

This presentation premiered at WaterSmart Innovations

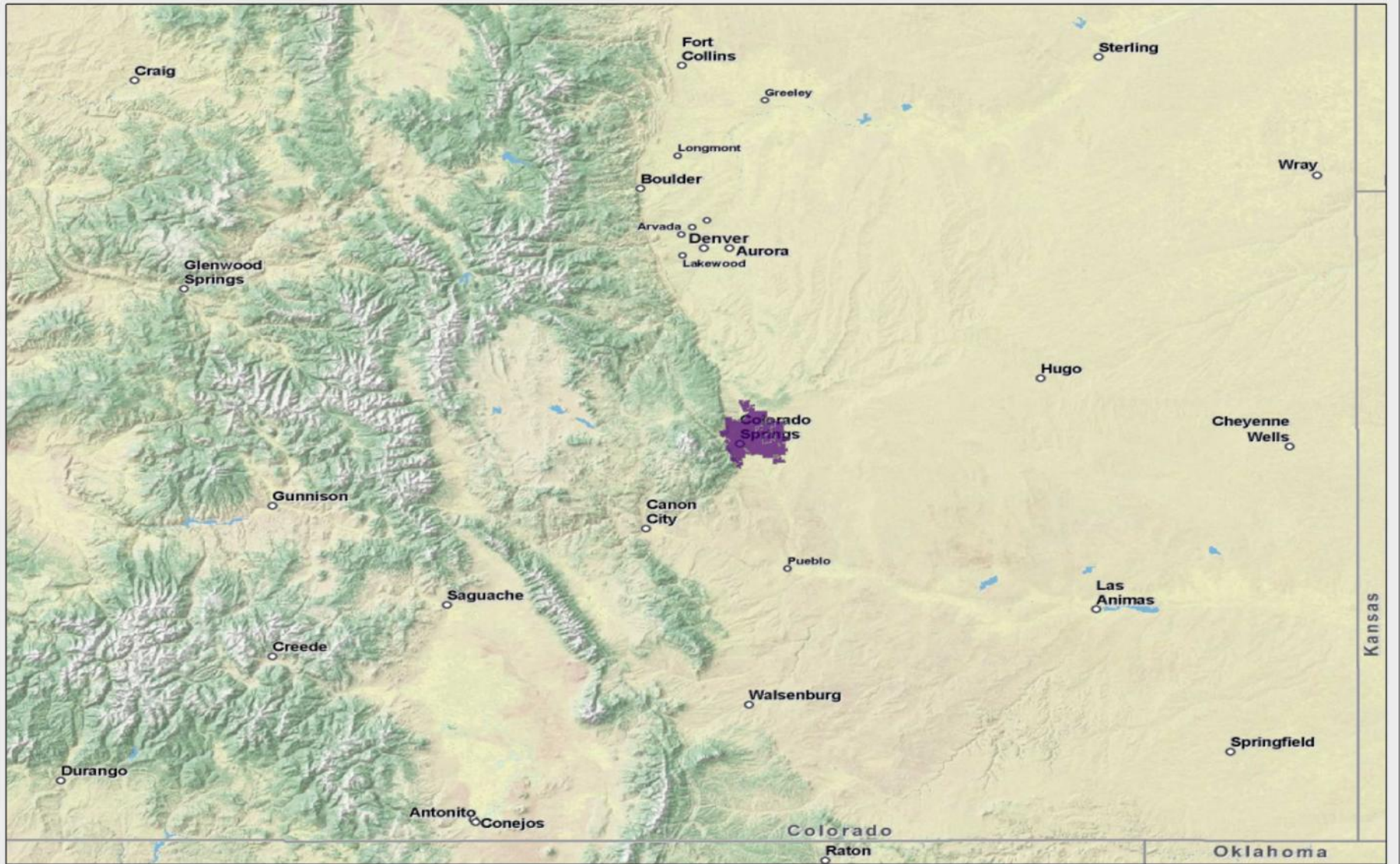
watersmartinnovations.com



Improving Demand Management Using Spatial Information

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Colorado Springs Utilities

Water Smart Innovations
October 5, 2011



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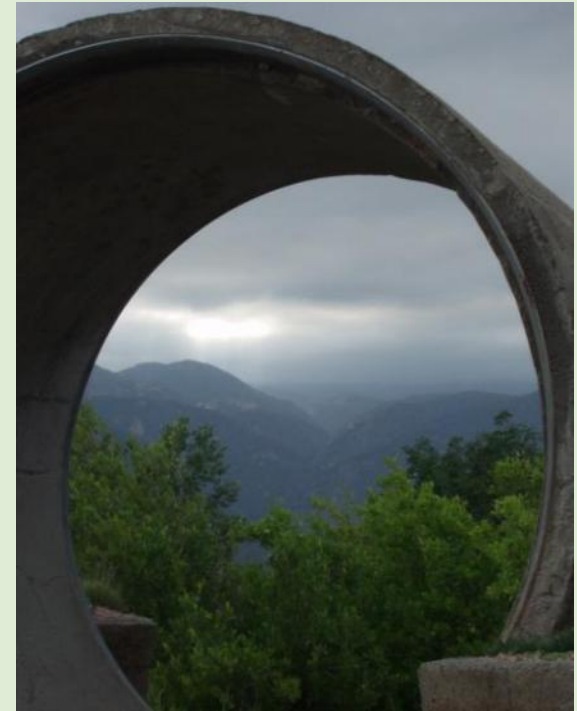
Colorado Springs Utilities Water Service Territory

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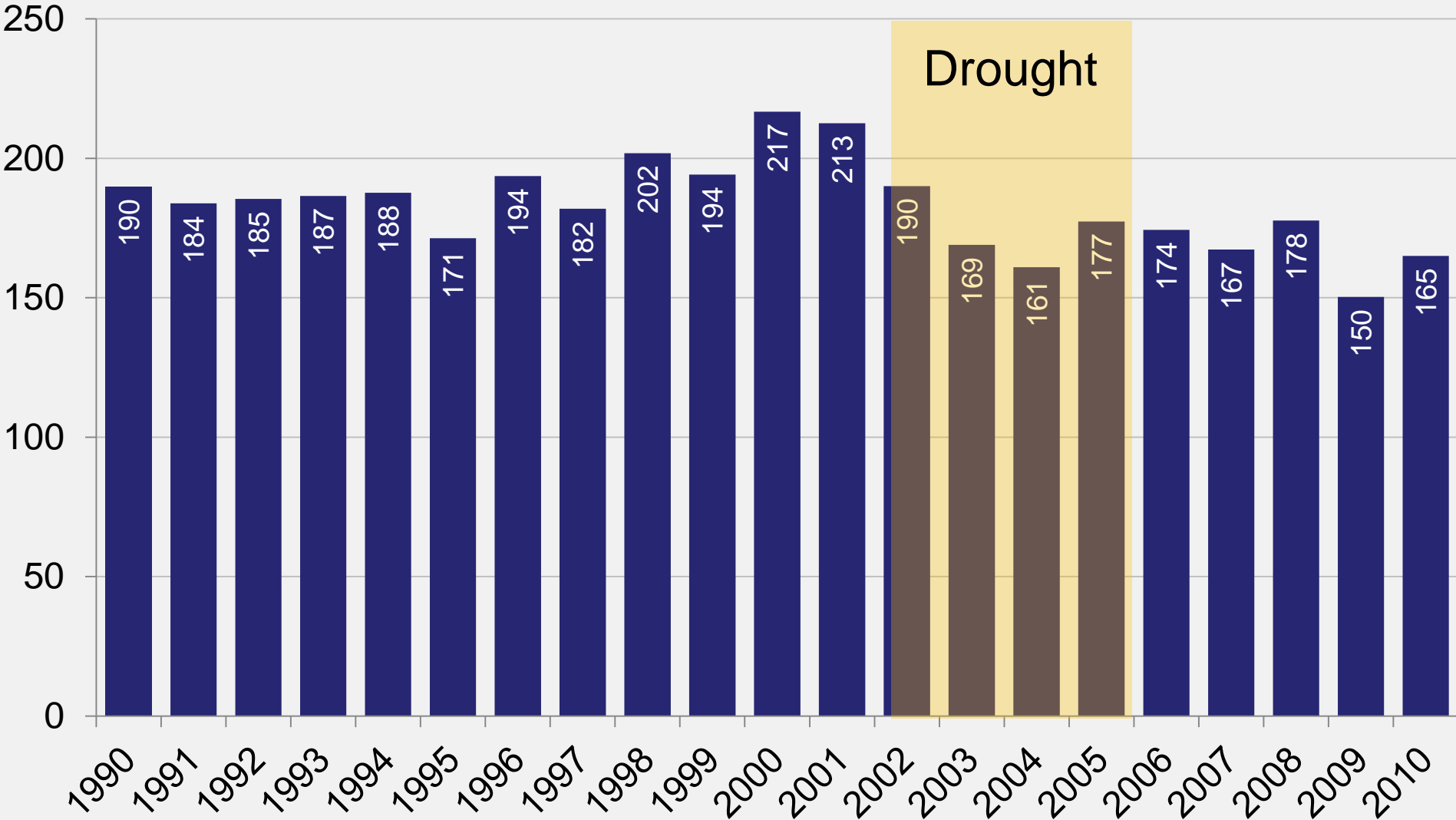
- Four-service utility
- Semi-arid climate
- 6,150' Elevation
- 24 to 27 billion gallons sold annually
- 184 square miles served
- Majority of water from 200 miles away



