

On-site Water Reuse Feasibility Studies in Fort Collins, Colorado



**Colorado
State**
University

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Agenda

- Introduction
- Objectives
- Study Approach
- Data Needs
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- Questions

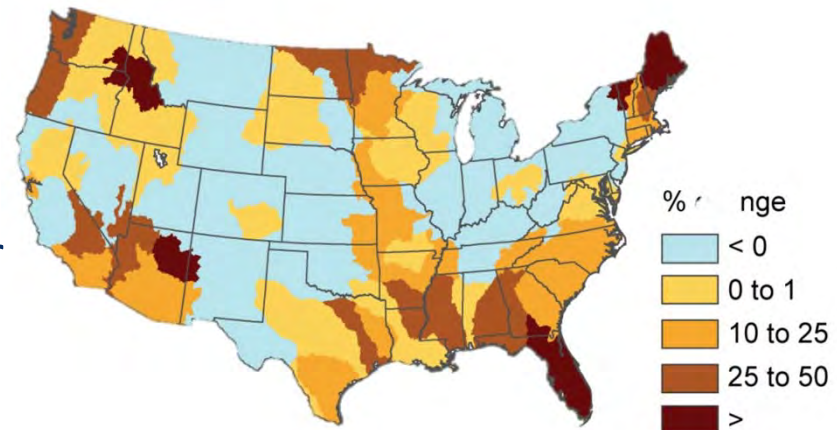


Introduction

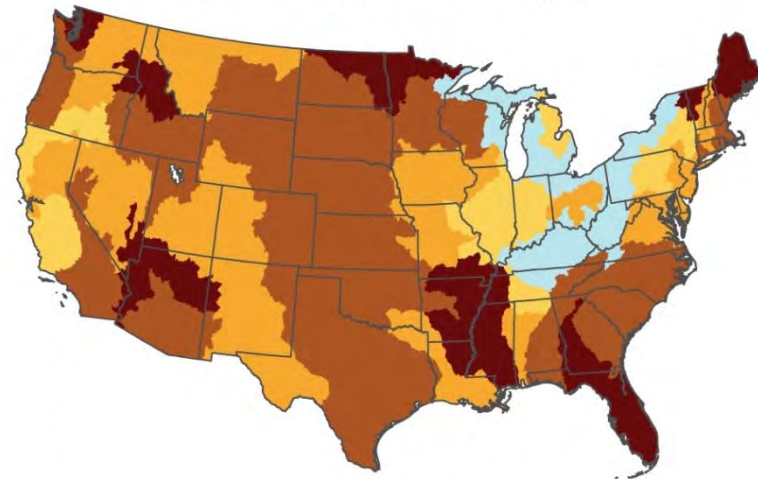
- Water conservation technologies are becoming increasingly important due to growing populations and increased water demands in U.S.
- Climate change affects the freshwater supply by causing less runoff due to increasing temperatures and evapotranspiration, and decreasing precipitation.
- Water supply shortage is especially prevalent in the southwestern region of the United States.

Projected Changes in Water Withdrawals

(a) Without Climate Change



(b) With Climate Change



Source: Brown et al. 2013

Commercial facilities can reduce potable water demand by reusing sources of low-strength wastewater for non-potable applications.

Regulation 84

Reclaimed Water: Domestic wastewater that has received secondary treatment by a domestic wastewater treatment works and such additional treatment as to enable the wastewater to meet the standards for approved uses.

Approved Uses: Industrial, landscape irrigation, agricultural irrigation, commercial, and fire protection

