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Evaluating the Impact of Water Waste Enforcement in Southern Nevada Landscapes

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Introduction

- Southern Nevada water challenges
 - Fastest growing metropolitan area in US
 - Hottest, highest evaporation areas of US
 - Limited water supplies
- Urban landscape irrigation
 - Subject to frequent drought
 - Low Colorado river flows
 - Demand exceeding supply
 - Water conservation critical



Introduction

- Southern Nevada Water Authority Water Conservation
 - Sophisticated and diverse water conservation programs
 - Water waste enforcement program highly developed
- Las Vegas Valley Water District
 - Sophisticated water waste enforcement program



Introduction

- Water waste enforcement
 - Issuing citations to end users in violation of watering restrictions
 - Violations related to maintenance issues, such broken, mis-aligned heads, stuck valves, leaks
 - Also violations related to management, such as time of day, day of week, over irrigation
- Evaluate effectiveness of water waste enforcement program important in terms of actual water savings

Objectives

- Goal: determine the effectiveness of water waste enforcement
- Specific objectives
 - Compare water savings in violator population (for all types) to non-violator population
 - Compare water savings in violator population to a population of non-violating neighbors (word of mouth effect)
 - Determine if patterns in water use can be explained through other variables

Methods: Water Waste Enforcement

Broken Sprinkler Head (BSF)	Sprinkler head is broken
Day of Week (DWF)	Non-compliance with watering assignments restricting which days of the week a particular property can irrigate..
Hose left running	Hose left to flow unattended.
Irrigation System Leak (ISF)	Irrigation system is leaking.
Misaligned Sprinkler Heads (MAF)	Sprinkler heads are adjusted improperly and spray off the property.
On Site Leak (OLF)	Failure to repair a malfunctioning device or supply line for more than 48 hours.
Over Irrigation (OIF)	Any LVVWD water allowed to flow or spray off the property.
Pool Draining (PDF)	Discharging swimming pool or spa water off the property where discharge into the sanitary sewer is available
Stuck Valve (SKF)	Valve does not close and irrigation system continuously runs.
Time of Day (TDF)	Using sprinklers between 11 a.m. and 7 p.m. from May 1 until September 30.

Methods: Enforcement Procedure

- Water waste reported
- Waste at site inspected, visually recorded
- If clear violation, warning letter sent
- If no action taken, fee assessed
 - \$20 for first violation
 - If continued no action, a second violation letter issued and fee assessed and doubled

Methods: Data analysis

- Violators selected from September/ October 2003, time of peak violations
- Water billing data-set for 1038 end users with violations, and comparison/control group of 1038 without (non-paired)
- Subset of violators (709) water users compared to neighbors (paired)
- Water use comparison
 - Total yearly water consumption
 - Pre violation use, average of 2001 and 2002 compared to post violation use, 2004

Methods:

Data Analysis

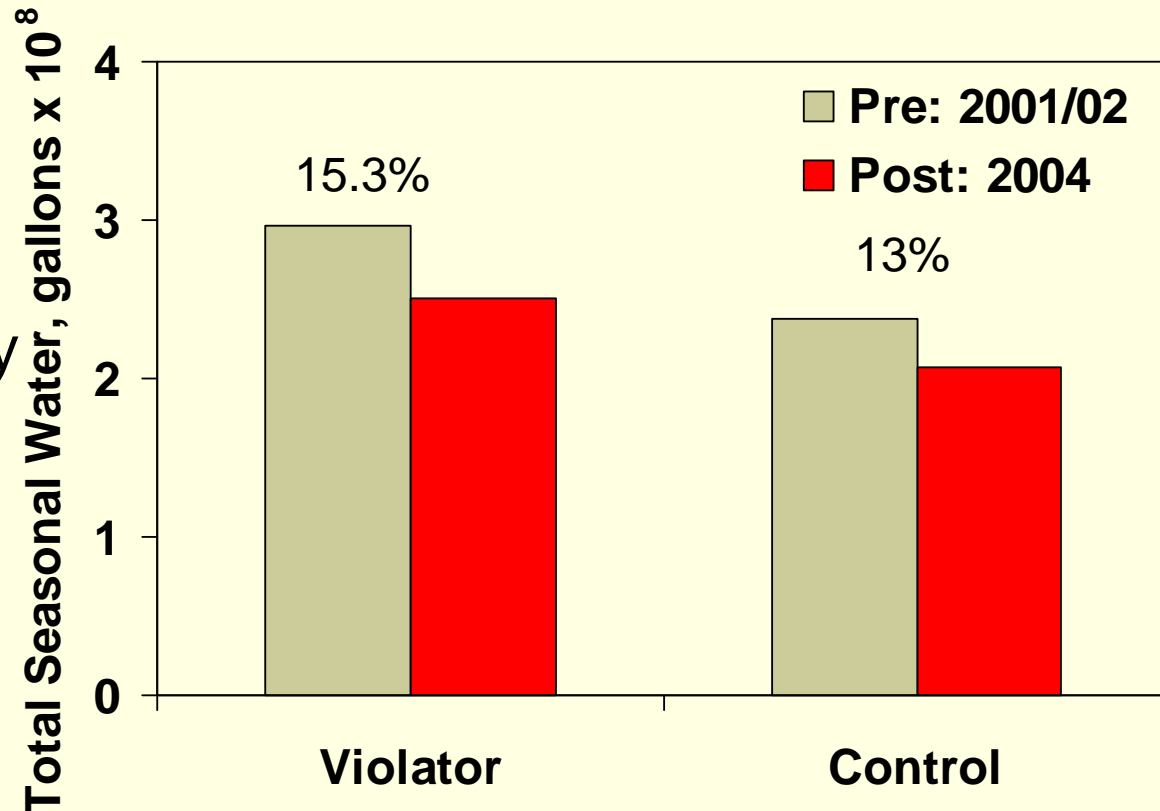
- Related absolute water use and change in water use to other variables
 - Age of house, sales value, landscaped area
 - Converted to depth units of water based on landscaped area, subtracting out indoor consumption
- One-way ANOVA used for comparing:
 - % savings between violator and comprehensive non-violator populations
 - % saving among violator, comprehensive non-violators, and non-violating neighboring populations