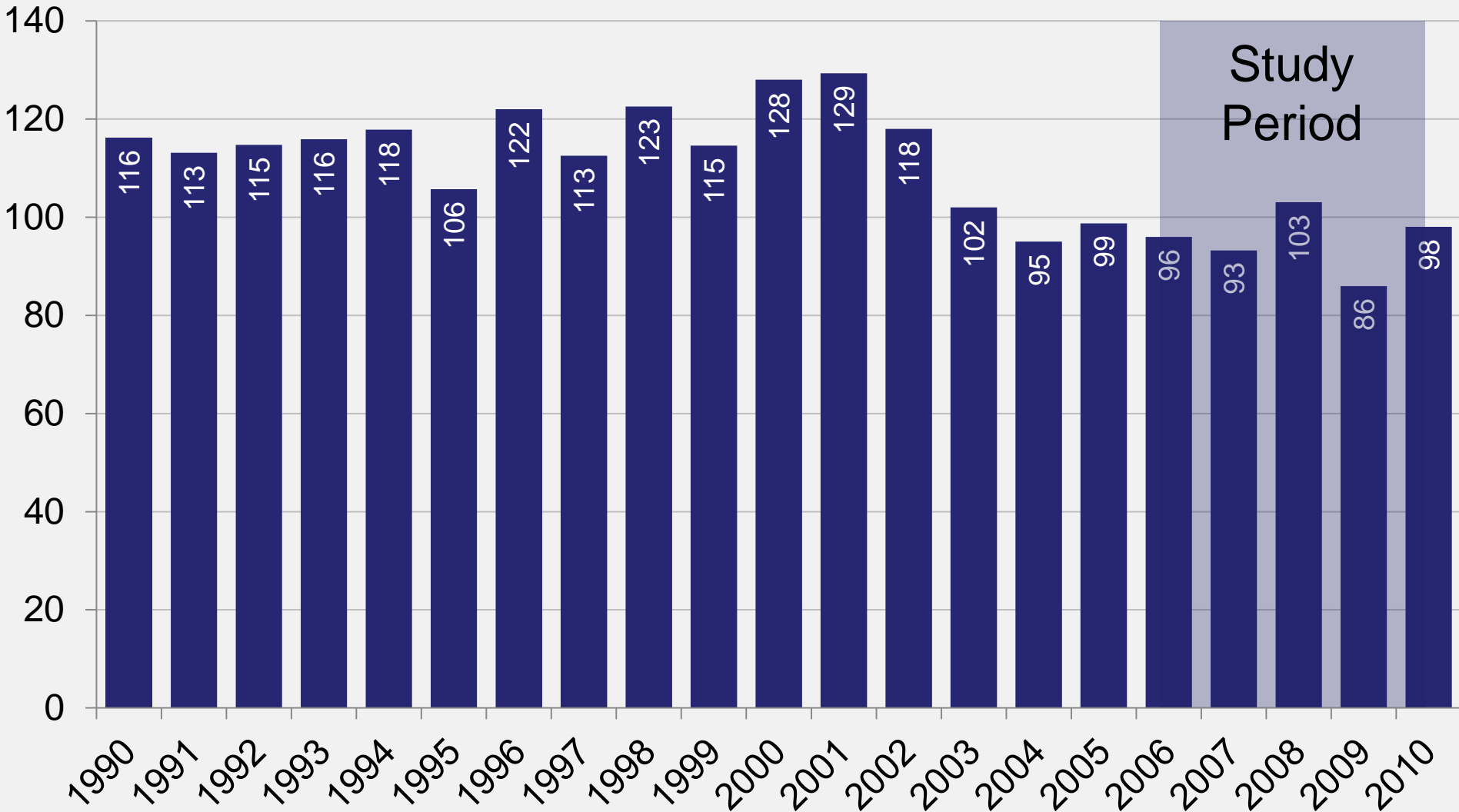
- Changing Water Demands
- Multiple Changing Influences
- Conservation & Pricing Policies
- Savings Estimates
- Role of Spatial Information
- Modeling Residential Water Use Spatially
- Spatial Information in Policy Management
- Moving Forward...



System-wide GPCD



Residential GPCD



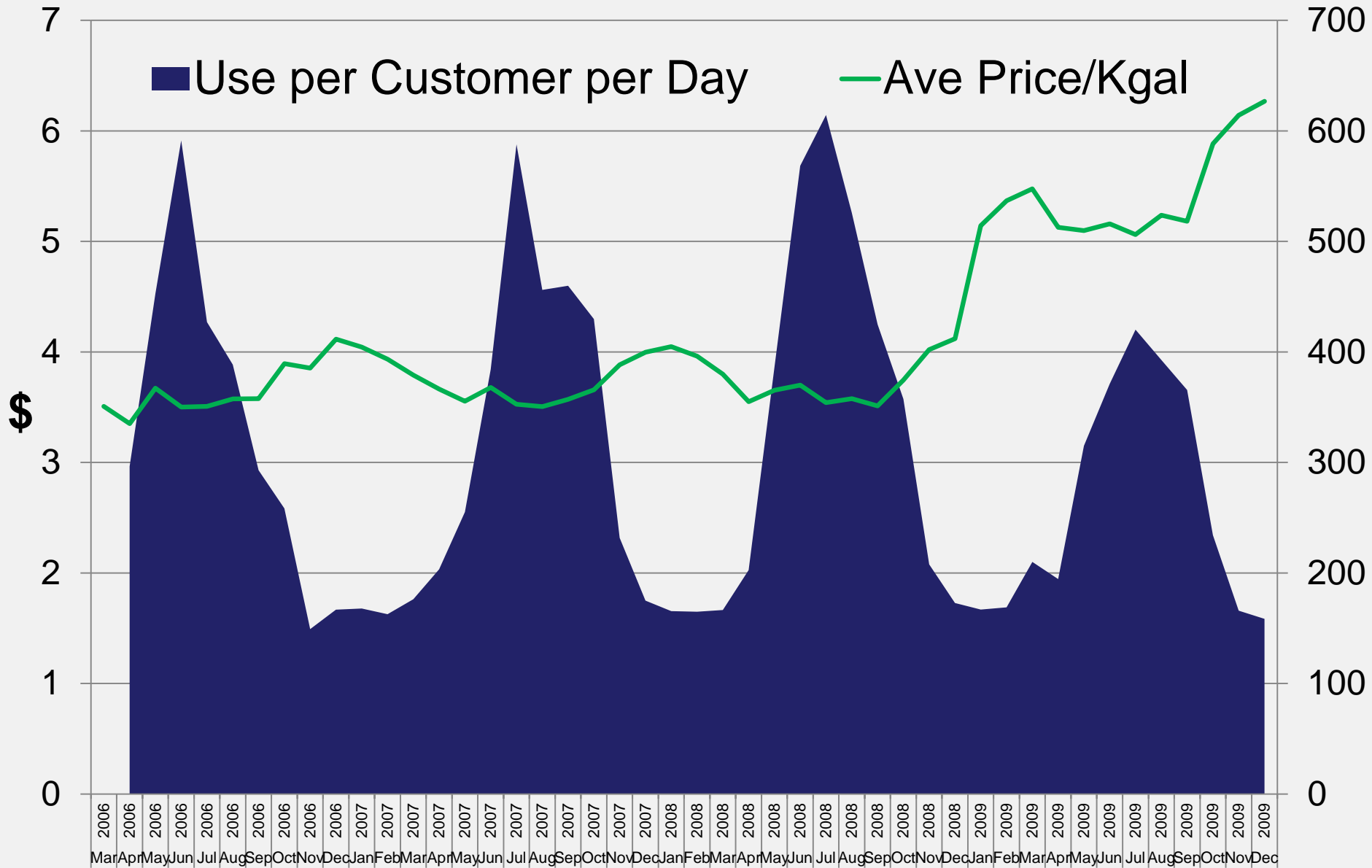
- Post-drought environment
 - Changing perspectives
 - Changing behaviors
 - Changing landscapes
- Economic downturn
- Penetration of efficient fixtures
- Water price increases

