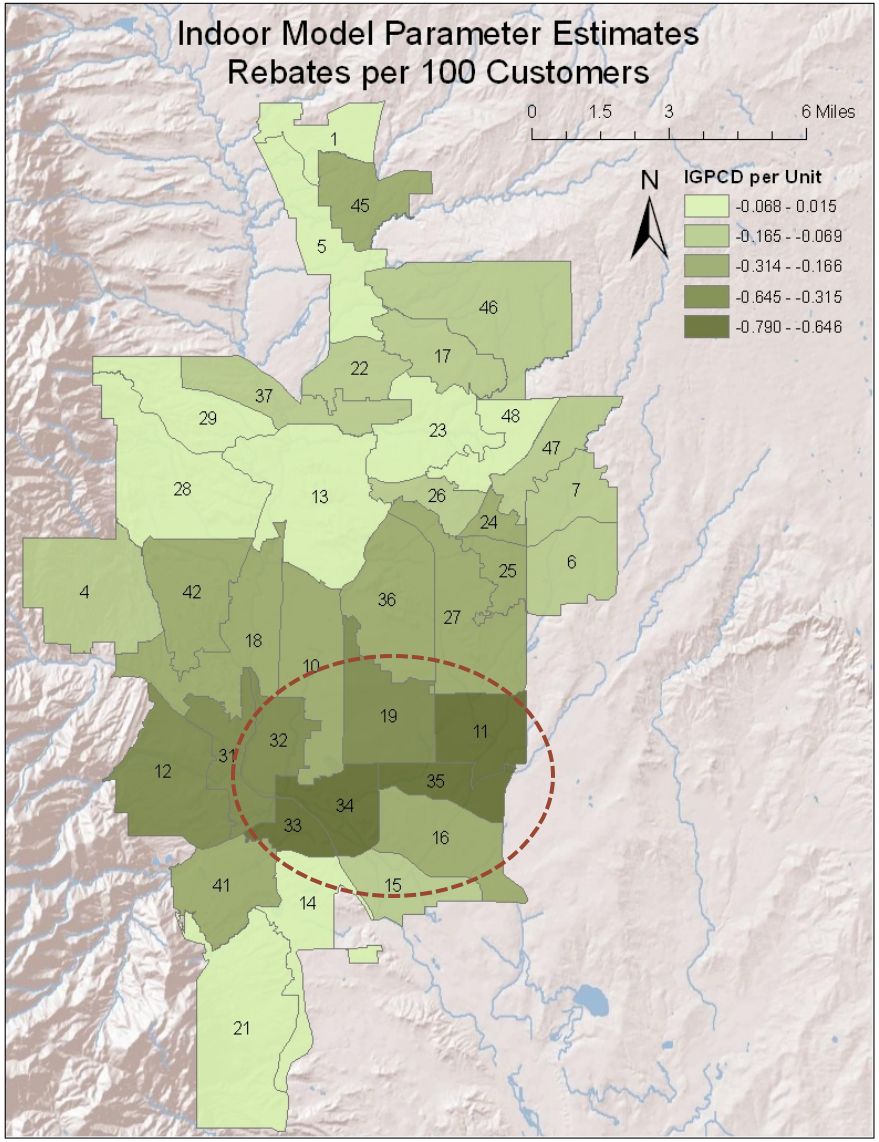
Residential Indoor Rebate Adoption

- Varies tremendously
- Adoption positively correlated with income and negatively correlated with house age