 - % savings among the different violation types

Results

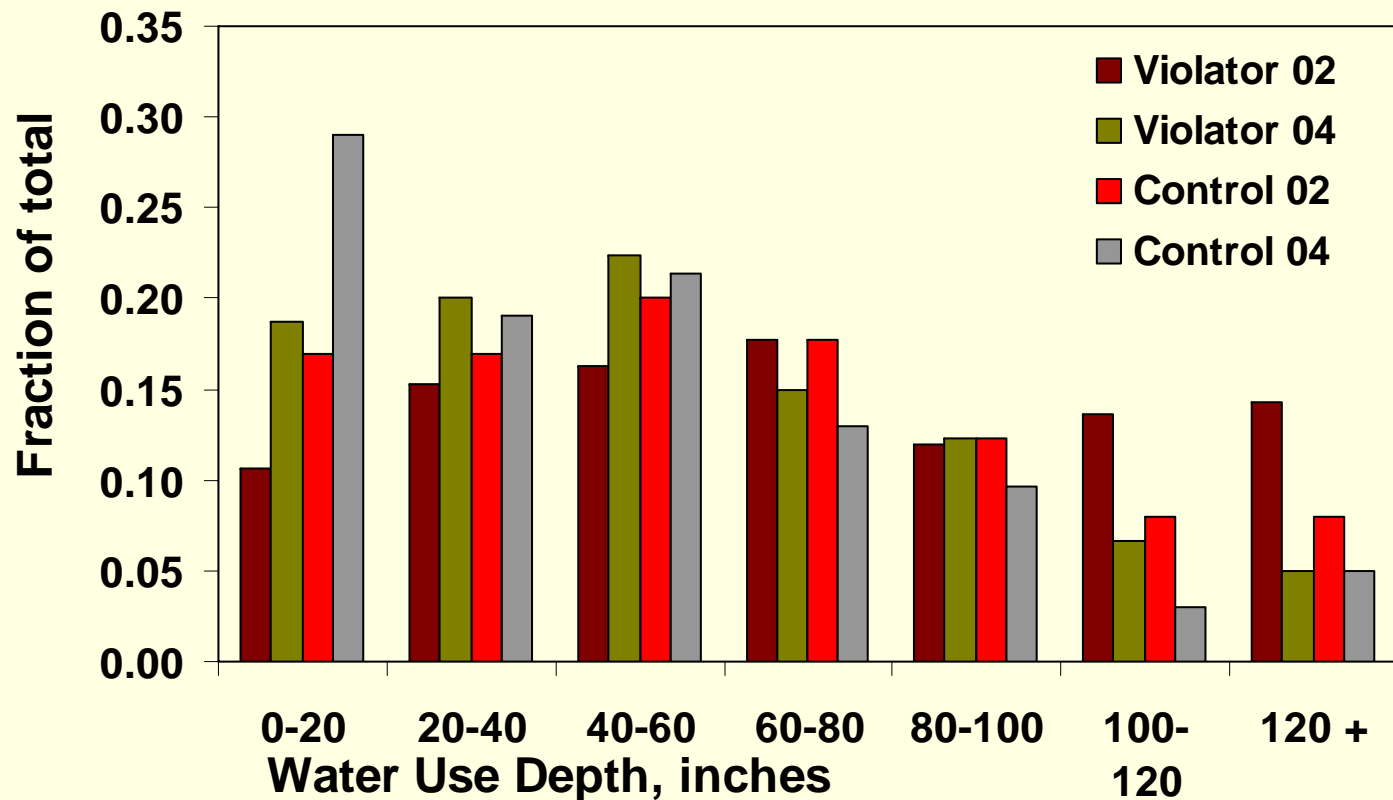
- Population characteristics
 - No differences in average landscaped area:
violator=4,142; control=4,145
 - Minimal differences in sales price:
violator=\$177,000; control =\$166,000
 - No differences in average age of construction:
1990
- Water use and water savings not related to
population characteristics

