WORKING WITH PEOPLE TO PROMOTE LANDSCAPE WATER CONSERVATION

DR. JOANNA ENDTER-WADA
Quinney College of Natural Resources
Utah State University
Logan, Utah
To Get Started....

- ... think about plants
- ... think about people

What do they have in common?
People are a lot like plants....

• They come in an array of different shapes, sizes, colors, and smells.
• They call different places “home.”
• Sometimes they grow up one place and then are transplanted somewhere else.
• They have to adapt to their new homes, to the weather, to things people do to them.
People are a lot like plants....

- Their needs differ.
- Some of them are tricky to raise.
- Certain ones are particularly temperamental.
- They do well in different settings.
- They have different habits.

→ So, you need to get to know them.
**Presentation Overview**

• Context and need for landscape water conservation

• Many people, many decisions

• USU WaterMAPS: software application for assessing urban landscape water use and providing information feedback to users

• Water conservation research: examples and findings

• Summary observations
CONTEXT:
need for urban landscape water conservation, especially in the U.S. West

Utah is 2nd driest state in the United States
Dimensions of Western Urban Water Context

Temporal:
• Forgotten past ~ paleo-climatic record
• Ignored present ~ aridity and drought
• Uncertain future ~ climate change

Spatial:
• Dynamic urban environments ~ many sources of change
• High variability ~ across urban landscapes; among users
• “Situational Waste” ~ site-specific constraints to efficiency
UTAH CONTEXT: Growth

- Rapid population increase
- Economic development
- Concentrated urbanization
Transfers of land and water from agriculture to municipal and industrial uses

**CONTEXT:**
Changing uses and needs

1958  \[\rightarrow\]  2012

**CLINTON UTAH**

**SYRACUSE UTAH**

**LAYTON UTAH**
About 60-70% of residential water is used to irrigate landscapes.

Urban irrigation systems often are not well designed, maintained, or operated.

Conservation of water used on urban landscapes has the greatest potential to contribute to urban water demand management.
Many People,

Many Decisions
Many People Influence Landscape Decisions

- Property...
  - ... owners
  - ... managers
  - ... renters
- Home Owner Associations (HOAs)
- Landscape architects and designers
- Landscape maintenance firms
- Growers, Nurseries
- Government officials (politicians, planners, employees)
- etc.......
Many decisions affect landscape water use

- Decisions ...
  - ... big and small
  - ... made frequently or occasionally
  - ... made in consultation with others or alone

- Decisions related to....
  - ... sites where landscapes are established
  - ... soil preparation
  - ... plant selection
  - ... irrigation system design and installation
  - ... irrigation system operated and maintenance
  - ... social pressure people feel to maintain certain types of landscapes
PEOPLE-ENVIRONMENT INTERACTIONS

CONCEPTUAL SYSTEMS
Beliefs, Perceptions, Values, Cosmology

BEHAVIORAL SYSTEMS
Economic, Political, Social, Cultural

TOOLS
Science, Technology, Language

NATURAL LAWS

People  —  Environment

Adapted from Endter-Wada, CEEM (Continuing Education in Ecosystem Management)
PEOPLE-ENVIRONMENT INTERACTIONS

CONCEPTUAL SYSTEMS
Beliefs, Perceptions, Values, Cosmology

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Economic, Political, Social, Cultural

TOOLS
Science, Technology, Language

NATURAL LAWS

People (issues of scale and differentiation)
- Individuals
- Families
- Households
- Social Groups
- Communities
- Watersheds
- Regions
- Nations, Cultures

Environment (issues of scale and differentiation)
- Resources:
  - Air
  - Water
  - Forests
  - Rangelands
  - Wildlife/Fish
- Systems:
  - Geological
  - Hydrological
  - Ecological
  - Atmospheric

Adapted from Endter-Wada, CEEM (Continuing Education in Ecosystem Management)
People act in the world based on “ways of knowing” it, i.e. how it is, how they perceive it to be, and how they want it to be.
Contextualizing People-Environment Interactions

**Context:**
- **When (location in time)**
- **Where (location in space)**

**WHO:** Which People

**WHAT:** Aspect of the Environment

**People linked to water and landscapes in various ways**

**Urban landscapes in a particular place**

Endter-Wada and Blahna, 2011
USU WaterMAPSTM
Water Management Analysis and Planning Software