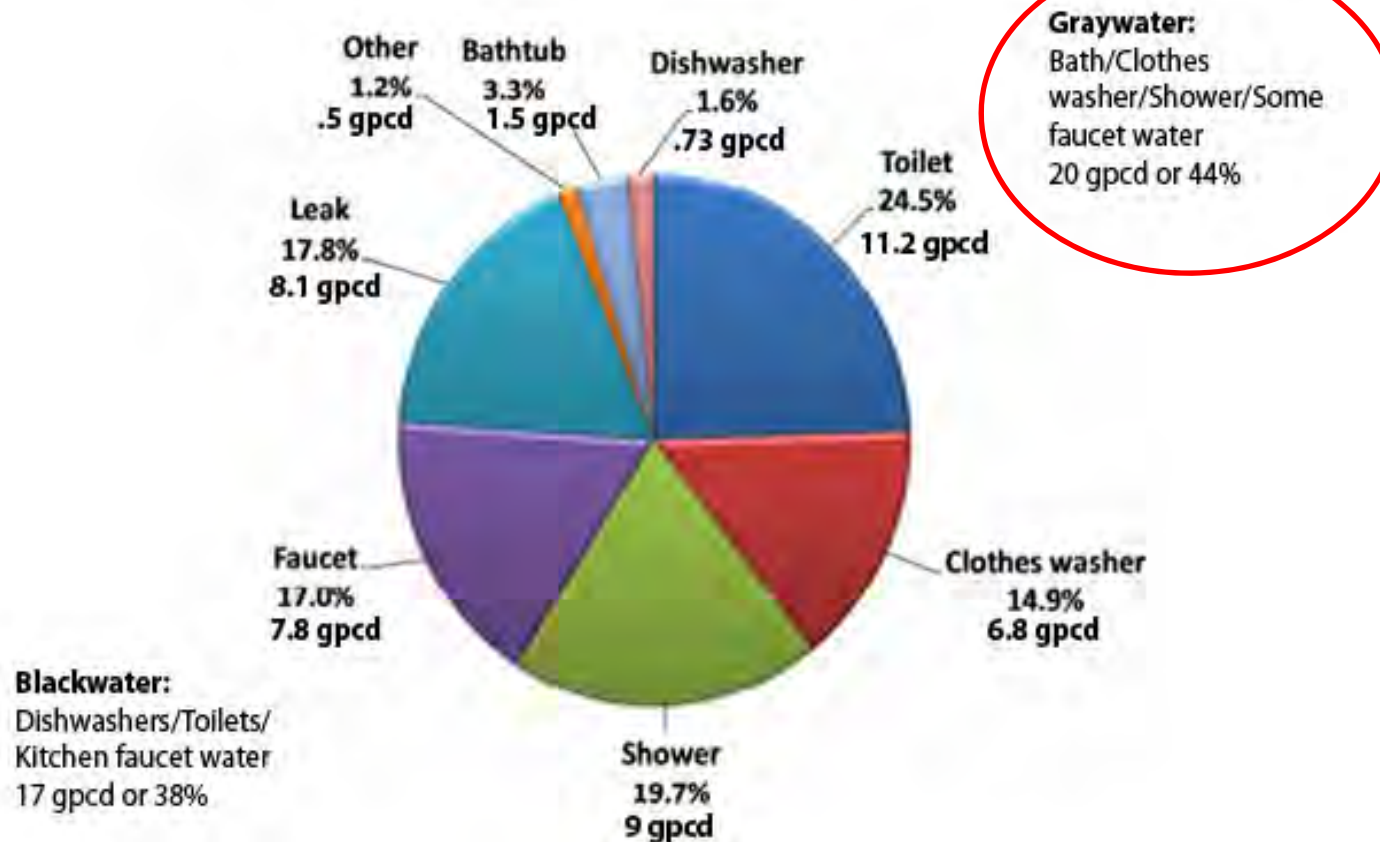
Regulation 86

Graywater: Wastewater from bathroom and laundry room sinks, bathtubs, showers, and laundry machines. Not including wastewater from toilets, urinals, kitchen sinks, dishwashers, or nonlaundry utility sinks.