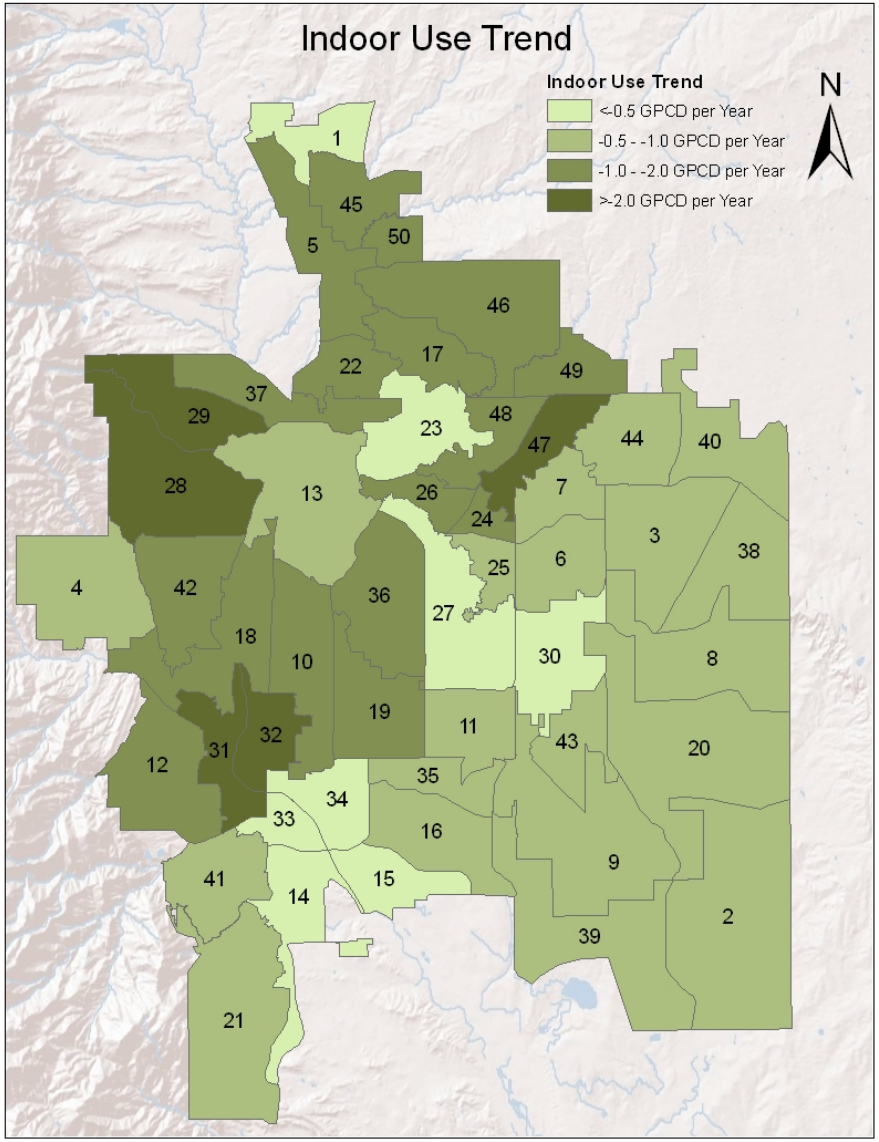
Influence of Indoor Rebate Adoption

- Greatest influence is generally in lower income and older areas
- This is nearly the inverse of adoption and represents opportunities for conservation



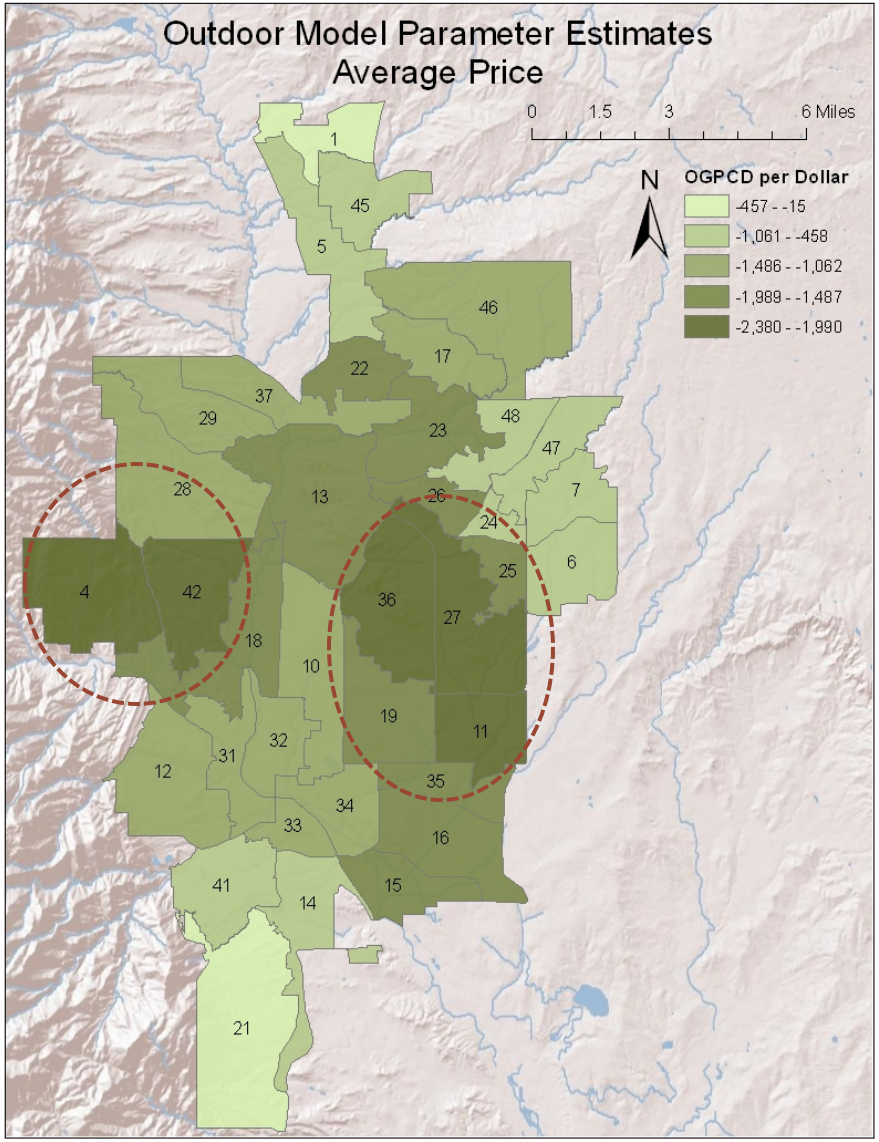
Residential Indoor Water Use Trends

- All areas are showing a downward trend
- Trends in some high use areas are minimal



