Conserving Water Without Reducing Quality of Life

Kelly Kopp & Joanna Endter-Wada *(presenters)*
with Paul Johnson, Roger Kjelgren, & Larry Rupp

UtahState University

Center for Water-Efficient Landscaping

- Created to conduct research on effective irrigation techniques, landscape water demand analysis, 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

+ Personnel

- Kelly Kopp
- Roger Kjelgren
- Larry Rupp
- Joanna Endter-Wada
- Paul Johnson





+ Presentation Overview

Center for Water Efficient Landscaping

- *Policy Dimensions and Context:*

  Water management challenges & conservation opportunities in Utah

- *CWEL Contributions:*
  - *Management Tools*: WaterMAPS™
  - *Interdisciplinary Research*:
    - Landscape Plant Materials
    - Irrigation Technologies
    - Human Water Use Behaviors
  - *Public Information*: Extension Programs

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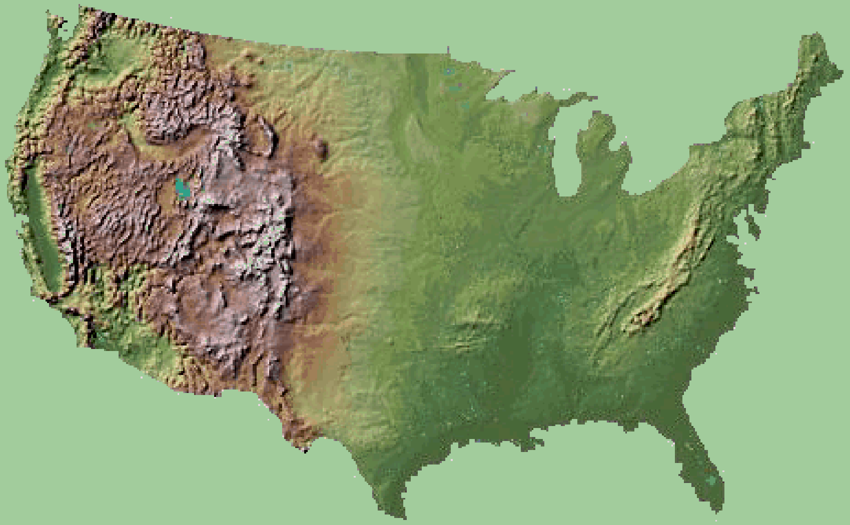
Policy Dimensions & Context:
Water Management Challenges & Opportunities



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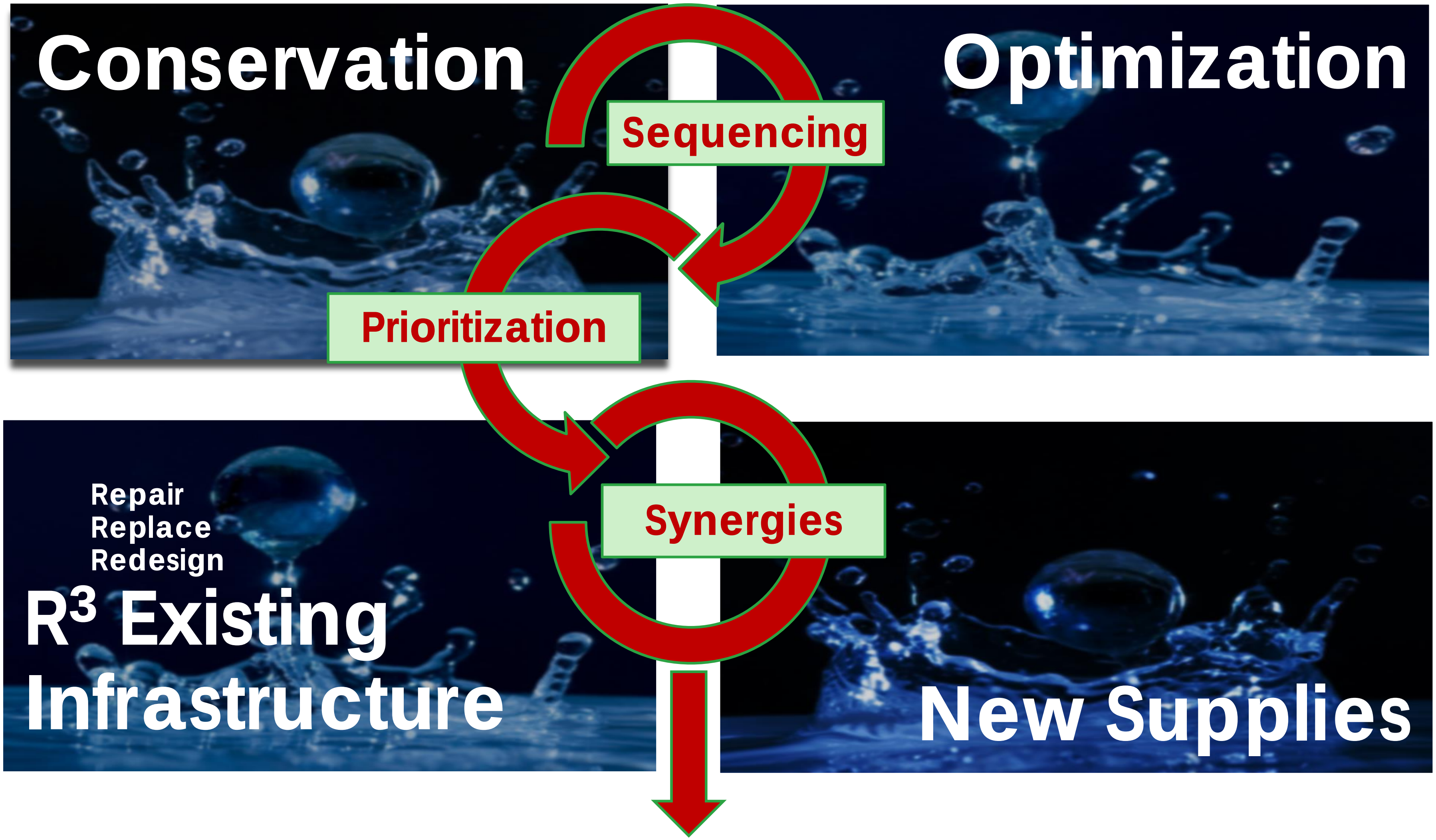
Water Management Strategies



Water and Financial Efficiencies

+ Urban Water Conservation
Why it Matters

Center for Water Efficient Landscaping

- 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 ag. 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

“Conservation is critical to minimize risk and build financial resilience”

(thinking long term)

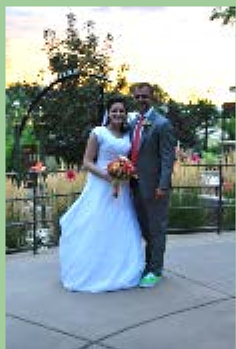
***Source:* C.E. Boyle, January 2014**

- Allows utilities to cut operation and maintenance costs
- Helps defer expensive supply expansion projects (avoided costs)
- Helps reduce total demand, shave peak use, provide revenue stability

“…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”