- Joanna Endter-Wada, Ph.D.
  - Dept. of Environment and Society
  - Water Law and Policy; Human Dimensions of Natural Resources

- Christopher M.U. Neale, Ph.D.
  - Division of Irrigation Engineering, Dept. of Civil and Environmental Engineering
  - Remote Sensing; Irrigation Engineering

- Roger Kjelgren, Ph.D.
  - Dept. of Plants, Soils and Climate
  - Plant Science; Native Plants; Water Efficient Landscaping

- Diana Glenn, M.S.
  - Urban Water Conservation Research Lab

- Clay Lewis, M.E.
  - Ph.D. Student, Civil and Environmental Engineering; Remote Sensing Laboratory
Landscape Water Use Efficiency Through Contextualized Systems Thinking

Outcomes to Avoid
1. Identify landscape type and area (from overflights) for urban parcels/lots

2. Integrate with reference ET$_o$ to estimate landscape water need

3. Use meter data to compare actual landscape water use with landscape water need, then categorize appropriateness of use

4. Interview/interact with water users to understand water use patterns and design appropriate water conservation programs
AIRBORNE MULTISPECTRAL REMOTE SENSING

USU Remote Sensing Aircraft & Lab
Obtains and classifies imagery for urban areas
Defining Appropriateness

of urban landscape irrigation relative to plant water needs

Beneficial Use without waste

Recognizing different water needs of turf vs. trees and shrubs

Can transition to native or low-water use landscapes

Based on a standard of ecologically appropriate water use given variations in urban lots, people’s choice of landscape type(s) and local climate estimates (ET)
- Determines water need for existing landscapes
- Includes parking strips as part of landscapes people water (even though not within their property boundaries)
**IDENTIFYING CAPACITY TO CONSERVE utilizing Landscape Irrigation Ratios (LIR)**

**Landscape Water Use** *estimated*
(derived from analysis of municipal or water provider meter data)

**LIR** = 

**Landscape Water Need** *estimated*
(derived from the classification of remotely-sensed airborne multispectral imagery and localized reference ET₀ rates modified by relevant landscape correction factors and irrigation system inefficiencies)

(per unit of landscaped area)

<table>
<thead>
<tr>
<th>LIR less than 1</th>
<th>Efficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between 1 and 2</td>
<td>Acceptable</td>
</tr>
<tr>
<td>Between 2 and 3</td>
<td>Inefficient</td>
</tr>
<tr>
<td>Greater than 3</td>
<td>Excessive</td>
</tr>
</tbody>
</table>
• Allows user to make different assumptions or choices for calculating LIR
• Automates analytic process
• Provides a software graphical user interface to run within the ArcGIS environment
• Facilitates the mining of water meter data
• Estimates water use and water need (with flexible assumptions)
• Provides spatial results and allows additional analyses
WATER CONSERVATION RESEARCH: examples and findings
CONNECTING SOCIAL SCIENCE AND POLICY

• Conservation psychology and insights into “multiple motivations”

• Behavioral approach looking at actions related to the resource domain of urban water

• Policy contexts and structures and the dynamics of framing, designing, and translating policies

RESEARCH METHODS

• Observational Studies: seeking to explain urban landscape water use patterns (utilizing interviews, focus groups, surveys, water diaries)

• Intervention Studies: experiments in trying to alter landscape water use and assess effectiveness of various conservation approaches (interventions)
## Multiple Motivations for Water Conservation