Approved Uses: Subsurface irrigation, toilet and urinal flushing

Graywater Production

Household Water Balance

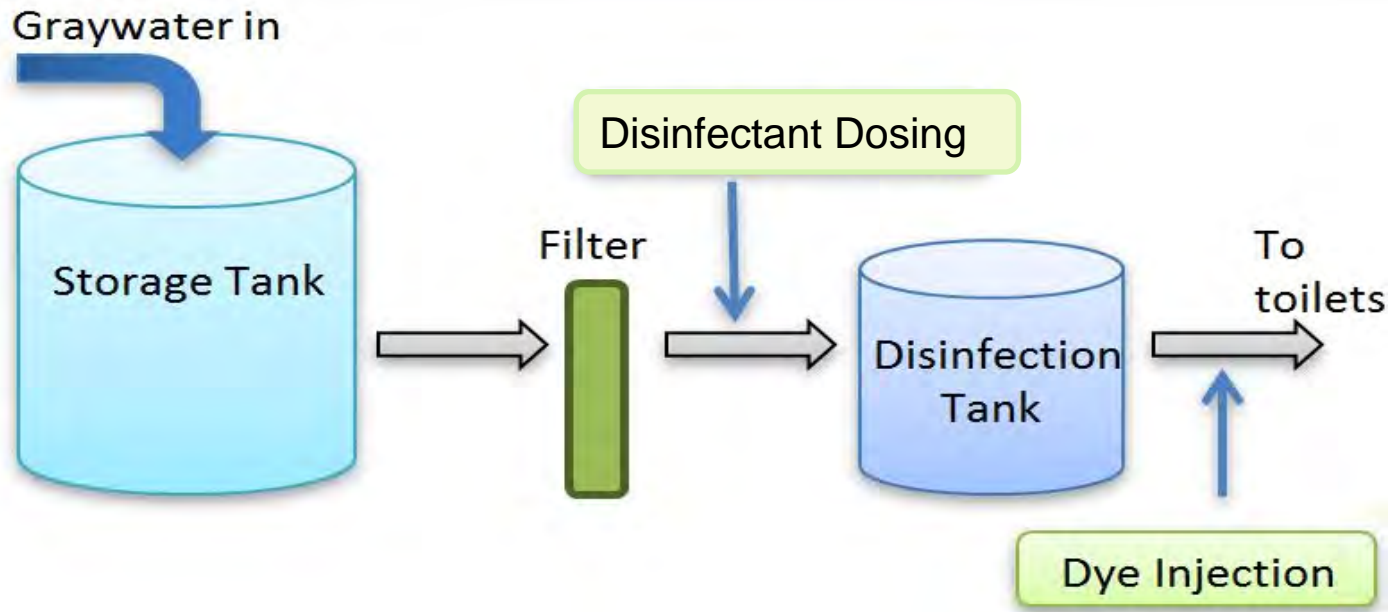


Average Indoor Residential Water Use for the City of Fort Collins (REUWSU Fort Collins, 2012)

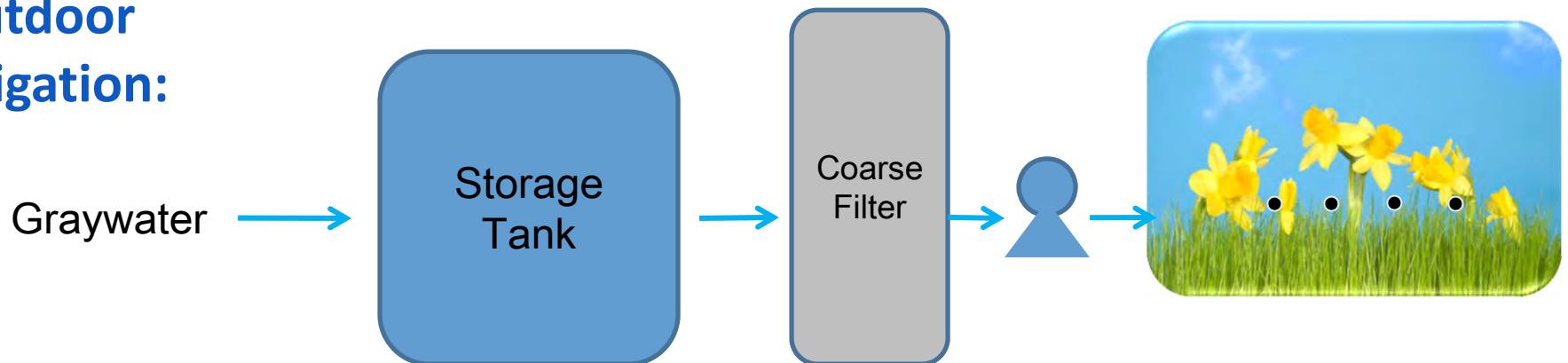
But what about water balance at commercial facilities?