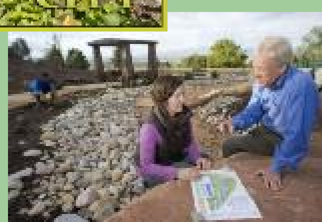
UTAH

SLOW THE FLOW SAVE H2O

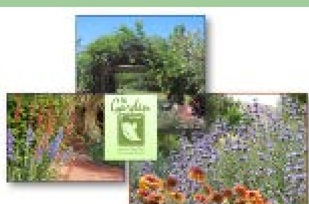


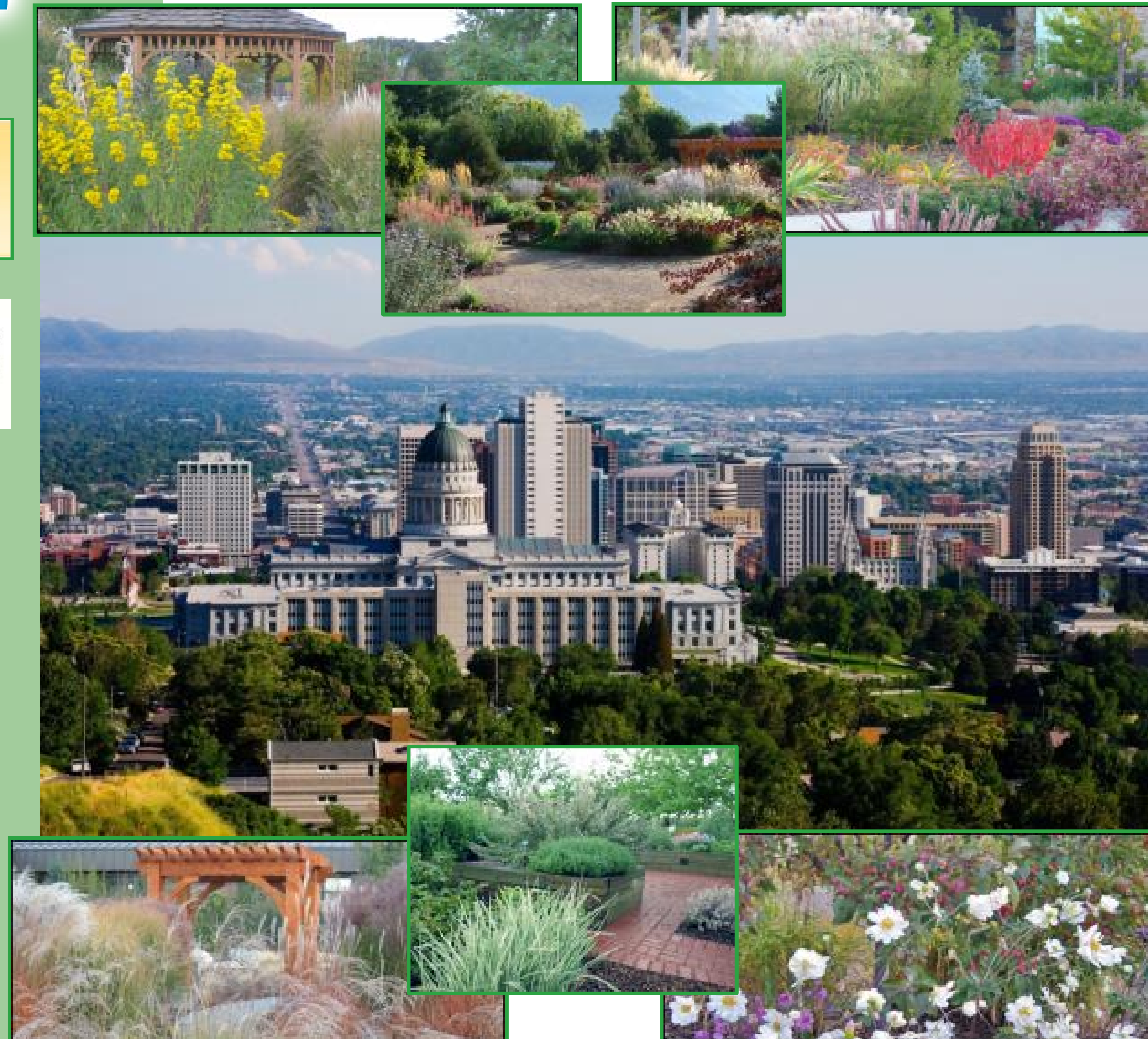
CONSERVATION GARDEN PARK

Weber Basin's Water Conservation Learning Garden



UTAH DNR WATER RESOURCES
SLOW THE FLOW
Utah Weekly Lawn Watering Guide





CENTRAL UTAH GARDENS
Conserving water through education

CWEL
CENTER FOR WATER-EFFICIENT LANDSCAPING

UtahStateUniversity
BOTANICAL CENTER

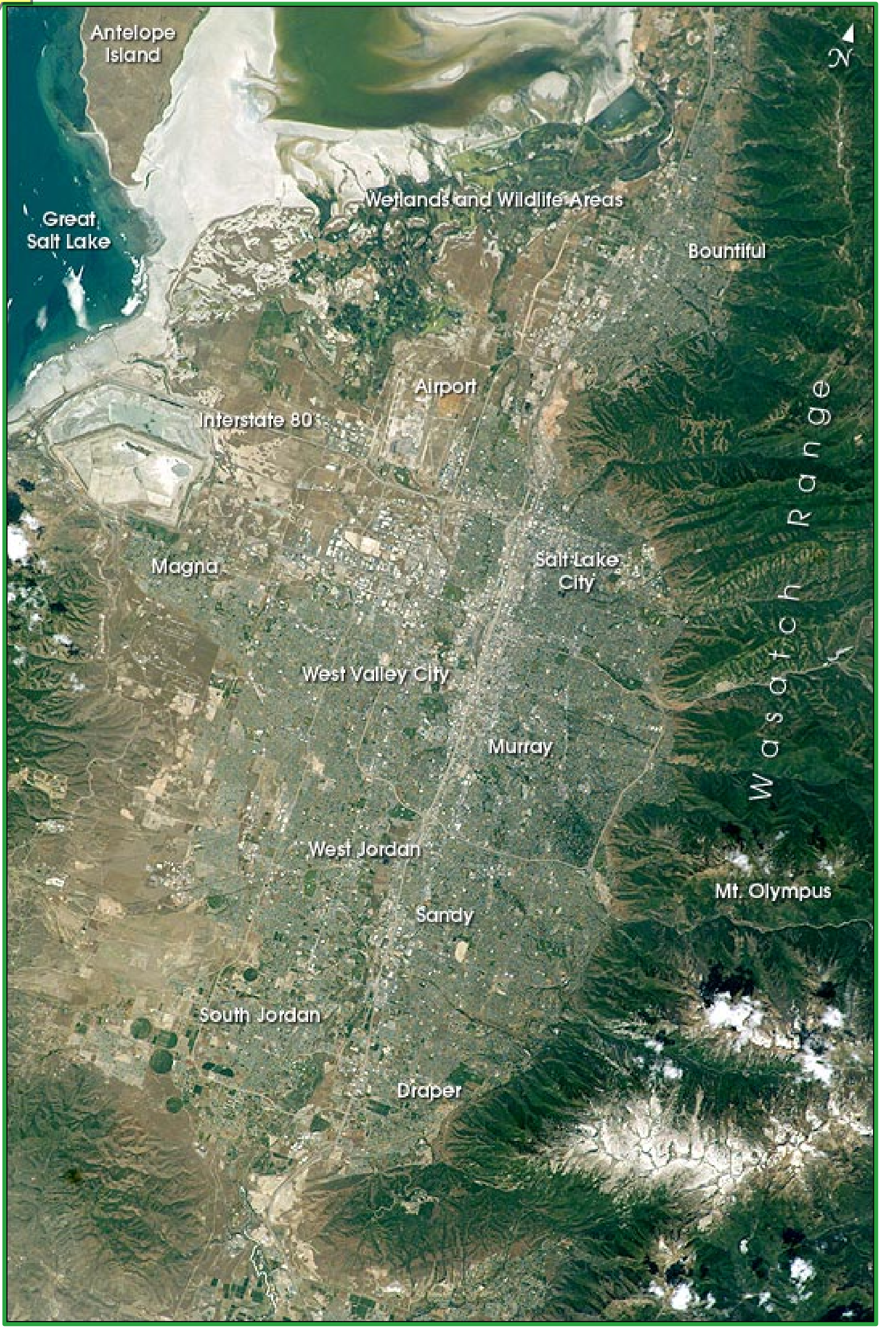
+ Conservation Assessment

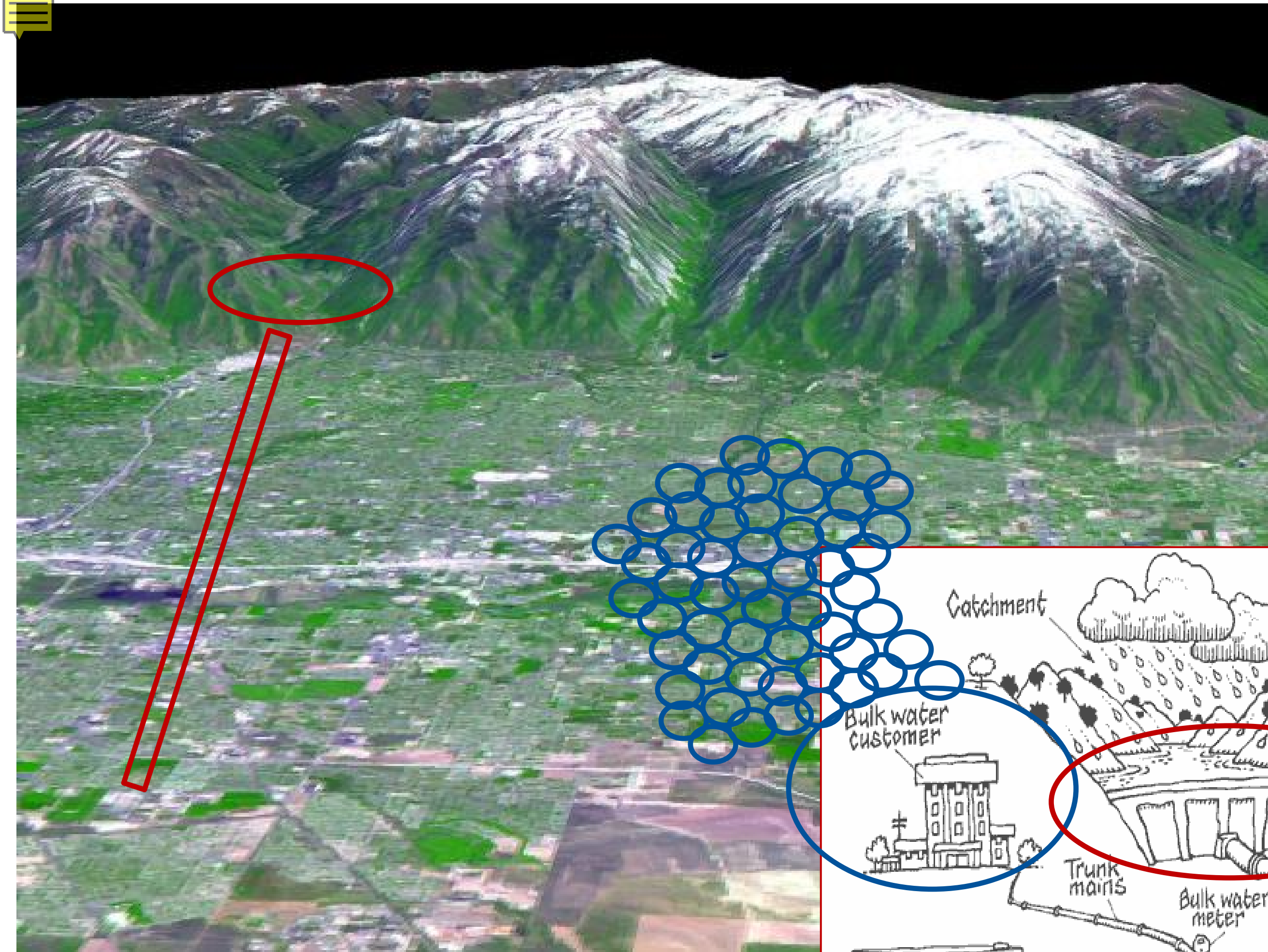
Conservation successes

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

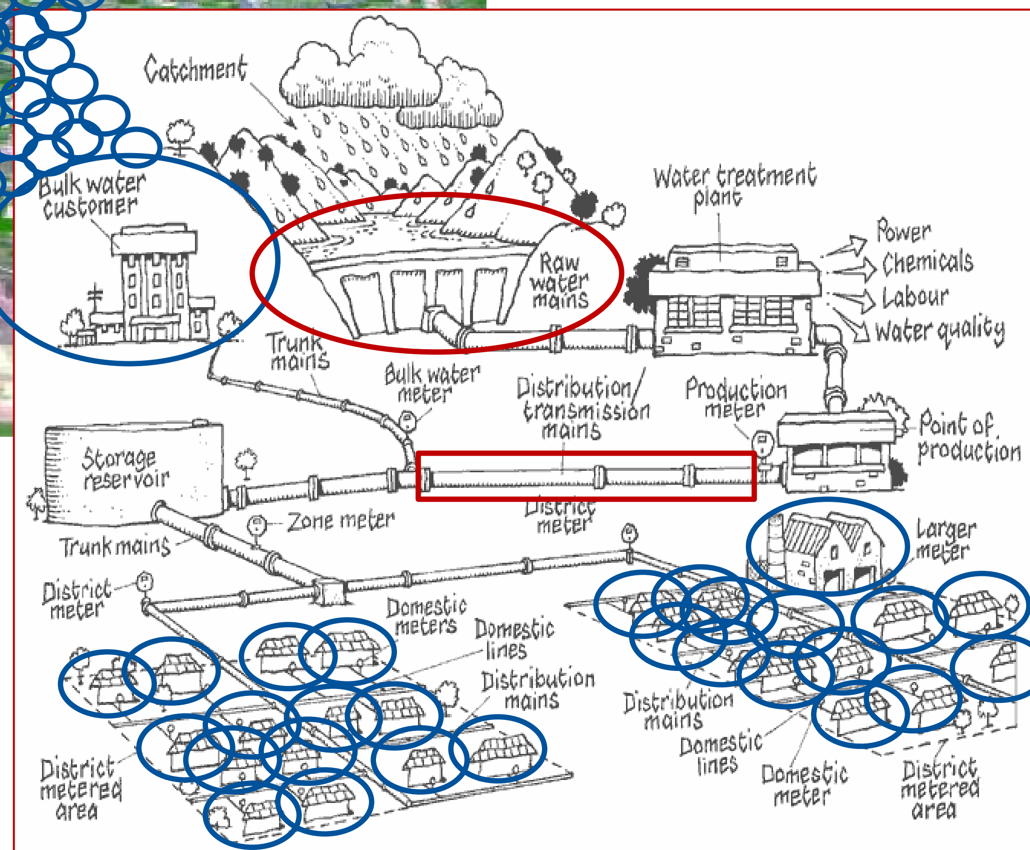
"Untapped " potential

- *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


Antelope Island
Great Salt Lake
Wetlands and Wildlife Areas
Bountiful
Airport
Interstate 80
Magna
Salt Lake City
West Valley City
Murray
Wasatch Range
West Jordan
Mt. Olympus
Sandy
South Jordan
Draper
N

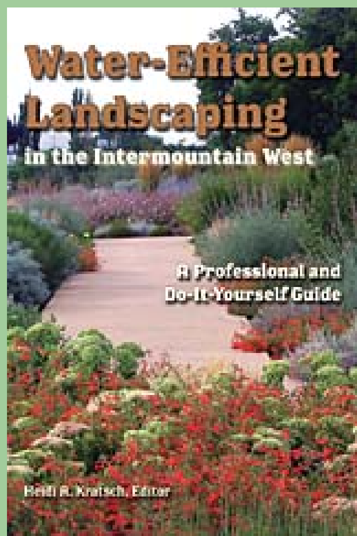


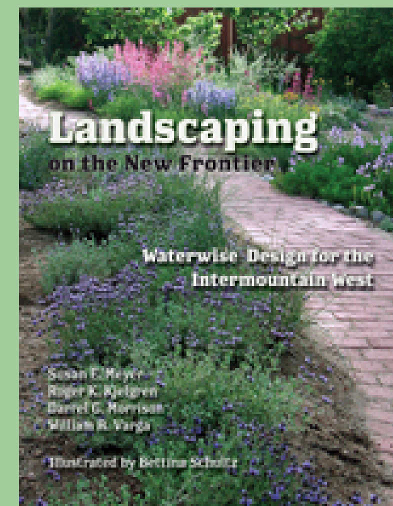
Supply-side management & investments

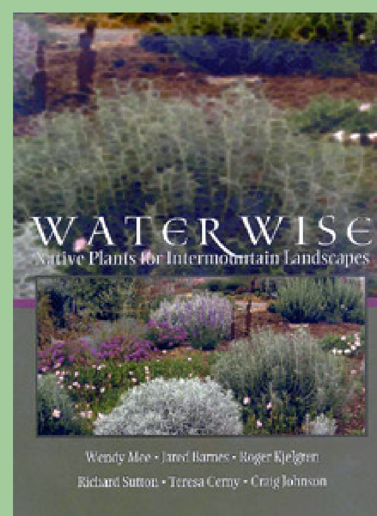


Demand-side management & investments

CWEL Contributions to Water Demand Management and Science







Management Tools: WaterMAPS™

Software application to analyze and manage urban landscape water use

Basic Approach: *defining appropriateness of urban landscape irrigation relative to plant water needs*





Basic Approach:
Identifying Capacity to Conserve

Landscape Irrigation Ratio (LIR)

$$\text{LIR} = \frac{\text{Landscape Water Use}_{\text{estimated}}}{\text{Landscape Water Need}_{\text{estimated}}}$$

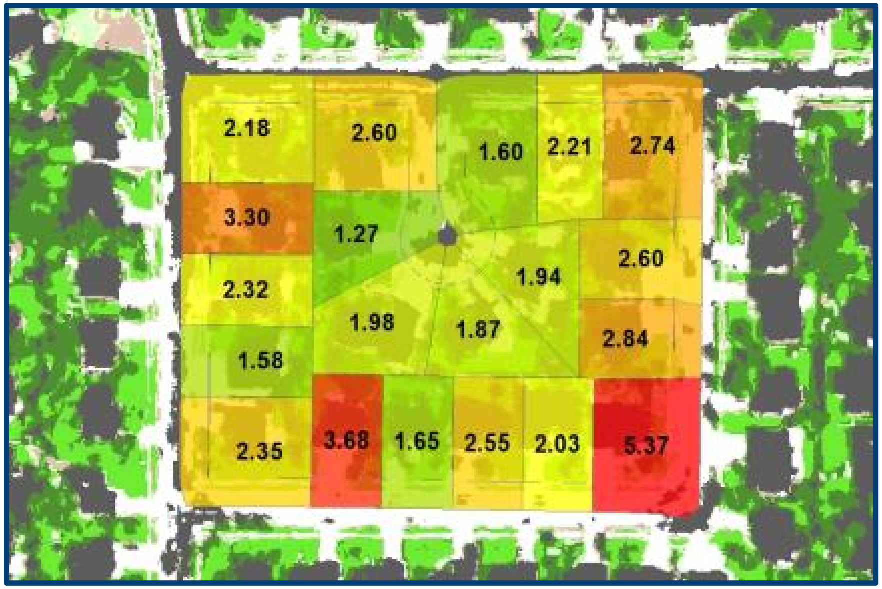
Landscape Water Use *estimated*

[gallons extracted from municipal or water provider meter/billing data]

Landscape Water Need *estimated*

[calculated from landscaped area (derived from classification of airborne remotely-sensed multispectral imagery) and local evapotranspiration (ET_o) modified by relevant landscape correction factors for turf vs. trees and shrubs]

(per unit of landscaped area)