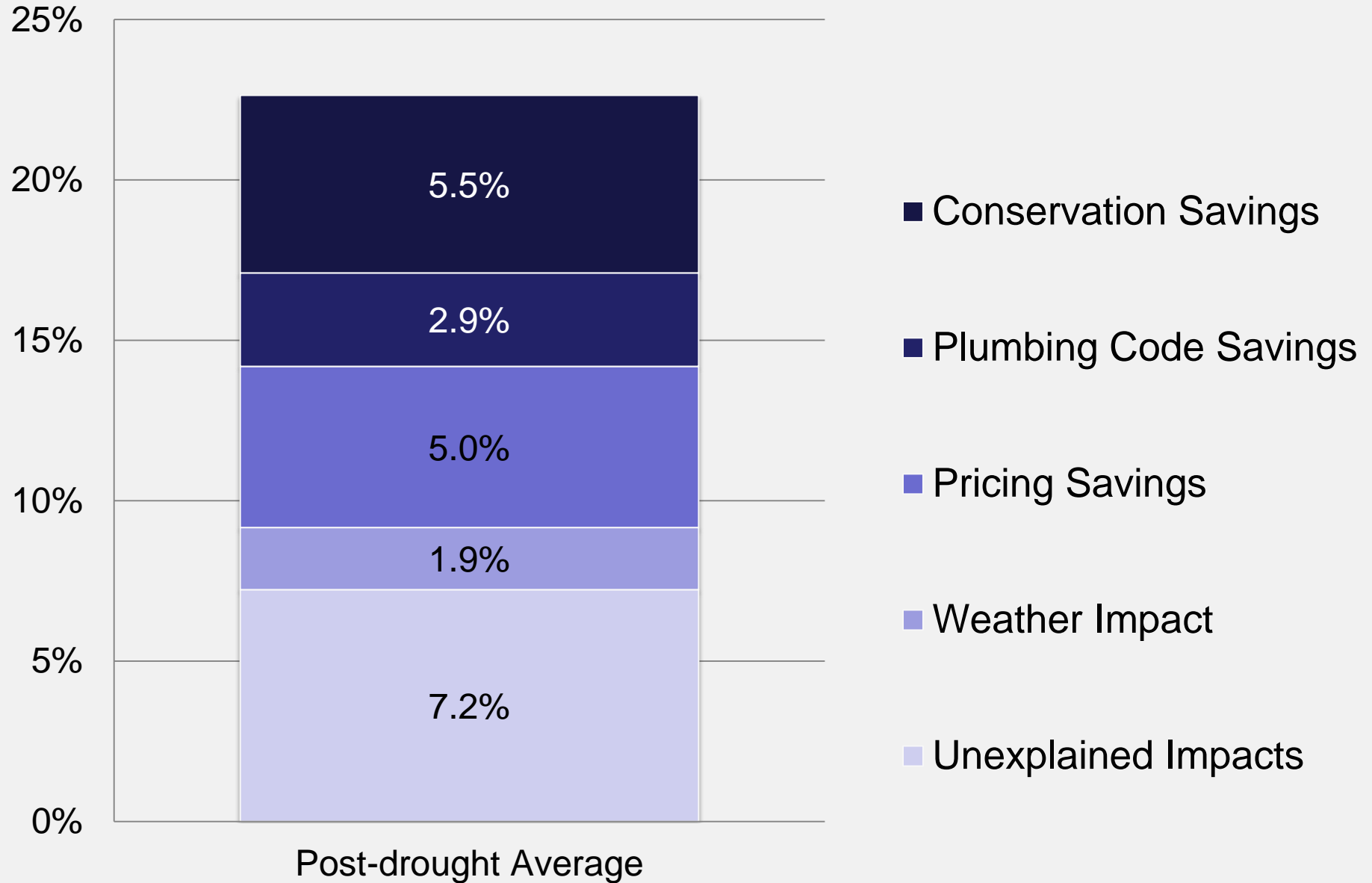


Drought, Conservation and Pricing

- Four years of watering restrictions (2002-2005)
- 22 rebate and retrofit programs since 2002
- More than 35,000 rebates provided
- Conservation pricing since 2003
- 2,000 conservation presentations
- Media campaigns
- Xeriscape Demonstration Garden

Increasing Prices





Improved understanding of demand variability over both time and space

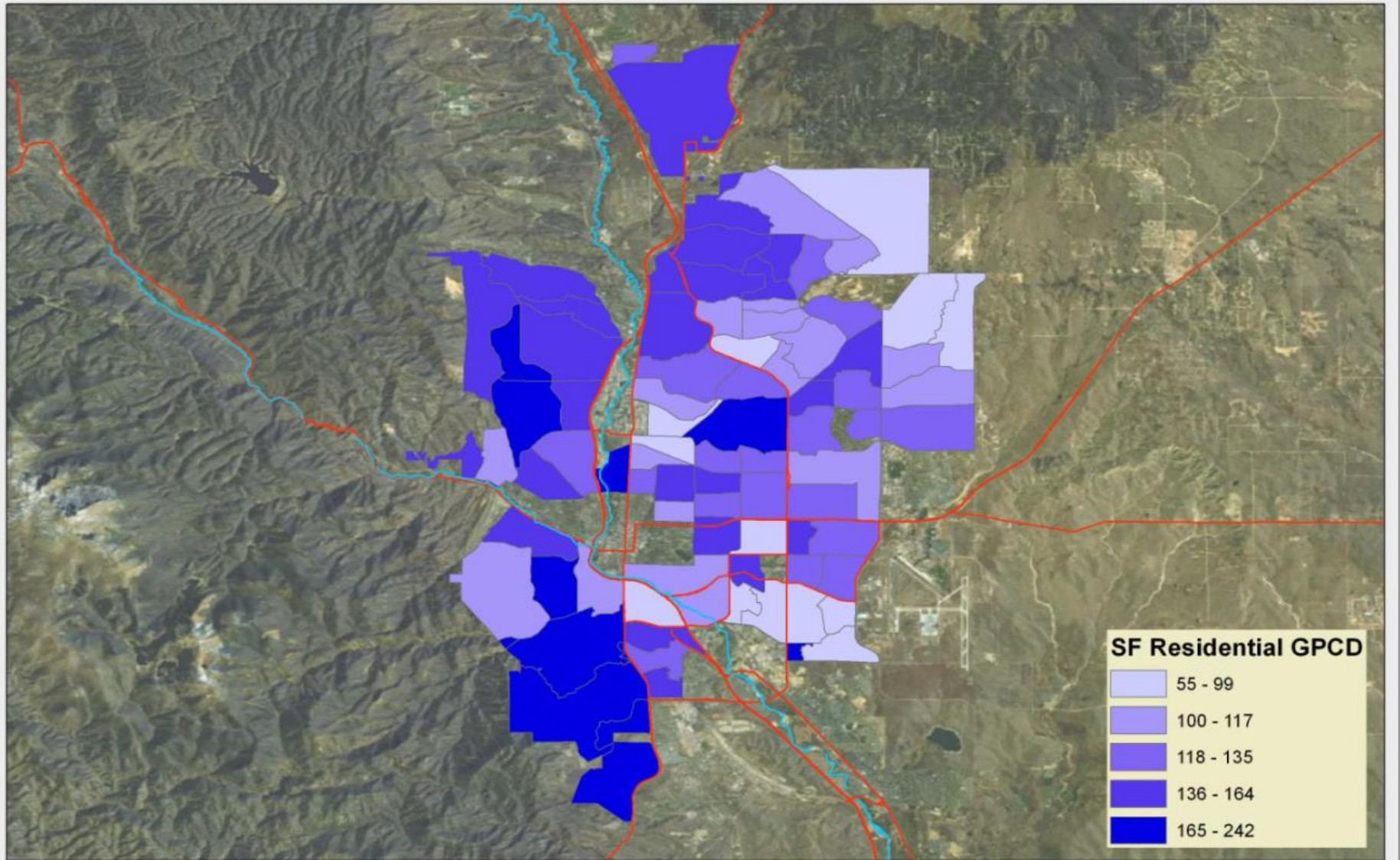
Improved understanding of conservation adoption