<table>
<thead>
<tr>
<th>Household respondents’ willingness to conserve water for various purposes</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypothetical uses of conserved water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>To increase residential development in the Layton area</td>
<td>2.74</td>
<td>2.64</td>
</tr>
<tr>
<td>To increase commercial development in the Layton area</td>
<td>2.60</td>
<td>2.41</td>
</tr>
<tr>
<td>To maintain or improve habitat for fish and other aquatic wildlife</td>
<td>6.18</td>
<td>2.95</td>
</tr>
<tr>
<td>To reduce your water bill</td>
<td>7.17</td>
<td>2.77</td>
</tr>
<tr>
<td>To improve stream and river levels for fishing, rafting and other instream recreation</td>
<td>5.60</td>
<td>3.08</td>
</tr>
<tr>
<td>To improve reservoir and lake levels for boating, water skiing and other open water recreation</td>
<td>4.66</td>
<td>3.18</td>
</tr>
<tr>
<td>To improve municipal parks, golf courses, ball fields and other urban recreation areas</td>
<td>4.72</td>
<td>2.96</td>
</tr>
<tr>
<td>To maintain visually pleasing, non-recreational open spaces and green spaces</td>
<td>5.10</td>
<td>2.89</td>
</tr>
<tr>
<td>To ensure adequate future water supplies for yourself and your household</td>
<td>7.85</td>
<td>2.33</td>
</tr>
<tr>
<td>To ensure adequate water supplies for future generations</td>
<td>7.81</td>
<td>2.40</td>
</tr>
<tr>
<td>To reduce pressure for converting agricultural lands to residential/commercial uses</td>
<td>5.20</td>
<td>3.17</td>
</tr>
<tr>
<td>To reduce the volume of water, and therefore the costs, at waste treatment facilities</td>
<td>5.77</td>
<td>2.79</td>
</tr>
<tr>
<td>To reduce impacts on rural areas that would result from diverting water to the Wasatch Front</td>
<td>5.84</td>
<td>2.73</td>
</tr>
<tr>
<td>To prevent the need for additional infrastructure costs to provide more water for the Wasatch Front</td>
<td>6.09</td>
<td>2.64</td>
</tr>
</tbody>
</table>

Total n = 296; valid n for these survey questions ranged from 280 to 292.

All variables were measured on an 11-point scale where 0 = “not at all willing to conserve water” and 10 = “very willing to conserve water.” Survey questions are listed in the order in which they appeared in the survey instrument.
Multiple Motivations for Water Conservation

<table>
<thead>
<tr>
<th>Hypothetical motivations</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiving educational information on the importance of conserving water on your landscape</td>
<td>5.31</td>
<td>3.10</td>
</tr>
<tr>
<td>Receiving educational information on how to conserve water on your landscape</td>
<td>6.04</td>
<td>3.10</td>
</tr>
<tr>
<td>If you made a written commitment to the city of Layton to conserve water</td>
<td>5.27</td>
<td>3.47</td>
</tr>
<tr>
<td>An increase in your water bill of 25%</td>
<td>6.94</td>
<td>3.02</td>
</tr>
<tr>
<td>An increase in your water bill of 100%</td>
<td>8.44</td>
<td>3.17</td>
</tr>
<tr>
<td>If the cost of water was no longer a tax-deductible expense for your business</td>
<td>6.33</td>
<td>3.56</td>
</tr>
<tr>
<td>If you knew the city of Layton was running out of water and needed everybody to conserve</td>
<td>8.86</td>
<td>1.84</td>
</tr>
<tr>
<td>If you knew all types of water customers in Layton were being asked to reduce water use on their landscapes</td>
<td>8.22</td>
<td>2.17</td>
</tr>
<tr>
<td>If you knew most other businesses in Layton had agreed to reduce water use on their landscapes</td>
<td>7.99</td>
<td>2.53</td>
</tr>
<tr>
<td>If you received a formal written request from the city of Layton asking you to voluntarily reduce the amount of water used on your landscape</td>
<td>8.18</td>
<td>2.15</td>
</tr>
<tr>
<td>If you received pressure from your customers to conserve water</td>
<td>7.70</td>
<td>2.80</td>
</tr>
<tr>
<td>A rebate offer to help offset the cost of installing water conserving devices</td>
<td>7.24</td>
<td>3.21</td>
</tr>
<tr>
<td>A city watering restriction that limited the amount of water you could use</td>
<td>8.07</td>
<td>2.77</td>
</tr>
<tr>
<td>A city landscape ordinance that mandated you to replace high water use landscapes with low water use landscapes</td>
<td>7.04</td>
<td>3.21</td>
</tr>
</tbody>
</table>

Total n = 95, valid ns for these survey questions ranged from 92 to 95.
All variables were measured on an 11-point scale where 0 = "not at all willing" and 10 = "very willing." Survey questions are listed in the order in which they appeared in the survey instrument.
Table 4: Range of Water Use by Automation of Watering System, All Cases

Level of automation of watering system\(^a\) (percentages within each category)