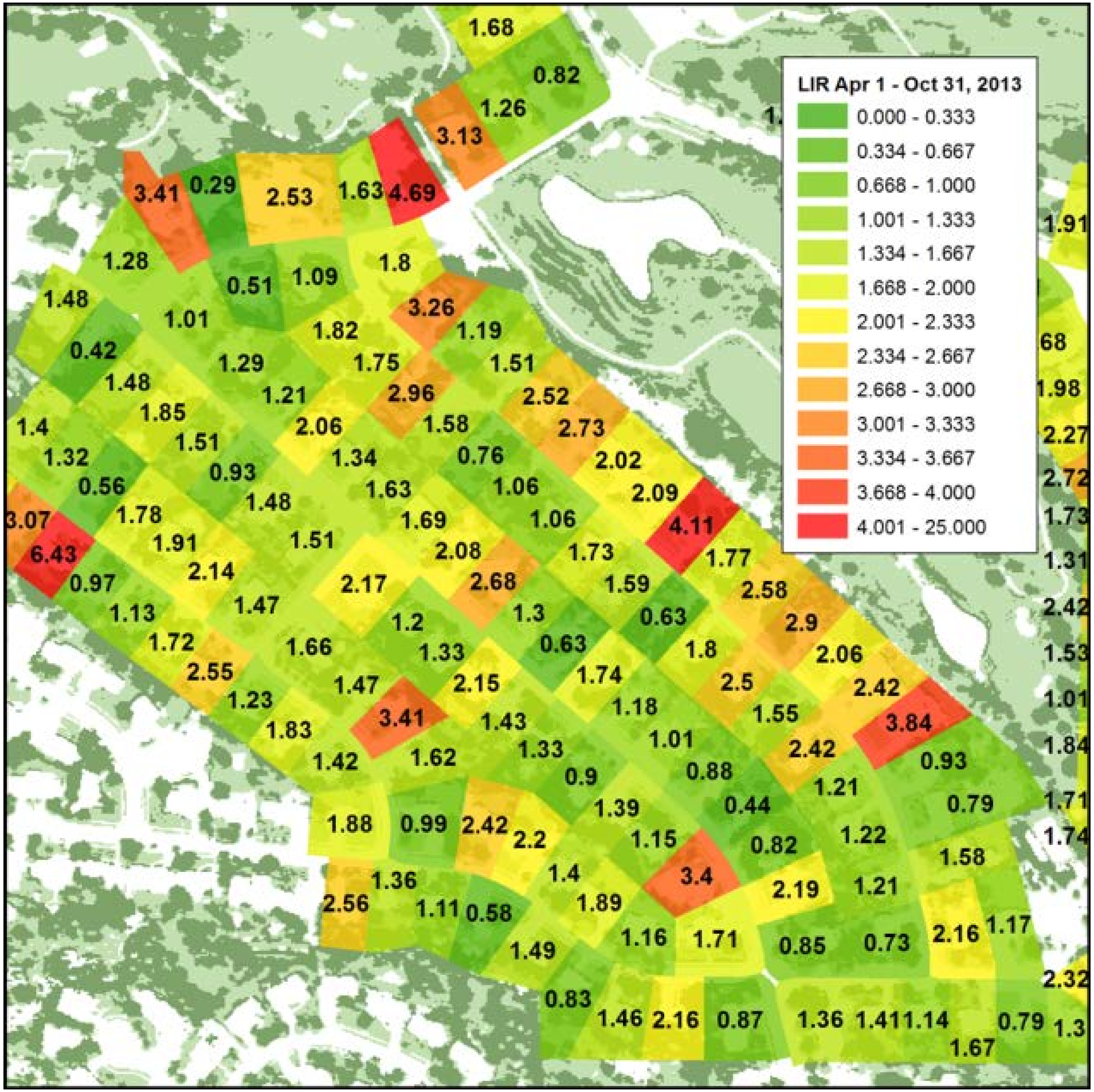
LIR less than 1	= Efficient
Between 1 and 2	= Acceptable
Between 2 and 3	= Inefficient
Greater than 3	= Excessive

WaterMAPS™

Seasonal LIR Calculations

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

Quantifies Conservation Potential



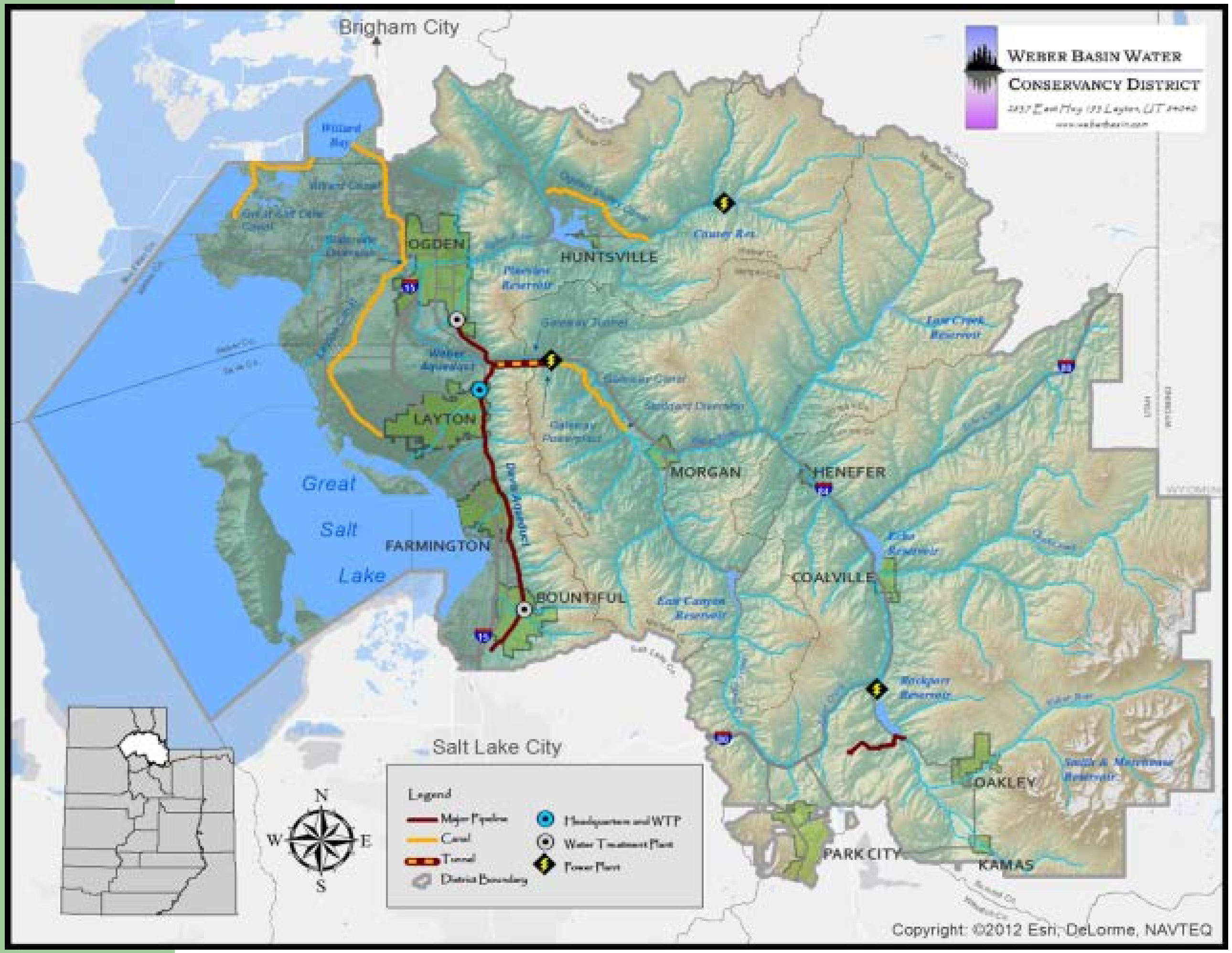
Weber Basin Project

WBWCD meter installation project for pressurized secondary irrigation systems

If you don't meter water, you can't manage it.

Issue in many ag-to-urban transition areas

Example:
Weber Basin Water Conservancy District



Meters Used

Elster, Smart meter

Evo Q4

Badger, E- Series

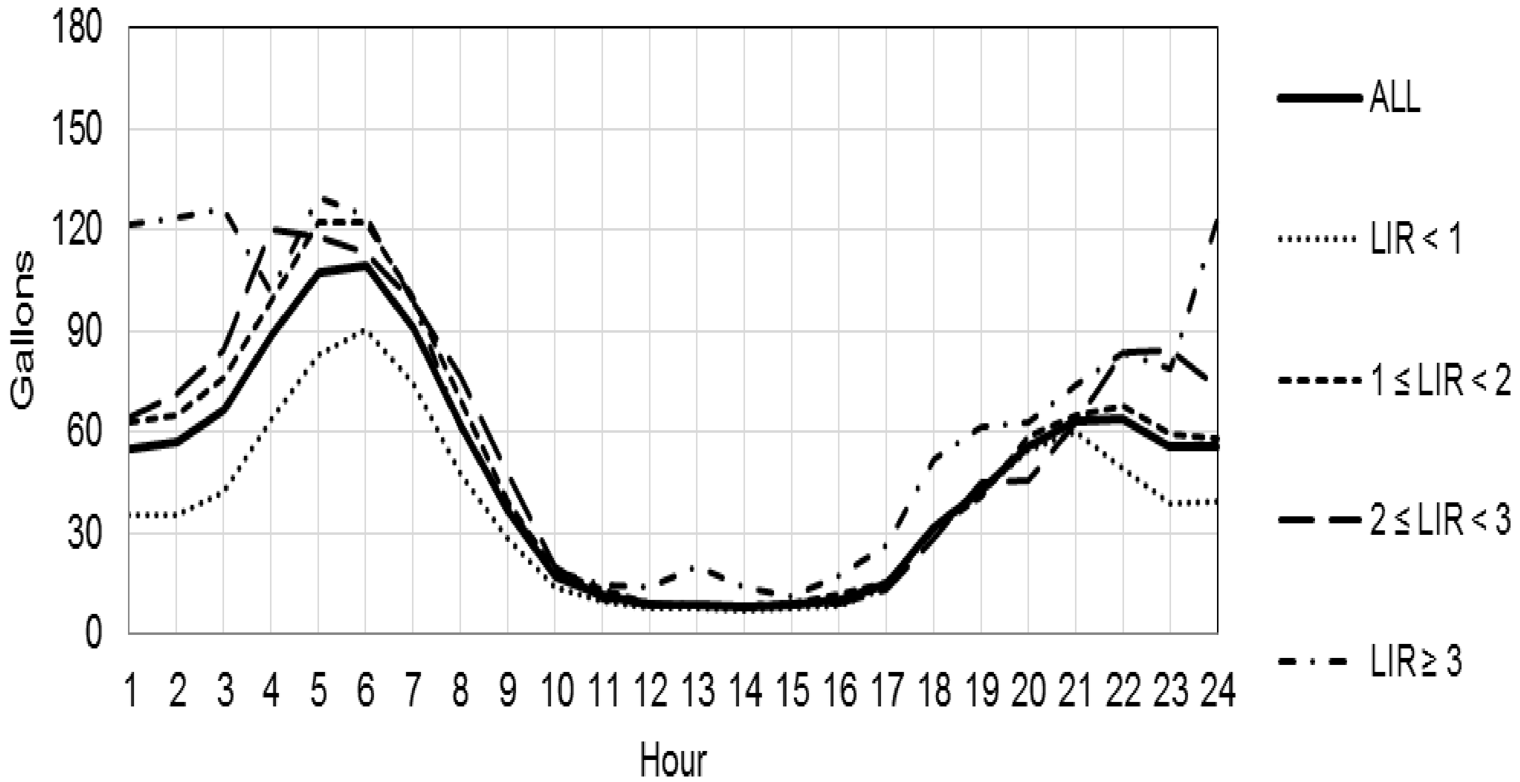
Sensus Ipearl

WBWCD METER TRANSITION:

- Approximately 16,500 direct retail connections
- Approximately 50,000-60,000 total secondary connections in the district's service area

Meter Valve Assembly

+ 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

+ Analysis of seasonal patterns

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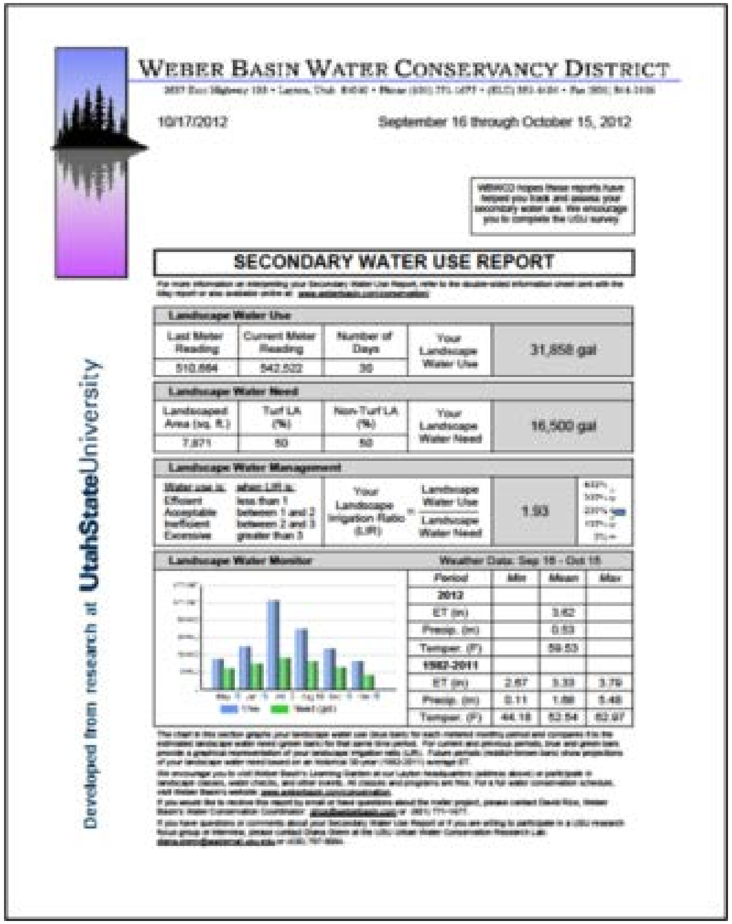