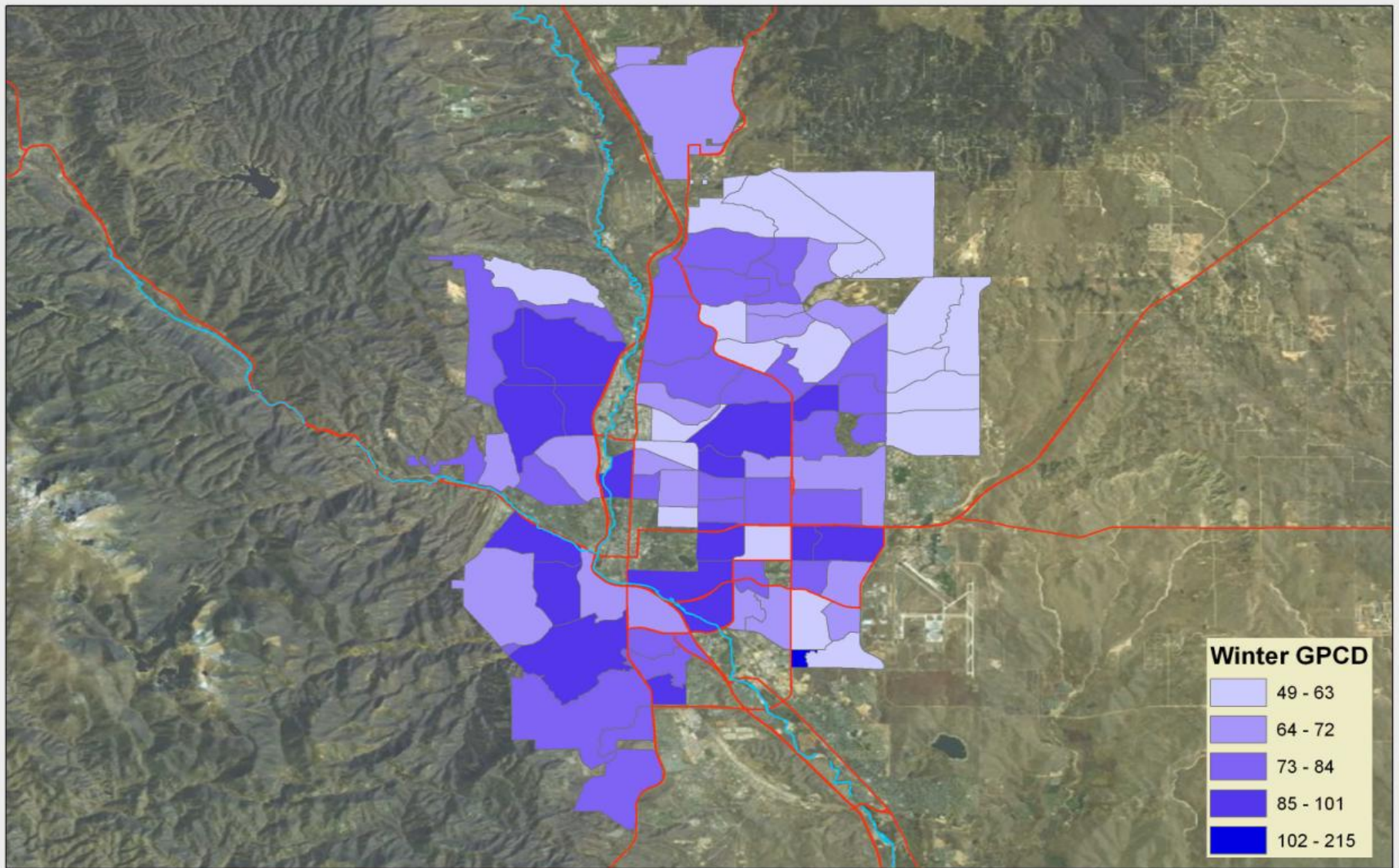
Improve efficacy of existing programs






Better integration of conservation/
demand management with resource
planning

Better policy development

- Random sample of more than 2,700 customers (125,000 records)
- March, 2006 through February, 2010 study period
- Aggregated by 2010 Census Tract (n=4,471)
- Eliminated statistically insignificant tracts
- Used 2006-2009 tract-level demographic estimates from Census Bureau



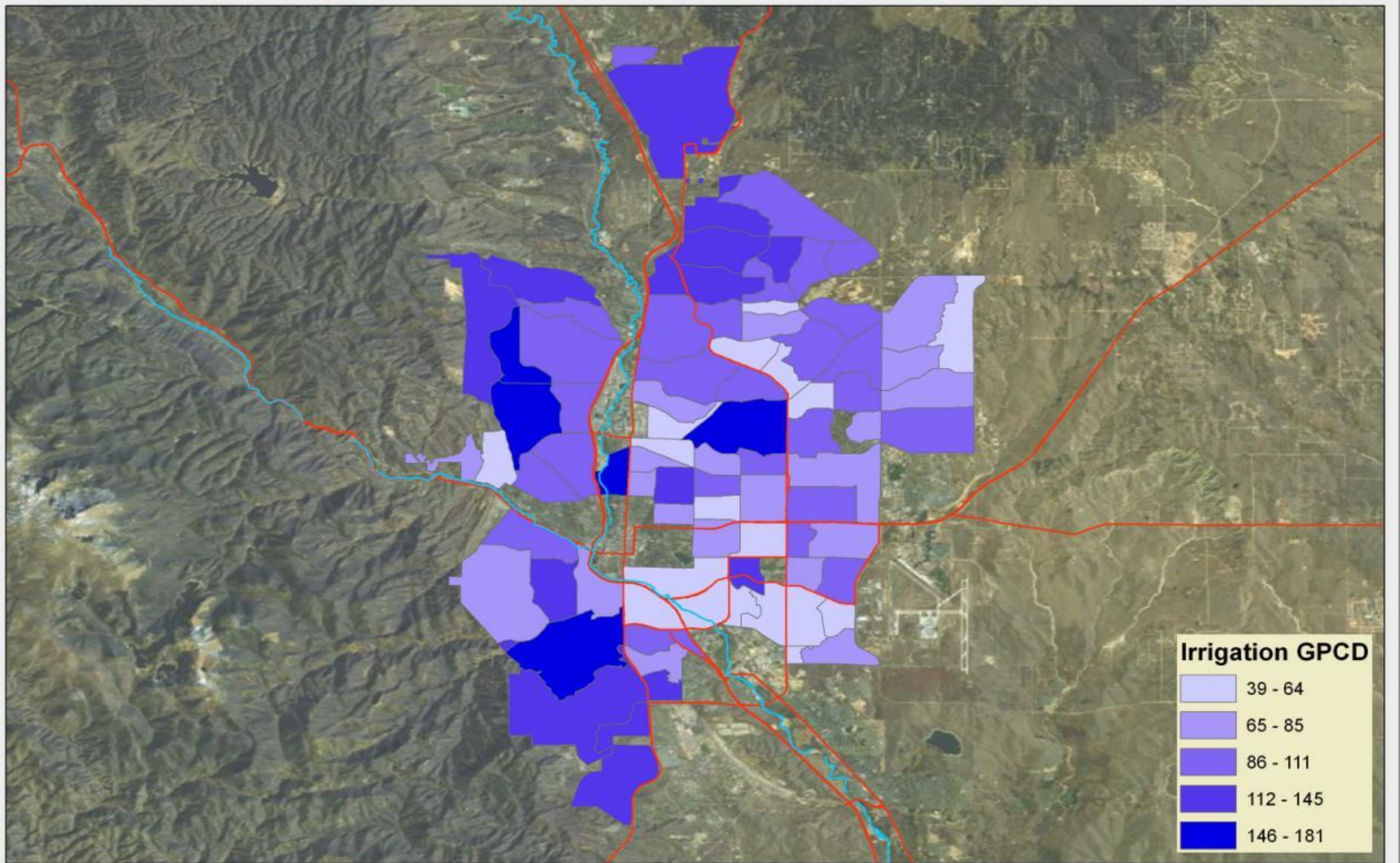


Winter GPCD	
	49 - 63
	64 - 72
	73 - 84
	85 - 101
	102 - 215



Single Family Residential GPCD November - March

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Single Family Residential GPCD Estimated Irrigation Use Only

