Research and Extension to Aid in Meeting Utah's Future Water Needs

Joanna Endter-Wada

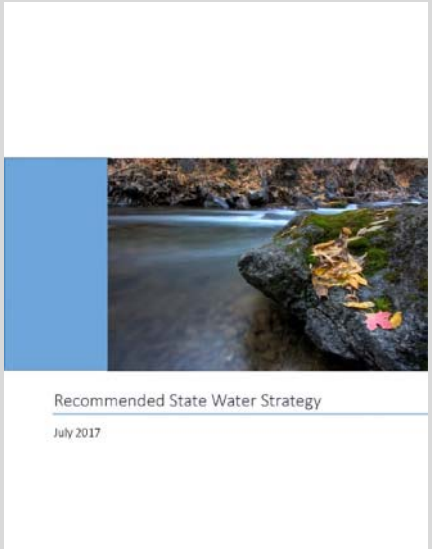
Center for Water Efficient Landscaping
USU Extension
Quinney College of Natural Resources
Utah State University

UtahState University

CENTER FOR WATER-EFFICIENT LANDSCAPING

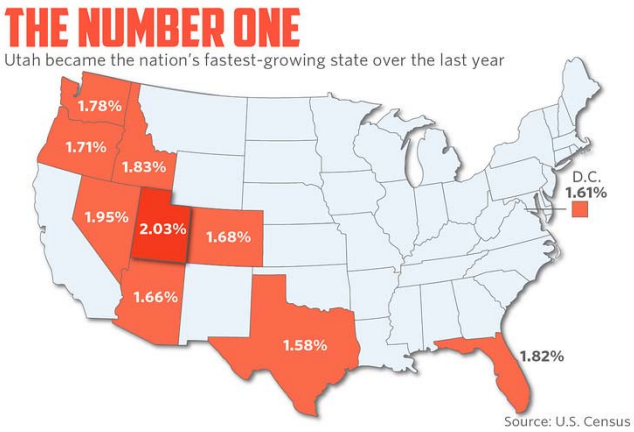
EXTENSION
UtahStateUniversity

CONTEXT

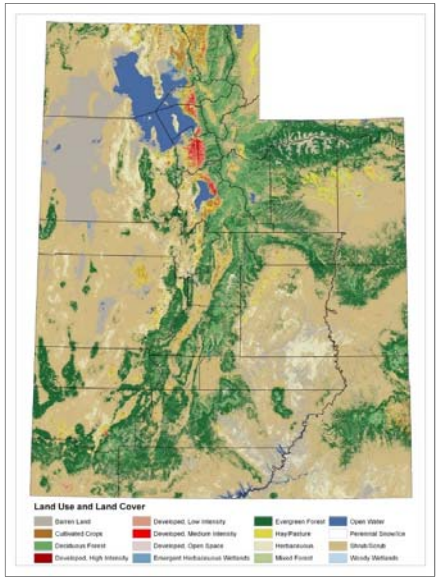


Water management challenges

Utah is 2nd driest state in the USA



Rapid population growth



Concentrated urbanization

http://pics4.city-data.com/cpicc/cfiles7647.jpg

Major land use transitions

- Increasing water shortages
- Declining per capita demand
- Aging infrastructure
- Tightened access to capital
- Climate change

"…the strongest financial solutions will be those that increase utilities' capacity to adapt to change"

"…credit rating agencies have recognized conservation as a best practice in water utility policy… [and] necessary to deal with long-term risks associated with supply shortages and high costs of capital"

"Conservation is critical to minimize risk and build financial resilience…"

Water utilities/providers are at the crossroads of a changing water resource and financial environment

Christine Boyle

Sources:

1) C.E. Boyle, January 2014, JAWWA
2) Measuring and Mitigating Water Revenue Variability: Understanding How Pricing Can Advance Conservation without Undermining Utilities' Revenue Goals, July 2014 (UNC, Ceres)

UtahState University
EXTENSION
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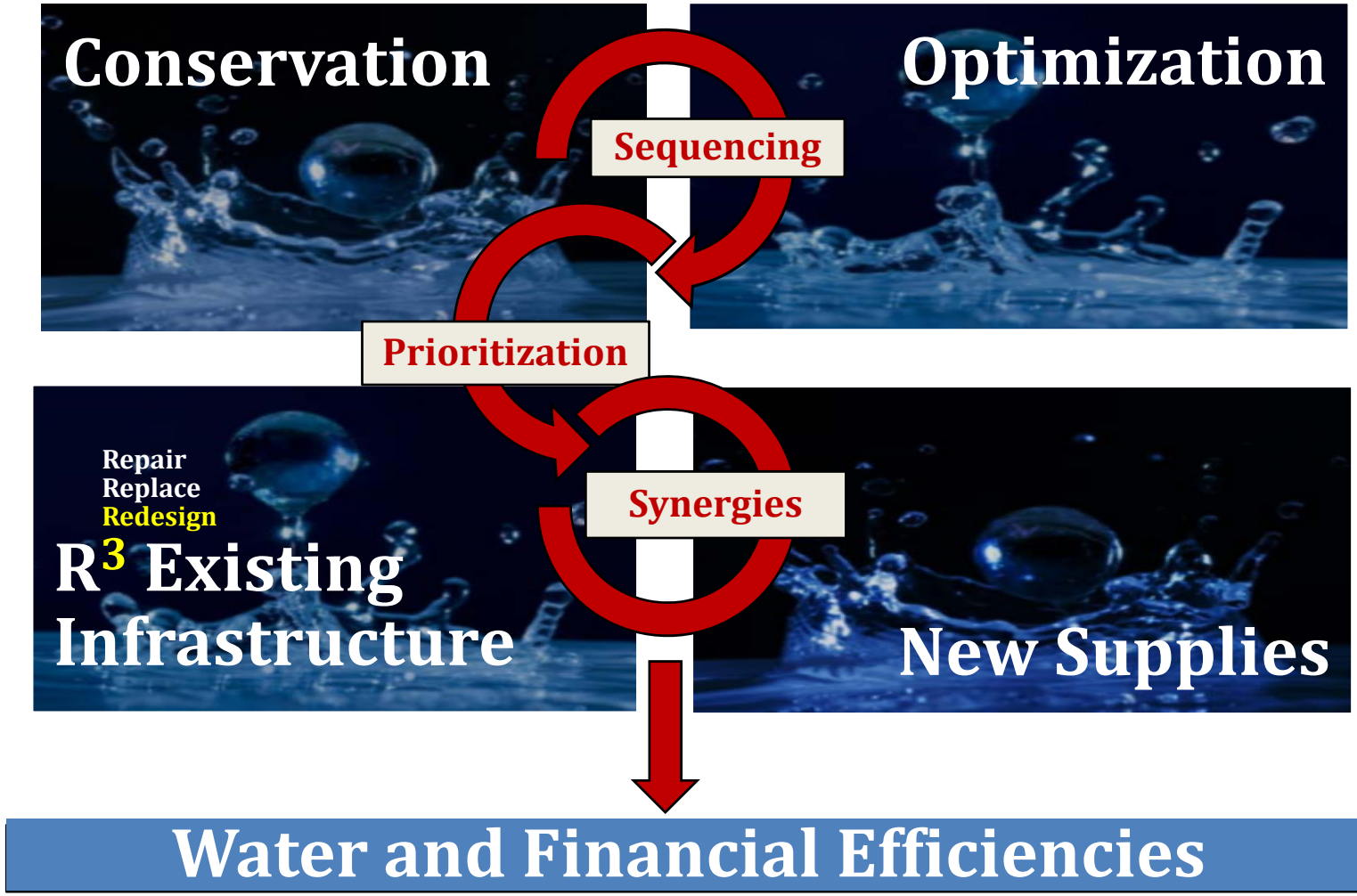
WATER MANAGEMENT STRATEGIES



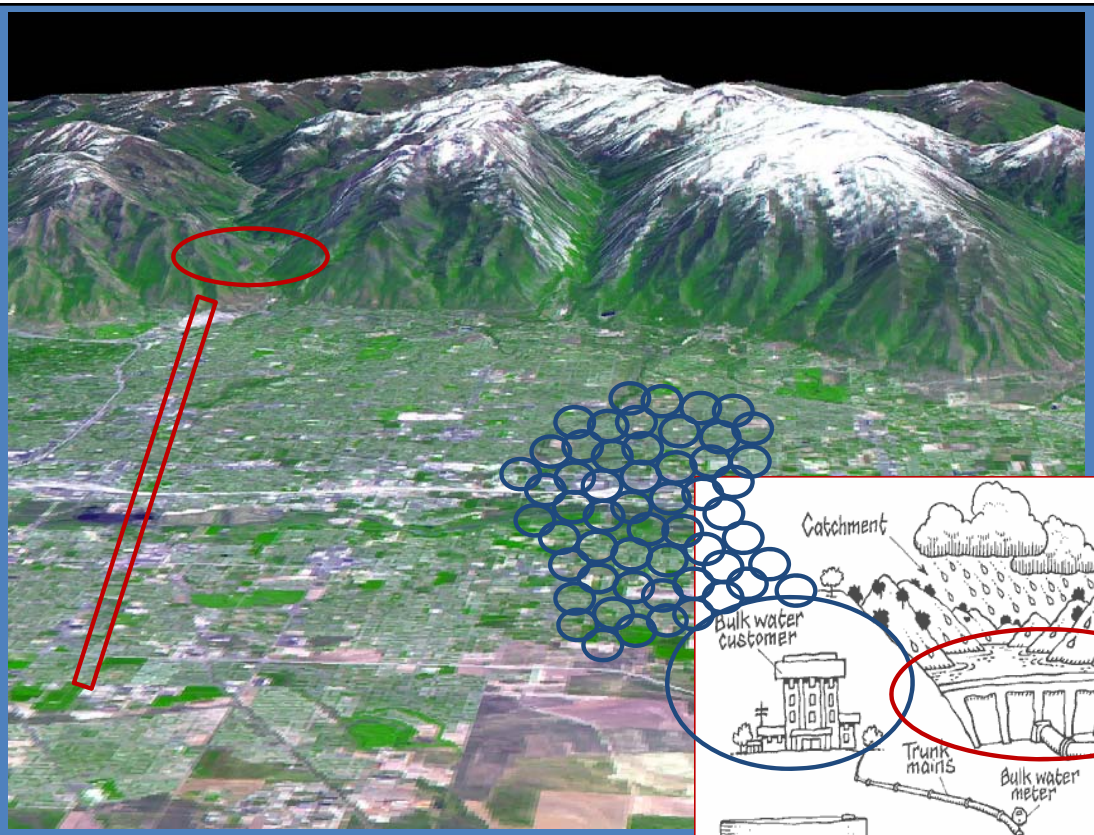
Conservation Assessment

Conservation successes

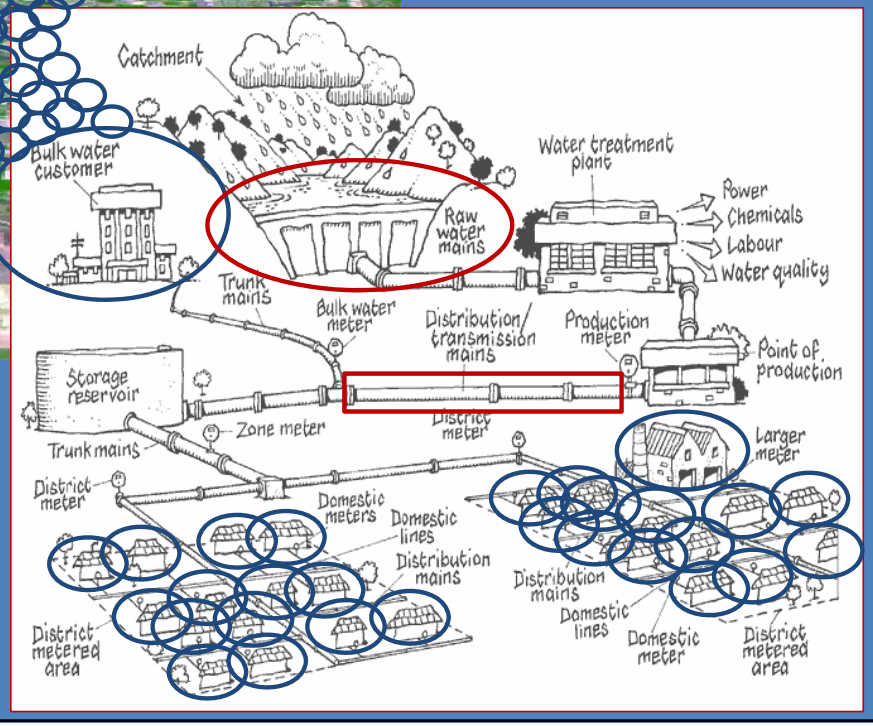
- Water use reductions
- Awareness raised & people responsive to drought
- Voluntary conservation programs implemented
- Uniform building code has had big effect indoors
- “Low-hanging fruit”

“Untapped” potential

- Outdoor water use efficiency
- More widespread and durable reductions through changes in habits and norms
- Greater use of markets and mandates (e.g. rates, codes)
- Finding outdoor equivalent of the building code
- **Needs greater investment**



Supply-side infrastructure



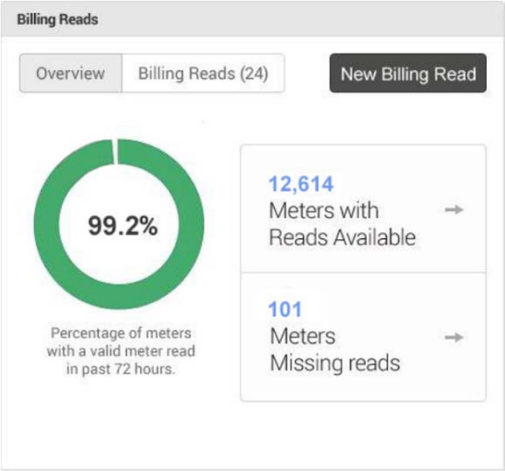
Demand-side infrastructure

Trend – Advanced Metering Analytics

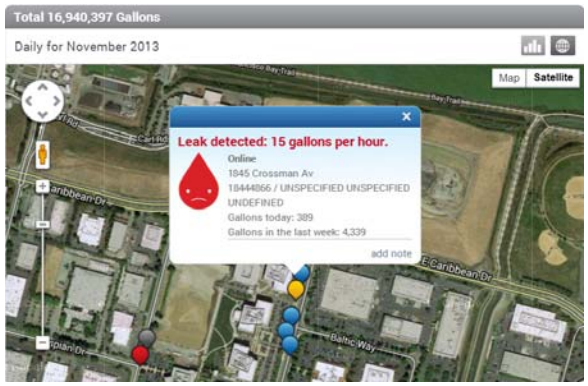
Evolution of AMR to AMA

AMR – Automated Meter Reading	AMI – Advanced Metering Infrastructure	AMA – Advanced Metering Analytics
Mobile Meter Reading	Fixed Network Meter Reading	Fixed Network with Powerful Analytics Software
Provides Efficient Reading with Monthly Billing Data	Provides Raw Daily or Hourly Data	Provides Actionable Proactive Intelligence