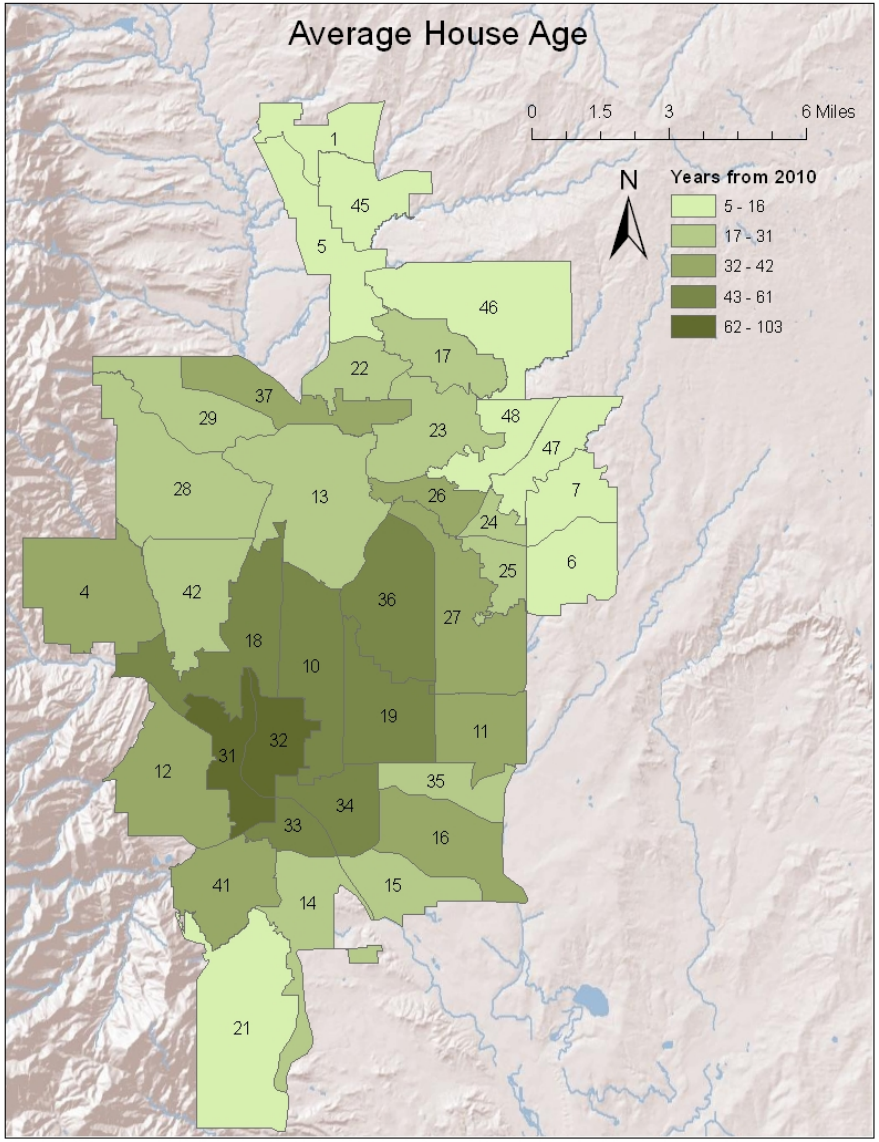
Influence of Average Price on Outdoor Use

- Greatest influence in middle income areas with moderate rates of outdoor use



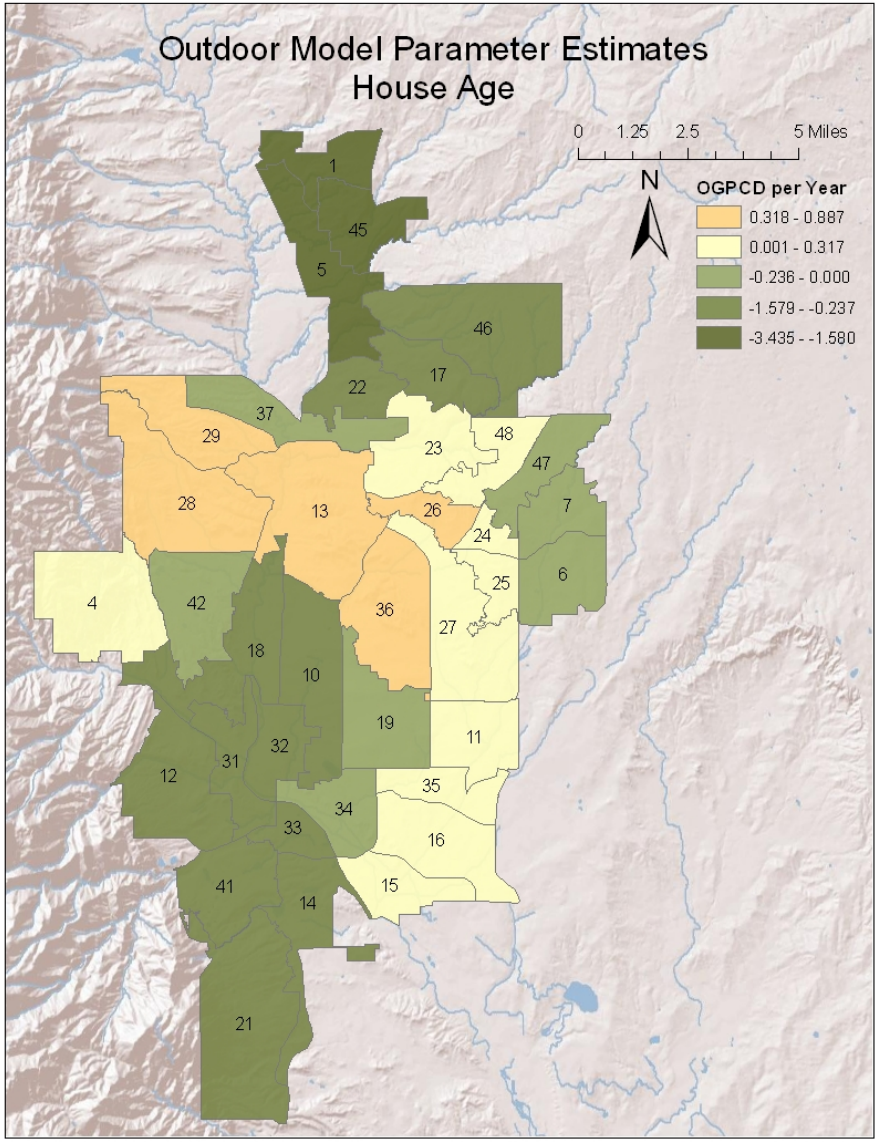
Housing Age

- Oldest homes are in the center of the city
- City is growing primarily toward north and east
- Future growth is likely to be almost exclusively infill and toward east