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- Geographically Weighted Regression (GWR)
 - Local statistics versus global
 - Water use is spatially dependent
 - Spatial models improve explanation

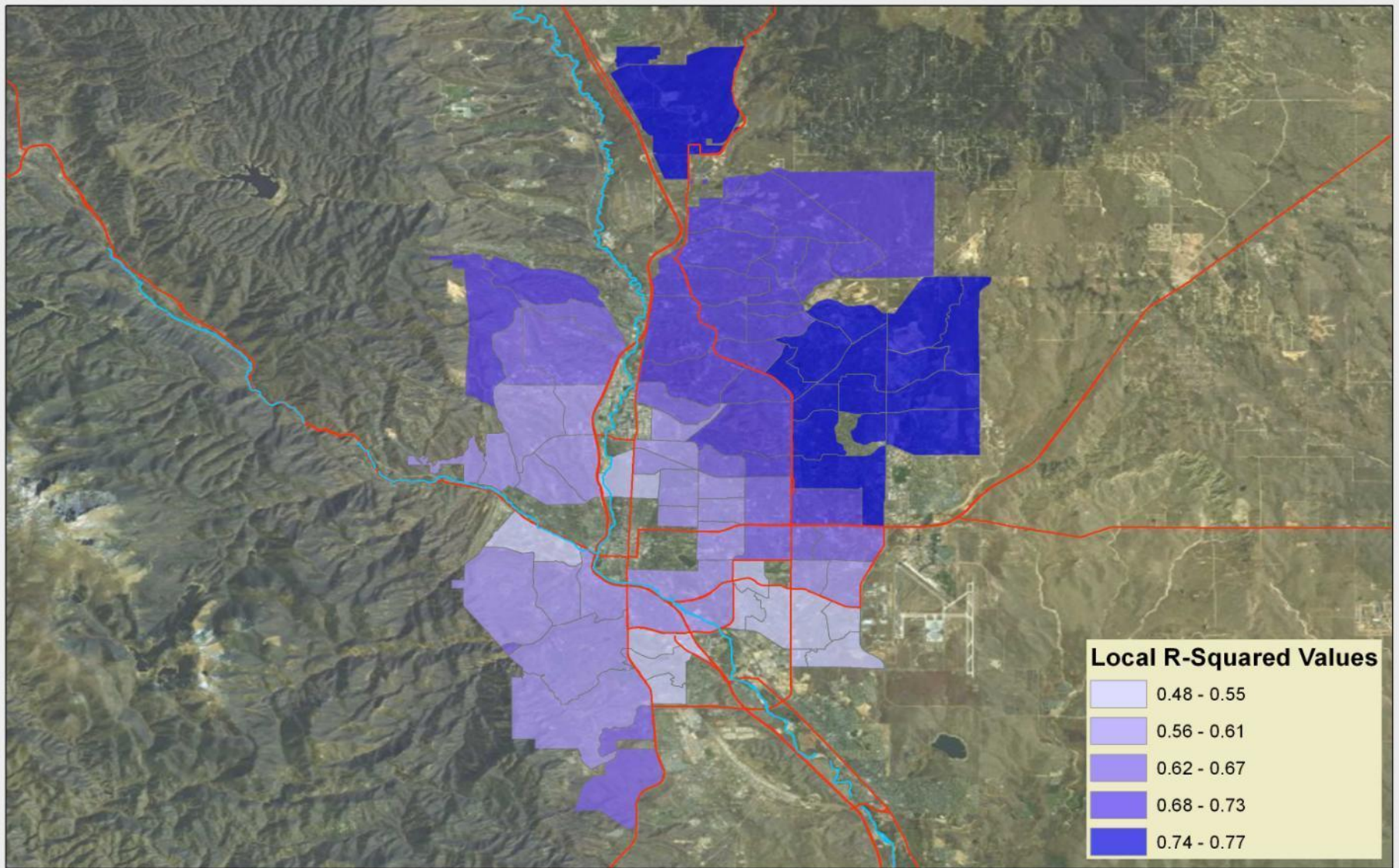
GWR Model Equation:

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

Model Explanatory Variables

- Gross evapotranspiration (Blaney Criddle)
- Effective precipitation (60% of total)
- Median lot size
- Average house age
- Average water price from previous bill

- R-Squared =.69 (OLS Model was .60)
- A 1-inch increase in gross ET results in an increase in use of 65.6 gallons/customer/day
- A 1-year decrease in house age results in a decrease of 1.3 gallons/customer/day
- A 1,000 square foot increase in lot size results in an increase of 7.2 gallons/customer/day
- An increase in effective precipitation of 1 inch results in a decrease of 32.1 gallons/cust/day
- An increase in price of 1 dollar per 1,000 cubic feet results in a decrease of 6 gallons/cust/day



Local R-Squared Values

	0.48 - 0.55
	0.56 - 0.61
	0.62 - 0.67
	0.68 - 0.73
	0.74 - 0.77



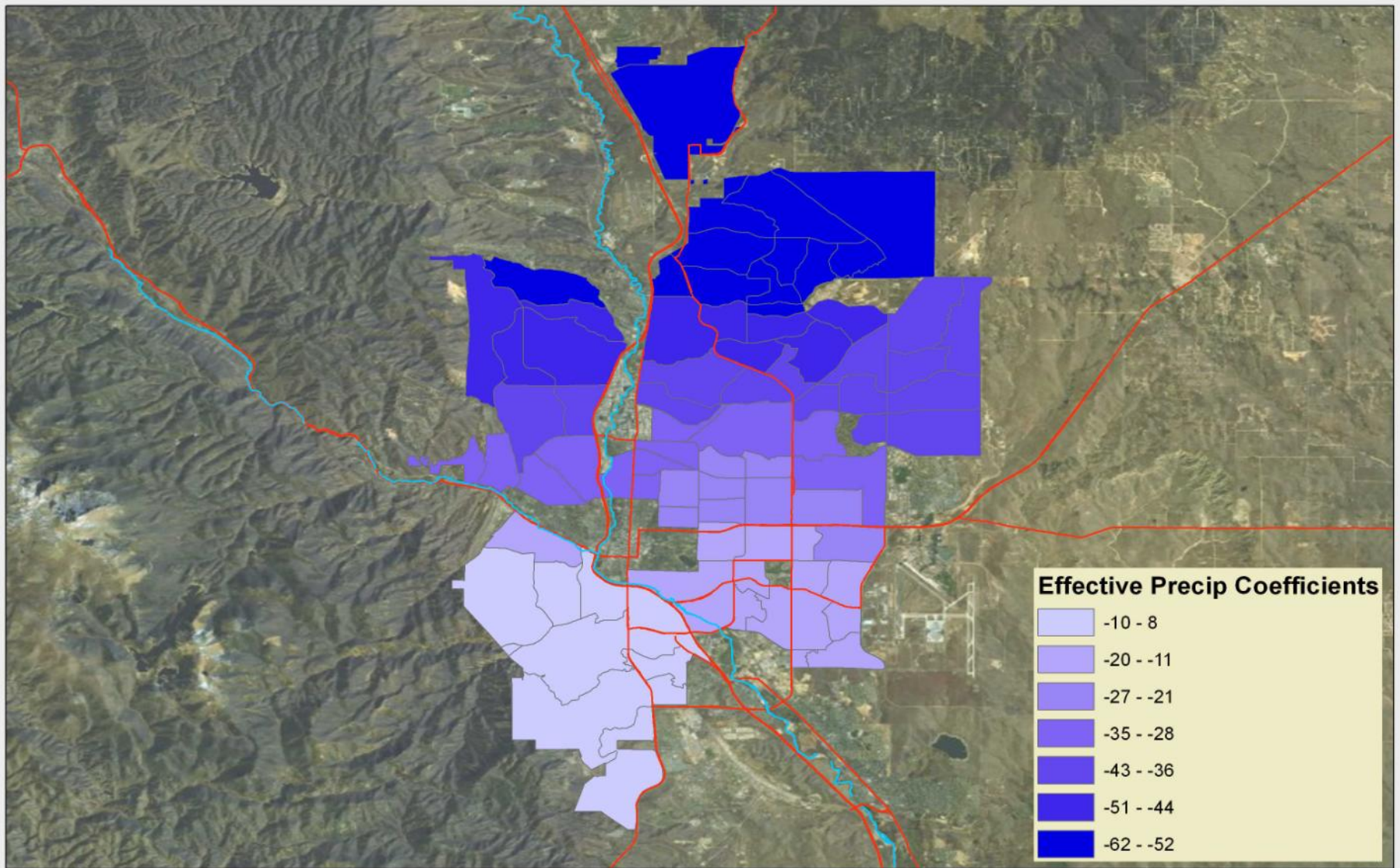
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0 0.5 1 2 3 4 Miles