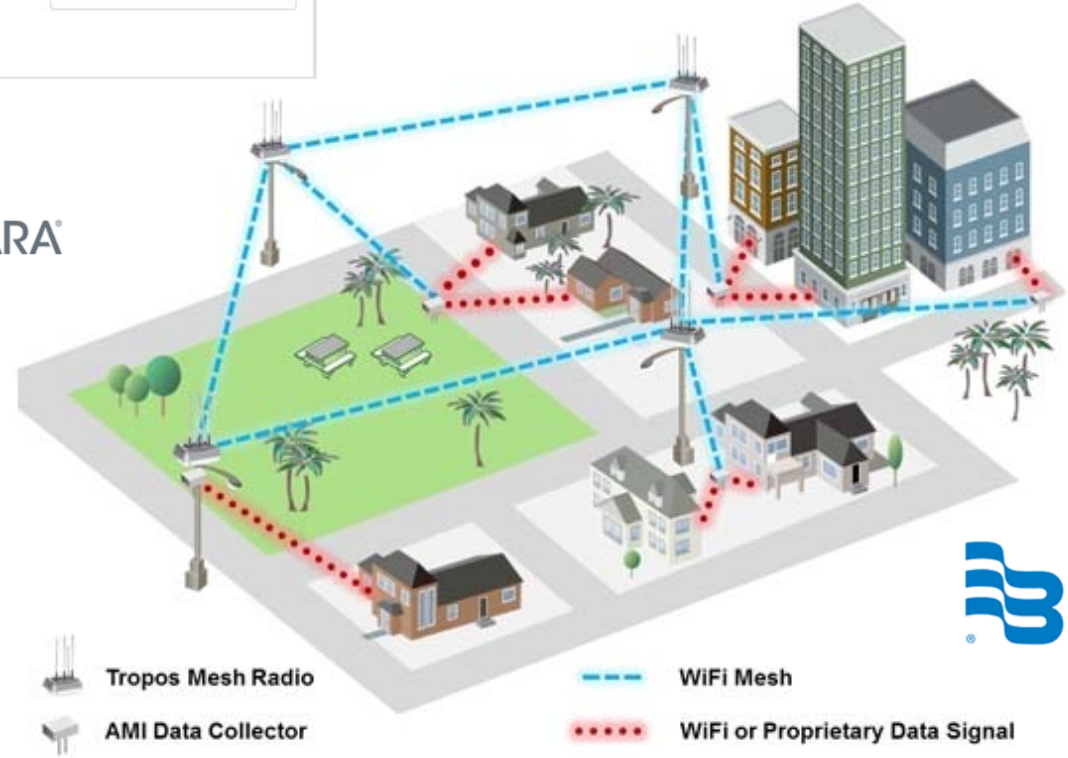
#WaterUtility



AQUATIC Informatics



ACLARA



Badger Meter

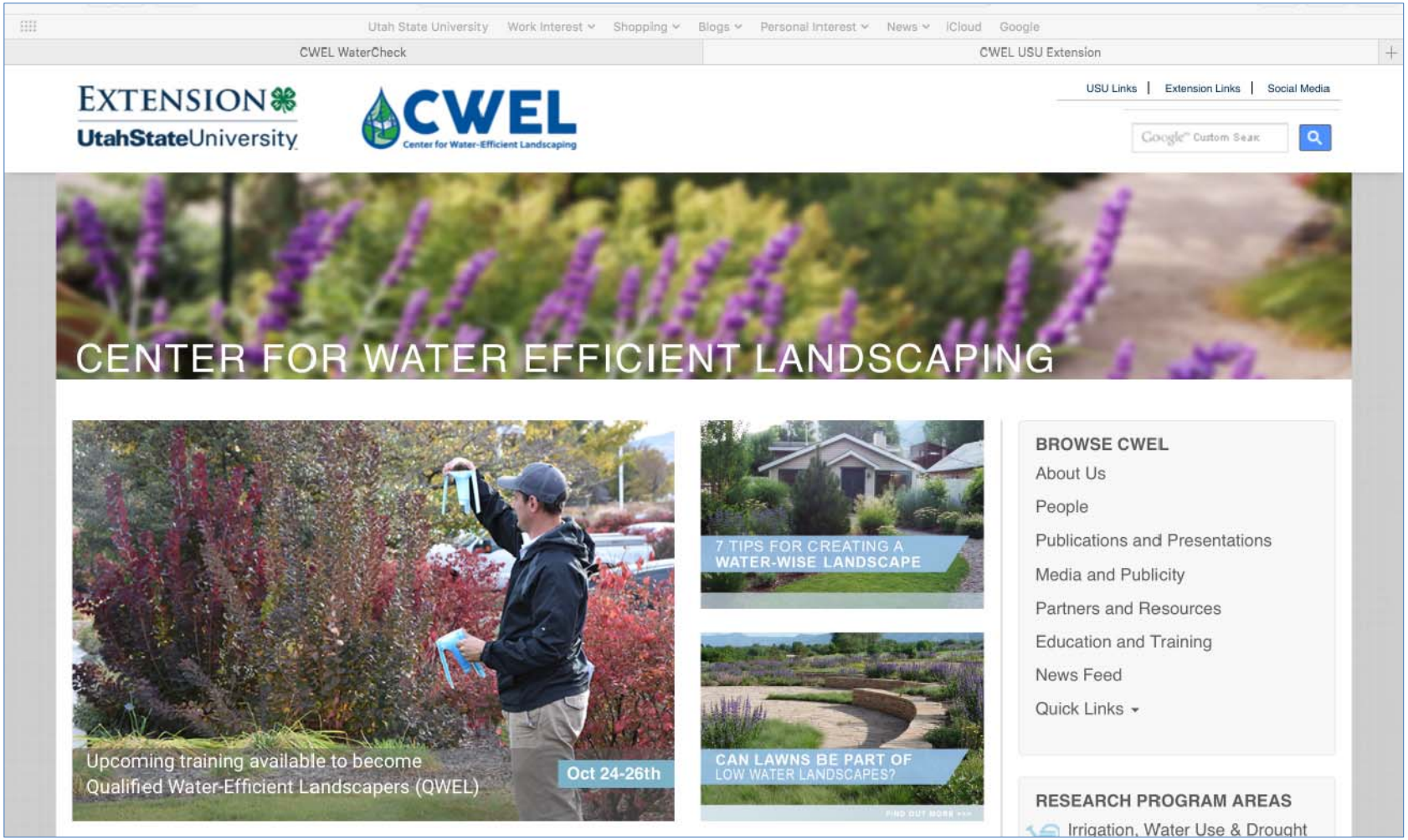
Urban Water Conservation: *Why it Matters*

- Rapidly growing percentage of Utah's total water use
- Location – requires large physical transfers of water from outlying rural and natural areas
- It is less flexible than agricultural water use in times of shortage (can't "fallow a subdivision")
- Water use expectations and behaviors are being established in the urbanization process
- Physical conversion of moving water from agriculture to urban use has long-term implications for future water demand:
  - water delivery and metering infrastructure
  - urban design and initial investments in landscaping
  - situational constraints on efficiency

CENTER FOR WATER-EFFICIENT LANDSCAPING

- Created to conduct research on effective irrigation techniques, landscape water demand analysis (human behavior), low-water use landscaping, and plant water needs.

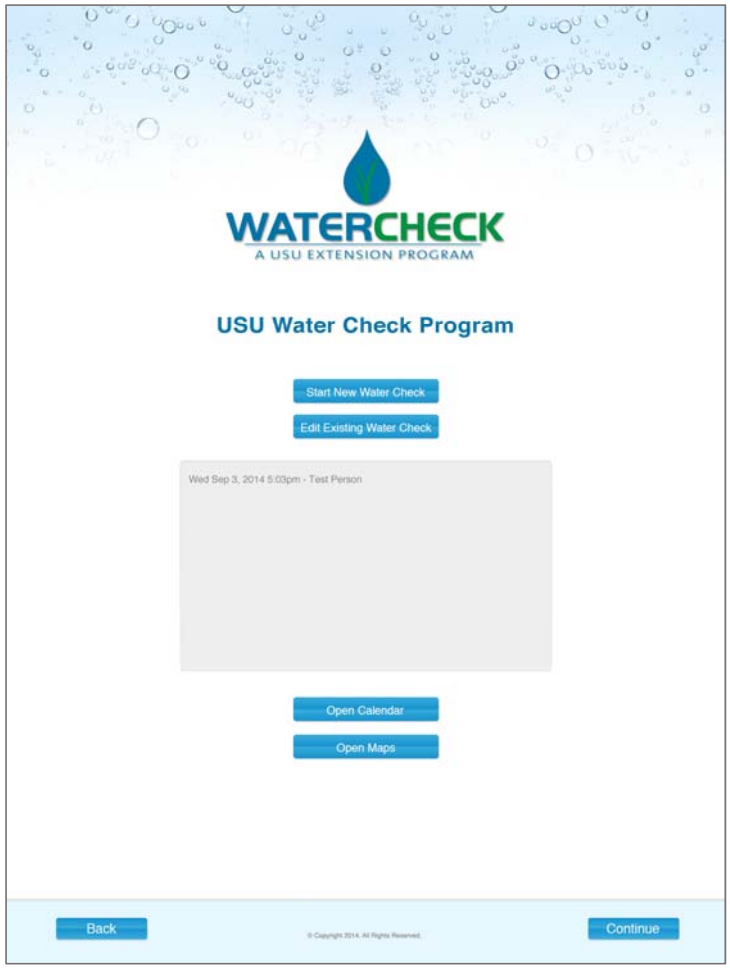
- Disseminates information to water purveyors, the Utah green industry, local USU Extension offices, and the public to support public education in water-efficient landscaping.

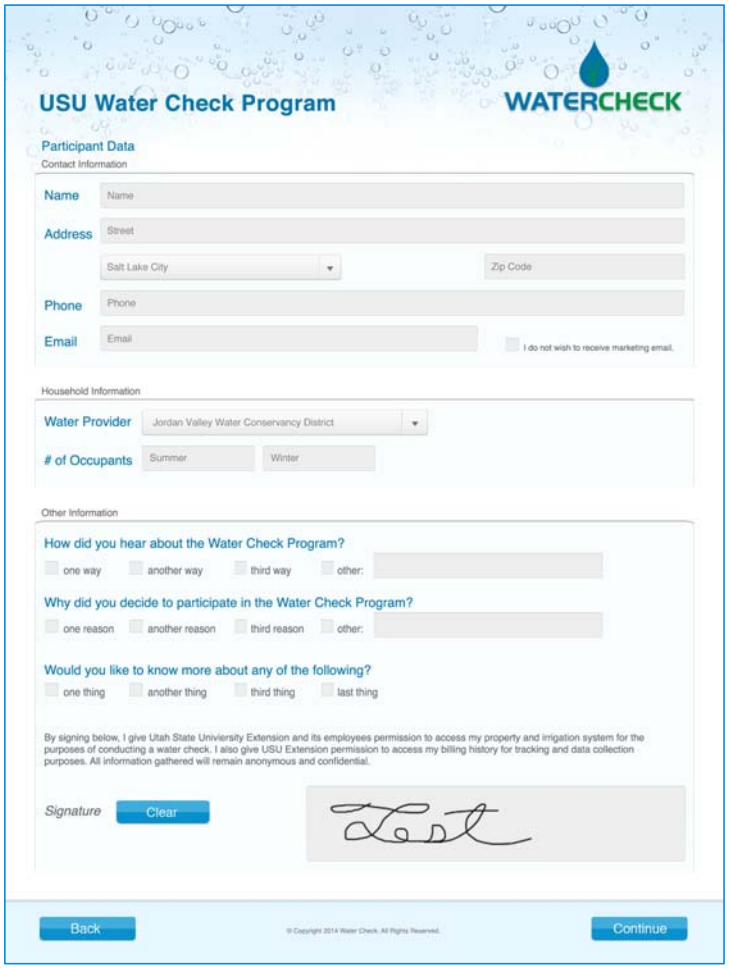

Utah State University
Work Interest
Shopping
Blogs
Personal Interest
News
iCloud
Google
CWEL WaterCheck
CWEL USU Extension
EXTENSION
UtahStateUniversity
CWEL
Center for Water-Efficient Landscaping
USU Links | Extension Links | Social Media
CENTER FOR WATER EFFICIENT LANDSCAPING
Upcoming training available to become Qualified Water-Efficient Landscapers (QWEL)
Oct 24-26th
7 TIPS FOR CREATING A WATER-WISE LANDSCAPE
CAN LAWNS BE PART OF LOW WATER LANDSCAPES?
BROWSE CWEL
About Us
People
Publications and Presentations
Media and Publicity
Partners and Resources
Education and Training
News Feed
Quick Links
RESEARCH PROGRAM AREAS
Irrigation, Water Use & Drought