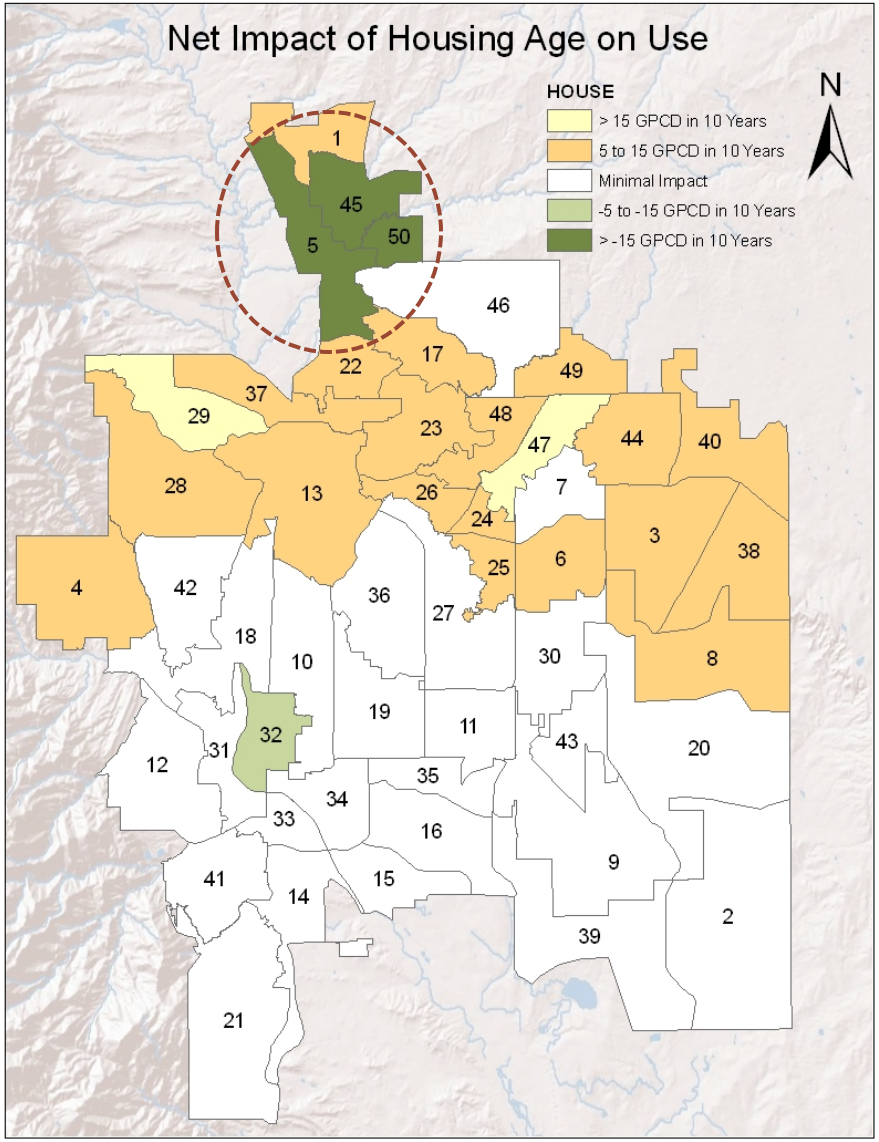
Influence of Housing Age on Outdoor Use

- For the majority of the city, outdoor use is higher in newer homes
- These areas present both opportunities and concerns
- Newer areas with lower use should be examined further to understand why



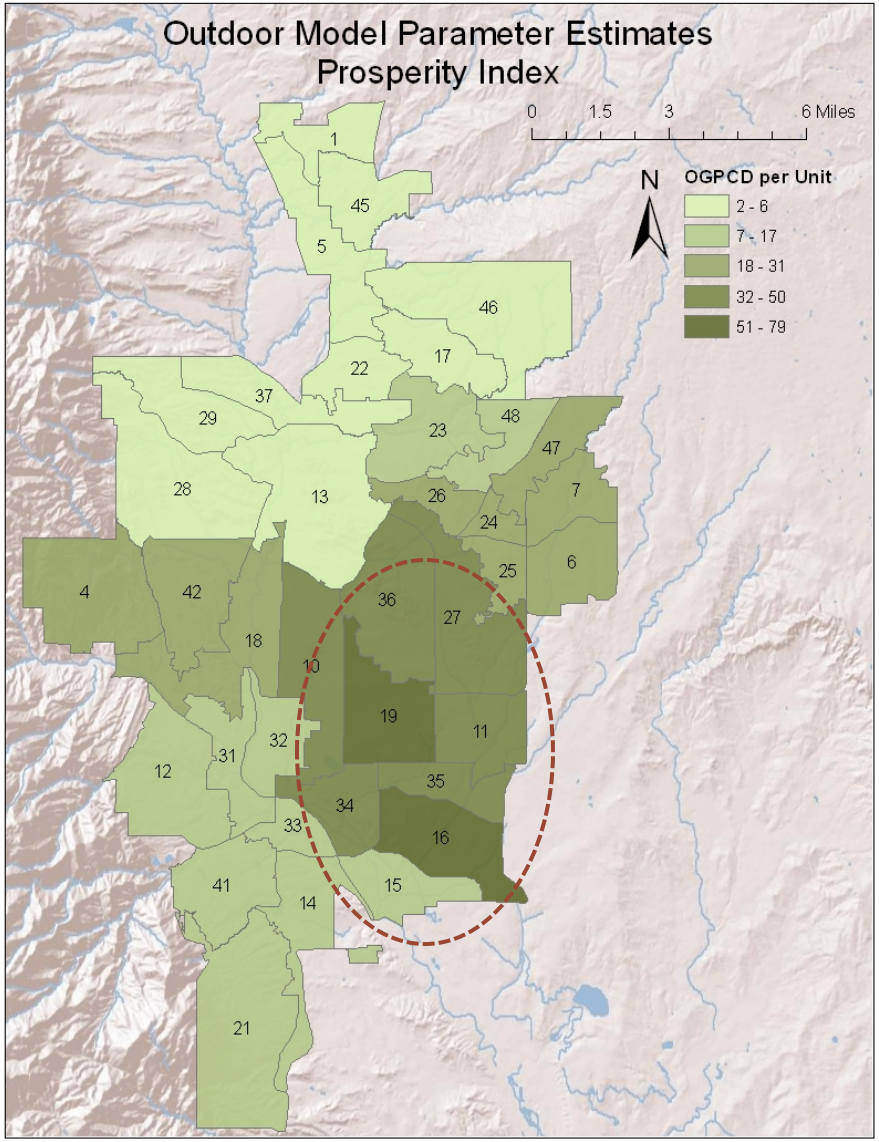
Net Influence of Housing Age on Total Use