Single Family Residential Water Use Model Local R-Squared Values



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0 0.5 1 2 3 4 Miles

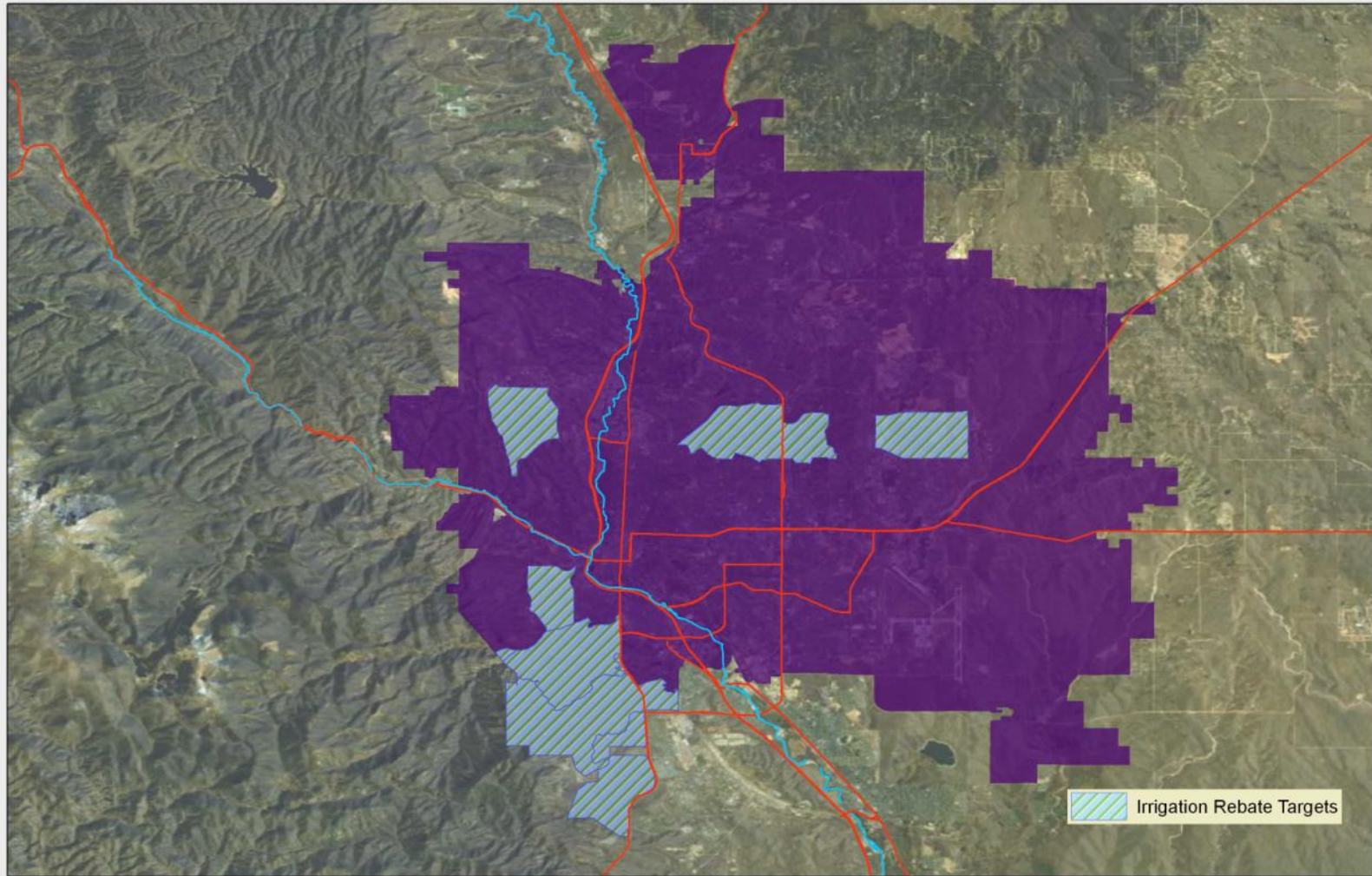
Single Family Residential Water Use Model Effective Precipitation Coefficients

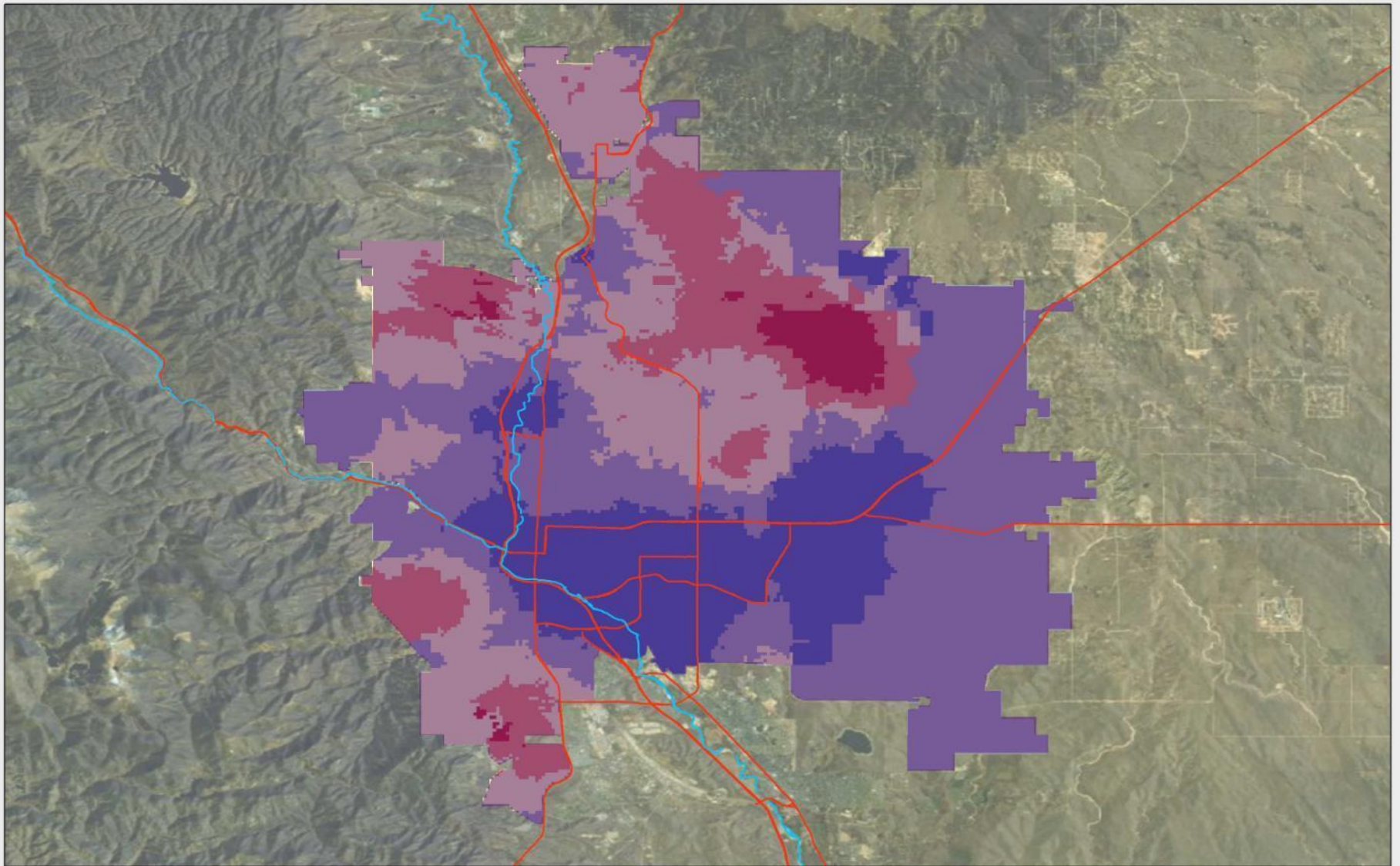
WaterSense Toilet Rebate

Savings per Day	52.43
Savings per Year	19,138
Engineering Estimate	8,522
Rebates Given	2,411
Annual Acre-feet	141
MGD	0.12

