



In Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy
Christa Brelsford

Will defend her dissertation

Whiskey is for Drinking; Water is for Fighting Over
Population Growth, Infrastructure Change, and Conservation Policy as
Drivers of Residential Water Demand

Abstract

The quote “Whiskey is for drinking; water is for fighting over”, often misattributed to Mark Twain, emphasizes the way people think about water in the western United States. As urban populations grow, water managers are becoming increasingly concerned about water scarcity. Historically, water managers relied on developing new sources of water supply to manage scarcity but economically feasible sources of unclaimed water are now rare, leading to conflict over existing supplies and an increased interest in demand side management. Water agencies in Las Vegas have developed many innovative demand side management strategies due to the cities rapid growth and limited water supply. In this dissertation, I address three primary questions. First, in the developed part of the Las Vegas Valley Water District service area, how did vegetation area change? To quantify changes in vegetation area, I develop the Matched Filter Vegetation Index (MFVI) from Mixture Tuned Match Filtering estimates of vegetation area calibrated against vegetation area estimates from high resolution aerial photography. In the established city core, there was a small but significant decline in vegetation area. Second, how much of the observed decline in per capita consumption can be explained by Las Vegas land use, land cover, and physical infrastructure change that resulted from extensive new construction and installation of newer water conserving technology, and how much can be attributed to water conservation policy choices? I perform a formal regression analysis followed by an analysis of several counter-factual scenarios analysis to decompose reductions in household water into its constituent parts. The largest citywide drivers of change in water consumption were increased water efficiency associated with new construction and rapid population growth. In the established urban core, the most significant driver was declining vegetation area. Finally, I quantify water savings generated by the Water

Smart Landscaping (WSL) program, a conservation program that provides incentives for homeowners to convert grass into desert landscaping. In the city core, 82 gallons of water are saved in June for each square meter of landscape converted under the WSL program in the first year after the landscape conversion, but the savings attenuate to 33 gallons per meter converted as the landscape ages. For every \$4,850 that was spent incentivizing landscape conversions, enough water in June is saved to support the June consumption of one household living in a newly constructed home. This shows that it is possible for voluntary landscape conversion programs to generate substantial water savings. The most significant result that water policy makers should take from this dissertation is that the most effective way to ensure long term, sustainable reductions in water consumption in a growing city without resorting to politically risky water price increases is to support and incentivize the construction of water efficient infrastructure. In this way, water efficiency can be built into the infrastructure of the city as it grows, rather than requiring expensive retrofits to existing infrastructure.

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1:30 PM
WGHL, room 323

Faculty, students, and the general public are invited.

Supervisory Committee:
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