Graywater Treatment

Toilet Flushing:



Outdoor Irrigation:



Objectives

City of Fort Collins Utilities was interested in researching commercial customers who may be good candidates for water reuse in efforts to:

1. Promote water conservation
 2. Reduce the strain on freshwater supplies
- Gauge feasibility of on-site reuse methods
 - Estimate water balance between graywater supply and demand
 - Estimate potential water savings



Study Approach

- Call for participation letter sent to Fort Collins businesses explaining the study and it's benefits.
- Meetings held at interested facilities.
- Water use trends discussed, graywater sources and applications identified.
- Tour of facility to note plumbing layouts and fixture locations.
- Action items and data needs acknowledged.
- Calculation of potential water savings.

Data Needs

On-site Water Reuse Commercial Customer Feasibility Studies, City of Fort Collins, Colorado

Data Needs

Fixture Counts

Toilets
Urinals
Showers
Bathtubs
Sinks
Laundry Machines
Dishwashers
Lab ware
Spray Nozzles

Fixture Flow Rates

Manufacturer and Model Number Information (If flow rates unknown)

Size of Irrigable Land

Daily Occupancy of Facility

Total Annual Water Use

Reusable Water Quality

Chemicals
Hazardous Wastes
Biological Load
Organics

Water Sample (If quality is unknown and waste stream constituents are estimated to be significant)



Recreational Pool



Site Description: Indoor pool, male and female locker rooms. Sees approximately 350 visitors daily.

Reusable Water Sources:

Locker room shower effluent

- 16 showers
- 2 GPM shower heads

Reuse Application:

Toilet flushing

- 12 toilets, 6 urinals
- Toilet: 1.6 GPF
- Urinal: .125 GPF

Considerations and Assumptions:

Regulation: 86

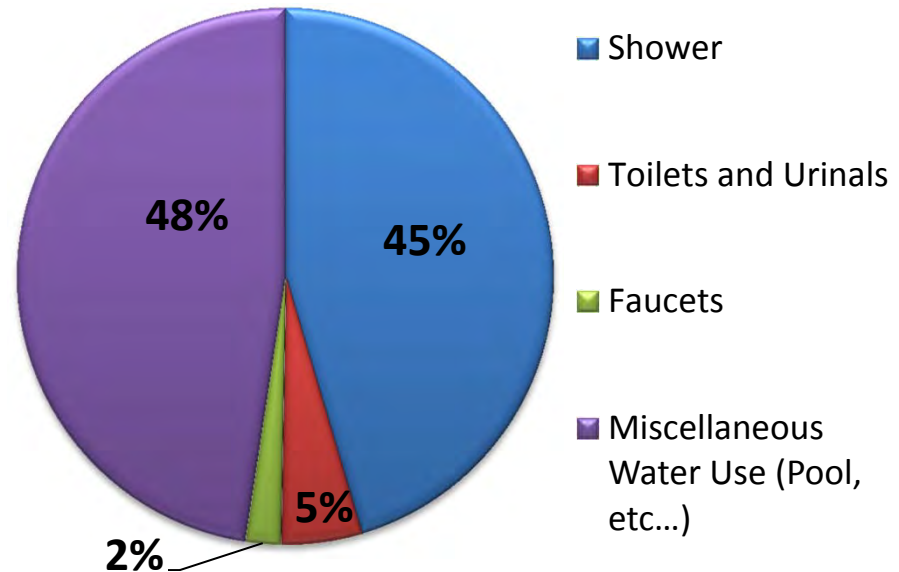
Four-minute shower

50% of visitors shower

Equal amounts male and female visitors

One toilet or urinal flush per visit

Recreational Pool Water Use



5%
110,184 gallons/year

Office Building



Site Description: Large office building complex, 1,700 employees on-site daily.