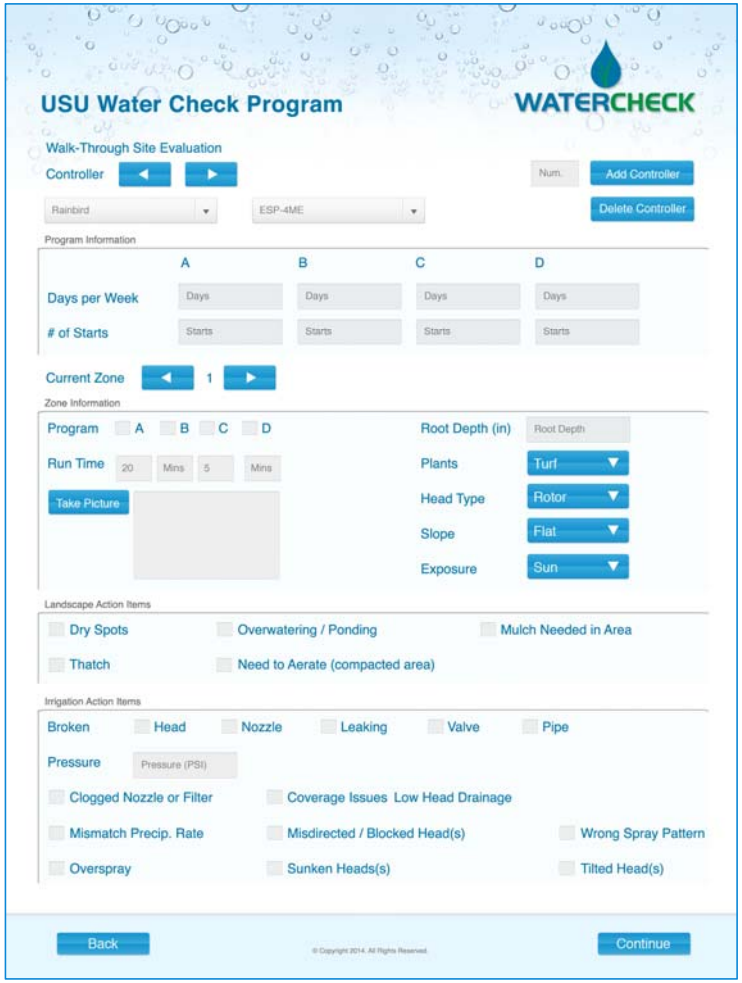
cwel.usu.edu

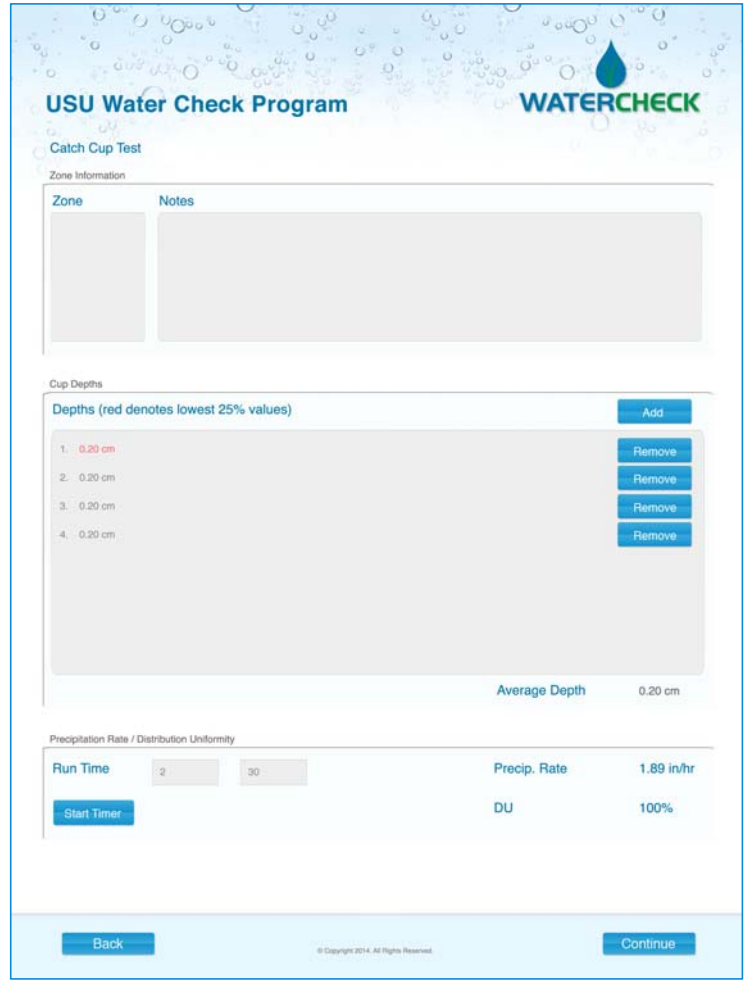
Water Check Program

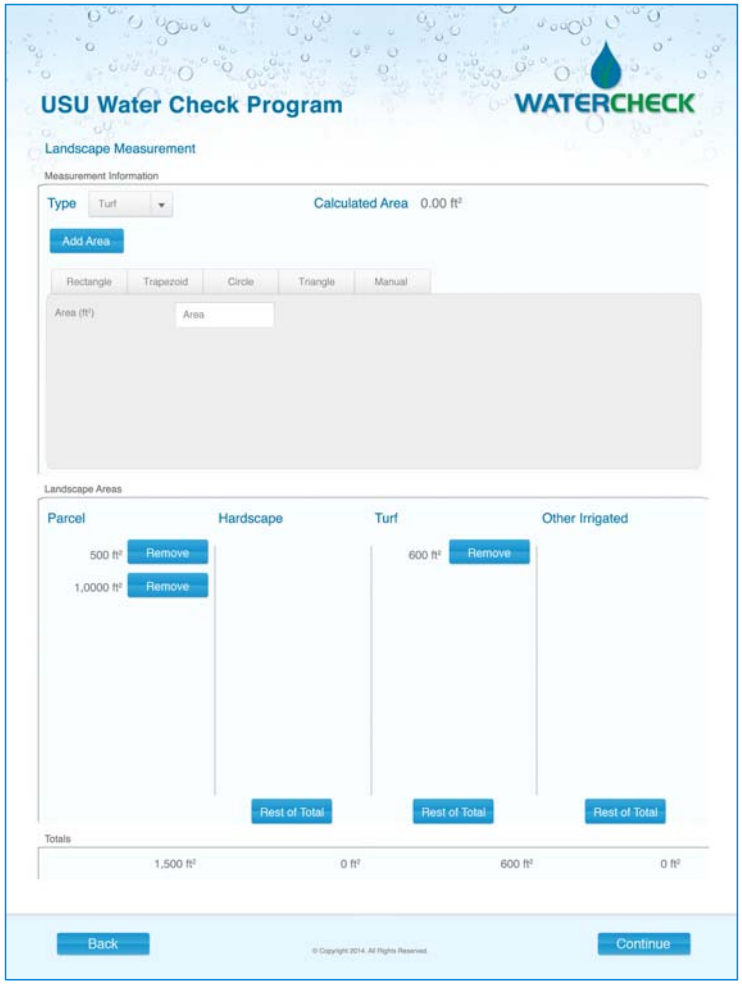
- Partnership program, began 1999
- Center for Water Efficient Landscaping (CWEL) administration since 2005
- Participation is voluntary, cost to participants is $0
- Pairs of interns visit homes, CII sites to evaluate outdoor irrigation systems
- More than 13,000 residential and 500 CII checks to date
- Extensive data gathering
- Data analyses showing effectiveness and revealing how to focus efforts

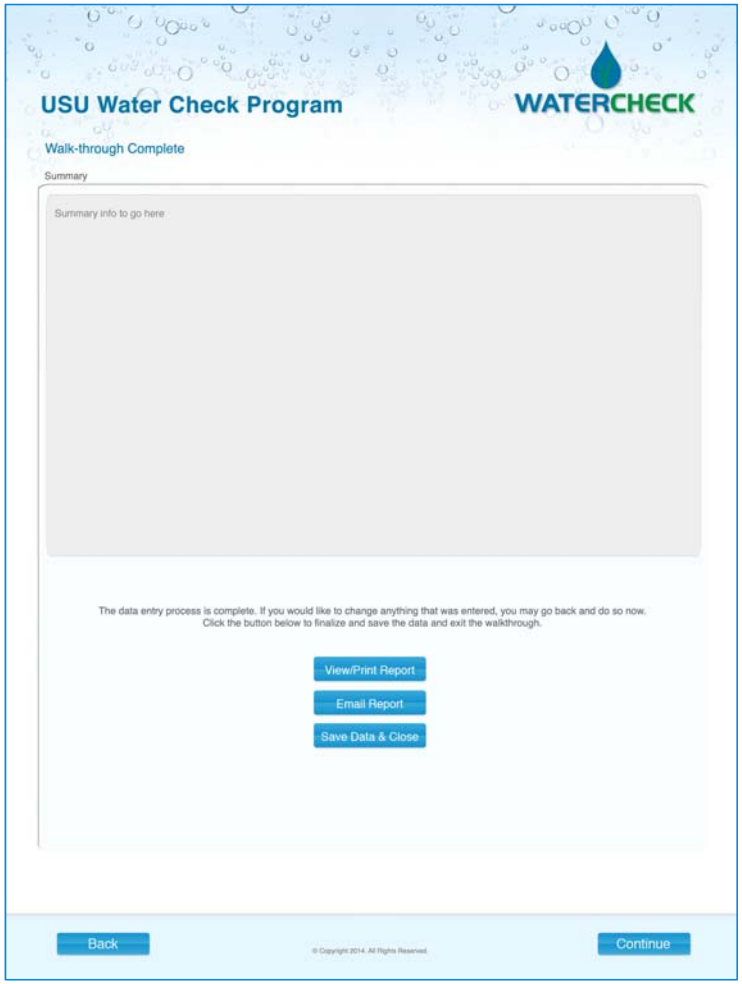

WATERCHECK
A USU EXTENSION PROGRAM
USU Water Check Program
Start New Water Check
Edit Existing Water Check
Wed Sep 3, 2014 5:03pm - Test Person
Open Calendar
Open Maps
Back
Continue


USU Water Check Program
WATERCHECK
Participant Data
Contact Information
Name
Address
Street
Salt Lake City
Zip Code
Phone
Email
I do not wish to receive marketing email.
Household Information
Water Provider
Jordan Valley Water Conservancy District
# of Occupants
Summer
Winter
Other Information
How did you hear about the Water Check Program?
one way
another way
third way
other:
Why did you decide to participate in the Water Check Program?
one reason
another reason
third reason
other:
Would you like to know more about any of the following?
one thing
another thing
third thing
last thing
By signing below, I give Utah State University Extension and its employees permission to access my property and irrigation system for the purposes of conducting a water check. I also give USU Extension permission to access my billing history for tracking and data collection purposes. All information gathered will remain anonymous and confidential.
Signature
Clear
Back
Continue


USU Water Check Program
WATERCHECK
Walk-Through Site Evaluation
Controller
Num.
Add Controller
Delete Controller
Rainbird
ESP-4ME
Program Information
A
B
C
D
Days per Week
Days
# of Starts
Starts
Current Zone
1
Zone Information
Program
Run Time
20
Mins
5
Mins
Take Picture
Root Depth (in)
Root Depth
Plants
Turf
Head Type
Rotor
Slope
Flat
Exposure
Sun
Landscape Action Items
Dry Spots
Overwatering / Ponding
Mulch Needed in Area
Thatch
Need to Aerate (compacted area)
Irrigation Action Items
Broken
Head
Nozzle
Leaking
Valve
Pipe
Pressure
Pressure (PSI)
Clogged Nozzle or Filter
Coverage Issues Low Head Drainage
Mismatch Precip. Rate
Misdirected / Blocked Head(s)
Wrong Spray Pattern
Overspray
Sunken Heads(s)
Tilted Head(s)
Back
Continue


USU Water Check Program
WATERCHECK
Catch Cup Test
Zone Information
Zone
Notes
Cup Depths
Depths (red denotes lowest 25% values)
Add
1. 0.20 cm
2. 0.20 cm
3. 0.20 cm
4. 0.20 cm
Remove
Remove
Remove
Remove
Average Depth
0.20 cm
Precipitation Rate / Distribution Uniformity
Run Time
2
30
Start Timer
Precip. Rate
1.89 in/hr
DU
100%
Back
Continue


USU Water Check Program
WATERCHECK
Landscape Measurement
Measurement Information
Type
Turf
Calculated Area 0.00 ft²
Add Area
Rectangle
Trapezoid
Circle
Triangle
Manual
Area (ft²)
Area
Landscape Areas
Parcel
Hardscape
Turf
Other Irrigated
500 ft²
Remove
1,0000 ft²
Remove
600 ft²
Remove
Rest of Total
Rest of Total
Rest of Total
Totals
1,500 ft²
0 ft²
600 ft²
0 ft²
Back
Continue


USU Water Check Program
WATERCHECK
Walk-through Complete
Summary
Summary info to go here
The data entry process is complete. If you would like to change anything that was entered, you may go back and do so now.
Click the button below to finalize and save the data and exit the walkthrough.
View/Print Report
Email Report
Save Data & Close
Back
Continue

That's Great But…

- Familiarity with irrigation system and controller
- Uncertainty about plant requirements
- Weak and muddled pricing signal
- Ongoing support
- Are we reaching the "right" customers

watermaps.usu.edu

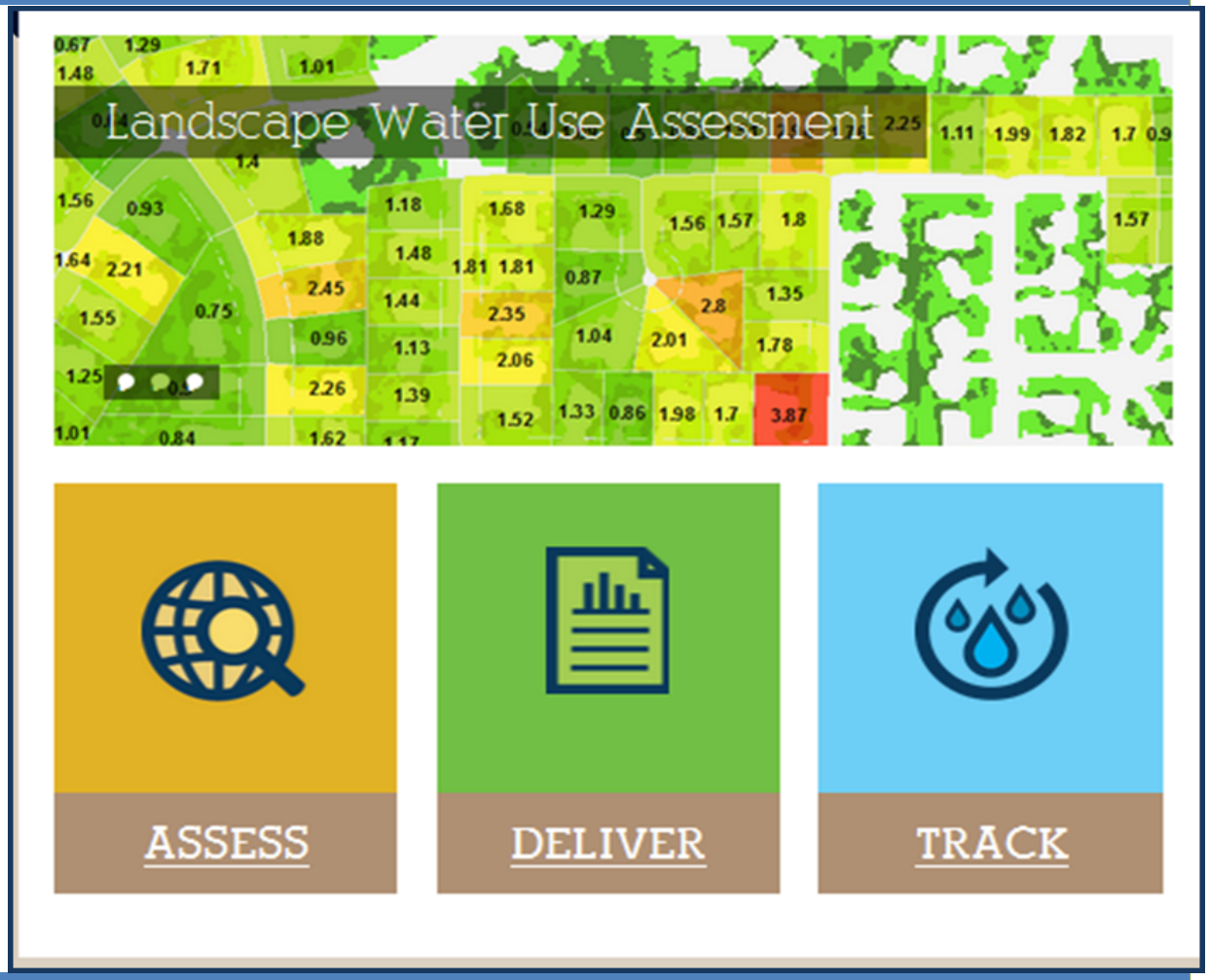
WATERMAPS™

Software application to analyze and manage urban landscape water use

ASSESS: identify locations with capacity to conserve

DELIVER: water use reports to help people conserve

TRACK: water use change over time; monitor conservation success



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Identifying Capacity to Conserve Utilizing Landscape Irrigation Ratio (LIR)