- Net use is higher among newer homes in only a small part of the city
- In the majority of the city, the net trend is flat



Influence of Economic Conditions on Use

- Influence of economic conditions on outdoor water use is greatest in middle and lower income areas in the southeast portion of the city

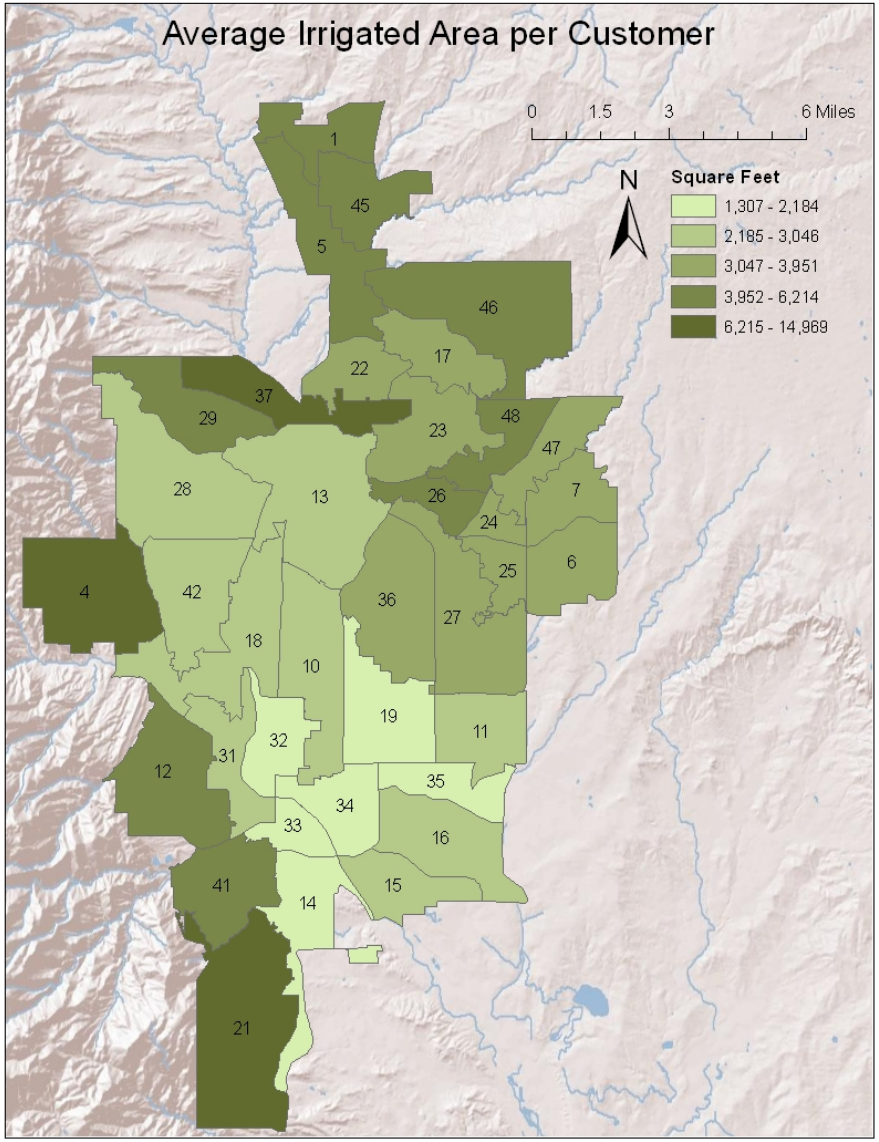


Important GWR Parameter Coefficients

- Each rebate for indoor water efficiency fixtures or appliances saves more than 7,200 gallons per year.
- Each year of age added to a house, results in an average reduction of 0.20 gallons per person per day outdoors.
- Each year of age added to a house, results in an average increase of 0.29 gallons per person per day indoors.
- Every 10% increase in water price results in a decrease in outdoor use of 3.4%.
- 2-day per week watering restrictions result in an average savings of 31.02 gallons per person per day.