Monthly LIR at this location	
May	1.41
June	1.48
July	2.81
Aug	2.13
Sept	1.84
Oct	1.93

- Can be used to better design water policies and deliver conservation programming

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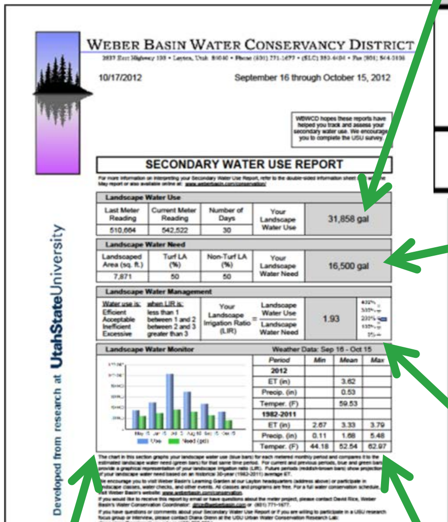


footnotes

Landscape Water Use

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

Landscape Water Need

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

Landscape Water Management

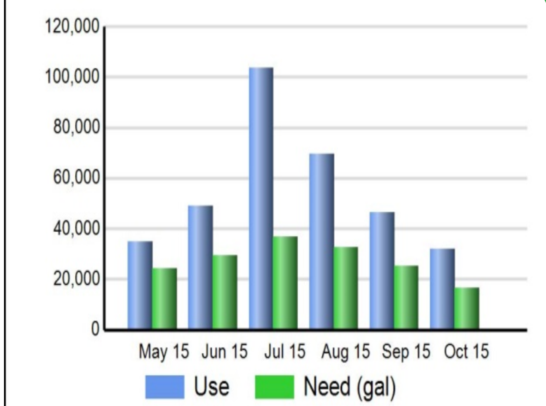
Water use is:	when LIR is:
Efficient	less than 1
Acceptable	between 1 and 2
Inefficient	between 2 and 3
Excessive	greater than 3

Your Landscape Irrigation Ratio (LIR) = Landscape Water Use / Landscape Water Need

1.93

400% 300% 200% 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	1.68	5.48
Temper. (F)	44.18	52.54	62.97

footnotes

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.

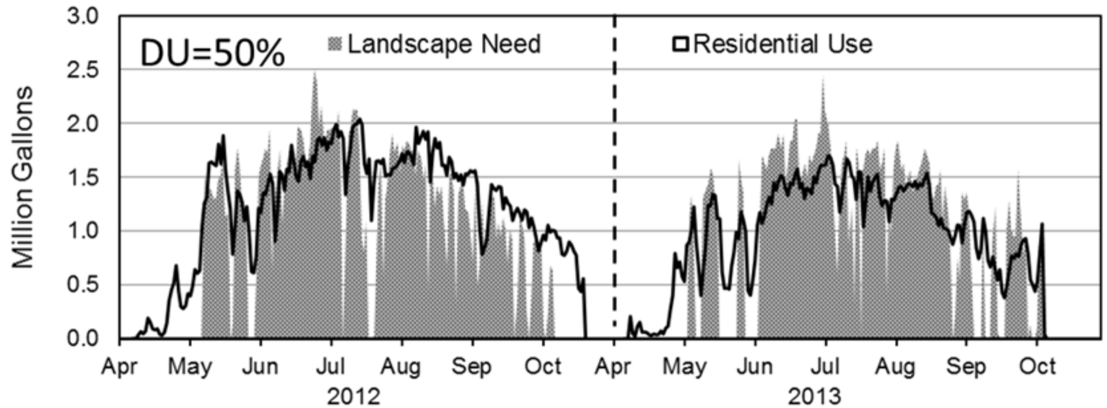
If you would like to receive this report by email or have questions about the meter project, please contact David Rice, Weber Basin's Water Conservation Coordinator: drice@weberbasin.com or (801) 771-1677.

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.

Made possible by investments in new sources of data

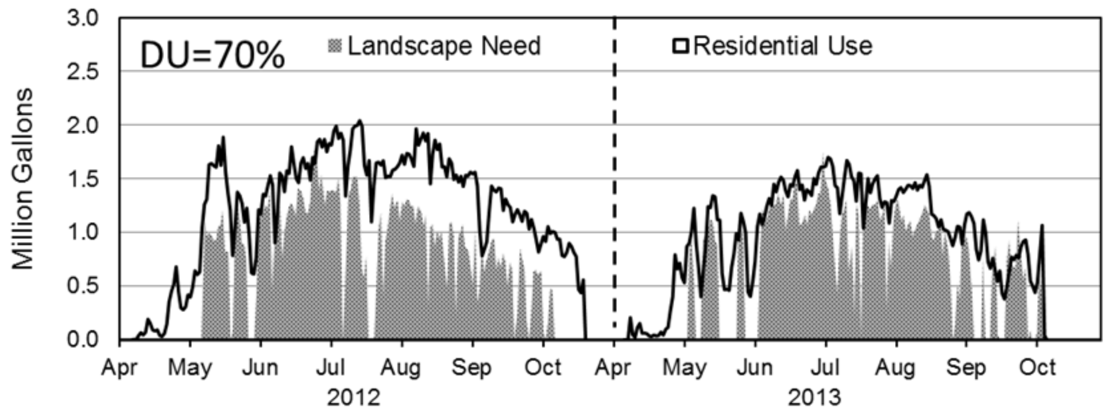
2012 average LIR = 1.26
(average savings = 56,583 gal)

2013 average LIR = 1.06
(average savings = 11,780 gal)



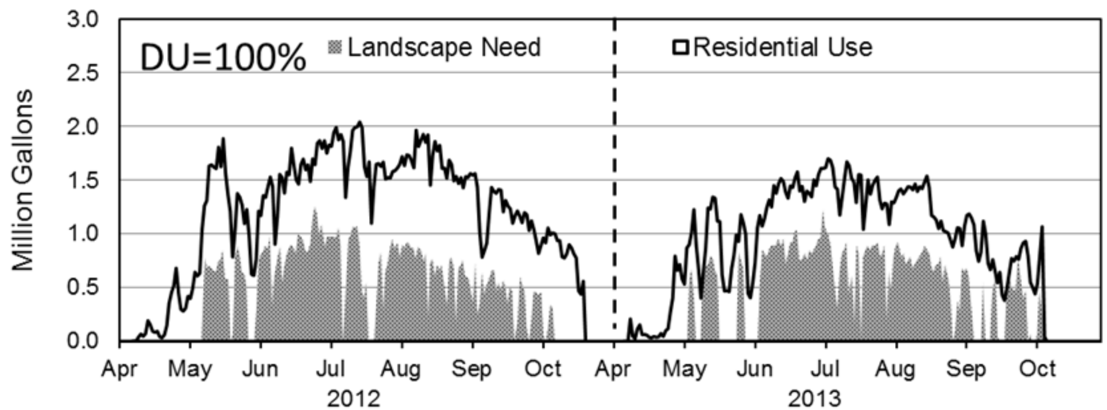
2012 average LIR = 1.89
(average savings = 129,703 gal)

2013 average LIR = 1.59
(average savings = 75,973 gal)



2012 average LIR = 2.52
(average savings = 166,213 gal)

2013 average LIR = 2.12
(average savings = 108,069 gal)



Increasing irrigation system efficiency increases conservation potential

Interdisciplinary Research

+ Turfgrass Research

Center for Water Efficient Landscaping

- Salt tolerant and drought tolerant lines of Kentucky bluegrass were crossed and progeny planted in small turf plots this fall.

- Currently evaluating collections of *Poa*, *Festuca*, *Agrostis*, and *Puccinellia* from Kyrgyzstan, Mongolia, and Russia for drought tolerance characteristics.

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+ Dormant Kentucky Bluegrass

Center for Water Efficient Landscaping

UtahState University

+ Recovering Perennial Ryegrass

Center for Water Efficient Landscaping

UtahState University

+ Collecting Seed in Russia

Center for Water Efficient Landscaping

UtahState University

+ Turfgrass Research Summary

Center for Water Efficient Landscaping

- Perennial ryegrass tolerates extended drought, but needs periodic irrigation to survive.
- Kentucky bluegrass tolerates extended dormancy without irrigation. Some difference in rate of dry-down and recovery, but most recover completely.
- Tall fescue retains some green cover throughout most of summer in deep soil. May not survive if root system is restricted.

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+ Ornamental Horticulture Research

Locating exceptional plants and determining how to propagate them.

Center for Water Efficient Landscaping

Bigtooth maple (found by Chad Reid, Parowan Canyon).

UtahState University

Bigtooth Maple Propagation by Layering

- Girdling and rooting hormone
- Mounded with pine shavings
- Sprinkler irrigated twice daily

May 16

July 11

July 11

Layering of other woody plants

Rabbit Brush (*Ericameria albicaulis*)

Mountain Mahogany (*Cercocarpus intricatus*)

Chokecherry (*Prunus virginiana*)

+ Ornamentals & Dendrochronology

Center for Water Efficient Landscaping

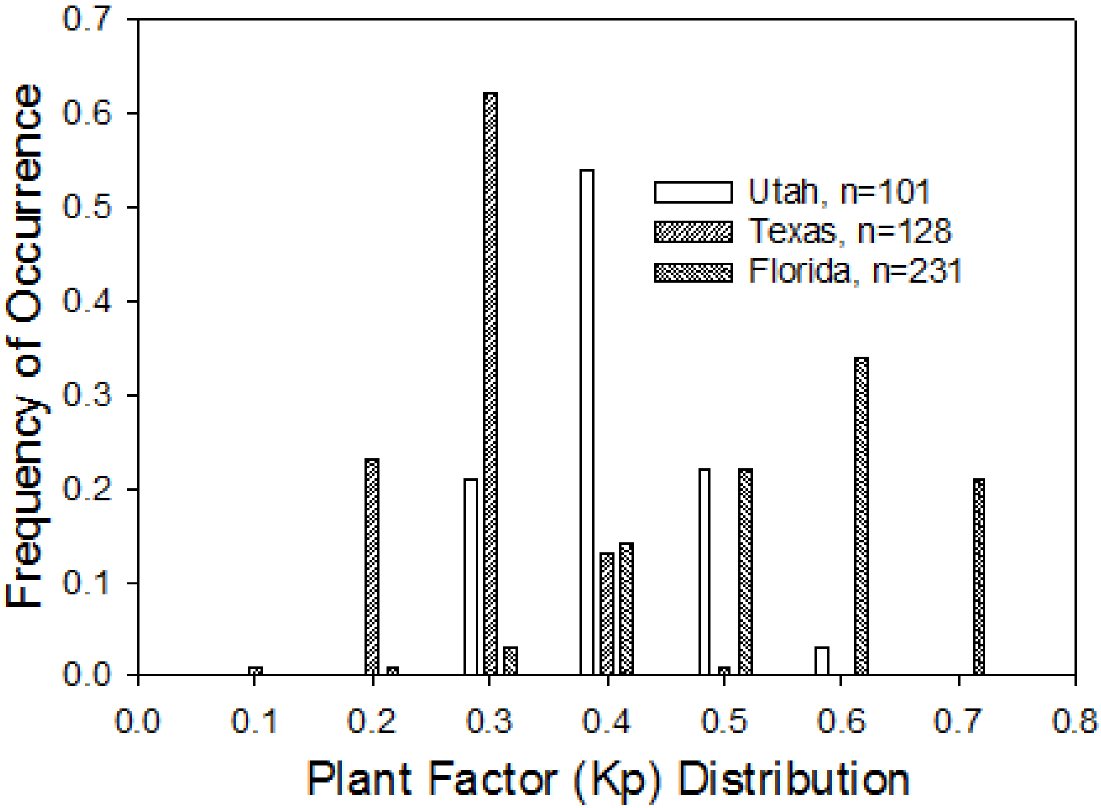
- Water management
  - Quantifying water use of woody plants
  - Tree rings for climate reconstruction
- Native plants
  - Roundleaf buffalo berry (*Shepherdia rotundifolia*) hybrid
  - Lacy buckwheat (*Eriogonum corymbosum*) cultivar development

+ Quantifying Woody Plant Water Use

Comparing three maples, Bigtooth (Native, hot dry), Sugar (East, hot humid) and Bigleaf (West, cool dry).