LIR=

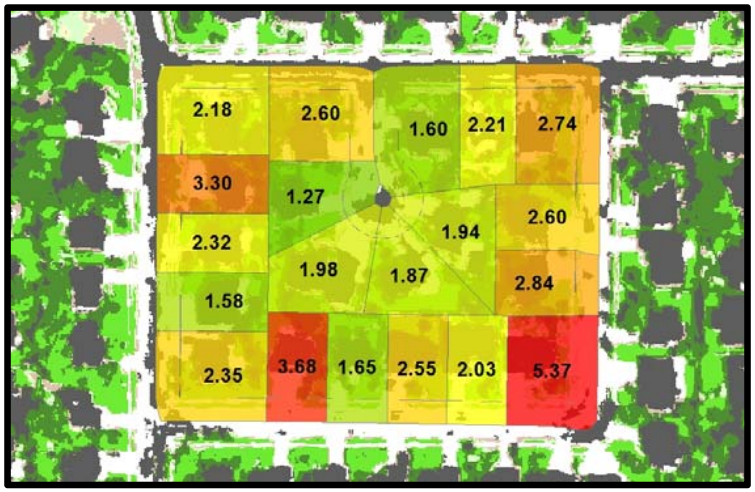
Landscape Water Use ***estimated***

(derived from analysis of municipal or water provider meter data)

Landscape Water Need ***estimated***

(derived from the classification of remotely-sensed airborne multispectral imagery and localized reference ET_o rates)

(per unit of landscaped area)

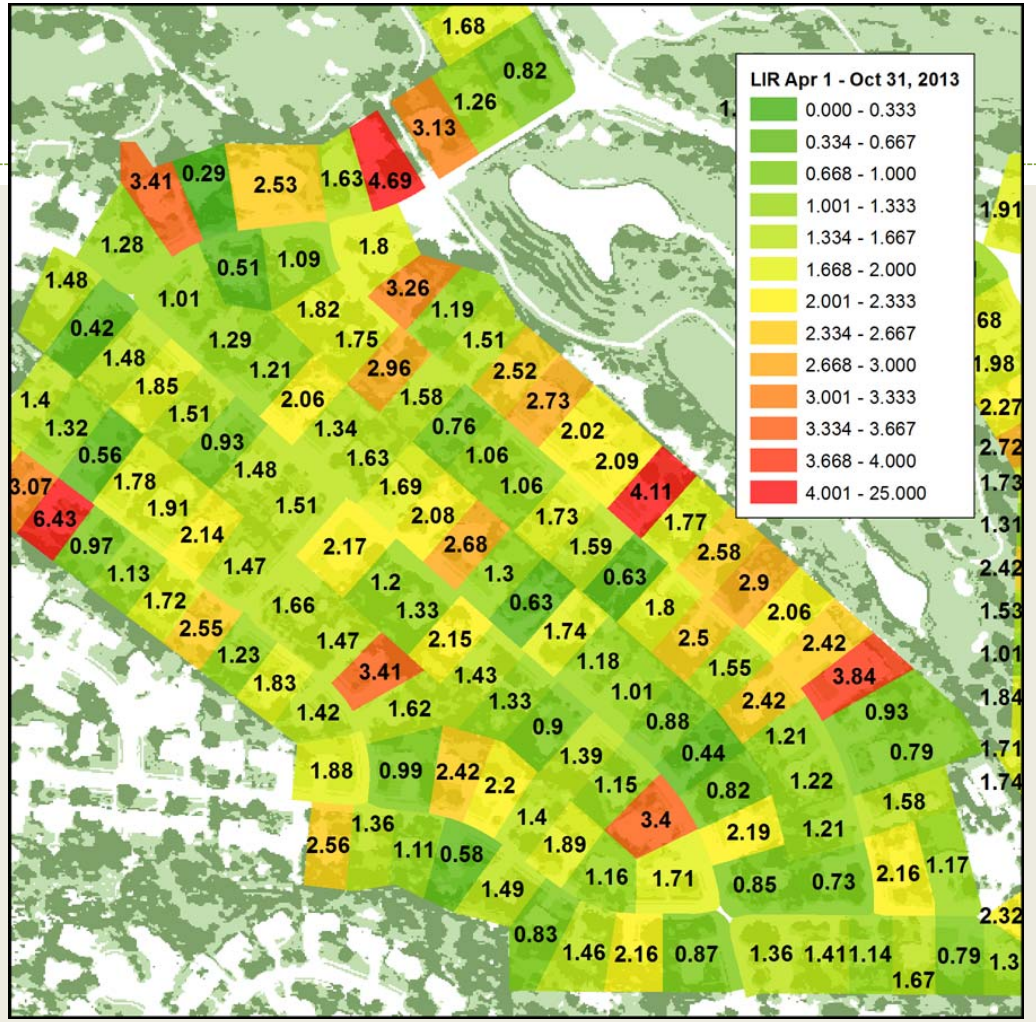


LIR less than 1	**=**	**Efficient**
Between 1 and 2	**=**	**Acceptable**
Between 2 and 3	**=**	**Inefficient**
Greater than 3	**=**	**Excessive**

Seasonal LIR Calculations

- **Time Period: 4/1 -10/31, 2013**
- **Locations analyzed: 1369**
- **Mean LIR: 2.01**

Quantifies Conservation Potential



PROJECT

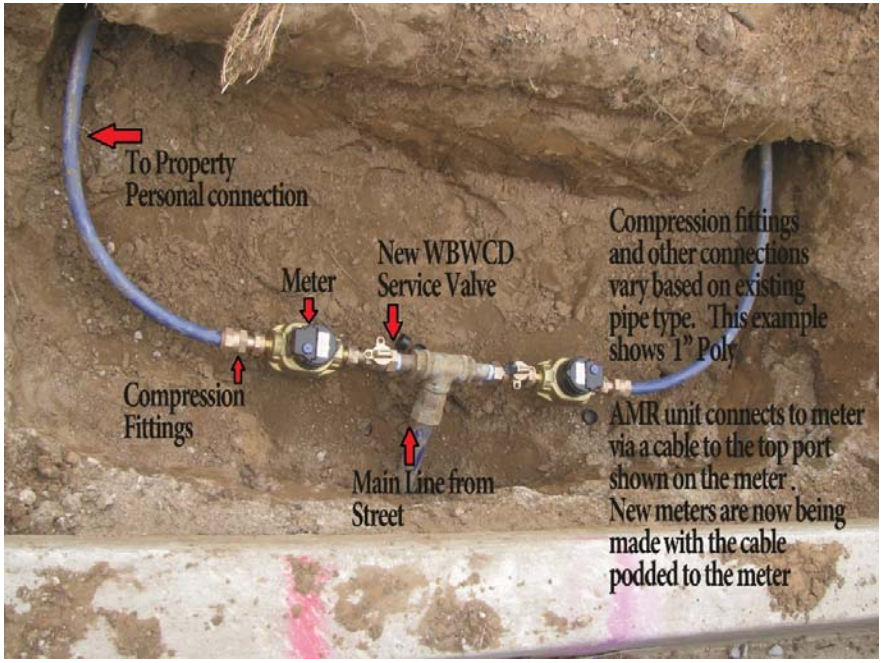
"Water user dimensions of meter implementation on secondary pressurized systems"

WEBER BASIN WATER CONSERVANCY DISTRICT

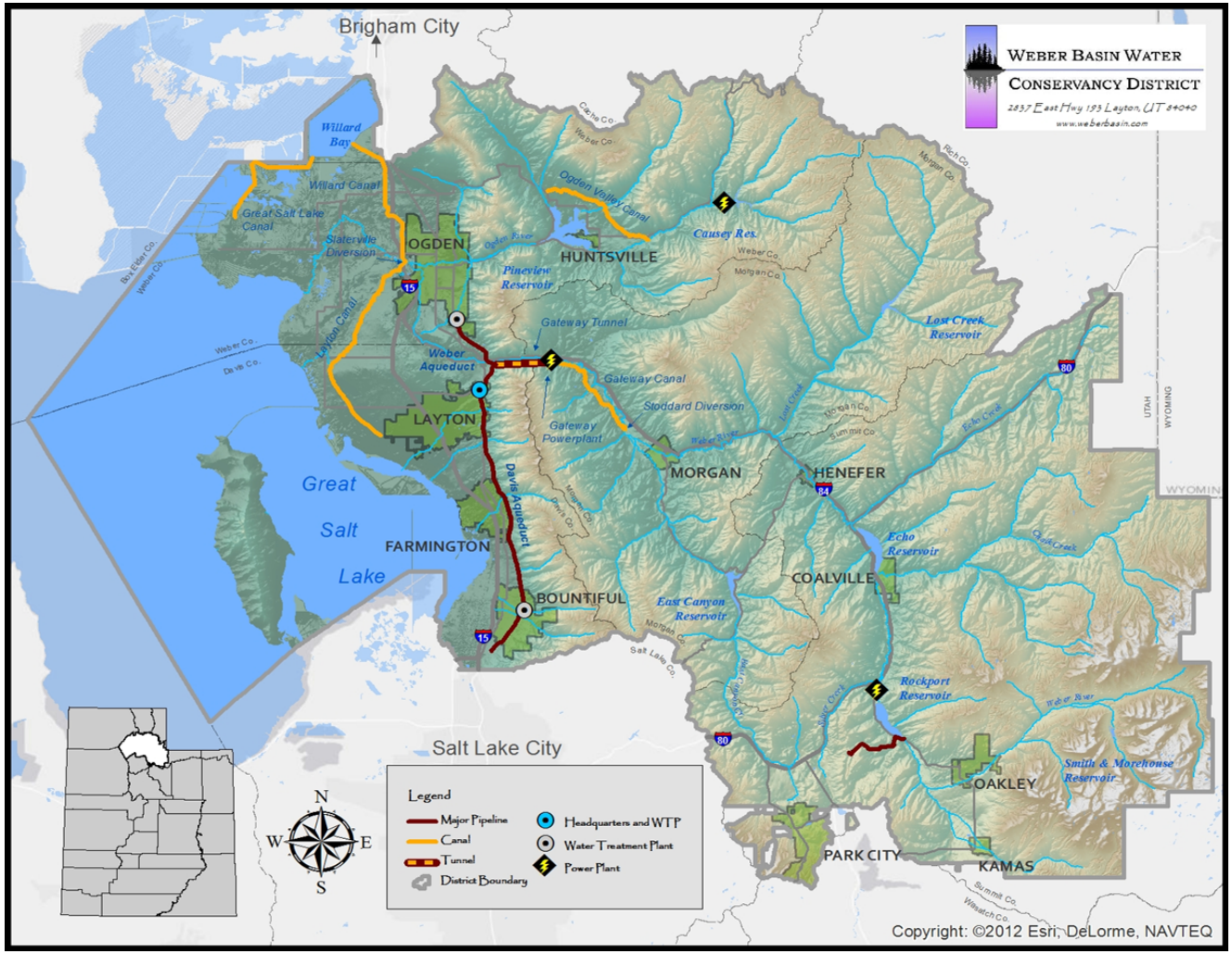
UtahState University

METER TRANSITION ISSUES

- Meter & AMR compatibility
- Data reading and calibration
- Public relations

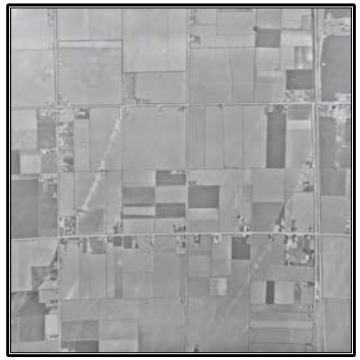


Water Supply From Weber Basin



- **Agricultural supplies**
  - 5 counties
- **Pressurized secondary systems**
  - wholesale
  - retail
- **Municipal**
  - 50 cities & districts
- **Industrial supplies**
  - minerals
  - refineries
  - manufacturers

Land Use Transitions

	1958		2012
Clinton Utah		→	
Syracuse Utah		→	
Layton Utah		→	

- **Pressurized secondary water systems**
  - agricultural-to-urban land use transitions
  - ≈ 100,000 connections
- **Water allocations or allotments**
  - attached to urban parcels that were agricultural lands
  - based on an agricultural duty of water – generally 3 af/acre in WBWCD

Project Goals

WBWCD Management Goals:

- Work to meet state and district water conservation goals
- Promote individual water use accountability
- Determine if secondary water use is within water allocations

USU Research Goals:

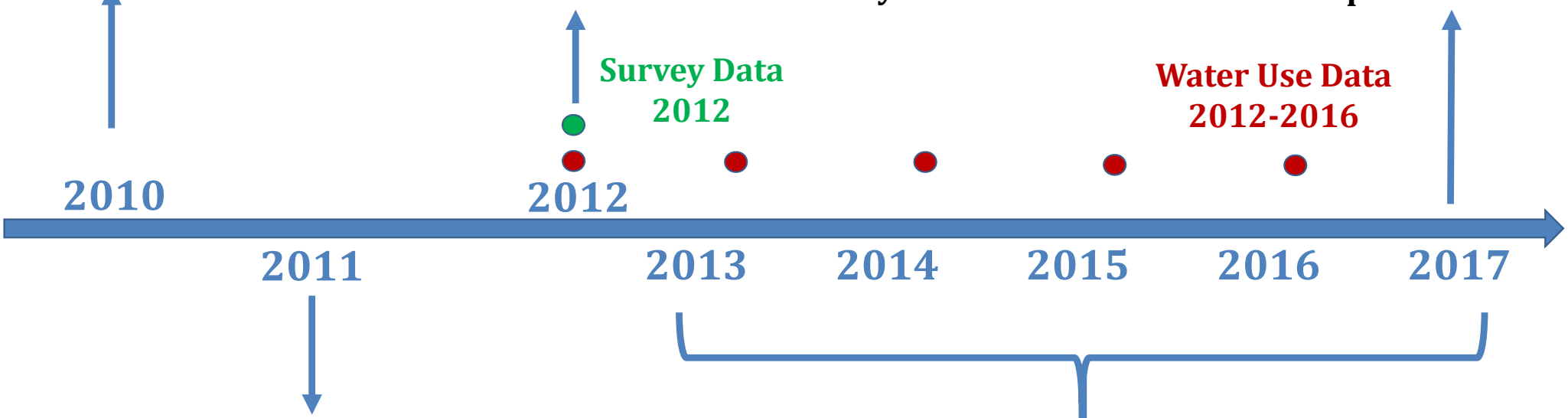
- Investigate human behaviors and perceptions related to meters
- Analyze urban landscape irrigation in relation to plant water need using USU WaterMAPS™ (software)
- Design innovative strategies for interpreting and sharing meter data with users to motivate conservation absent a price signal
- Encourage people to monitor their own water use by reinforcing conservation through information feedback mechanisms

Project Timeline and Continuation

- WBWCD implements district policy to meter secondary connections

WBWCD and USU:
- Utilize WaterMAPS™ analysis approach
- Design/send secondary water use reports
- Conduct social science survey

- WBWCD and USU analyze water use results for 2012-2016 using 842 locations from Phase 1 that had complete data.



- WBWCD-USU collaboration initiated.
- USBOR 2011-2012 Water Smart grant secured.
- Meter implementation begins.
- Users informed of gallons used.

WBWCD:
- Expands metering to more phases and locations.
- Continues sending slightly simplified secondary water use reports to all locations with meters.

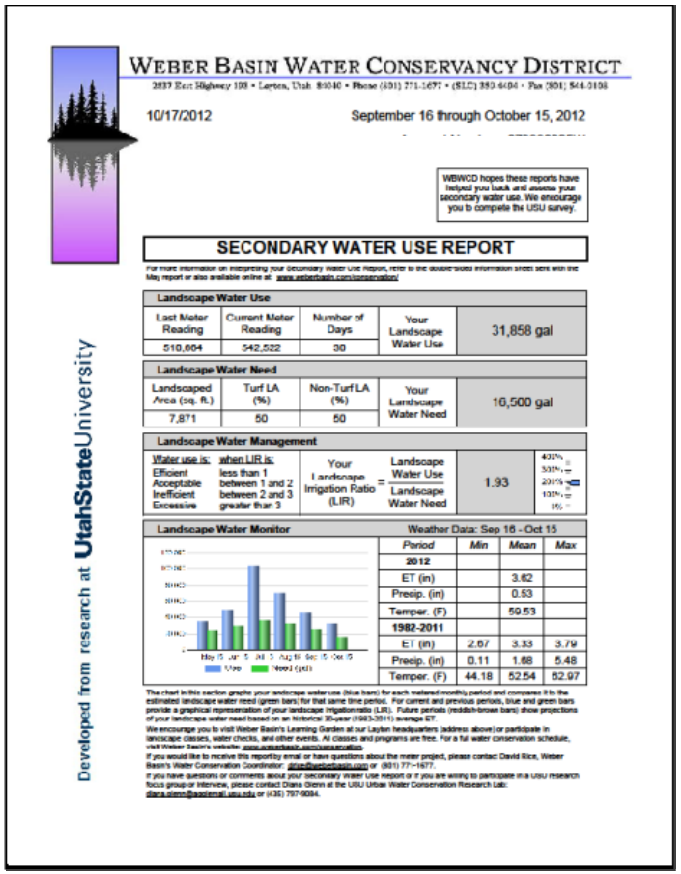
CONSERVATION STRATEGY

Water meter data interpretation and sharing through Secondary Water Use Reports

Not a bill.

People pay for secondary water in connection with property taxes.

Sample 2012 Secondary Water Use Report



WEBER BASIN WATER CONSERVANCY DISTRICT

2837 East Highway 193 • Layton, Utah 84040 • Phone (801) 771-1677 • (SLC) 359-4494 • Fax (801) 544-0103

10/17/2012 September 16 through October 15, 2012

WBWCD hopes these reports have helped you look and assess your secondary water use. We encourage you to complete the USU survey.

SECONDARY WATER USE REPORT

For more information on interpreting your Secondary Water Use Report, refer to the double-sided information sheet sent with the May report or also available online at www.weberbasin.com/conservation/

Landscape Water Use

Last Meter Reading	Current Meter Reading	Number of Days	Your Landscape Water Use	31,858 gal
510,664	542,522	30		

Landscape Water Need

Landscaped Area (sq. ft.)	Turf LA (%)	Non-Turf LA (%)	Your Landscape Water Need	16,500 gal
7,871	50	50		

Landscape Water Management

Water use is:	when LIR is:	Your Landscape Irrigation Ratio (LIR) = Landscape Water Use / Landscape Water Need	1.93
Efficient	less than 1		40%
Acceptable	between 1 and 2		50%
Inefficient	between 2 and 3		200%
Excessive	greater than 3		100%
			0%

Landscape Water Monitor Weather Data: Sep 16 - Oct 15

Period	Min	Mean	Max
2012			
ET (in)		3.62	
Precip. (in)		0.53	
Temper. (F)		59.53	
1982-2011			
ET (in)	2.67	3.33	3.79
Precip. (in)	0.11	1.88	5.48
Temper. (F)	44.18	52.54	62.97

The chart in this section graphs your landscape water use (blue bars) for each metered monthly period and compares it to the estimated landscape water need (green bars) for that same time period. For current and previous periods, blue and green bars provide a graphical representation of your landscape irrigation ratio (LIR). Future periods (reddish-brown bars) show projections of your landscape water need based on an historical 30-year (1982-2011) average ET.

We encourage you to visit Weber Basin's Learning Garden at our Layton headquarters address above) or participate in landscape classes, water checks, and other events. At classes and programs are free. For a fall water conservation schedule, visit Weber Basin's website: www.weberbasin.com/conservation

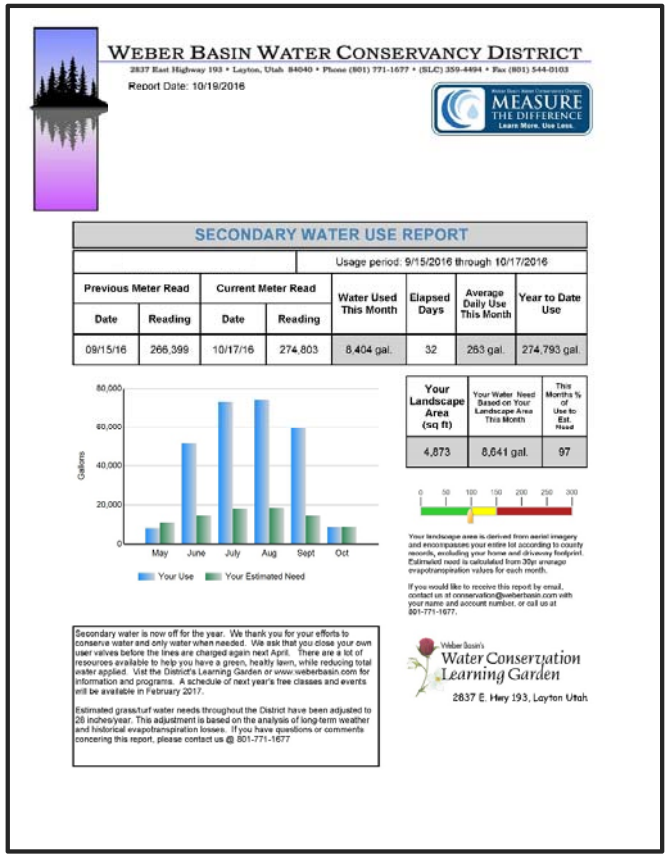
If you would like to receive this report by email or have questions about the meter project, please contact David Rice, Weber Basin's Water Conservation Coordinator: drice@weberbasin.com or (801) 771-1677.

If you have questions or comments about your secondary water use report or if you are willing to participate in a USU research focus group or interview, please contact Diana Glenn at the USU Urban Water Conservation Research Lab: diana.glenn@aggiemail.usu.edu or (435) 797-9084.

Developed from research at UtahStateUniversity

Reports are based on defining appropriateness of landscape water use relative to plant water need (landscape water budgeting)

Sample 2013-2016 Secondary Water Use Report



WEBER BASIN WATER CONSERVANCY DISTRICT

2837 East Highway 193 • Layton, Utah 84040 • Phone (801) 771-1677 • (SLC) 359-4494 • Fax (801) 544-0103

Report Date: 10/19/2016

MEASURE THE DIFFERENCE Learn More. Use Less.

SECONDARY WATER USE REPORT

Usage period: 9/15/2016 through 10/17/2016

Previous Meter Read		Current Meter Read		Water Used This Month	Elapsed Days	Average Daily Use This Month	Year to Date Use
Date	Reading	Date	Reading				
09/15/16	266,399	10/17/16	274,803	8,404 gal.	32	263 gal.	274,793 gal.

Your Landscape Area (sq ft)	Your Water Need Based on Your Landscape Area This Month	This Months % of Use to Est. Need
4,873	8,641 gal.	97

Gallons: 80,000, 60,000, 40,000, 20,000, 0

May, June, July, Aug, Sept, Oct

Your Use / Your Estimated Need

0 50 100 150 200 250 300

Your landscape area is derived from aerial imagery and encompasses your entire lot according to county records, excluding your home and driveway footprint. Estimated need is calculated from 30yr average evapotranspiration values for each month.

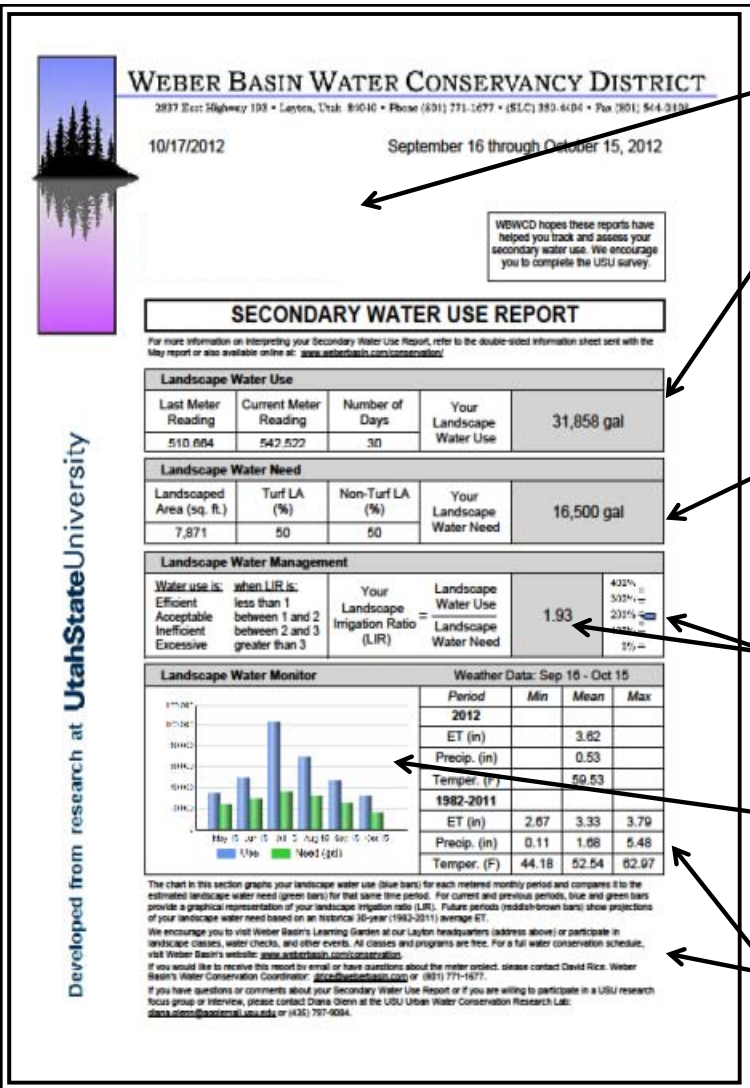
If you would like to receive this report by email, contact us at conservation@weberbasin.com with your name and account number, or call us at 801-771-1677.

Secondary water is now off for the year. We thank you for your efforts to conserve water and only water when needed. We ask that you close your own user valves before the lines are charged again next April. There are a lot of resources available to help you have a green, healthy lawn, while reducing total water applied. Visit the District's Learning Garden or www.weberbasin.com for information and programs. A schedule of next year's free classes and events will be available in February 2017.