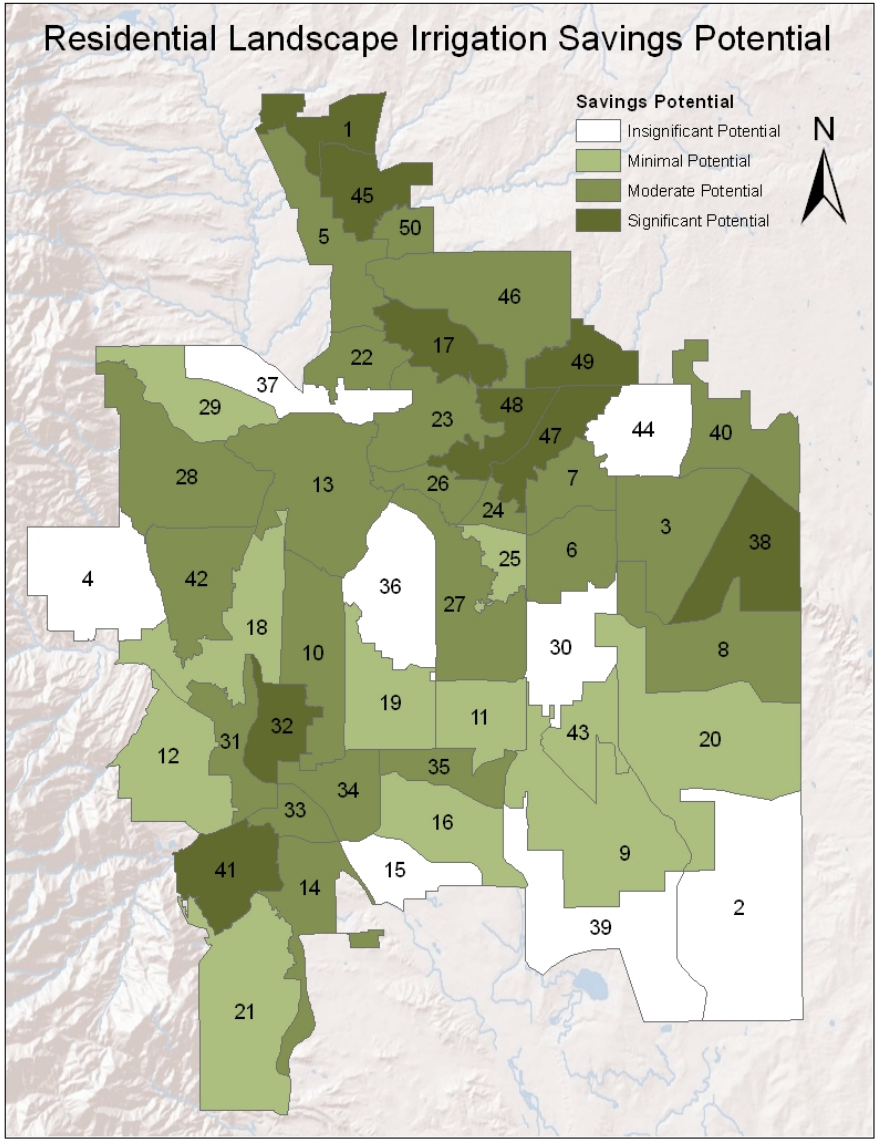
Irrigated Area per Single Family Customer

- Estimated using aerial image taken in 2009
- This is a measure of living ground cover, including turf and trees
- Many newer areas have more irrigated area than older areas



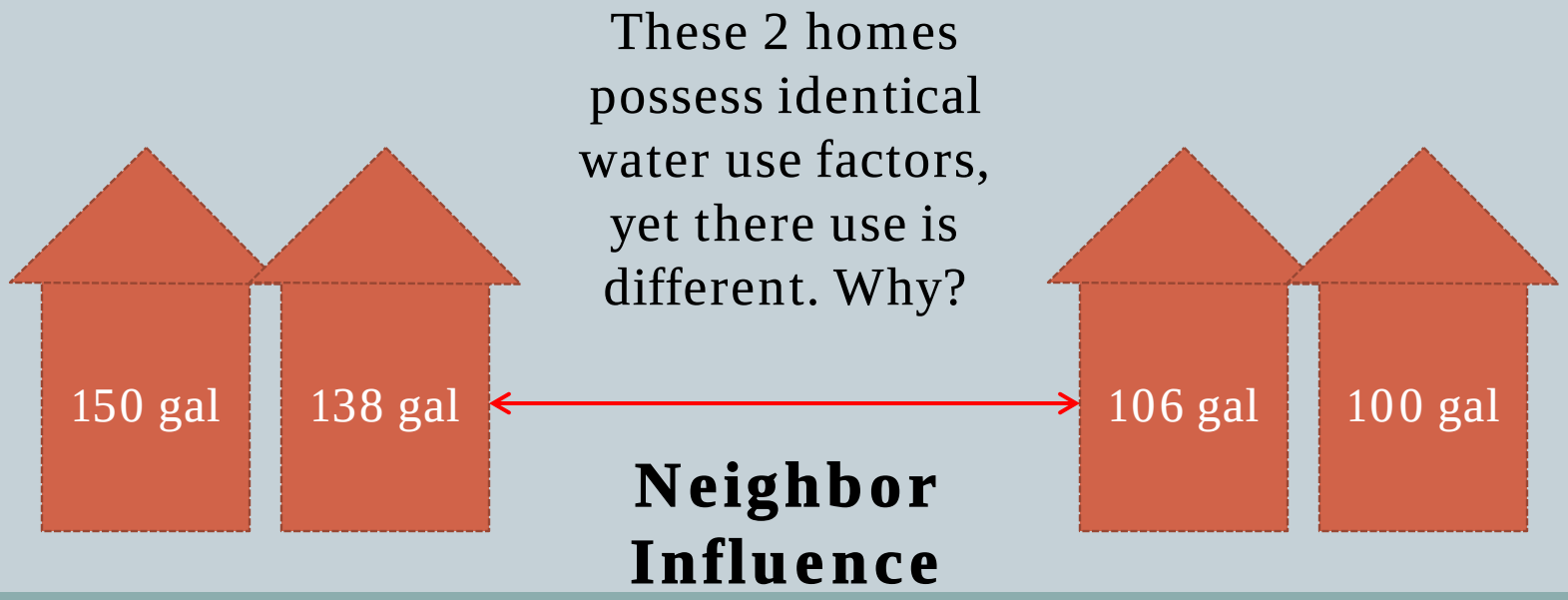
Residential Irrigation Savings Potential