Reusable Water Sources:

Locker room shower effluent

- 20 showers
- 2 GPM shower heads

Reuse Application:

Cooling towers

- Two large towers
- Use 47,121 GPD

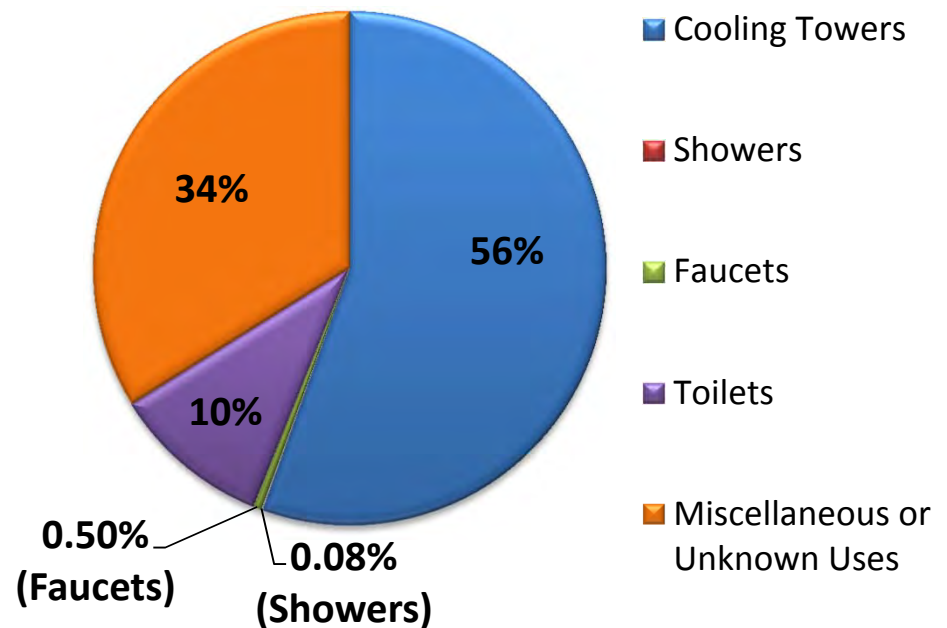
Considerations and Assumptions:

Regulation: 84

Shower frequency measured by two-week tally period in locker rooms

Four-minute shower

Office Building Water Use



.08%
25,550 gallons per year

Research Lab



Site Description: Large research lab

Reusable Water Sources:

Autoclaves, glassware washers, dishwashers

- 2 autoclaves
- 2 glassware washers
- 6 dishwashers

Reuse Application:

Cooling towers

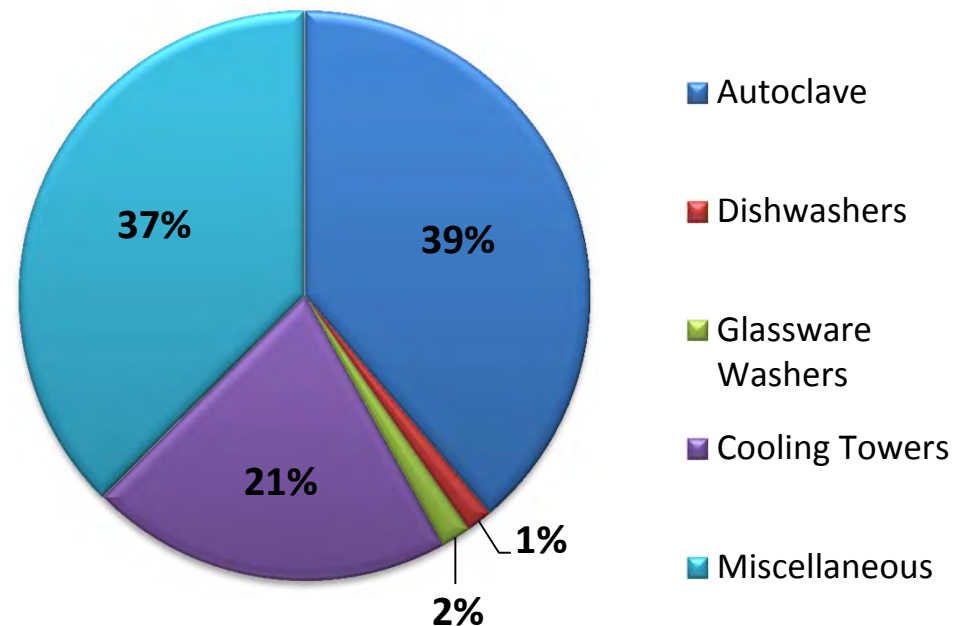
- Cooling tower 1: 12,200 GPD
- Cooling tower 2: 213 GPD

Considerations:

Regulation: 84

Plant hormones and growth media present in wastes streams

Research Lab Water Use



21%
148,956 gallons per year

Athletic Center



Site Description: Full –service gym including pool, sees 1,100 visitors, 364 days out of the year

Reusable Water Sources:

Shower and laundry effluent

- 14 showers
- 1 industrial washing machine
- 24 loads daily

Reuse Application:

Indoor toilet and urinal flushing

- 14, 1.6 GPF toilets
- 3, .125 GPF urinals

Considerations and Assumptions:

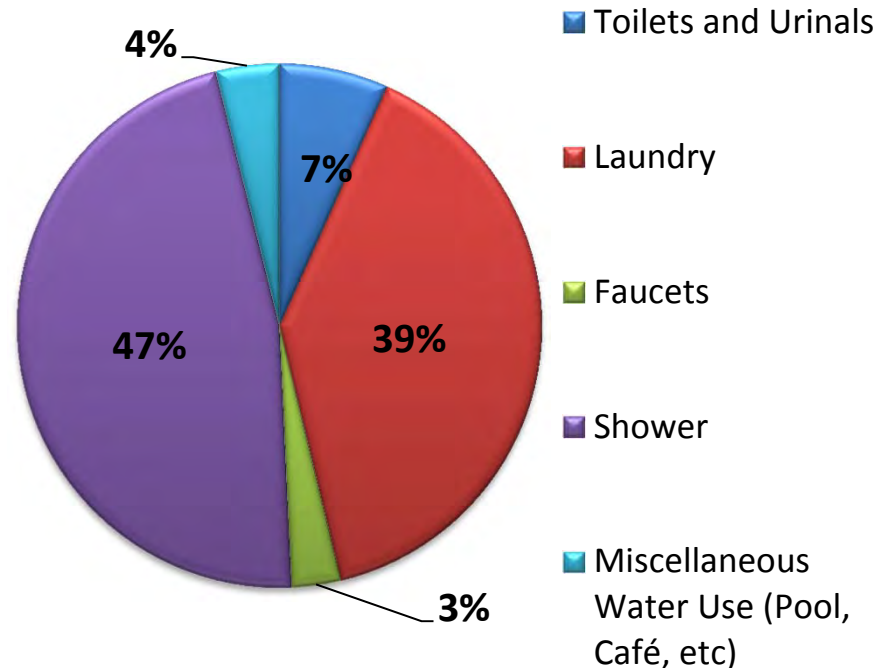
Regulation: 86

50% of gym attendees flush

25% of gym visitors shower

Four-minute shower

Athletic Club Water Use



7%
173,147 gallons per year

Hotel



Site Description: Large hotel, 254 rooms

Reusable Water Sources:

Laundry machine effluent

- Two industrial washing machines
- 15 loads daily
- **Showers**

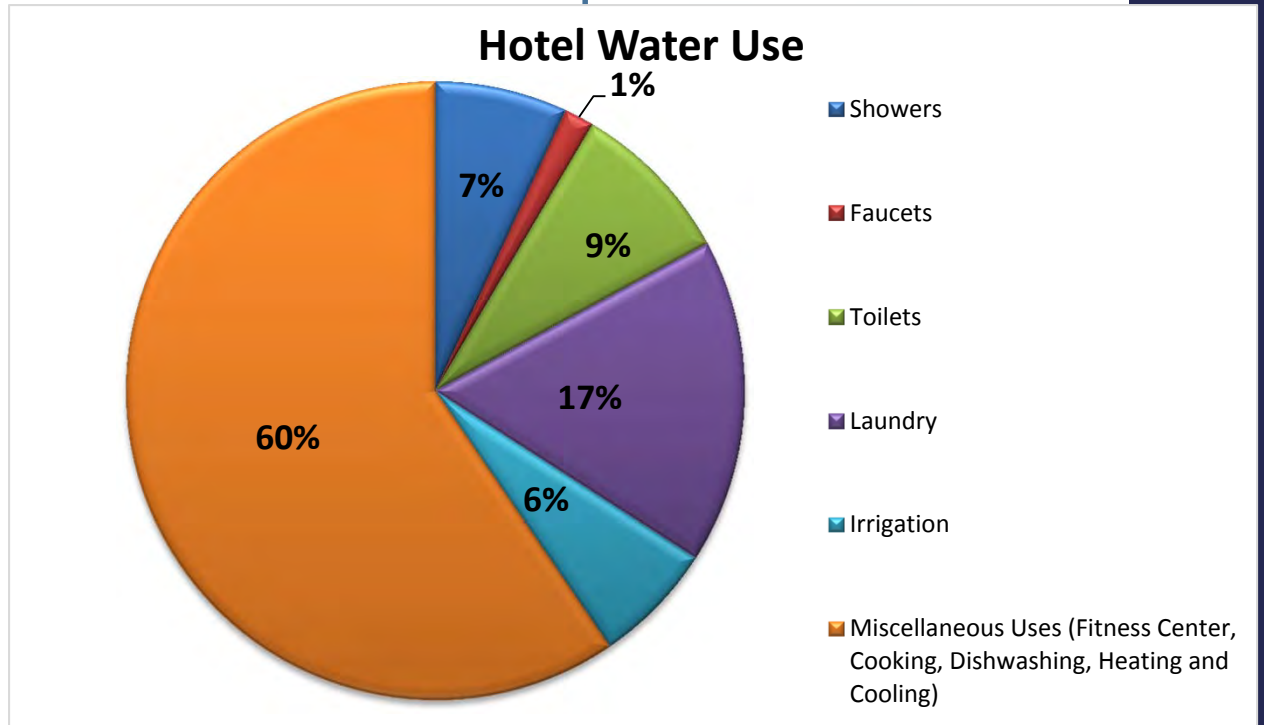
Reuse Application:

Outdoor drip irrigation

- 1 acre irrigable land
- Currently irrigating with drip lines
- **Toilet Flushing**

Considerations and Assumptions:

Regulation: 86



11%
1,296,000 gallons per year

7-9%
~1,024,128 gallons per year

Brewery 1



Site Description: Brewery currently reuses city water three times before going to the drain for cooling vacuum pump, bottling rinsing, and external bottle rinse off.

Reusable Water Sources:

External bottle rinse off effluent

- Water sample: 700 mg/L COD
- High organics
- 2,304 GPD water used in bottle rinse off

Reuse Application:

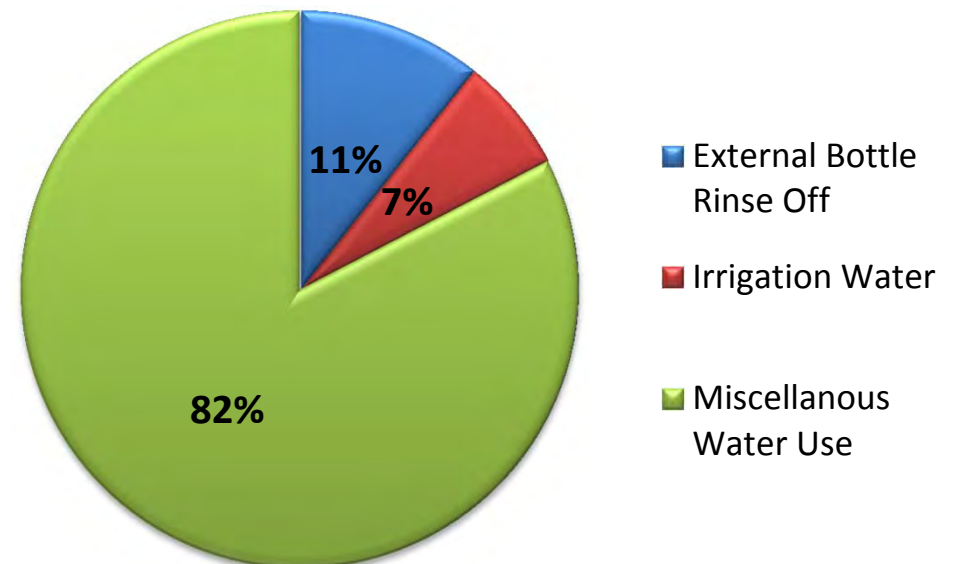
Outdoor irrigation

- 5.2 acre property
- Currently connected to spray irrigation
- 2,520 GPD demand

Considerations and Assumptions:

Regulation: 84

Brewery 1 Water Use



7%
483,840 gallons per year

Brewery 2



Site Description: Brewery sees approximately 240 visitors, six days of the week

Reusable Water Sources:

Canning and bottling rinse off effluent

Dishwasher used for taster glasses

- Rinse off line operates 100 hours/week
- Dishwasher cleans 10 loads per day

Reuse Application:

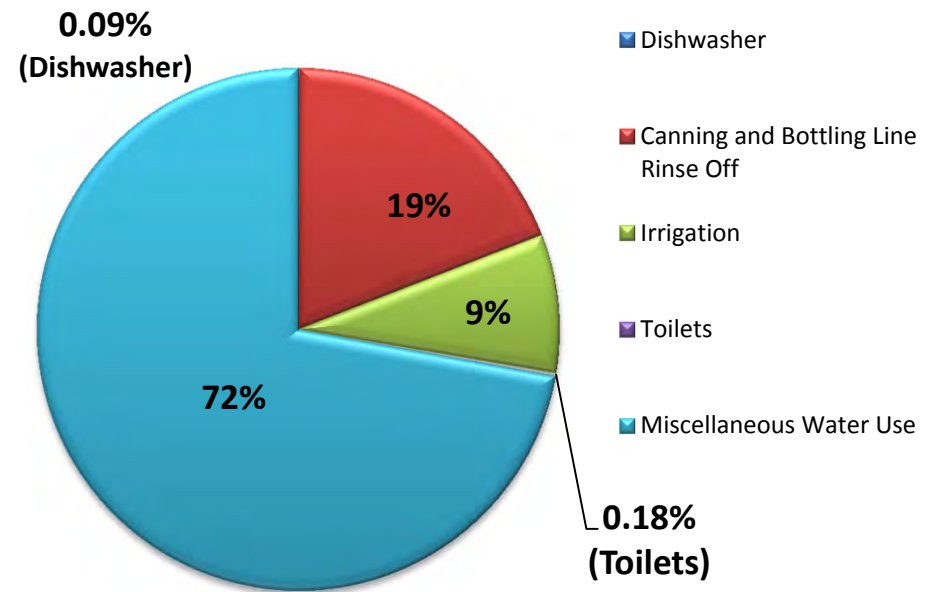
Outdoor irrigation with rinse water

- 465,616 GPD demand
- Toilet flushing with dishwasher effluent

Considerations and Assumptions:

Regulation: 84

Brewery 2 Water Use



9%
3,259,312 gallons per year

Summarized Results

Business	Graywater Sources	Possible Uses	Graywater as % of Total Water Use	Estimated % Reduction in Potable Water Consumption	Recycled Water Category
Recreational Pool	Showers	Toilet and Urinal Flushing	47%	5%	Regulation 86
Office Building	Showers	Cooling Towers	0.58%	.08%	Regulation 84
Research Lab	Autoclaves, glassware washers, dishwashers	Cooling Towers	42%	21%	Regulation 84
Athletic Center	Showers and Laundry Machine	Toilet Flushing	89%	7%	Regulation 86
Hotel	Laundry Machines Showers	Outdoor Irrigation	25%	11%	Regulation 86
		Toilet Flushing		7-9%	
Brewery 1	External Bottle Rinse Off Effluent	Outdoor Irrigation	11%	7%	Regulation 84
Brewery 2	Canning and Bottling Line Effluent, Dishwasher Effluent	Outdoor Irrigation, Toilet Flushing	19.09%	9%	Regulation 84

Conclusions

- Results from this study show the research lab could see highest savings from on-site water reuse at 21%.
- Office buildings without on-site laundry do not generate a large amount of graywater therefore resulting in negligent water savings.
- Office buildings with on-site laundry should explore graywater reuse further, may meet toilet demand or other end-use applications.
- Cities who are interested in reducing commercial sector water use should first look at hotels, gyms, and research labs.
 - ❖ Likely will provide largest savings
 - ❖ Less costs than treating domestic wastewater to fully reclaimed standards



- The other facilities show water savings potential of 5-11%, will have to decide if the benefits in terms of water saved will outweigh the cost burdens.
 - ❖ Main reason for system: Water conservation (green points) or \$ savings?
- Facilities with low estimated water savings could explore on-site water reuse using domestic wastewater to decrease demand on potable water.



Questions?