Estimated grass/turf water needs throughout the District have been adjusted to 28 inches/year. This adjustment is based on the analysis of long-term weather and historical evapotranspiration losses. If you have questions or comments concerning this report, please contact us @ 801-771-1677

Weber Basin's Water Conservation Learning Garden

2837 E. Hwy 193, Layton Utah



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10/17/2012 September 16 through October 15, 2012

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7,871	50	50		16,500 gal

Landscape Water Management

Water use is:	when LIR is:	Your Landscape Irrigation Ratio (LIR) = Landscape Water Use / Landscape Water Need	
Efficient	less than 1		
Acceptable	between 1 and 2		
Inefficient	between 2 and 3		
Excessive	greater than 3		1.93

Landscape Water Monitor — Weather Data: Sep 16 - Oct 15

Period	Min	Mean	Max
2012			
ET (in)		3.62	
Precip. (in)		0.53	
Temper. (F)		59.53	
1982-2011			
ET (in)	2.67	3.33	3.79
Precip. (in)	0.11	1.68	5.48
Temper. (F)	44.18	52.54	62.97

Developed from research at UtahStateUniversity

Customer name, address, account (not shown)

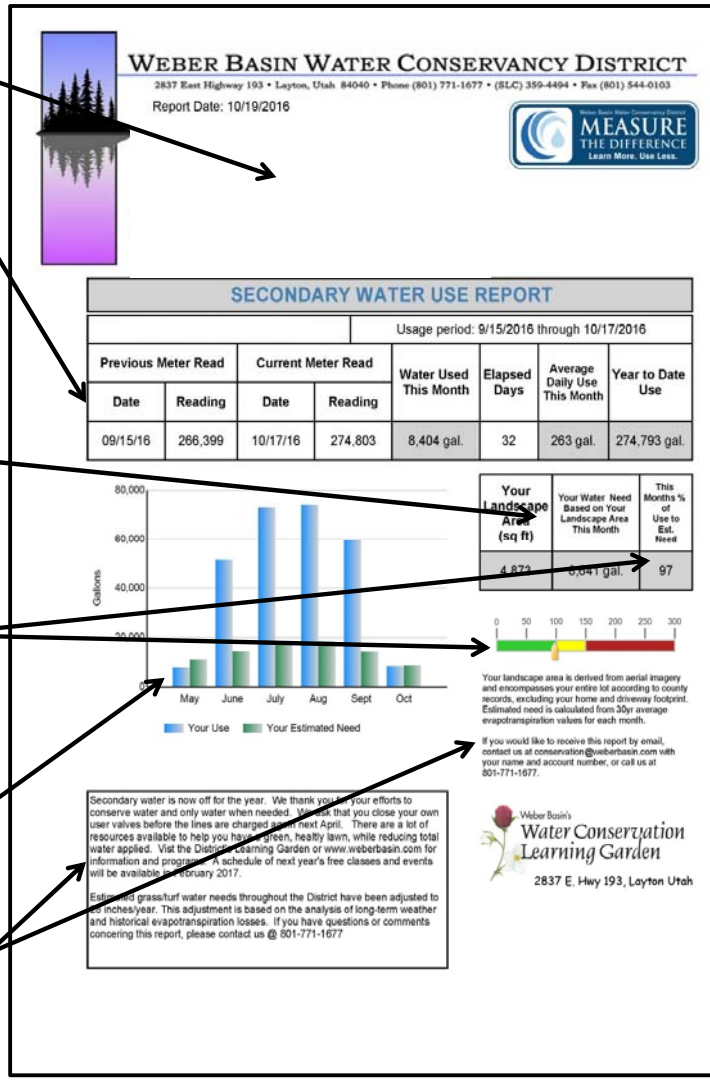
Landscape water use: secondary meter readings and landscape water use in gallons

Landscape water need: estimated landscape water need in gallons based on landscaped area and weather data

Watering appropriateness: reported as a landscape irrigation ratio (LIR) and/or a %

Landscape water monitor: graph of monthly landscape water use compared to need

Information & messaging: weather data, conservation programs, contact information



WEBER BASIN WATER CONSERVANCY DISTRICT

2837 East Highway 193 • Layton, Utah 84040 • Phone (801) 771-1677 • (SLC) 359-4494 • Fax (801) 544-0103

Report Date: 10/19/2016

MEASURE THE DIFFERENCE Learn More. Use Less.

SECONDARY WATER USE REPORT

Usage period: 9/15/2016 through 10/17/2016

Previous Meter Read		Current Meter Read		Water Used This Month	Elapsed Days	Average Daily Use This Month	Year to Date Use
Date	Reading	Date	Reading				
09/15/16	266,399	10/17/16	274,803	8,404 gal.	32	263 gal.	274,793 gal.

Your Landscape Area (sq ft)	Your Water Need Based on Your Landscape Area This Month	This Months % of Use to Est. Need
4,872	6,641 gal.	97

Your landscape area is derived from aerial imagery and encompasses your entire lot according to county records, excluding your home and driveway footprint. Estimated need is calculated from 30yr average evapotranspiration values for each month.

If you would like to receive this report by email, contact us at conservation@weberbasin.com with your name and account number, or call us at 801-771-1677.

Secondary water is now off for the year. We thank you for your efforts to conserve water and only water when needed. We ask that you close your own user valves before the lines are charged again next April. There are a lot of resources available to help you have a green, healthy lawn, while reducing total water applied. Visit the District Learning Garden or www.weberbasin.com for information and programs. A schedule of next year's free classes and events will be available in February 2017.

Estimated grass/turf water needs throughout the District have been adjusted to 35 inches/year. This adjustment is based on the analysis of long-term weather and historical evapotranspiration losses. If you have questions or comments concerning this report, please contact us @ 801-771-1677

Weber Basin's Water Conservation Learning Garden

2837 E. Hwy 193, Layton Utah

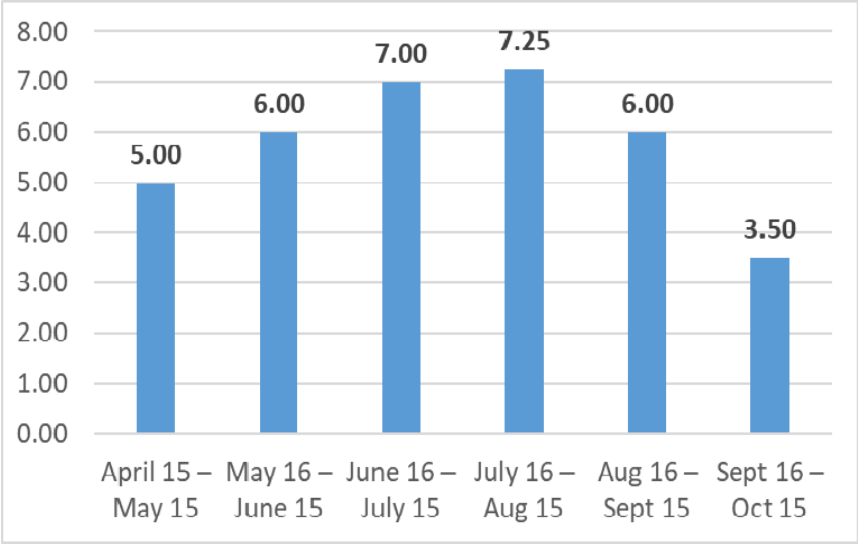
Elements of Secondary Water Use Reports

WEBER BASIN WATER CONSERVANCY DISTRICT

UtahState University

Key Conservation Messages:

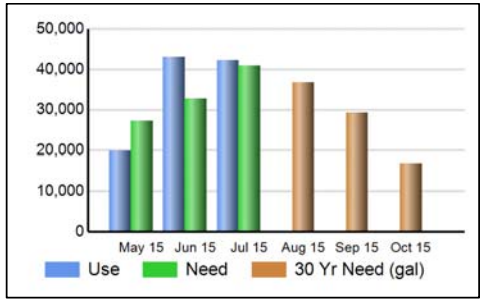
- ***Water to meet landscape need (or demand) over the irrigation season***
- ***Importance of irrigation scheduling***
- ***How to access additional information***

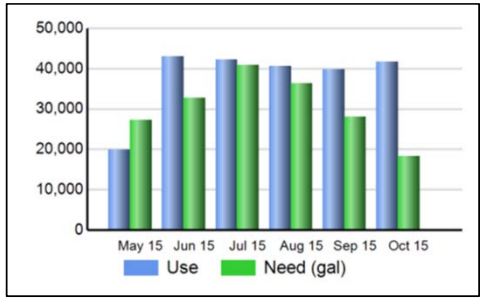


30 Year Average Monthly Reference ET (in.)

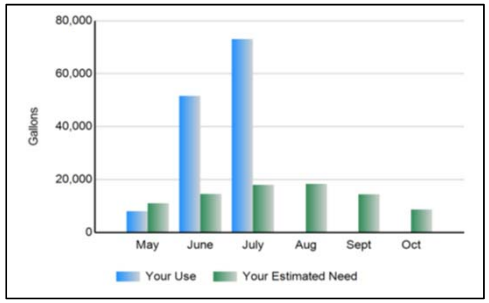
Landscape Water Monitor on Reports:

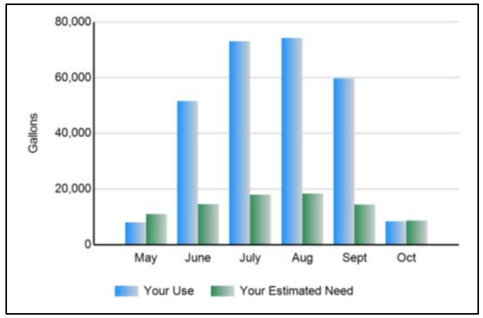
- predictive in advance to condition people to changing landscape water needs
- actual comparison with each monthly report