- Based on an estimate of average use per square foot per month compared to measured ET
- Varies considerably
- Significant potential for savings only exists in a small percentage of the city



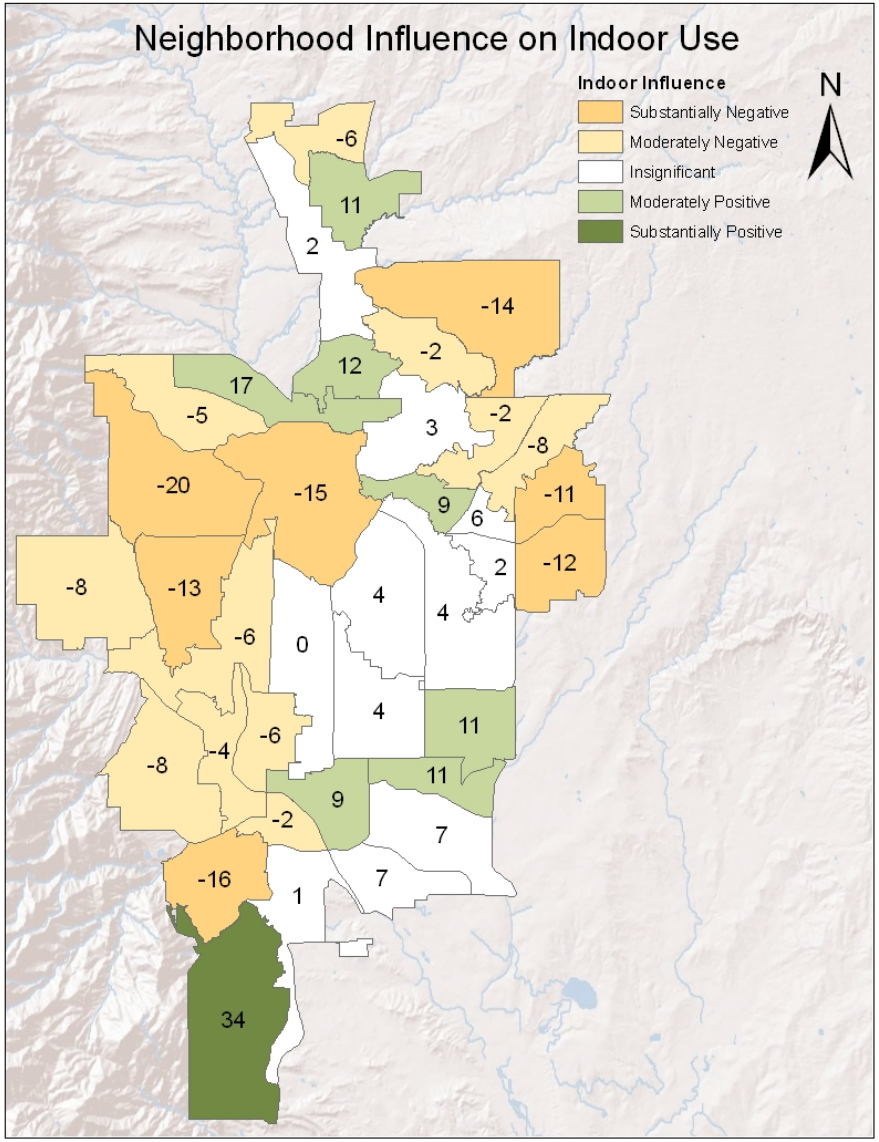
Neighborhood Influences

- Neighborhood influences are essentially “peer pressure”.
- This is the influence of the proximity to neighbors with particular habits.
- This influence varies spatially.