- Local weather data –
currently using airport data
- Irrigated area estimations –
currently using lot size
- 2010 Census block-level demographics –
currently using tract-level estimates
- Consider larger sample or population
- Consider post-drought variable
- Consider including drought period data

Rebate Target Analysis





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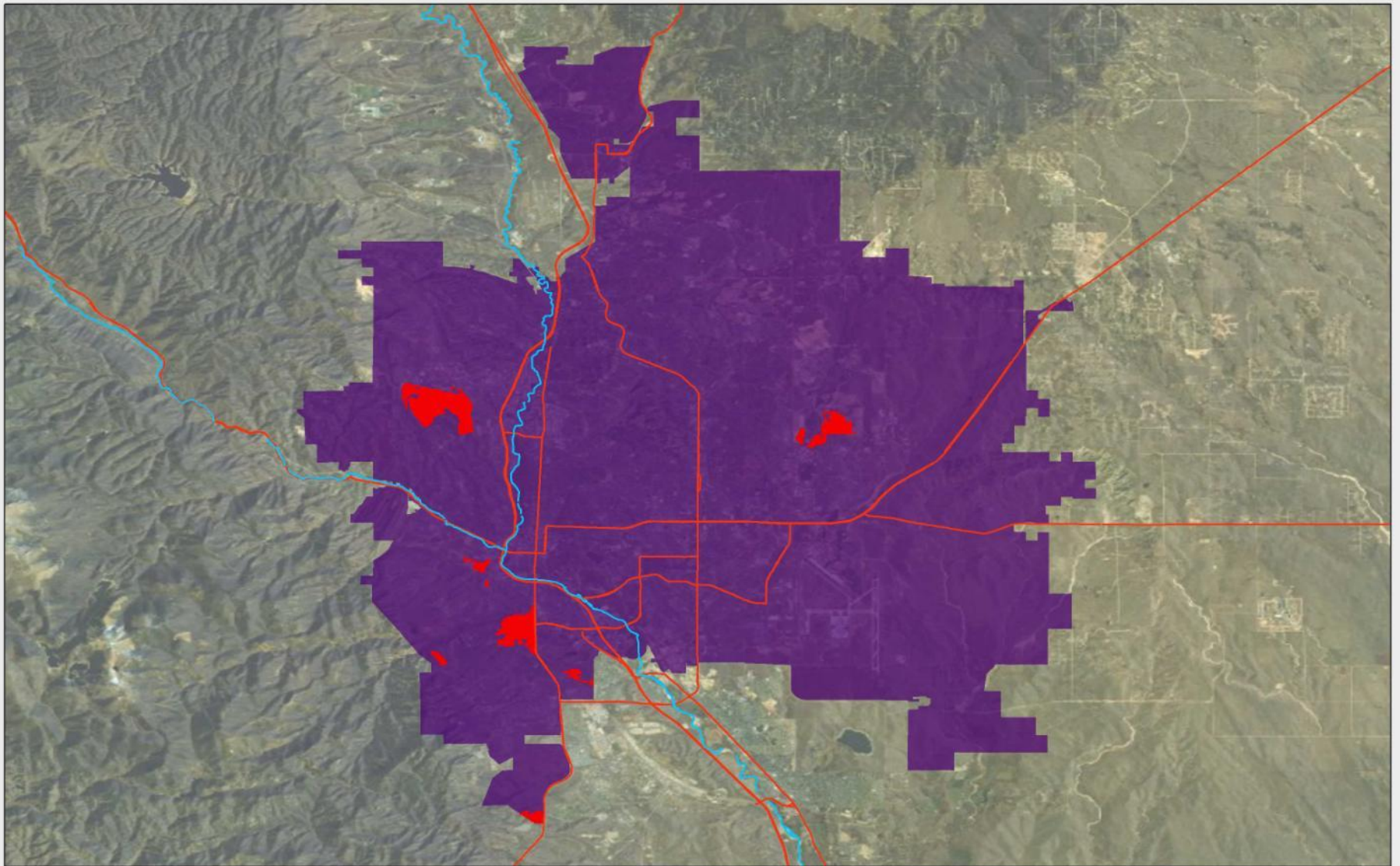
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0 0.5 1 2 3 4 Miles