2012 Examples:
July Report
October Report

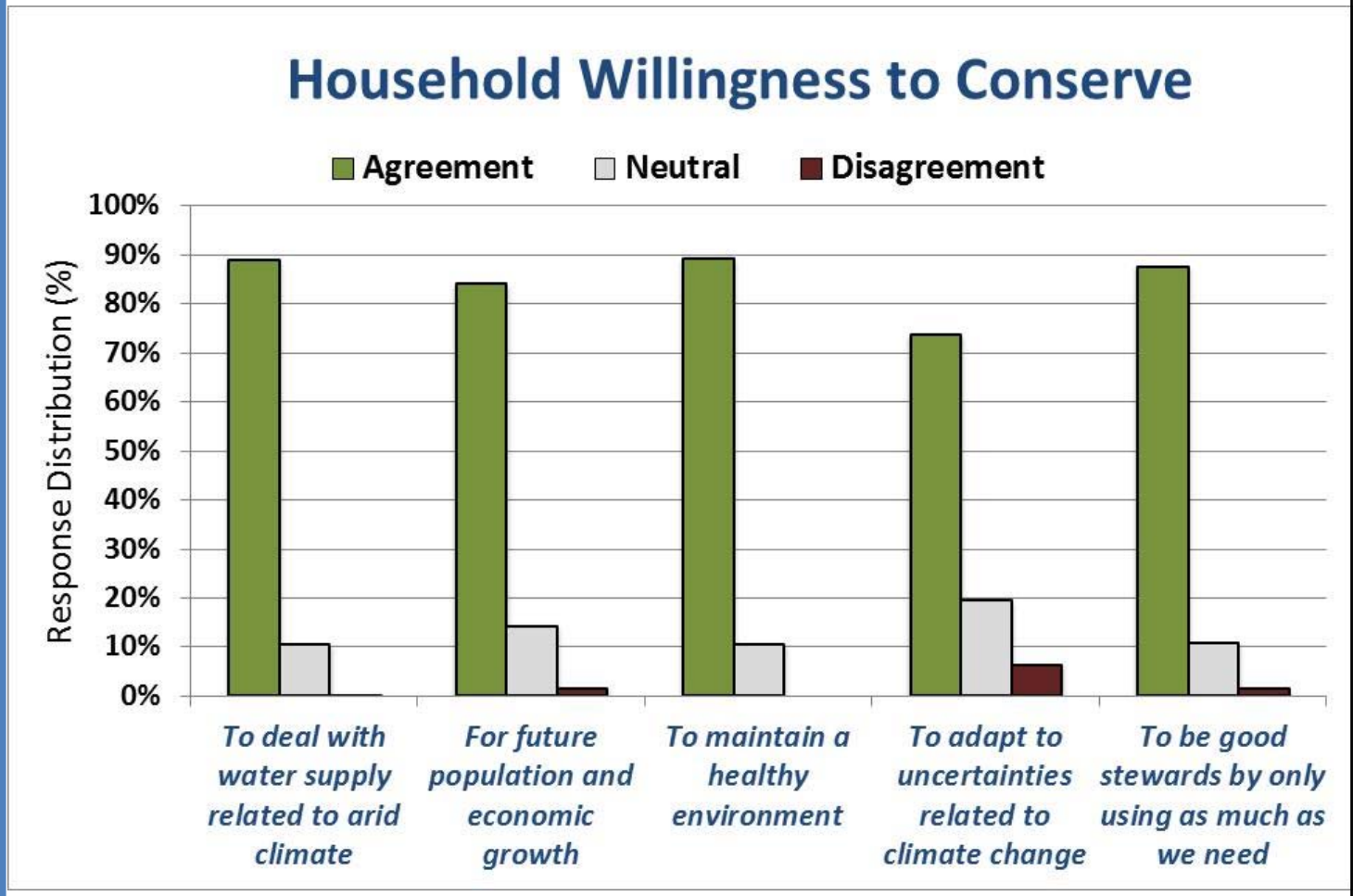




2013-2017 Examples:
July Report
October Report

RESULTS:
Customer Response 2012 Survey

Participants indicated high willingness to conserve for a variety of reasons

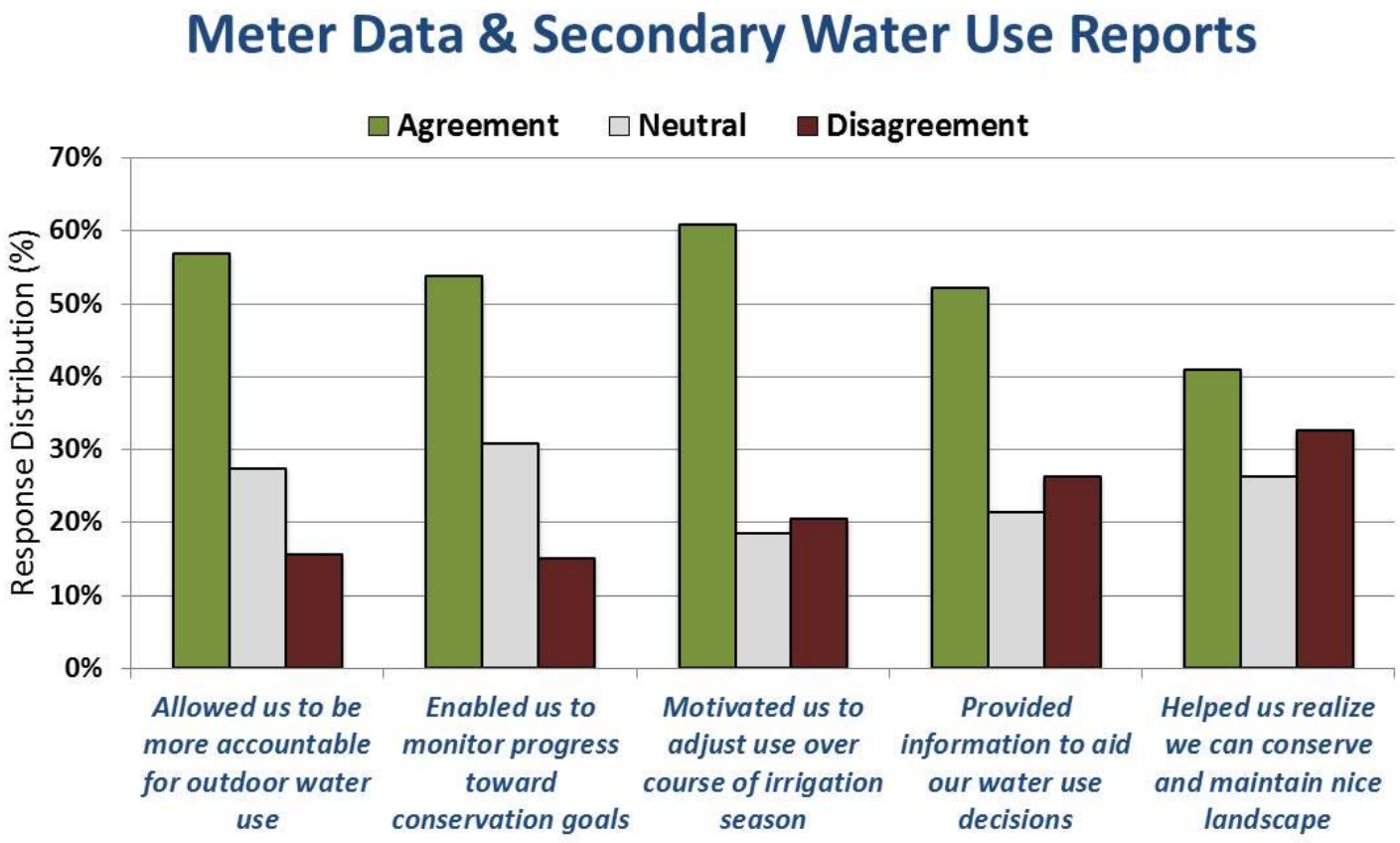


n=210 survey respondents

RESULTS:
Customer Response 2012 Survey

- *73% were surprised to learn the amount of water used on their landscape*
- *Reports sent the intended message to most users*
- *Reports provided actionable information to users*

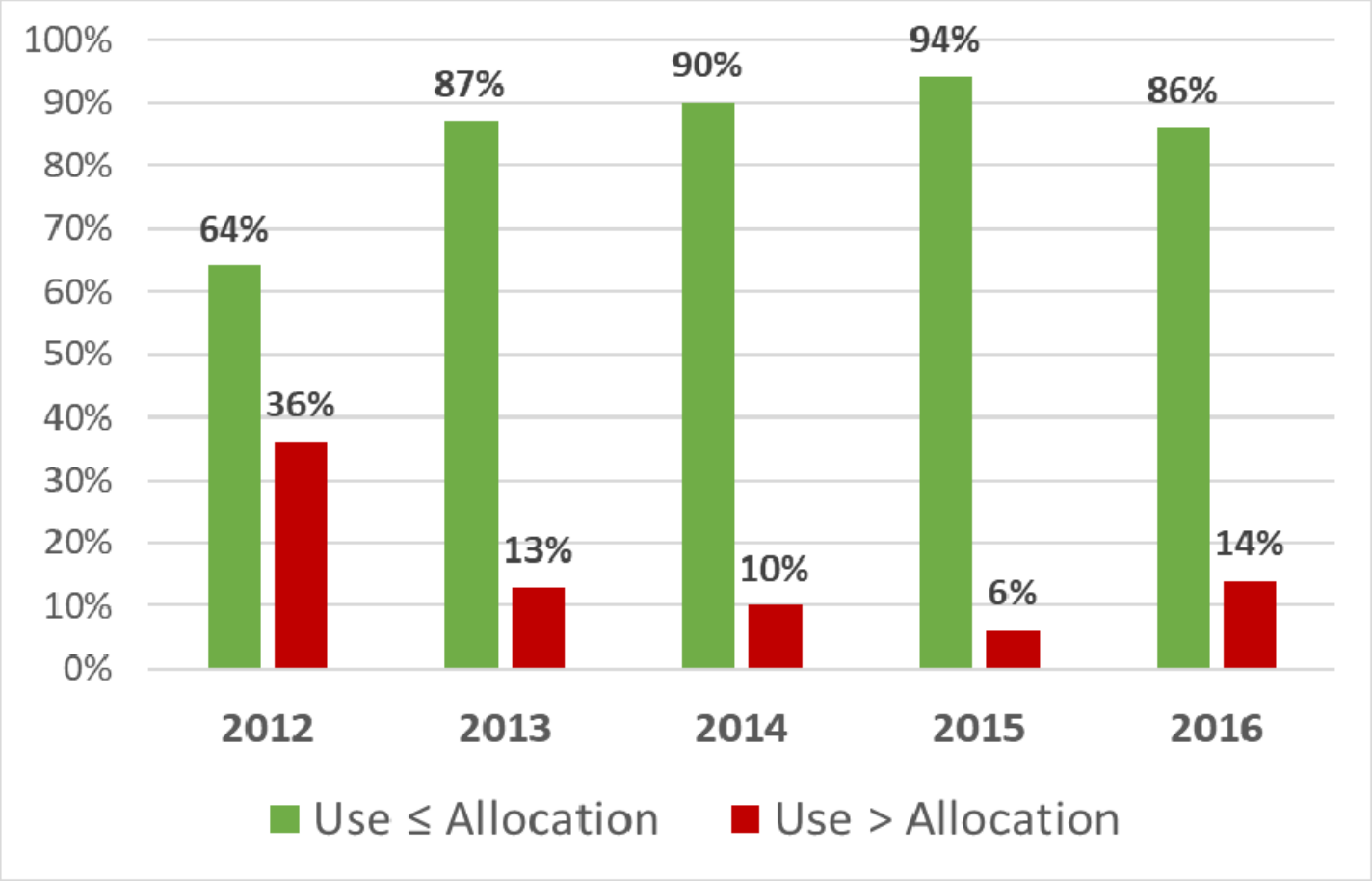
Actionable Information the Reports Provided



n=210 survey respondents

RESULTS:
Water Use Trends 2012-2016

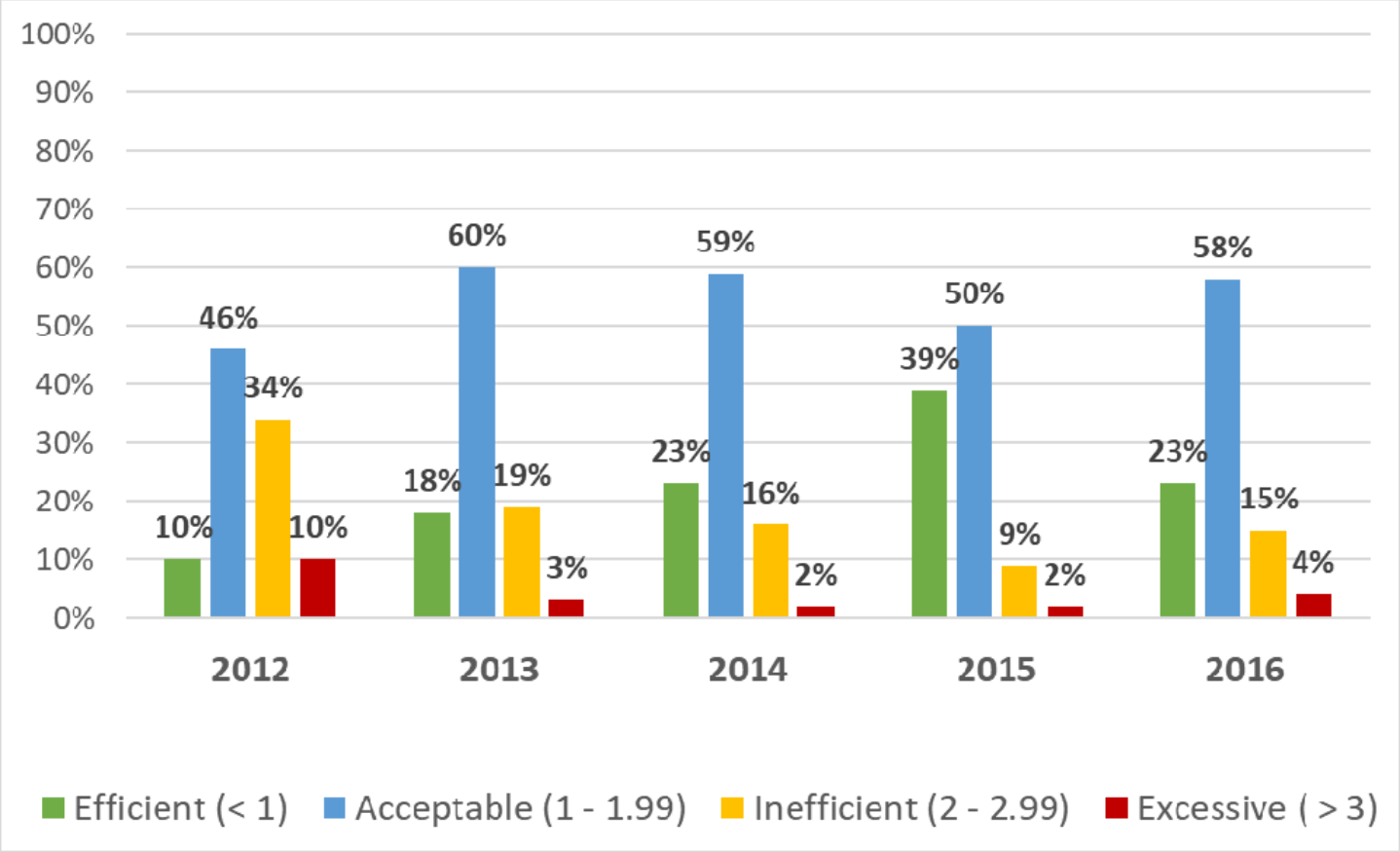
More households are staying within their property's water allocation



n=842 metered locations

RESULTS:
Water Use Trends 2012-2016

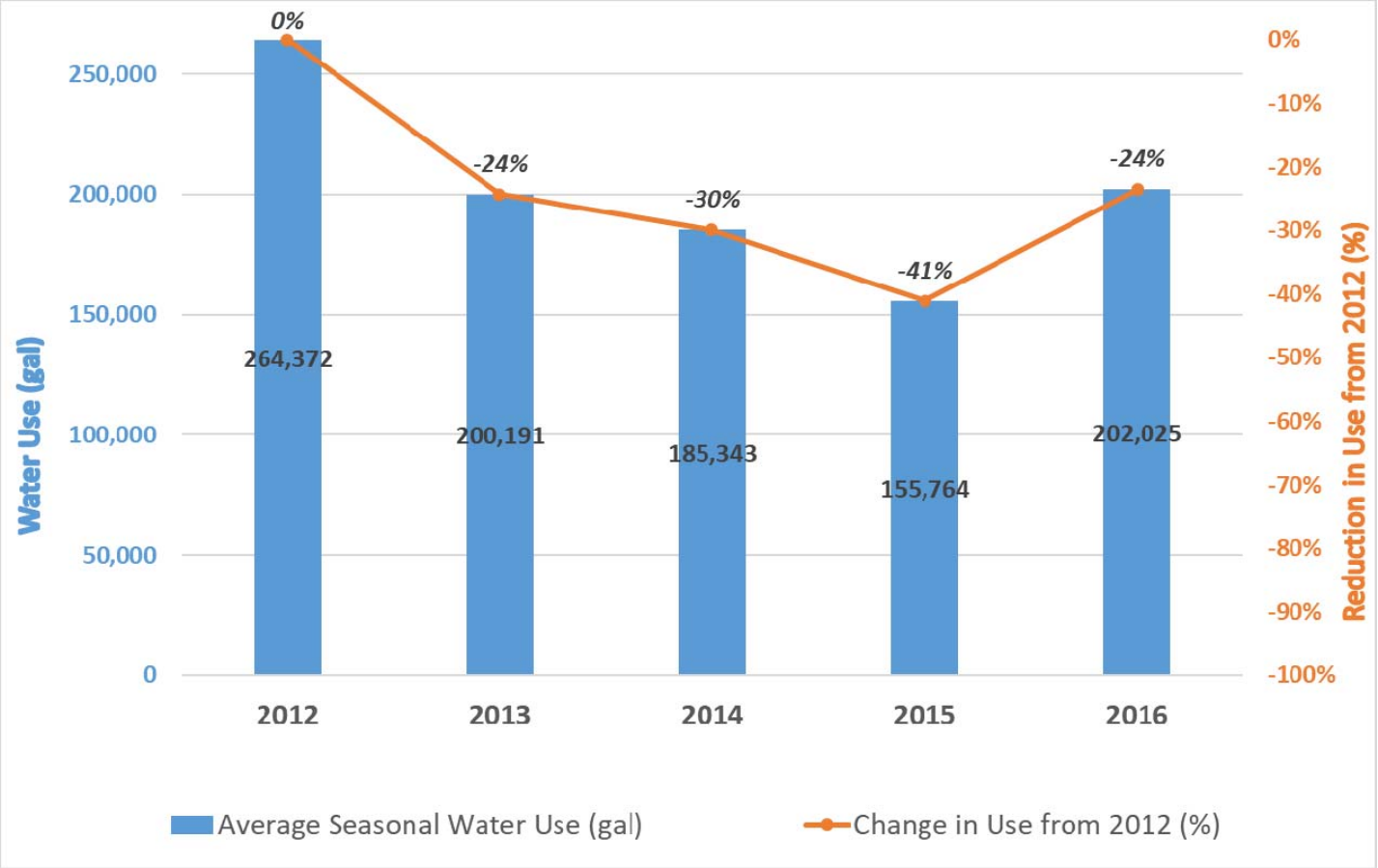
Households are generally becoming more efficient in their secondary landscape water use