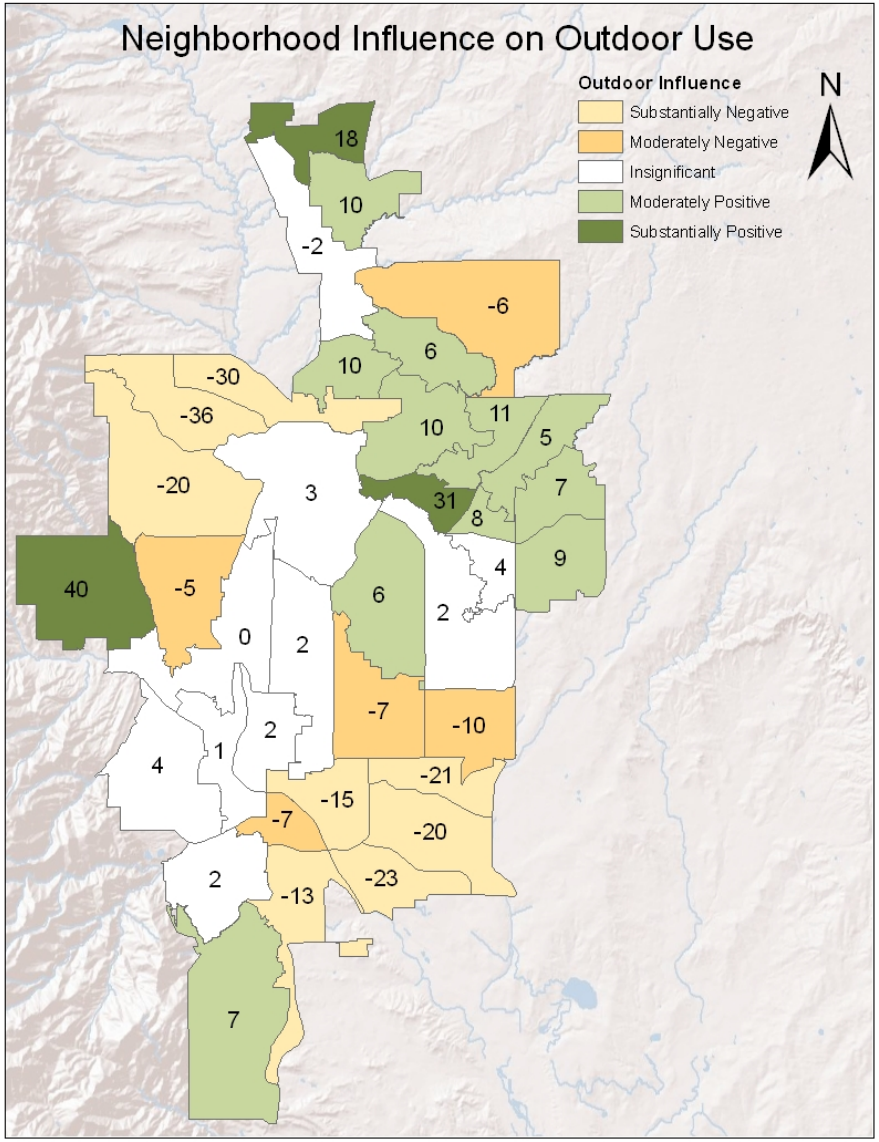
Neighborhood Influence on Indoor Use

- The influence of "neighborhood" on indoor use is substantial in many areas of the city
- More research is needed to understand



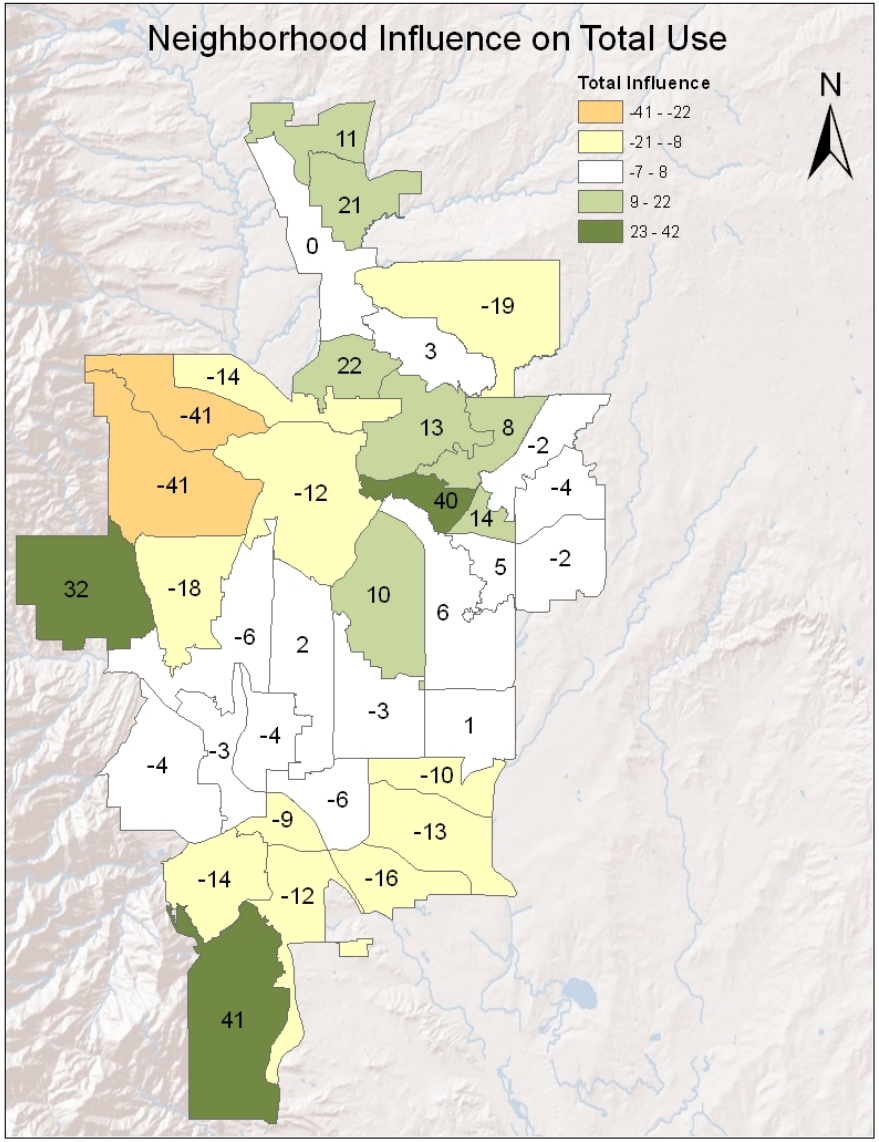
Neighborhood Influence on Outdoor Use

- The influence of “neighborhood” on outdoor use is substantial in many areas of the city
- The variation of influence indicates disparate underlying causes



Neighborhood Influences on Total Use

- The variation of neighborhood influence on total use is substantial
- More research is needed



Conclusions and Next Steps

- Water use is a function of complex relationships between many variables
- Conservation potential exists, but a much more strategic approach is required to achieve it in an efficient and cost-effective manner
- Neighborhood influences are apparent in much of the city. Some are positive and others are negative
- Demand model is being integrated with supply-side models
- Results of study will inform conservation plan update

Thank You!

Questions?

Scott Winter

swinter@csu.org

719.668.4590