+ Quantifying Woody Plant Water Use

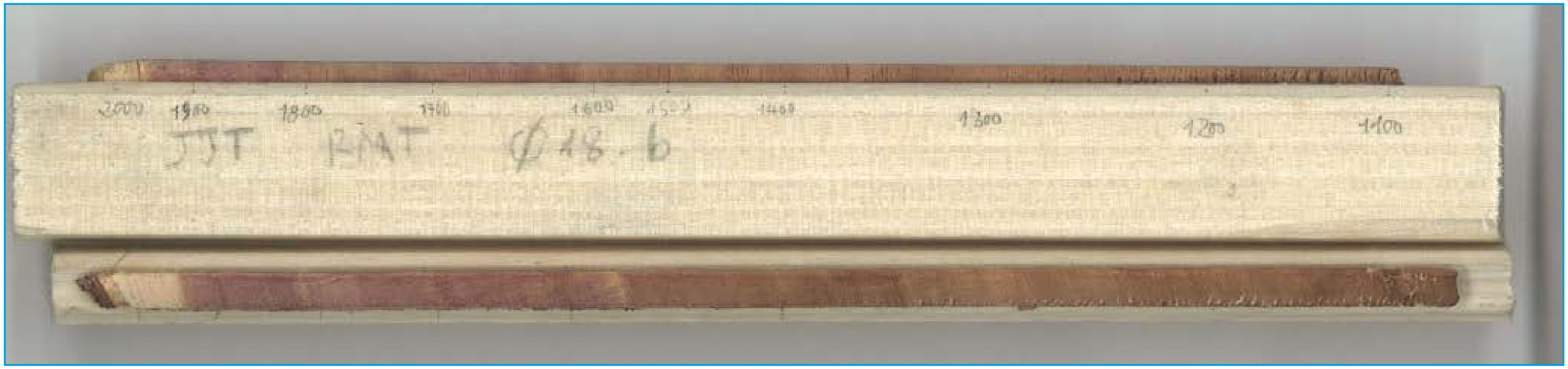
Sweetgum water use rate, as fraction of ET_o in three climates: Utah, Texas, Florida.



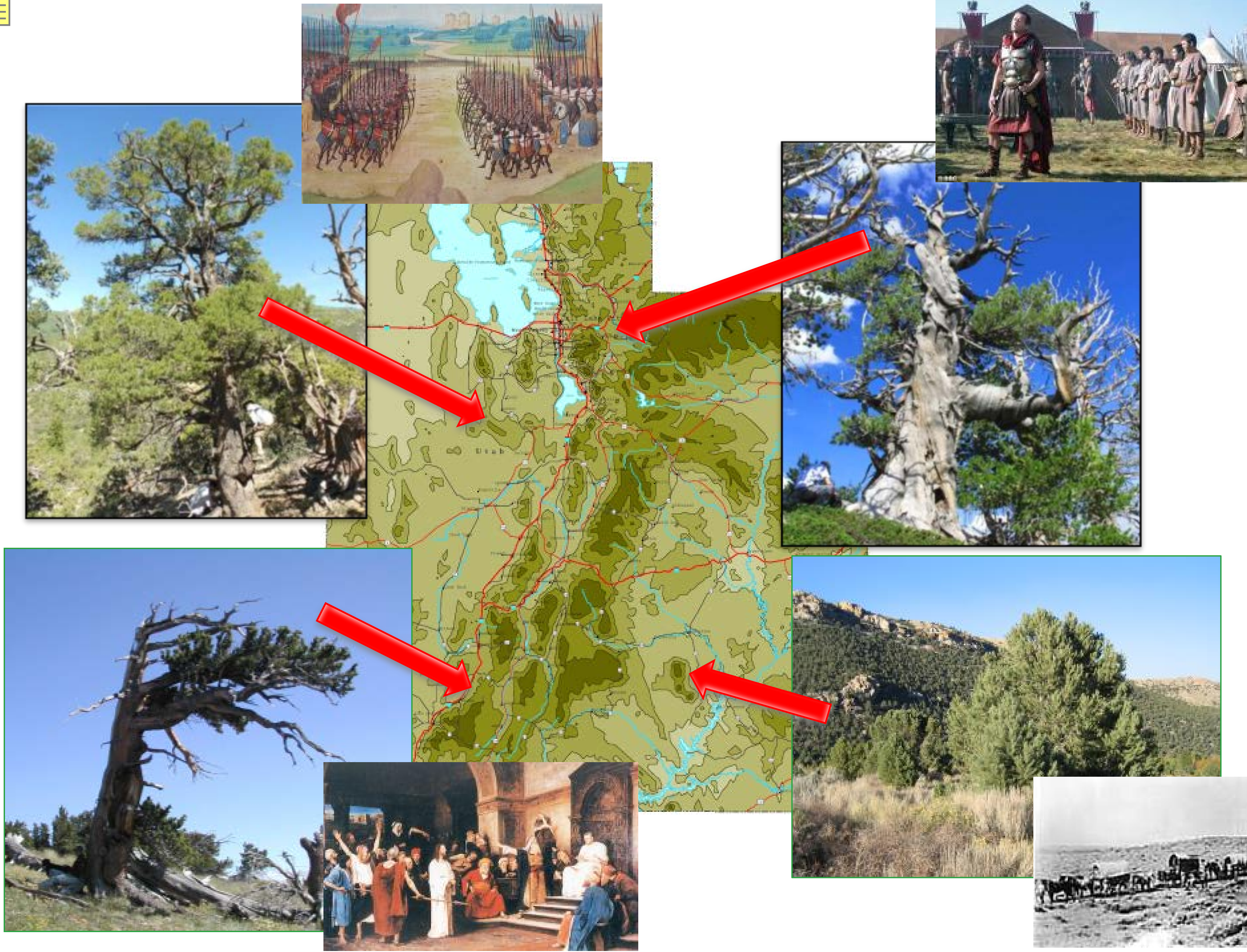
- Rate of water use highest in humid Florida.
- Rate of water use lower in arid Utah and Texas as trees reduce transpiration in response to drier air.

Tree Rings for Climate Reconstruction

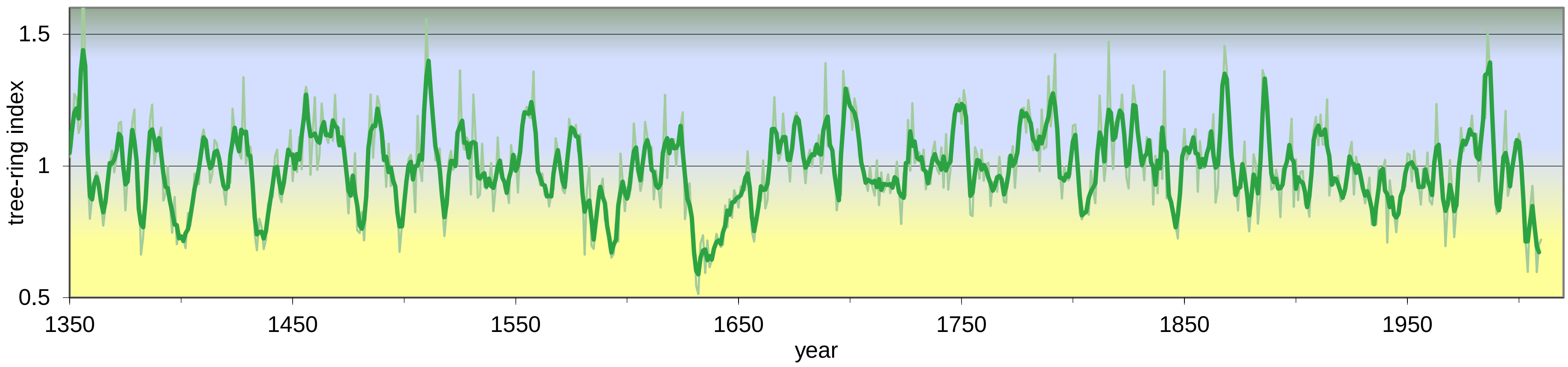
- Relate tree ring width to past precipitation, river flow, temperature.
- Juniper and Douglas Fir

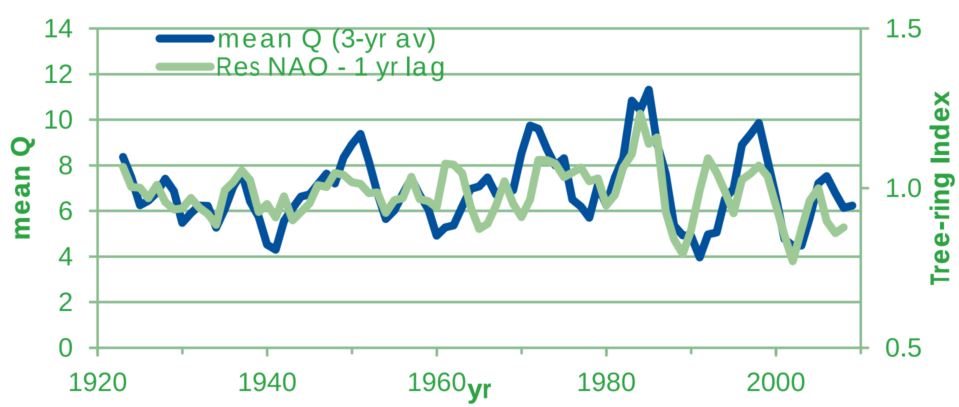


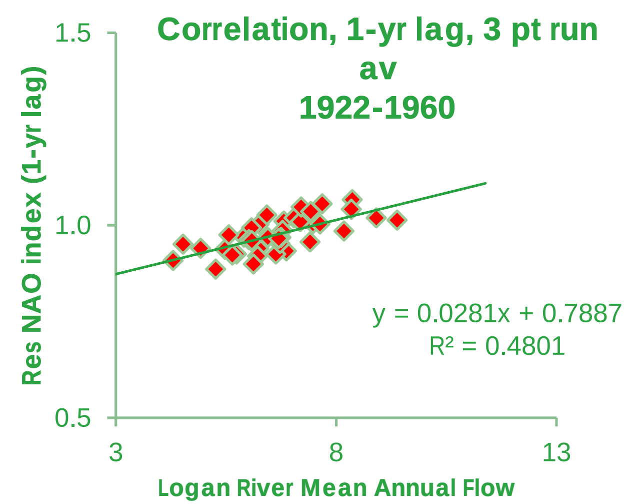
- Across the western US, annual growth is limited by moisture availability
  - a dry year leads to a *narrow* growth ring
  - a wet year leads to a *wide* growth ring



Naomi Peak Douglas-Fir Tree Ring Index (~700 yrs)



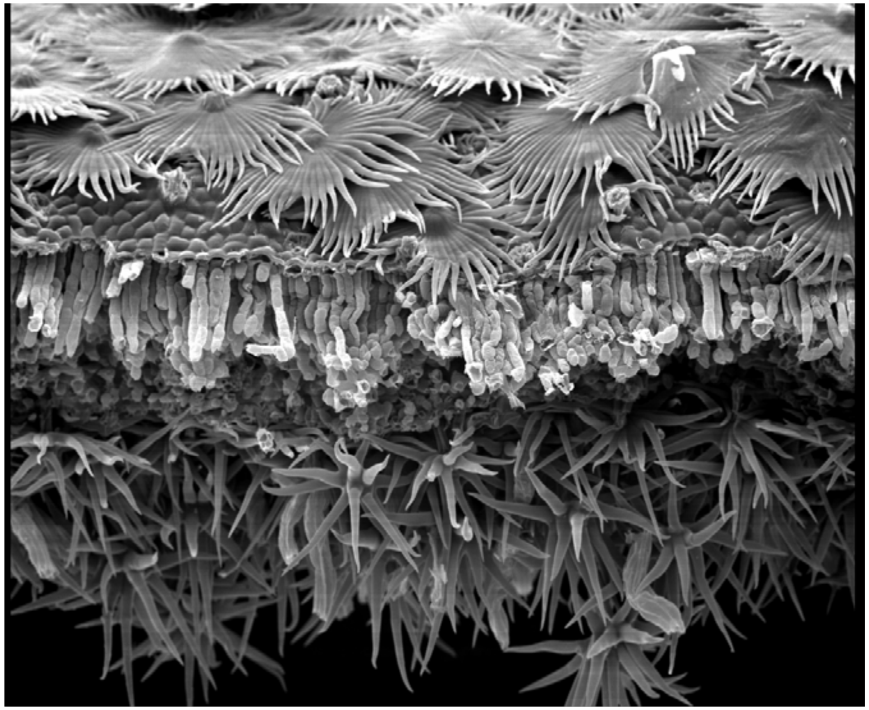




+ Native Plants: *Shepherdia* Hybrid

Hybrid with *S. argentea* more able to tolerate landscape conditions.

Understand *Shepherdia rotundifolia* adaptation.