Comprehensive Violations: Violator vs. Non-violator Populations

- Both violator and non-violator populations (n=1039) reduced water post violation
 - Violators saved ~45 M gal, non-violators saved 31 M gal
 - But, violators used nearly 50 M gal more than non-violators initially
- Violators reduced water use 2.3% more than control ($P < 0.05$)



Water Use Converted to Depth Units

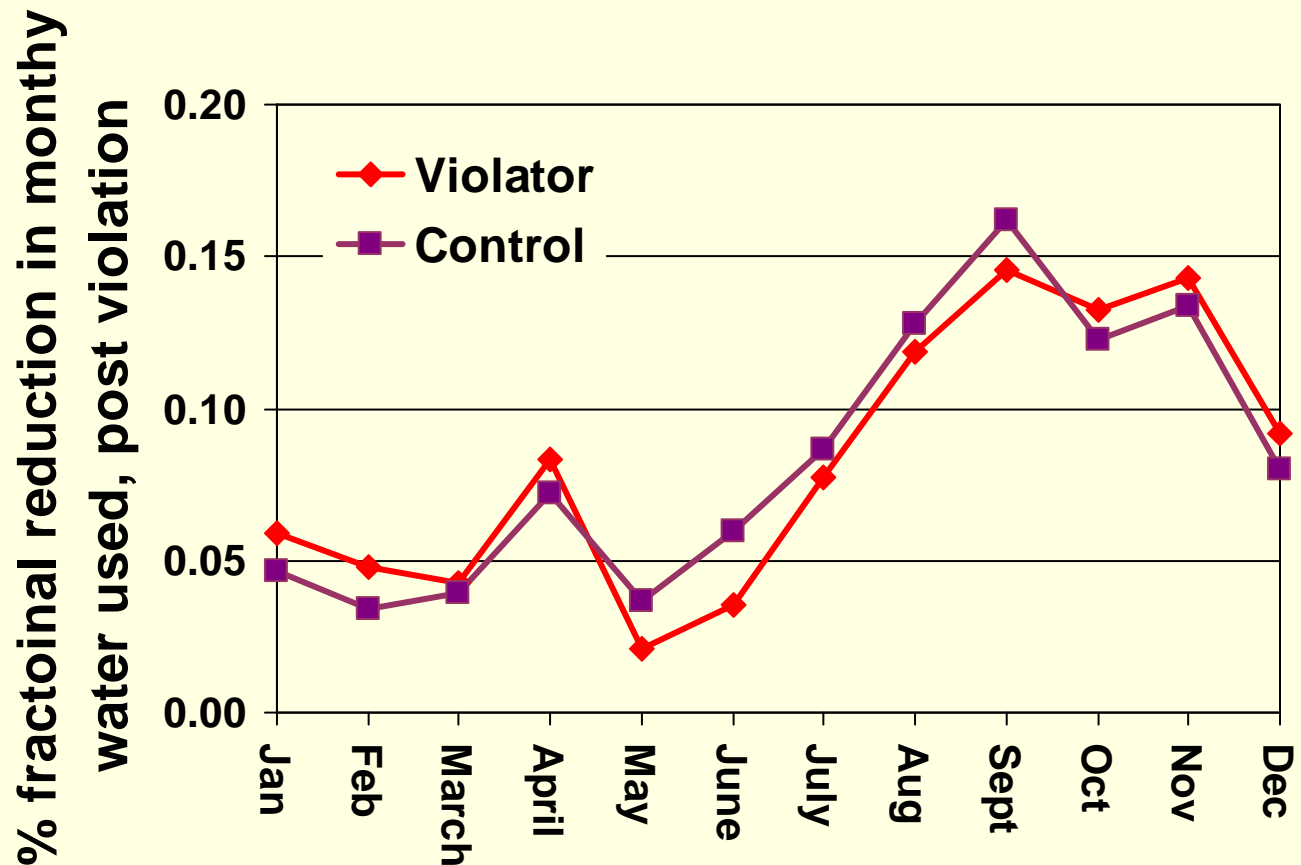


■ More of violator population consuming more

Comprehensive Violators

Monthly Water Savings

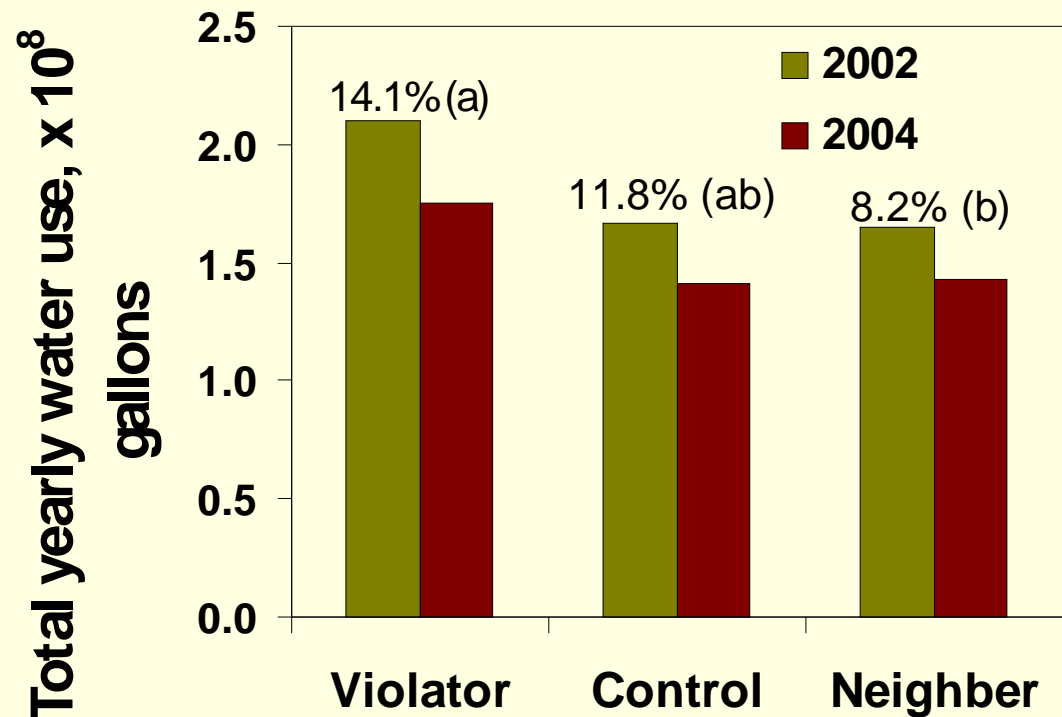
- Most savings occurred in the Fall
- Least savings in spring /early summer



Neighbor Effect

- All populations (n=709) reduced water use in 2004
- Violator population greatest reduction in water use
- No apparent neighbor effect