n=842 metered locations

RESULTS:
Water Use Trends 2012-2016

Resulting in documented and durable landscape water savings in gallons



n=842 metered locations

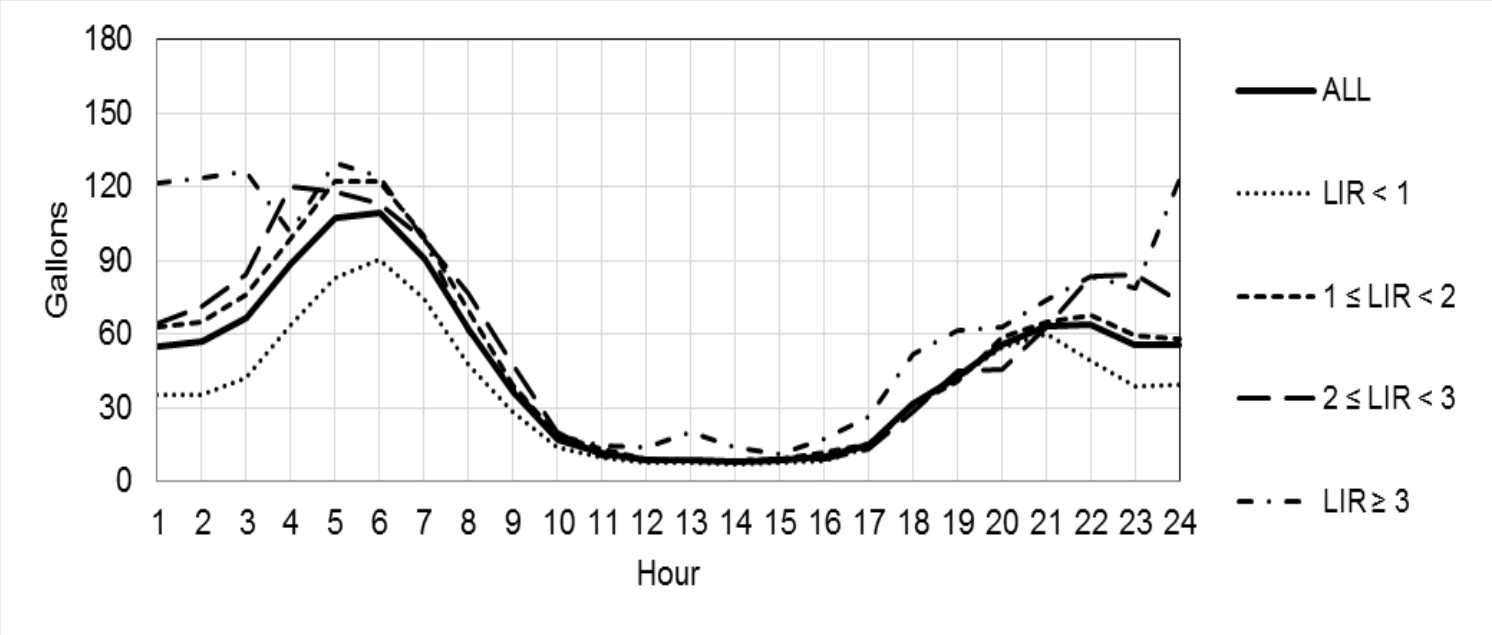
RESULTS:
Water Use Trends 2012-2016

- *Households use, on average, 150% (LIR=1.5) of the water that their landscapes need*
- *Seasons unfold differently, requiring adaptability for maximum efficiency*
- *More overuse tends to occur later in the irrigation season*

Average LIRs for months and seasons by year

	2012	2013	2014	2015	2016	5-year average
April 15-May 15	1.2	1.0	0.5	0.5	0.3	**0.7**
May 16-June 15	1.9	1.5	1.8	0.7	1.2	**1.4**
June 16-July 15	2.2	1.9	1.6	1.6	1.9	**1.8**
July 16-Aug. 15	2.1	1.7	1.6	1.3	2.0	**1.7**
Aug. 16-Sept. 15	2.1	1.4	1.4	1.7	1.9	**1.7**
Sept. 16-Oct. 15	2.4				1.3	**1.9**
Sept. 16-Oct. 1		2.0	2.0	2.0		
Seasonal	**2.0**	**1.6**	**1.5**	**1.3**	**1.4**	**≈ 1.5**

Analysis using hourly data



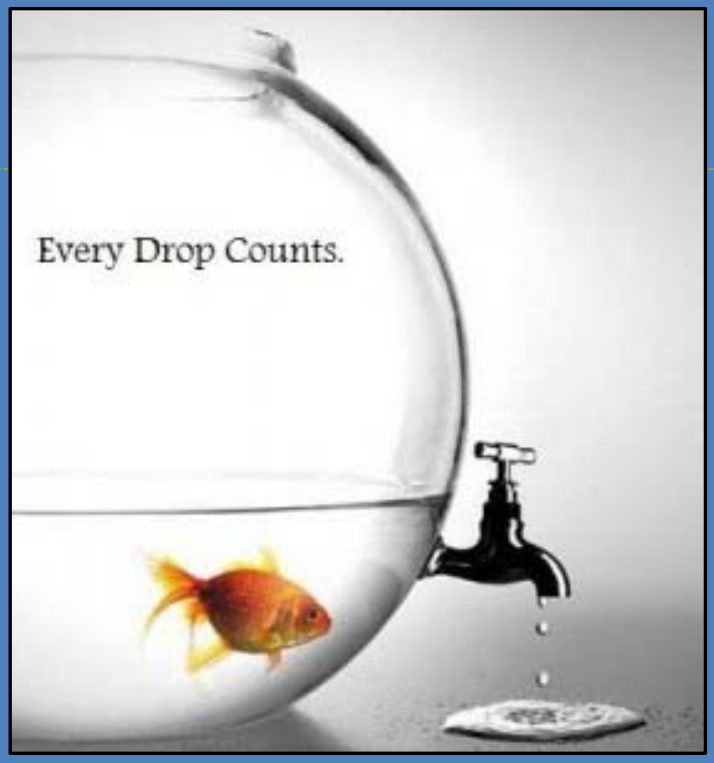
- People generally do not water during the middle of the day
- People who overwater do so at night
- Caution about only using “visual cues” to enforce waste restrictions

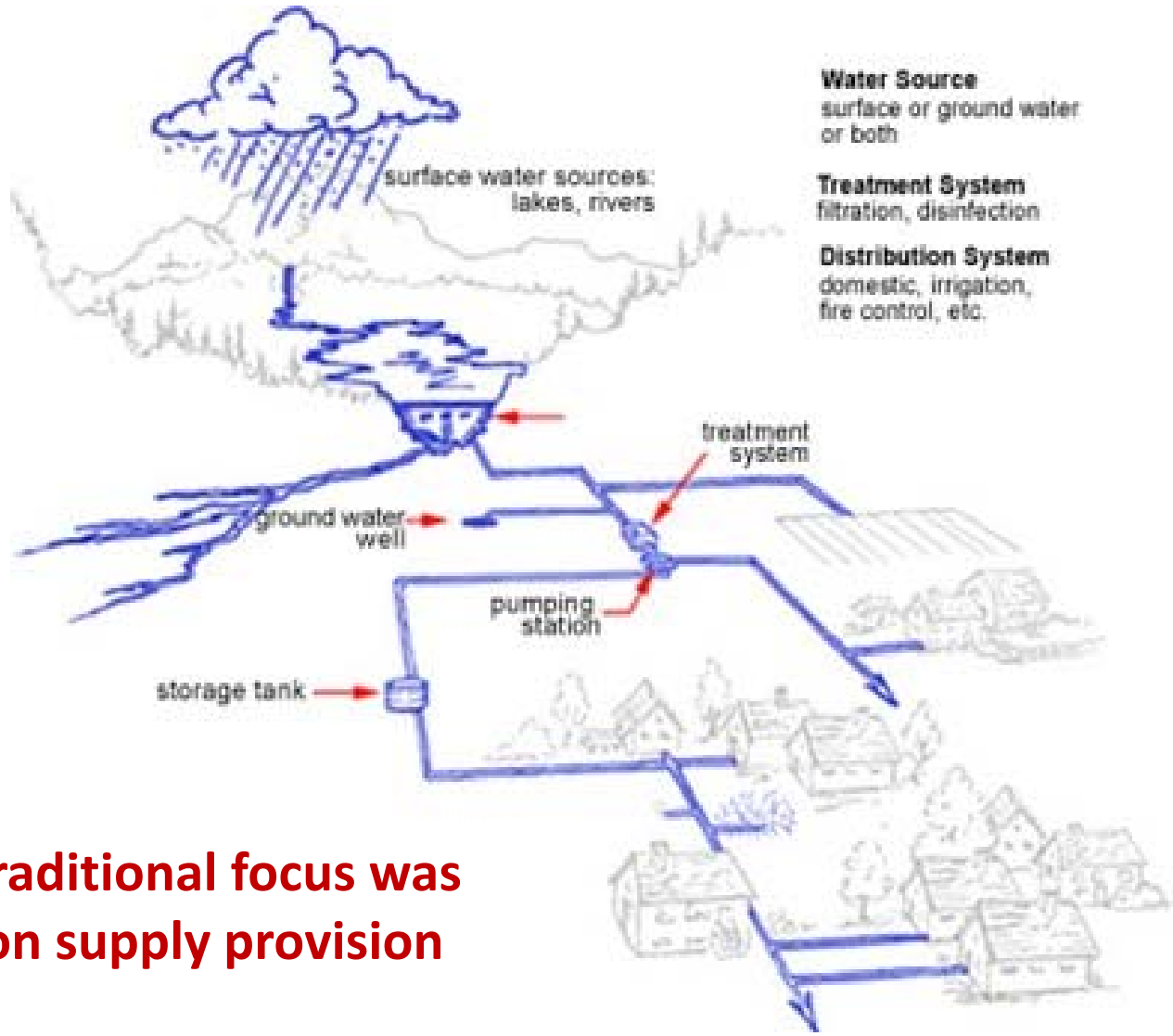
LESSONS

Analyzing appropriateness in landscape water use

- Applied interdisciplinary sciences can help address management challenges (plant, climate, and social/policy sciences).
- Water budgeting approaches based on science and responsive to policy contexts are important conservation tools.
- Site-specific information in addition to more general conservation information motivates and helps people to conserve.
- Conservation education can be effective even absent economic incentives (prices).
- Reports reach all users with metered secondary water. The approach avoids conservation program recruitment issues.

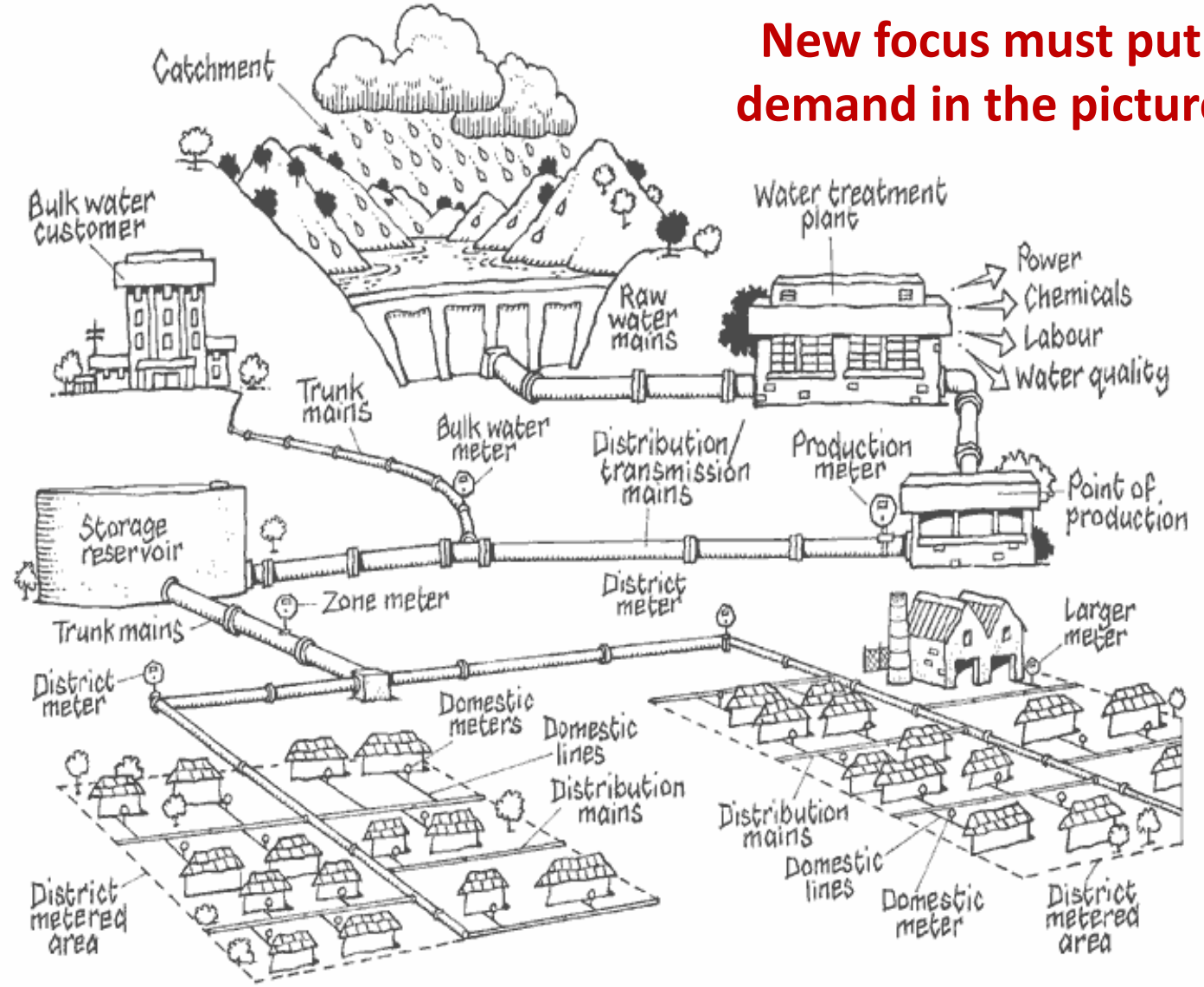
Investment Strategies





Traditional focus was on supply provision

New focus must put demand in the picture



Summary Thoughts

- Current opportunities in infrastructure investment decisions to shape and sustain our future
- Be serious about water demand management
- Backed by a portfolio of strategic investments in “water conservation infrastructure”
- Propelled by commitment to using water wisely
- Dedicated to making Utah a leader (again) in irrigation and water management in the West

PRESENTER CONTACT INFORMATION

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