<table>
<thead>
<tr>
<th>Water use range relative to plant need:</th>
<th>Low (manual hose watering)</th>
<th>Medium (manual start sprinkler)</th>
<th>High (programmed sprinkler)</th>
<th>All cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (conserving use)</td>
<td>62.7</td>
<td>29.4</td>
<td>17.5</td>
<td>37.0</td>
</tr>
<tr>
<td>Medium (acceptable use)</td>
<td>22.9</td>
<td>17.6</td>
<td>25.9</td>
<td>23.9</td>
</tr>
<tr>
<td>High (wasteful use)</td>
<td>14.4</td>
<td>52.9</td>
<td>56.6</td>
<td>39.1</td>
</tr>
<tr>
<td>Column percentage totals</td>
<td>100.0</td>
<td>99.9</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Number of total cases                    | 153                       | 34                             | 189                       | 376       |
Percentage of total cases                | 40.7                      | 9.0                            | 50.3                      | 100.0     |

Descriptive statistics:
- Pearson’s chi-square = 88.84 (p < 0.001)
- Gamma correlation coefficient = 0.63

*Endter-Wada et al., 2008, JAWRA*
c) ... and human interface with that technology

Irrigation system design, maintenance, operation and the type of controller or timer have a significant influence on landscape water use.

**LOGAN STUDY:**
Baseline Landscape Irrigation Ratio (LIR) by Controller Type

<table>
<thead>
<tr>
<th>Baseline LIR Category</th>
<th>Controller Typea</th>
<th>Manual</th>
<th>Mechanical</th>
<th>Combo</th>
<th>Digital</th>
<th>All Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Justifiable (&lt; 2)</td>
<td></td>
<td>100</td>
<td>37</td>
<td>47</td>
<td>63</td>
<td>53</td>
</tr>
<tr>
<td>Unjustifiable (≥ 2)</td>
<td></td>
<td>0</td>
<td>63</td>
<td>53</td>
<td>37</td>
<td>47</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td>(13)</td>
<td>(24)</td>
<td>(79)</td>
<td>(32)</td>
<td>(148)</td>
</tr>
</tbody>
</table>

*Pearson’s $\chi^2 = 16.215***, Cramer’s $V = 0.331***, Goodman & Kruskal’s $\tau = 0.11***

*Note.* Sprinkler systems < 2 years old omitted.

*a* Coded: 1 Manual, 2 Mechanical, 3 Combo, 4 Digital.

*p ≤ .05, **p ≤ .01.
Study/program participants ...  
a) vary

- Volunteers and “recruits” are different:
  - Motivations, Needs
  - Responses

- Participants need different kinds of help based on:
  - Their own past efforts and experiences with conservation
  - Level of sophistication in the information they are seeking and the detail they expect
  - Whether they can make changes (“do-it-yourselfers”) or need help (“hand holders”)
b) ... volunteers are more conserving

<table>
<thead>
<tr>
<th>Benchmark LIR Category</th>
<th>Mean Water Use (^a) (mm/day)</th>
<th>Distribution of Cases (^c)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2004 Volunteers</td>
</tr>
<tr>
<td><strong>Justifiable Water Use:</strong></td>
<td></td>
<td>percentage</td>
</tr>
<tr>
<td>Efficient: ( LIR \leq 1 )</td>
<td>2.01</td>
<td>30</td>
</tr>
<tr>
<td>Acceptable: ( 1 &lt; LIR \leq 2 )</td>
<td>4.99</td>
<td>35</td>
</tr>
<tr>
<td><strong>Unjustifiable Water Use:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inefficient: ( 2 &lt; LIR \leq 3 )</td>
<td>7.72</td>
<td>24</td>
</tr>
<tr>
<td>Unnecessary: ( 3 &lt; LIR )</td>
<td>12.20(^b)</td>
<td>11</td>
</tr>
<tr>
<td><strong>Total %</strong></td>
<td></td>
<td>100</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td></td>
<td>(148)</td>
</tr>
</tbody>
</table>

\(^a\) Compared to the 2004 baseline ET\(_o\) of 4.56 mm/day and 2005 baseline ET\(_o\) of 4.28 mm/day.

\(^b\) 2 outlier cases with greater than 30 mm/day were excluded, 1 case in each year.