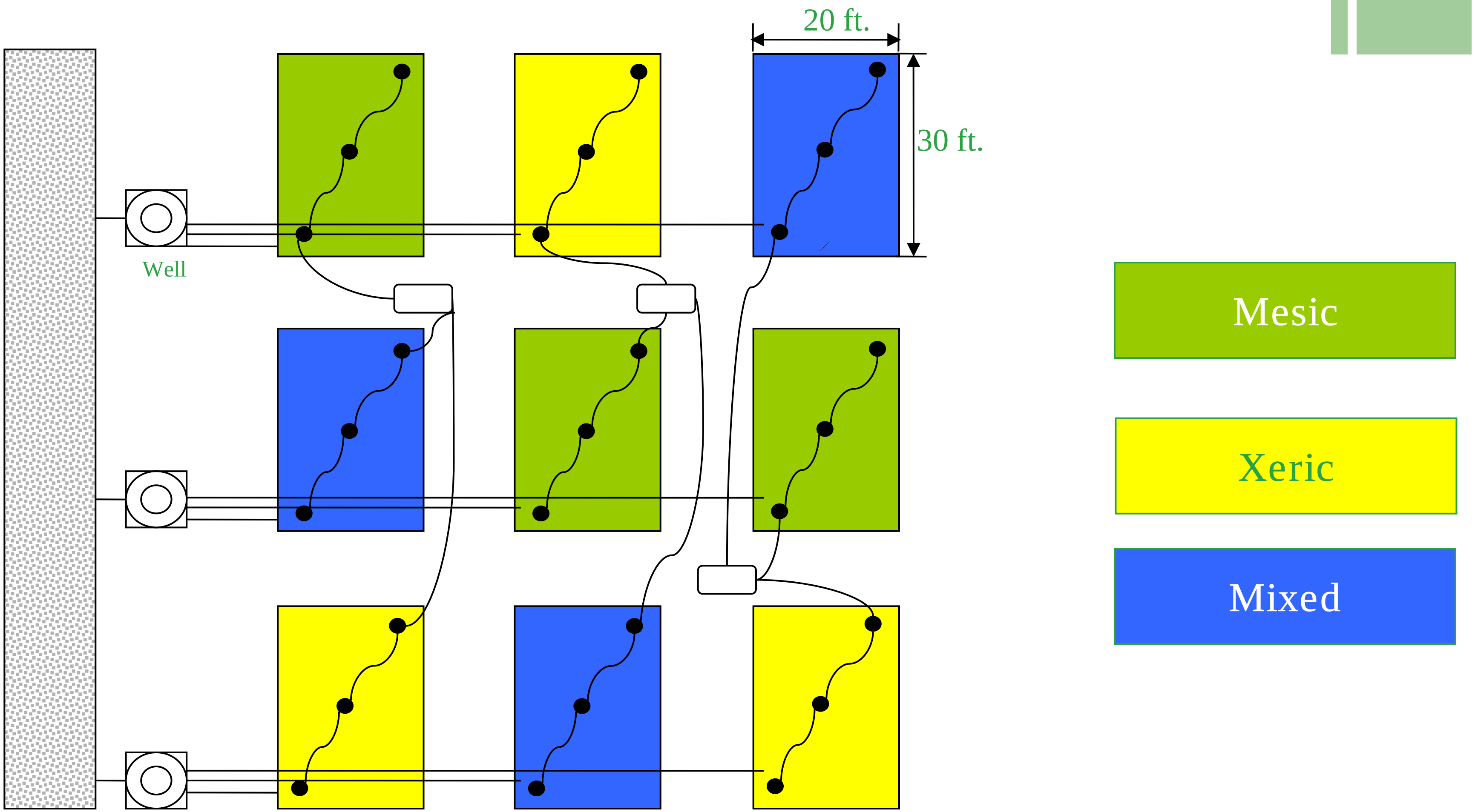
+ Native Plants: *Eriogonum corymbosum*

- Identifying lines of lacy buckwheat with attractive flower color.
- Tolerant of landscape conditions.

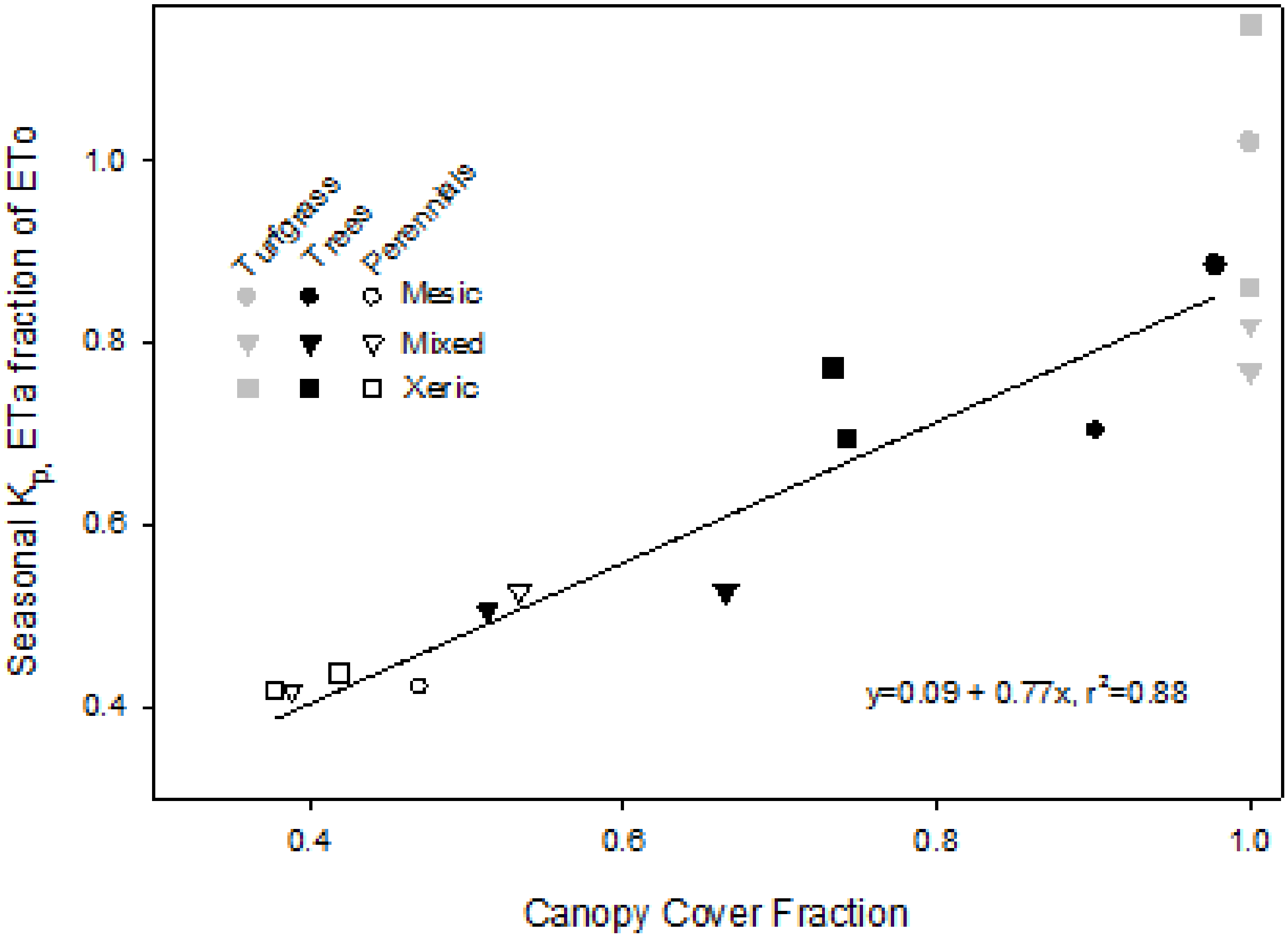
+ Turf and Ornamental Research

- Comparison of water use of landscapes (Mesic, Mixed and Xeric) differing only in plant materials utilized.
- Simulation of landscape water and nitrogen transport in the landscapes.
- Simulation of different landscape management scenarios and their effects on water and nitrogen transport in the Salt Lake Valley.

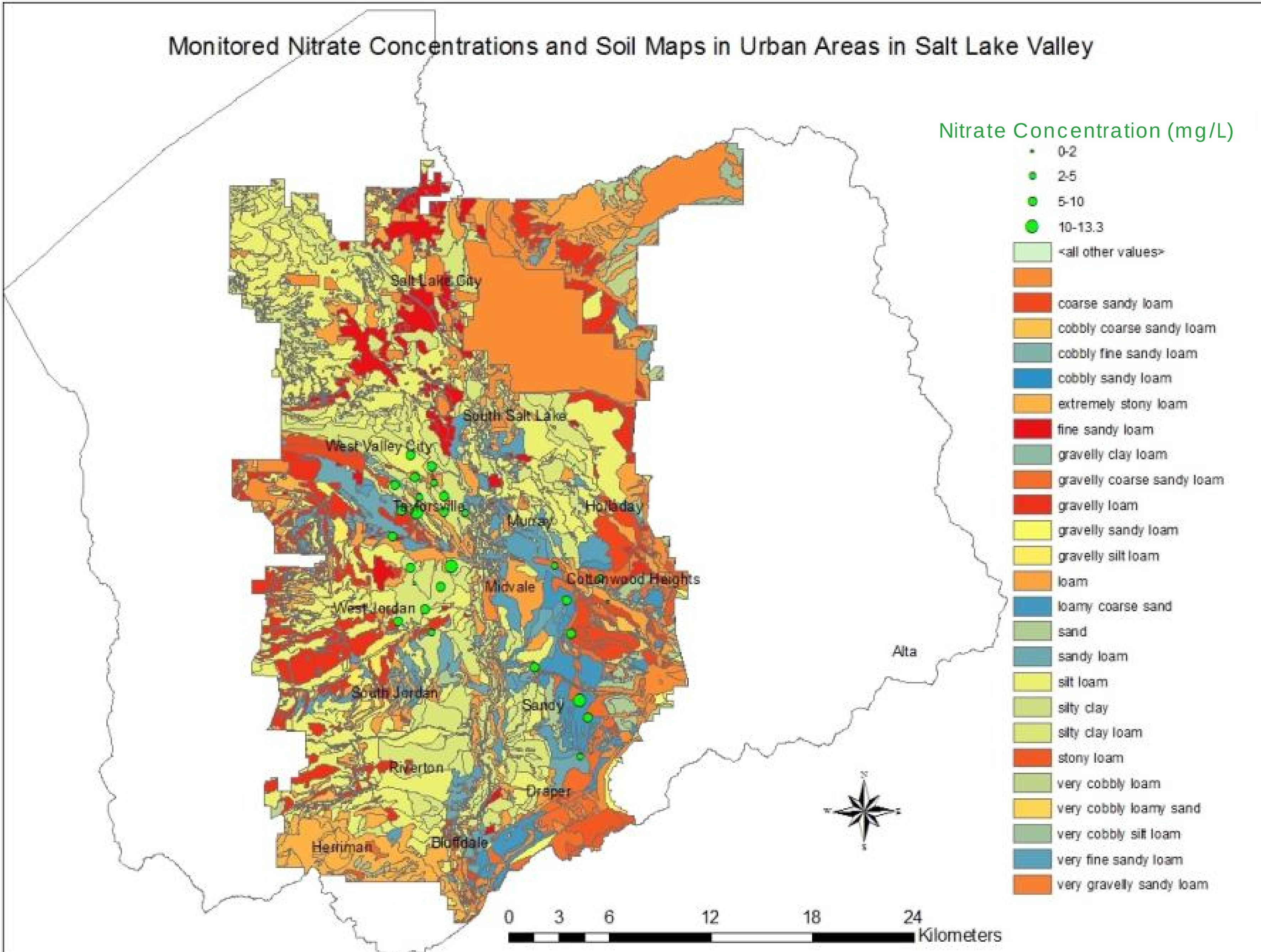
+ Birds-Eye View of Landscapes



+ Mixed Landscape at Maturity



Plant canopy cover was a better predictor of overall landscape water use than water use classification.


Monitored Nitrate Concentrations and Soil Maps in Urban Areas in Salt Lake Valley
Salt Lake City
South Salt Lake
West Valley City
Taylorsville
Murray
Holladay
Midvale
Cottonwood Heights
West Jordan
South Jordan
Sandy
Alta
Riverton
Draper
Herriman
Bluffdale
Nitrate Concentration (mg/L)
0-2
2-5
5-10
10-13.3
<all other values>
coarse sandy loam
cobbly coarse sandy loam
cobbly fine sandy loam
cobbly sandy loam
extremely stony loam
fine sandy loam
gravelly clay loam
gravelly coarse sandy loam
gravelly loam
gravelly sandy loam
gravelly silt loam
loam
loamy coarse sand
sand
sandy loam
silt loam
silty clay
silty clay loam
stony loam
very cobbly loam
very cobbly loamy sand
very cobbly silt loam
very fine sandy loam
very gravelly sandy loam
0 3 6 12 18 24
Kilometers