■ Neighbor reduction significantly less than violator population



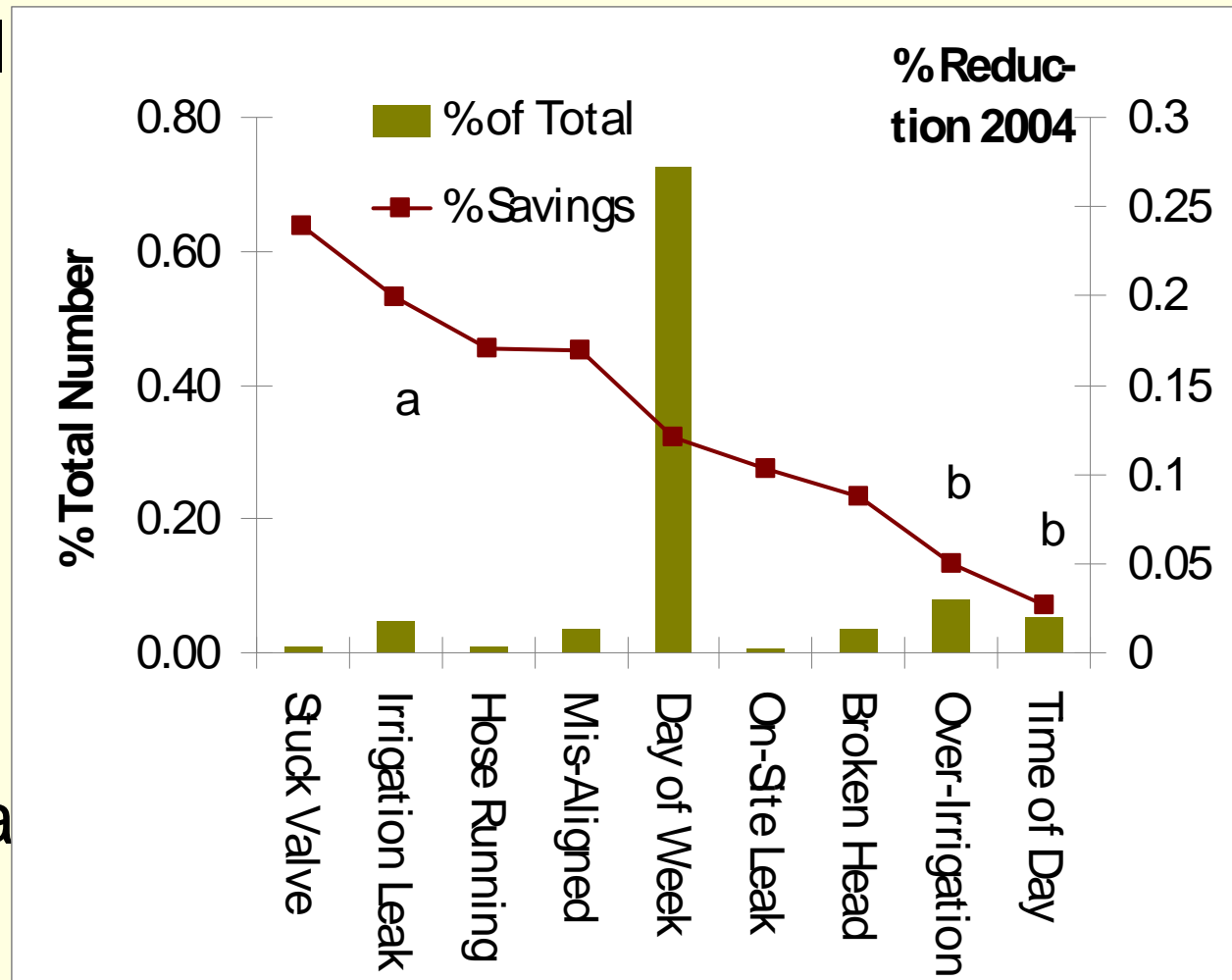
Comprehensive Violators

Violation Type

■ Day of week most common violation

■ Mechanical irrigation system violations did result in water savings

■ Behavioral violations had minimal savings



Conclusions

- Water waste enforcement did have significant and measurable savings
- Mechanical violations saved the most, behavioral the least
- No neighbor effect
- Water waste enforcement part of larger, integrated water conservation plan
 - Effect similar to traffic police: existence contributes to compliance
 - Positive public perception of fairness