\(^c\) Pearson’s \( \chi^2 = 45.479, p \leq .000 \) (indicative of inherent differences in recruitment methods)
CONSERVATION “SUCCESS”...

a) ... is related to initial “capacity to conserve”
b) ... is not easily characterized

c) ... or promoted

Kilgren, Endter-Wada, Kjelgren, Johnson, 2010, JAWRA
1 – South Ogden (365 meters)
2 – Washington Terrace (250 meters)
3 – South Weber (400 meters)
SECONDARY WATER USE REPORTS

• Purposes:
  1) use meter data as information tool instead of pricing tool
  2) share meter data with people
  3) increase awareness of landscape water use
  4) motivate people to become more efficient
  5) provide way for people to monitor their own use

• Design:
  1) based on focus group feedback regarding information needs
  2) comparisons based on individuals’ own landscapes and use
  3) transparent explanation of estimated landscape water need
  4) awareness that this could be new “anchor point” for water use
**Letter from WBWCD**

Weber Basin Water Conservancy District

May 2023

Dear Water User,

As we begin another irrigation season, we look back on a warmer than average winter in which we received about 35% of normal snowpack (based on average snowpack on April 1 of each year). This year it is important to monitor our water use closely and use our water more efficiently.

We appreciate your patience as we install meters and make improvements to your secondary water connection. This meter project was completed in order to accomplish the following goals:

- **To reduce water usage and accurately account for secondary water use.**
- **To improve efficiency.**
- **To provide measurable results.**
- **To help you evaluate your water usage.**

The meter data can help the District identify opportunities for water conservation and develop more effective water conservation programs.

Inbtnuance of your new water meter for Weber Basin’s use has been installed on your connection. This allows the District to shut off individual lines, instead of neighborhoods, when a homeowner needs to make repairs.

The District is collaborating with Utah State University to conduct research investigating the influence of water use information on landscape water conservation and efficiency efforts. The USU research team has developed a method for assessing capacity to conserve landscape water by computing measured secondary water use on an estimate of your site-specific landscape water use. USU’s method integrates water use data from your lot location, site and landscape characteristics. This method differs from the approach used last year in responding to inquiries where meters were installed in 2011, when estimates of landscape water use were based on a household’s lot size and a set of simplified assumptions about lot’s landscape characteristics.

The USU research team and the District have designed the enclosed Secondary Water Use Report to be an informational tool that is intended to aid your water use decisions, such as adjusting your watering schedule. Please see the enclosed information sheet explaining USU’s method for estimating capacity to conserve and providing tips for interpreting and using the Secondary Water Use Report. We will mail these reports to you this year but if you would also like to receive it via email, please send your email address to contact@waterbasin.org. USU researchers will be connecting you to gather feedback and information that will help us evaluate the Water Use Reports.

We encourage you to visit Weber Basin’s Learning Guides at our Layton headquarters (address above) or participate in free landscape classes and other events. All classes are free. For a full schedule and other landscape information, visit www.waterbasin.org/conservation. We hope you will use these resources to achieve your conservation goals while maintaining a healthy landscape.

Sincerely,

David Rice
WBWCD Conservation Coordinator
(801) 771-1677

**Letter from USU**

Dear Water User,

We are excited to collaborate with Weber Basin Water Conservancy District and continue our research in connection with the Secondary Water Use Information Project. The mission is to develop secondary water use information and encourage efficient water use. The research is expected to provide valuable information to help you conserve water through a grant from the U.S. Bureau of Reclamation and Utah State University.

Throughout the irrigation season, we will work closely with the Weber Basin Water Conservancy District to provide you with a Monthly Secondary Water Use Report. We are available to answer any questions you may have about those reports and are interested in your feedback.

We will also conduct research to better understand how the perceptions of landscape users (i.e., what people believe water use is or is not) impact their water use behaviors and their views on water efficiency, conservation, and affordability. We invite you to participate in one of the following research activities during the irrigation season: (1) a survey that will consist of 15-20 questions on how people think about water use (as an input to the planning), and (2) a water audit, which will be conducted at your property. The water audit will help us understand how to improve our research efforts and your experiences and insights will provide valuable contributions to our research on water management.

If you have questions or comments about your Secondary Water Use Report, or if you would like to participate in the surveys or water audit, please contact Robert Elkin at the UW Water Conservation Research Lab at (435) 799-0804 or robert.elkin@usu.edu.

We appreciate your cooperation and look forward to your continued support of our research. The success of this research is dependent upon the participation of our community partners, and we are grateful to you for your contributions.

Sincerely,

Robert Elkin, Ph.D.