Landscape Rebate Hot Spots 2002-2010

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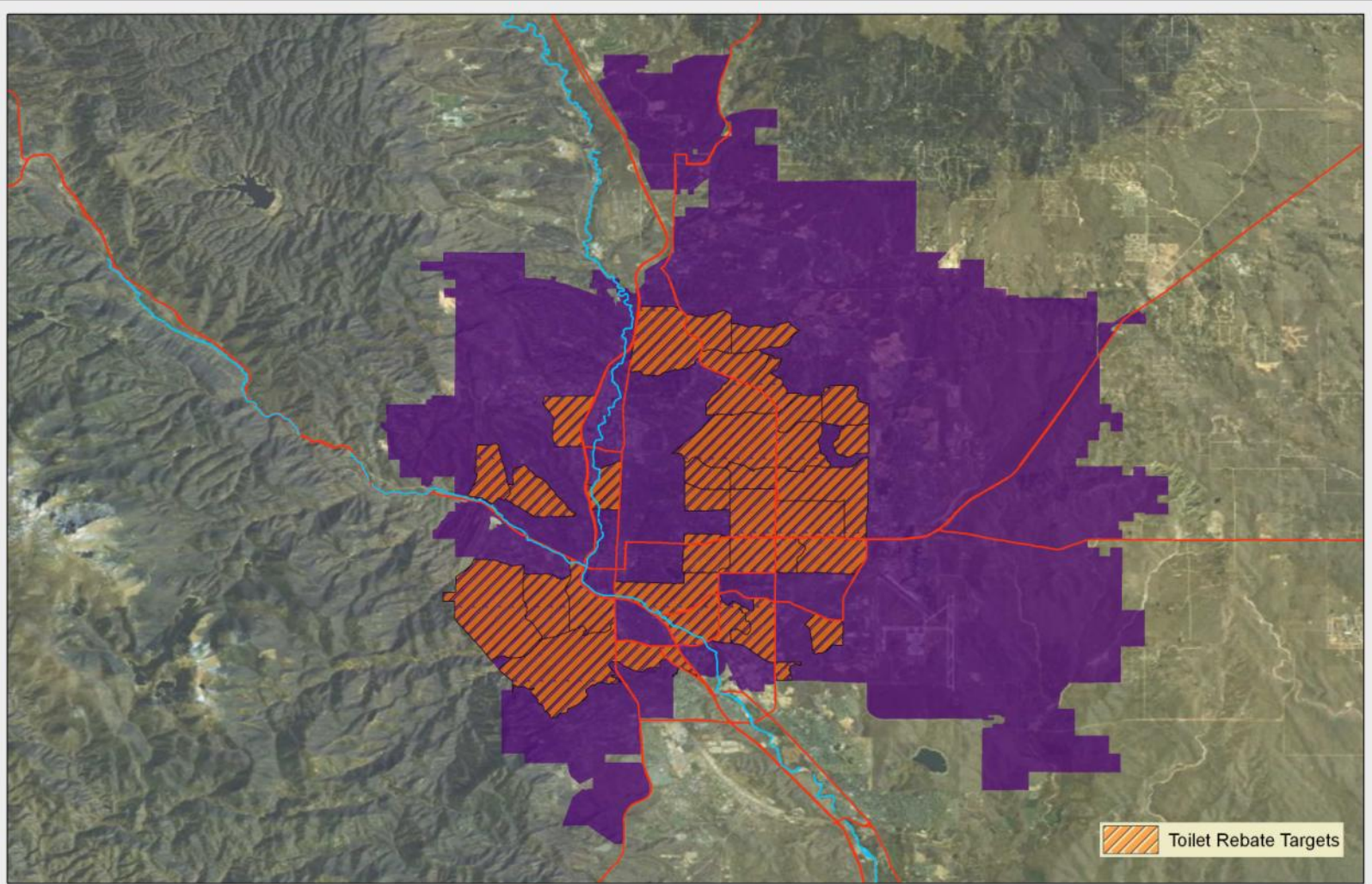
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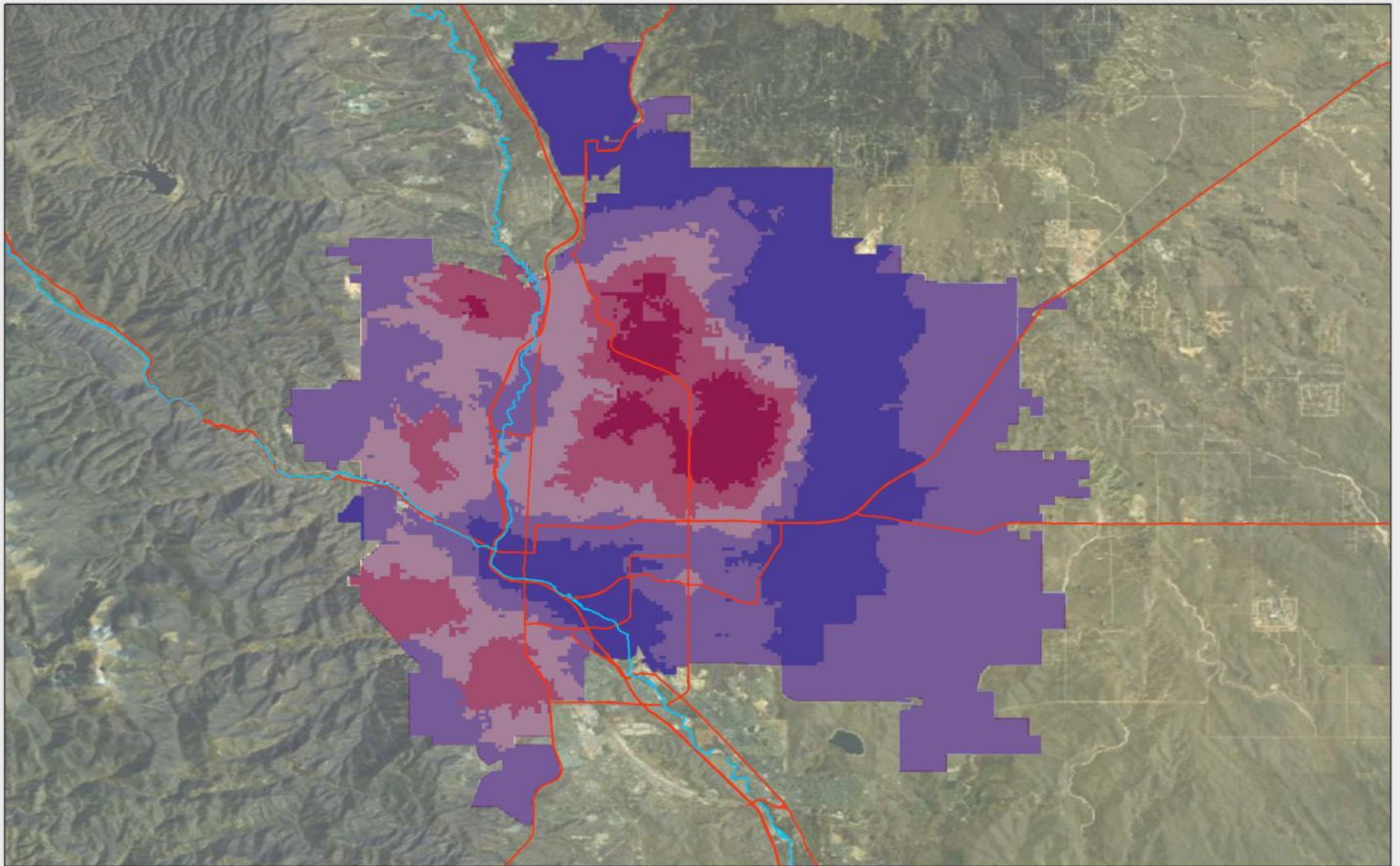
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Primary Irrigation Rebate Targets

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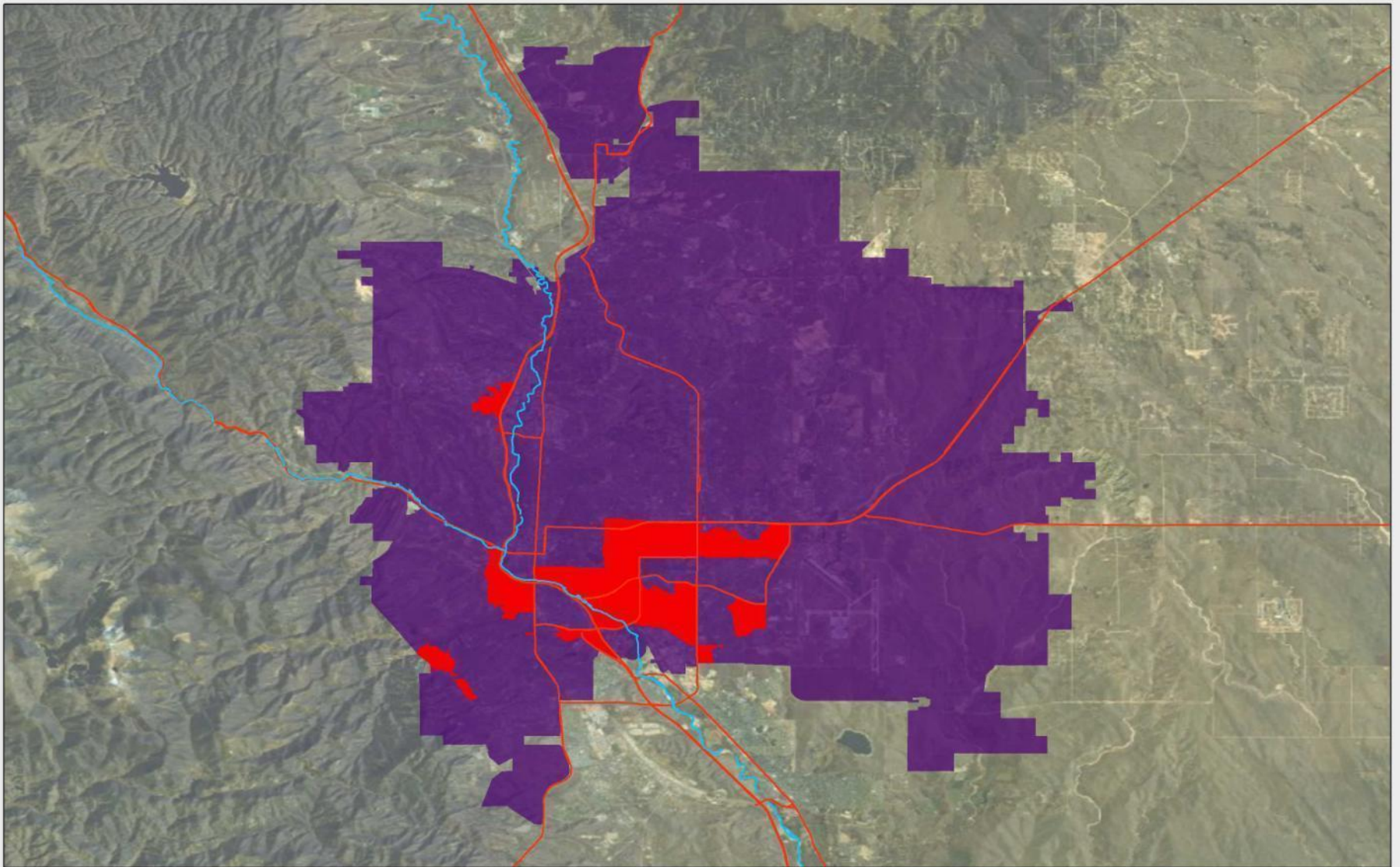
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Toilet Rebate Hot Spots

2002-2010

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0 0.5 1 2 3 4 Miles

Primary Toilet Rebate Targets

- Modify marketing or programming tactics to reach target markets
- Refine conservation savings assumptions
- Integrate spatial modeling techniques into resource and conservation planning efforts
- Mine data to improve models
- Develop new approaches to understand unknowns
- Model non-residential use by land use



Questions?

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SUSTAINABLE

KNOWLEDGE EXCHANGE

INTERNATIONAL CODE COUNCIL



**Meet Me at the Knowledge
Exchange, Located at Booth #102
in the WSI Expo.**

Date: Tomorrow

Time: 3 pm