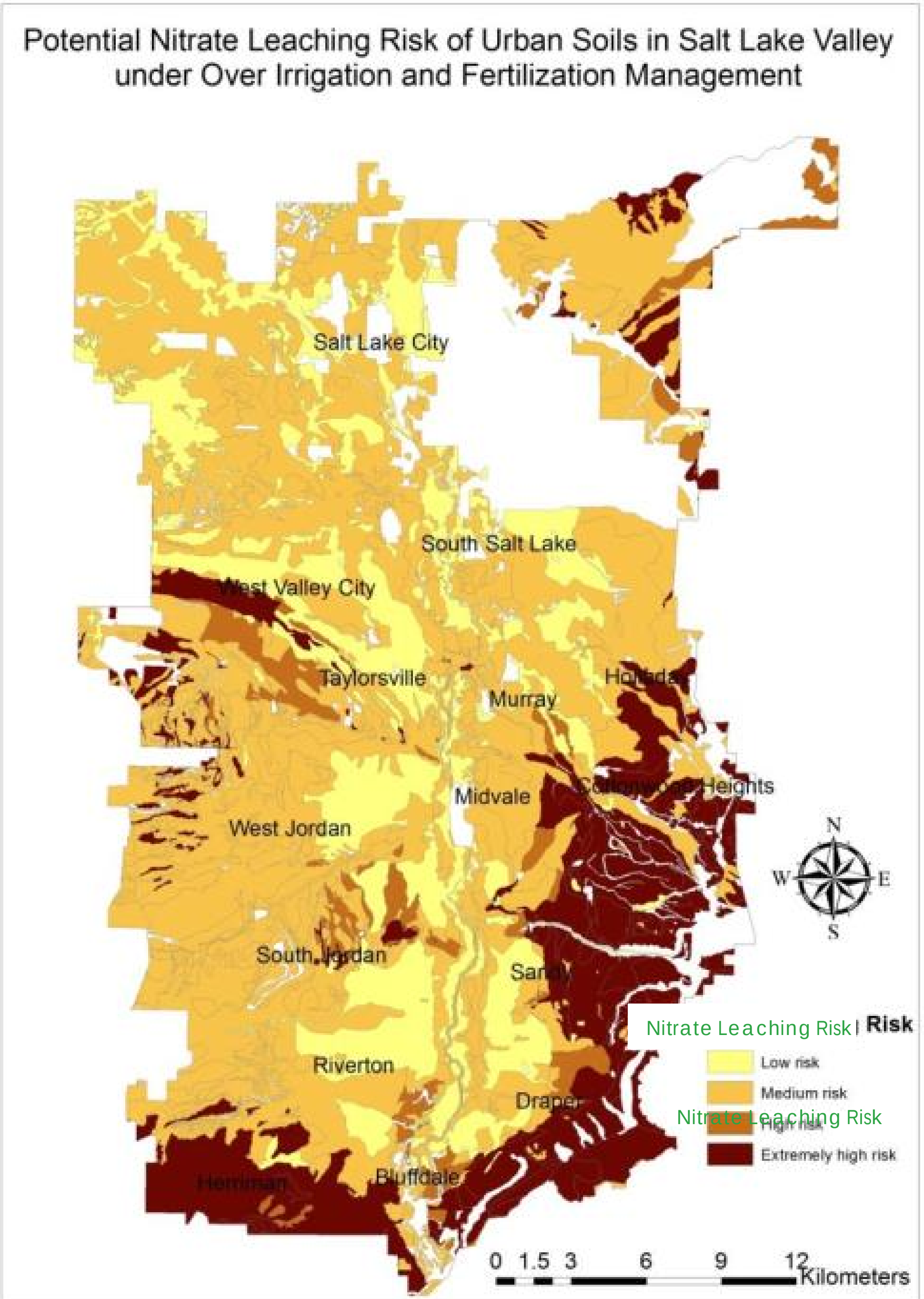
- Low risk

  <10 kg N/ha
- Medium risk

  10-25 Kg N/ha
- High risk

  25-40 kg N/ha
- Extremely high risk

  >40 kg N/ha



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  <10 kg N/ha
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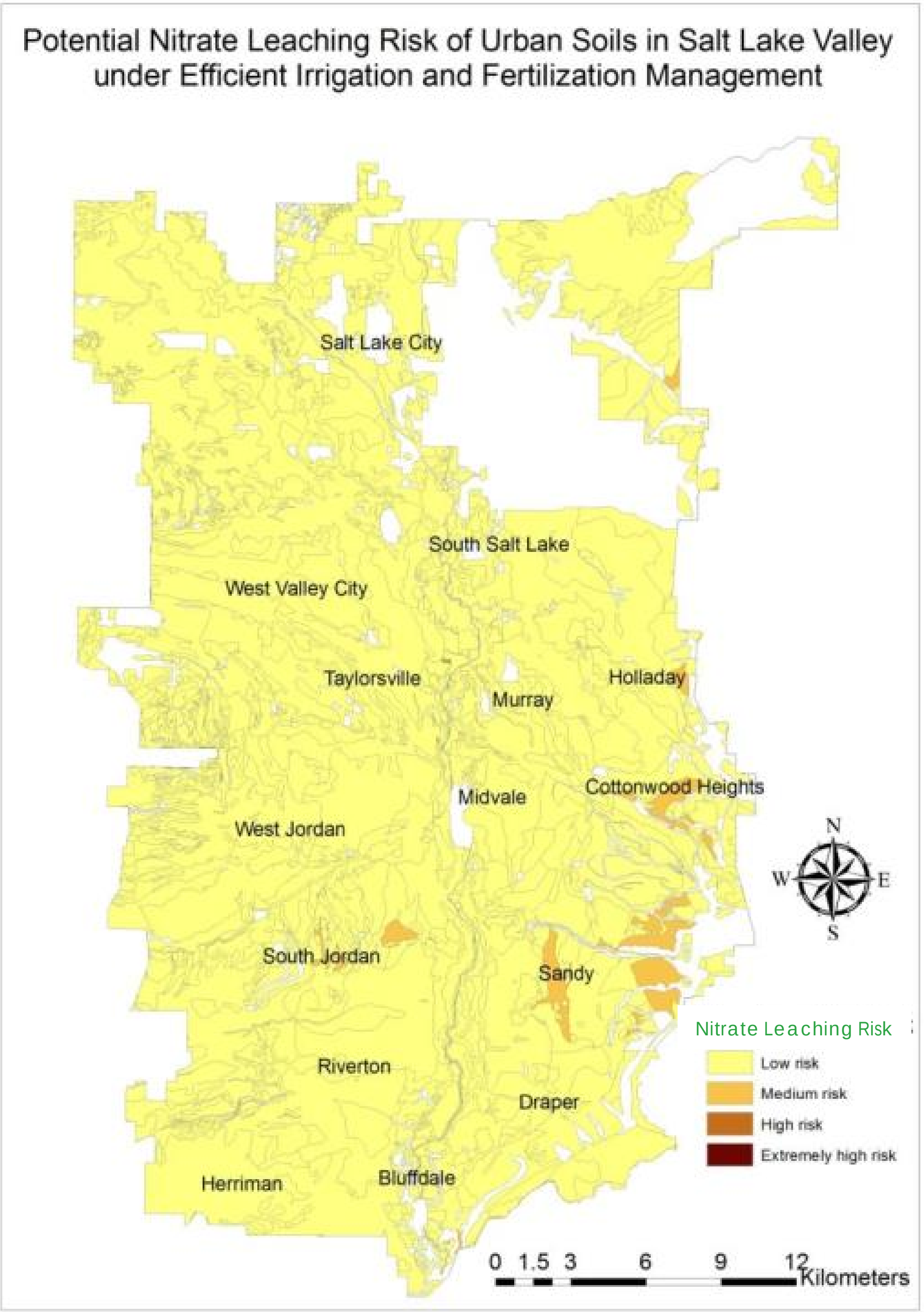


+ Summary Findings

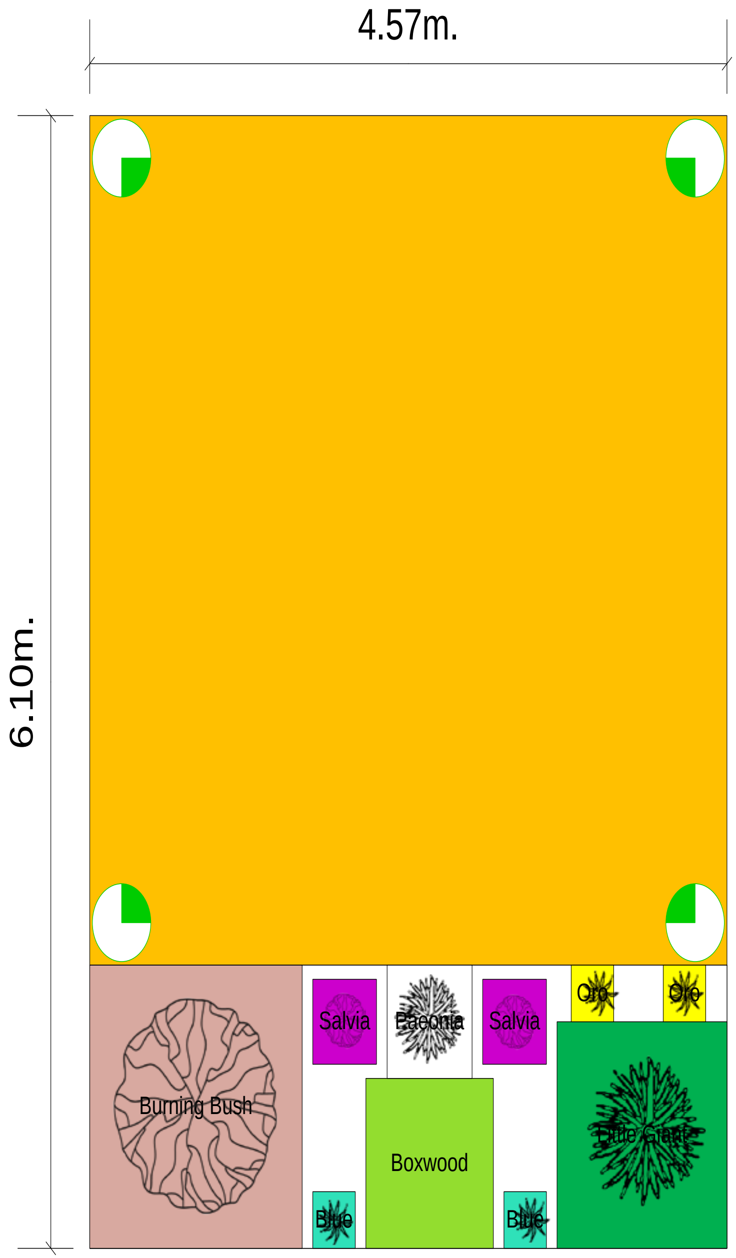
- Plant canopy cover–rather than water use classification–was the controlling factor in woody plant and perennial water use.

- Over irrigation was the main contributing factor to NO_3-N leaching, and NO_3-N leaching increased as irrigation increased.

- Improved irrigation and fertilization management may reduce turf NO_3-N leaching significantly, and result in lower NO_3-N leaching risk areas in urban areas of the Salt Lake Valley.

+ Turf and Ornamental Research

- Do different climate-based irrigation controller technologies achieve landscape water conservation without negatively impacting landscape quality?
  - Quantify the amount of water saved in turfgrass and ornamental area using different controllers.
  - Determine the level of drought stress in turfgrass and ornamental plant for the different treatments.
  - Evaluate plant quality and growth on the plants under different treatments.



Plants

- Turfgrass (*Poa pratensis* blend)
- ‘Little Giant’ Arborvitae (*Thuja occidentalis*)
- ‘Koreana’ Boxwood (*Buxus microphylla*)
- Dwarf Burning Bush ‘Compactus’ (*Euonymus alatus*)
- Paeonia Hybrid (*Paeonia lactiflora*)
- ‘May Nights’ Salvia (*Salvia nemorosa*)
- Stella D’oro Daylilly (*Hemerocallis lilioasphodelus*)
- Blue Oat Grass (*Helictotrichon sempervirens*)