Department of Engineering and Natural Resources
Utah State University

### 2012 SECONDARY WATER USE REPORTS

**Information Sheet (2 pgs)**

**Letter from USU**

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We will also conduct research to better understand how the perceptions of landscape users (i.e., what people believe water use is or is not) impact their water use behaviors and their views on water efficiency, conservation, and affordability. We invite you to participate in one of the following research activities during the irrigation season: (1) a survey that will consist of 15-20 questions on how people think about water use (as an input to the planning), and (2) a water audit, which will be conducted at your property. The water audit will help us understand how to improve our research efforts and your experiences and insights will provide valuable contributions to our research on water management.

If you have questions or comments about your Secondary Water Use Report, or if you would like to participate in the surveys or water audit, please contact Robert Elkin at the UW Water Conservation Research Lab at (435) 799-0804 or robert.elkin@usu.edu.

We appreciate your cooperation and look forward to your continued support of our research. The success of this research is dependent upon the participation of our community partners, and we are grateful to you for your contributions.

Sincerely,

Robert Elkin, Ph.D.

Department of Engineering and Natural Resources
Utah State University

### 2012 SECONDARY WATER USE REPORTS

**Information Sheet (2 pgs)**

**Letter from USU**

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Utah State University

### 2012 SECONDARY WATER USE REPORTS

**Information Sheet (2 pgs)**
Example map of property location sent in May

Example of Secondary Water Use Report for July for that location

Secondary Water Use Reports
Elements of the Secondary Water Use Report

### Landscape Water Use

<table>
<thead>
<tr>
<th>Last Meter Reading</th>
<th>Current Meter Reading</th>
<th>Number of Days</th>
<th>Your Landscape Water Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>510,664</td>
<td>542,522</td>
<td>30</td>
<td>31,858 gal</td>
</tr>
</tbody>
</table>

### Landscape Water Need

<table>
<thead>
<tr>
<th>Landscaped Area (sq. ft.)</th>
<th>Turf LA (%)</th>
<th>Non-Turf LA (%)</th>
<th>Your Landscape Water Need</th>
</tr>
</thead>
<tbody>
<tr>
<td>7,871</td>
<td>50</td>
<td>50</td>
<td>16,500 gal</td>
</tr>
</tbody>
</table>

### Landscape Water Management

Water use is: when LIR is:
- Efficient: less than 1
- Acceptable: between 1 and 2
- Inefficient: between 2 and 3
- Excessive: greater than 3

Your Landscape Irrigation Ratio (LIR) = \[
\text{Landscape Water Use} \div \text{Landscape Water Need}
\]

<table>
<thead>
<tr>
<th>Period</th>
<th>Min</th>
<th>Mean</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>3.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ET (in)</td>
<td>0.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precip. (in)</td>
<td>59.53</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Period</th>
<th>Min</th>
<th>Mean</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982-2011</td>
<td>2.67</td>
<td>3.33</td>
<td>3.79</td>
</tr>
<tr>
<td>ET (in)</td>
<td>0.11</td>
<td>1.68</td>
<td>5.48</td>
</tr>
<tr>
<td>Precip. (in)</td>
<td>44.18</td>
<td>52.54</td>
<td>62.97</td>
</tr>
</tbody>
</table>

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. All classes and programs are free. For a full water conservation schedule, visit Weber Basin’s website: [www.weberbasin.com/conservation](http://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.glen@aggiemail.usu.edu or (435) 797-9084.
### Monthly LIR at this location

<table>
<thead>
<tr>
<th>Month</th>
<th>LIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>May</td>
<td>1.41</td>
</tr>
<tr>
<td>June</td>
<td>1.48</td>
</tr>
<tr>
<td>July</td>
<td>2.81</td>
</tr>
<tr>
<td>Aug</td>
<td>2.13</td>
</tr>
<tr>
<td>Sept</td>
<td>1.84</td>
</tr>
<tr>
<td>Oct</td>
<td>1.93</td>
</tr>
</tbody>
</table>

- **Example of a final, end of season report sent in October**

- **Example of monthly LIR tracked over the irrigation season**
<table>
<thead>
<tr>
<th>VOLUME:</th>
<th>INEFFICIENCY [(\text{Landscape Irrigation Ratio})]</th>
</tr>
</thead>
<tbody>
<tr>
<td>\textit{Use \leq \text{allocation}}</td>
<td>\begin{tabular}{c</td>
</tr>
<tr>
<td>\textit{Use &gt; allocation}</td>
<td>\begin{tabular}{c</td>
</tr>
</tbody>
</table>

\textbf{SECONDARY WATER USERS \ (869)}
IRRIGATION PATTERNS: AVERAGES FOR THE 869 WBWCD METERED PROPERTIES IN 2012

<table>
<thead>
<tr>
<th>Property Subset</th>
<th>No. Cases (% of cases)</th>
<th>Seasonal LIR</th>
<th>Number Days Usage</th>
<th>Total Hours Usage</th>
<th>Number Times Usage</th>
<th>Per Property Usage (gal)</th>
<th>Property allocation (gal)</th>
<th>% allocation used</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL</td>
<td></td>
<td>1.55</td>
<td>143</td>
<td>887</td>
<td>255</td>
<td>264,925</td>
<td>294,061</td>
<td>90%</td>
</tr>
<tr>
<td>LIR &lt; 1</td>
<td>146 (16.8%)</td>
<td>0.71</td>
<td>128</td>
<td>728</td>
<td>209</td>
<td>171,236</td>
<td>358,077</td>
<td>49%</td>
</tr>
<tr>
<td>1 ≤ LIR &lt; 2</td>
<td>560 (64.5%)</td>
<td>1.46</td>
<td>143</td>
<td>866</td>
<td>262</td>
<td>259,080</td>
<td>288,117</td>
<td>90%</td>
</tr>
<tr>
<td>2 ≤ LIR &lt; 3</td>
<td>130 (14.9%)</td>
<td>2.33</td>
<td>154</td>
<td>1088</td>
<td>271</td>
<td>344,862</td>
<td>263,089</td>
<td>130%</td>
</tr>
<tr>
<td>3 ≤ LIR</td>
<td>33 ( 3.8%)</td>
<td>3.73</td>
<td>158</td>
<td>1143</td>
<td>276</td>
<td>463,714</td>
<td>233,730</td>
<td>198%</td>
</tr>
</tbody>
</table>
LANDSCAPE IRRIGATION USE BY HOUR FOR 869 WBWCD METERED RESIDENTIAL PROPERTIES IN 2012
Assuming 70% Distribution Uniformity (DU)

- Sum of daily landscape irrigation and need at 869 WBWCD metered residential properties 2012
- Use tracks weather but above landscape need
- Reports assumed 70% DU
- Average DU was 53% (WBWCD Water Check Program 2012)
- People misinterpret poor DU for plant water need

Assuming 53% Distribution Uniformities (DU)
POTENTIAL LANDSCAPE CONSERVATION THROUGH IMPROVED IRRIGATION EFFICIENCY

- Sum of daily landscape irrigation and need at 869 WBWCD metered residential properties 2012
- Increasing DU above 70% would realize savings
- 93% of households use automated irrigation systems
- 2.4% of respondents stated their sprinkler system is well maintained
PARTICIPANTS INDICATED HIGH WILLINGNESS TO CONSERVE FOR A VARIETY OF REASONS
73% of respondents 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.
- Rewarded efficient users with right message
- Created some cognitive dissonance for high users
SUMMARY OBSERVATIONS: what research tells us about human behavior and water conservation
HUMAN BEHAVIOR AND WATER CONSERVATION

- **Good Intentions**: people are generally willing to conserve water and motivated to do so for a variety of reasons

- **Innocent Overwatering**: people don’t know how much water landscapes actually need in the context of weather/climate variability

- “Situational Waste”: role of site specific constraints and opportunities for efficient water use (great variability in residential parcels)
Human Behavior and Water Conservation

- Conservation programs: attract people who are already efficient and seeking information to increase their conservation skills

- Conserving water is a process: involving many actions of change, monitoring, adjustment, and reinforcement; it is iterative over time
Landscape Water Conservation Challenges

- Broaden influence of conservation programs: reach the “information receivers” as well as the “information seekers”

- Identify conservation opportunities: find locations with inefficient landscape water use and direct conservation efforts there

- Provide relevant information: help people understand water needs of their landscape and how to maintain it while saving water
**LANDSCAPE WATER CONSERVATION CHALLENGES**

- **Promote long-term habit change:** provide consistent and repeated messaging to aid people’s decision making and helps them monitor their own progress toward conservation goals.

- **Prepare for droughts and growing scarcity:** fine-tune people’s ability to water appropriately during droughts with less consequence.
CLOSING THOUGHT:
so remember ..... 

People are a lot like plants!