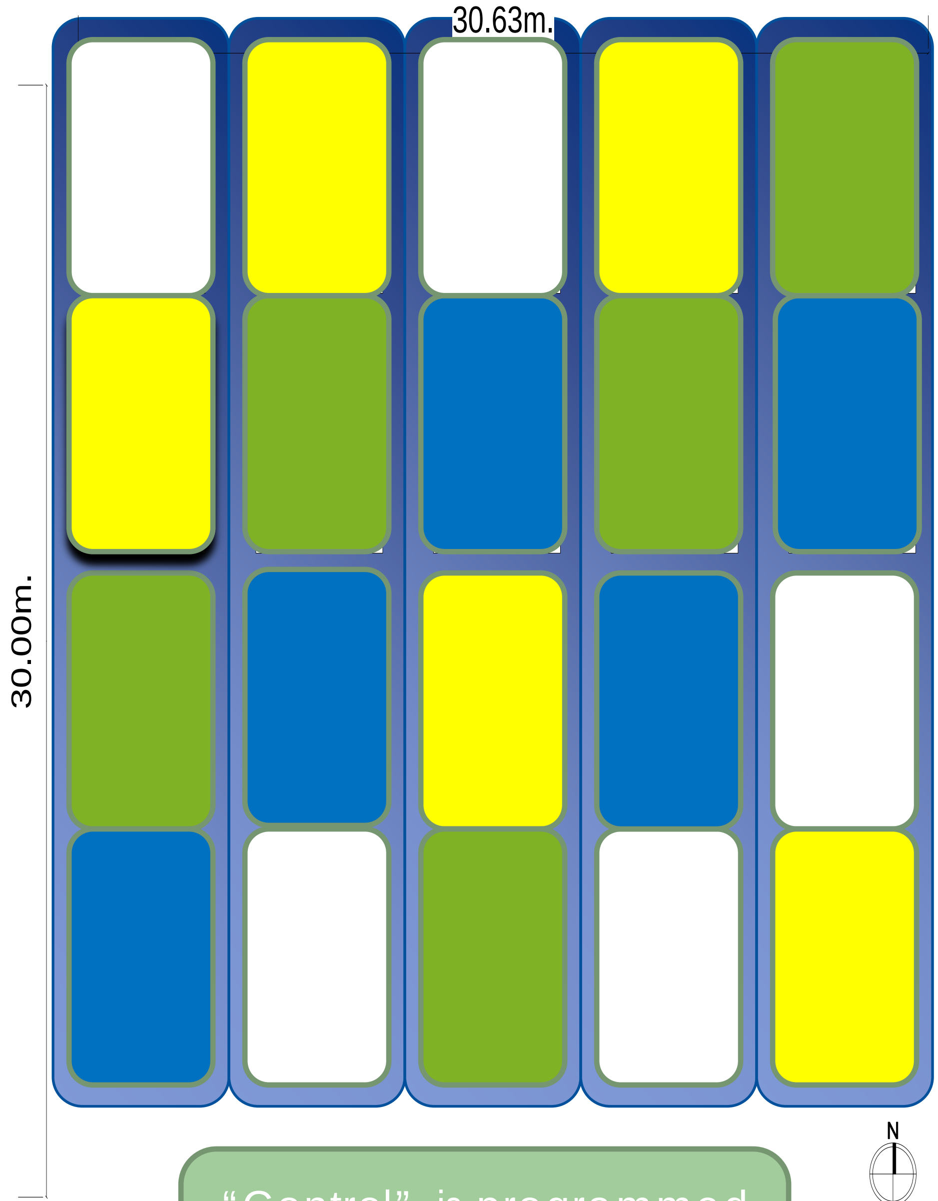
+ Controllers

Rainbird

Hunter

WeatherMatic

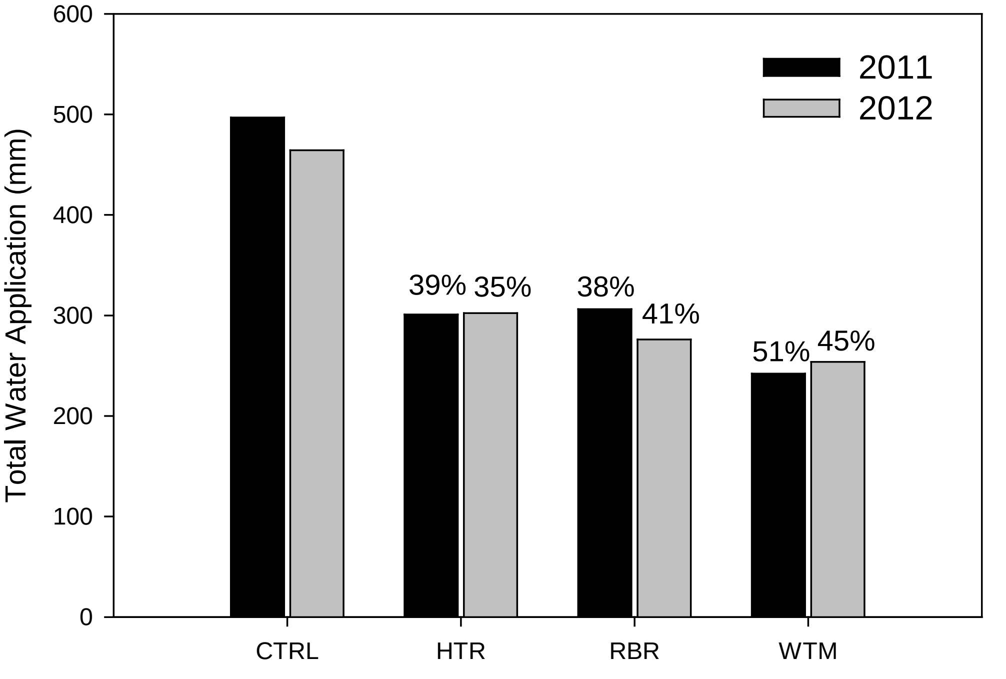
"Control" (Hunter)



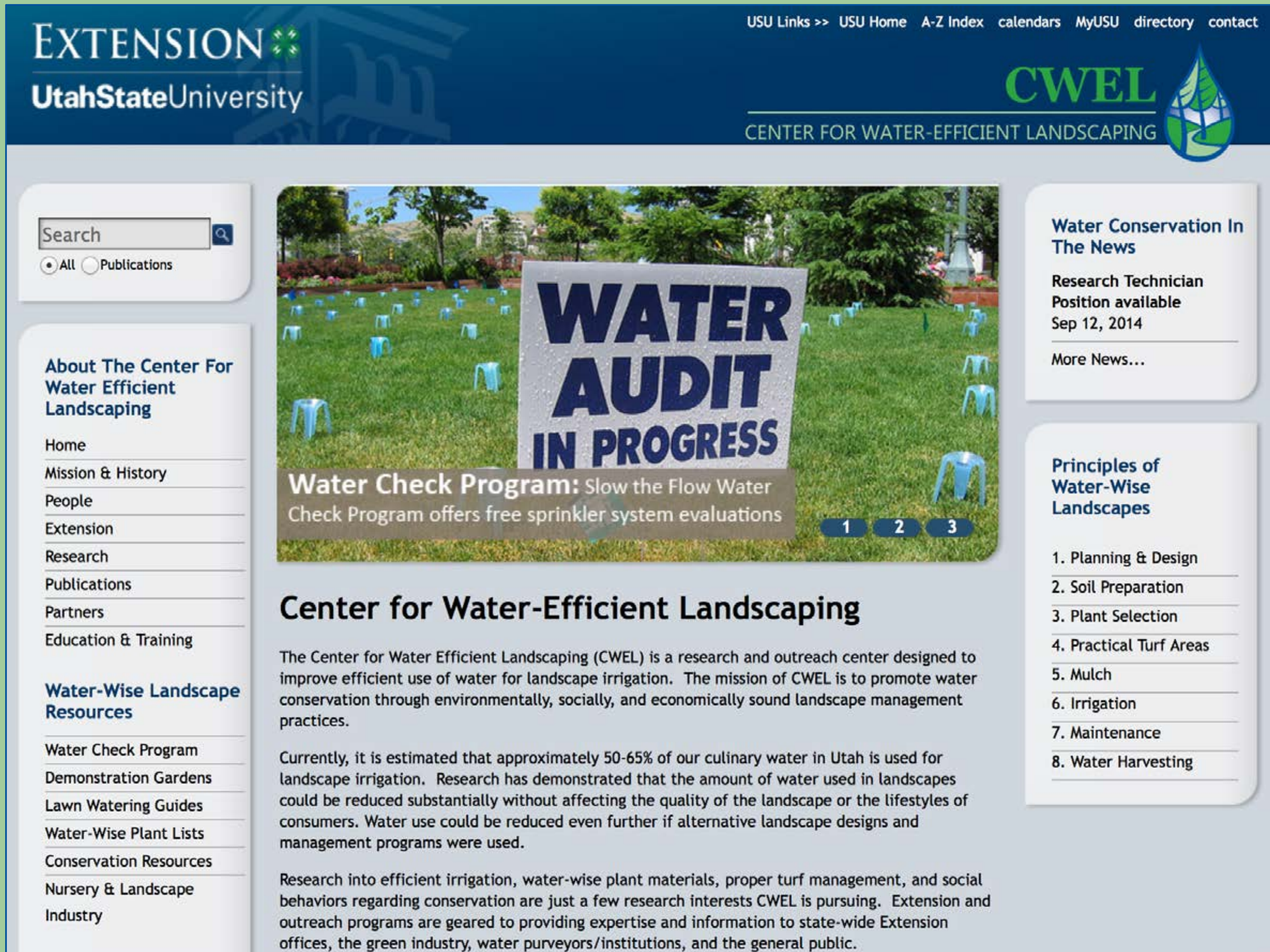
"Control" is programmed according to recommended schedules.

+ Conclusions

- In 2011, WeatherMatic® controller had the best performance.
- In 2012, all climate-based controllers had similar performance and all used less water than the standard controller.



Public Information: Extension Programs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UtahStateUniversity

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- Extension
- Research
- Publications
- Partners
- Education & Training

Water-Wise Landscape Resources

- Water Check Program
- Demonstration Gardens
- Lawn Watering Guides
- Water-Wise Plant Lists
- Conservation Resources
- Nursery & Landscape Industry

WATER AUDIT IN PROGRESS

Water Check Program: Slow the Flow Water Check Program offers free sprinkler system evaluations

1 2 3

Center for Water-Efficient Landscaping

The Center for Water Efficient Landscaping (CWEL) is a research and outreach center designed to improve efficient use of water for landscape irrigation. The mission of CWEL is to promote water conservation through environmentally, socially, and economically sound landscape management practices.

Currently, it is estimated that approximately 50-65% of our culinary water in Utah is used for landscape irrigation. Research has demonstrated that the amount of water used in landscapes could be reduced substantially without affecting the quality of the landscape or the lifestyles of consumers. Water use could be reduced even further if alternative landscape designs and management programs were used.

Research into efficient irrigation, water-wise plant materials, proper turf management, and social behaviors regarding conservation are just a few research interests CWEL is pursuing. Extension and outreach programs are geared to providing expertise and information to state-wide Extension offices, the green industry, water purveyors/institutions, and the general public.

Water Conservation In The News

Research Technician Position available
Sep 12, 2014

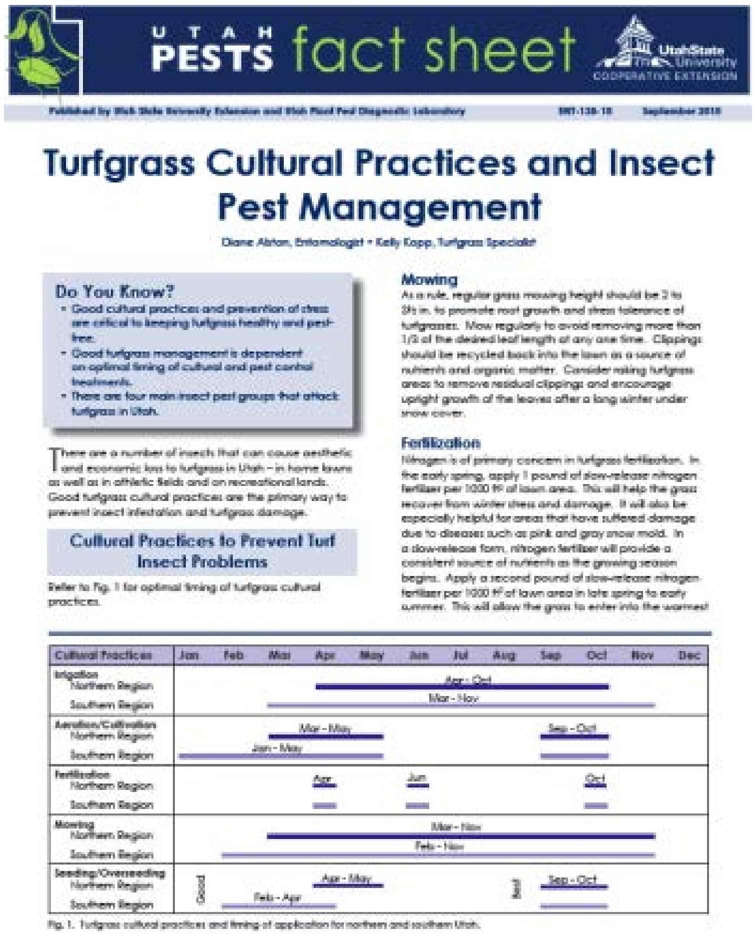
More News...

Principles of Water-Wise Landscapes

1. Planning & Design
2. Soil Preparation
3. Plant Selection
4. Practical Turf Areas
5. Mulch
6. Irrigation
7. Maintenance
8. Water Harvesting

cwel.usu.edu

+ Outreach Materials



UTAH PESTS fact sheet — Utah State University Cooperative Extension

Published by Utah State University Extension and Utah Plant Pest Diagnostic Laboratory — ENT-138-10 — September 2010

Turfgrass Cultural Practices and Insect Pest Management

Diane Alston, Entomologist • Kelly Kopp, Turfgrass Specialist

Do You Know?
- Good cultural practices and prevention of stress are critical to keeping turfgrass healthy and pest-free.
- Good turfgrass management is dependent on optimal timing of cultural and pest control treatments.
- There are four main insect pest groups that attack turfgrass in Utah.

There are a number of insects that can cause aesthetic and economic loss to turfgrass in Utah – in home lawns as well as in athletic fields and on recreational lands. Good turfgrass cultural practices are the primary way to prevent insect infestation and turfgrass damage.

Cultural Practices to Prevent Turf Insect Problems

Refer to Fig. 1 for optimal timing of turfgrass cultural practices.

Mowing

As a rule, regular grass mowing height should be 2 to 3½ in. to promote root growth and stress tolerance of turfgrasses. Mow regularly to avoid removing more than 1/3 of the desired leaf length at any one time. Clippings should be recycled back into the lawn as a source of nutrients and organic matter. Consider raking turfgrass areas to remove residual clippings and encourage upright growth of the leaves after a long winter under snow cover.

Fertilization

Nitrogen is of primary concern in turfgrass fertilization. In the early spring, apply 1 pound of slow-release nitrogen fertilizer per 1000 ft² of lawn area. This will help the grass recover from winter stress and damage. It will also be especially helpful for areas that have suffered damage due to diseases such as pink and gray snow mold. In a slow-release form, nitrogen fertilizer will provide a consistent source of nutrients as the growing season begins. Apply a second pound of slow-release nitrogen fertilizer per 1000 ft² of lawn area in late spring to early summer. This will allow the grass to enter into the warmest

Fig. 1. Turfgrass cultural practices and timing of application for northern and southern Utah.

UtahState University extension — Turfgrass IPM Advisory — UTAH PESTS

Seasonal Turfgrass Pest Update, Utah State University Extension, Fall 2008

Turfgrass Pest Management

The management of turfgrass insect pests and diseases is most effective when an integrative approach is taken. Oftentimes, cultural practices will help grasses to resist and recover from pest damage. Resistant turfgrass varieties may also be available.

News/What to Watch For

Diagnosed insect pests in the fall of the year have included armyworms, sod webworms, cutworms, white grubs, and billbugs. Diagnosed diseases have included necrotic ring spot, fading out (*Curvularia* blight), pink snow mold, and take-all patch.

Insect and Disease Activity and Information

Necrotic Ring Spot (*Ophiosphaerella korrae*)

Favorable Conditions: cool (40-60°F) and moist conditions, may be compounded by drought and compaction.

Necrotic ring spot (NRS) primarily infects Kentucky bluegrass, though it may also be seen in annual bluegrass and tall fescue. The disease damages the roots and crowns of the grass plants and the first symptoms are small, light green patches of turf that get larger over time. Frequently the turf will survive the infection and re-grow in the center of the patches, giving them a ring-like ("frog eye") appearance.

Cultural Practices

Maintain the highest mowing height possible and follow recommended irrigation practices to prevent drought stress. Core aerate once annually to reduce thatch and avoid over application of N fertilizers.

Resistant Turfgrass Varieties

Kentucky bluegrass: Adelphi, Eclipse, Midnight, Majestic, Wabash, Monte Carlo, Baron, Blue-Tastic, Unique, Voyager, Beyond, Eagleton, Cabernet, Abbey, Award, Brooklawn.

*Fungicide Options**

Azoxystrobin (Heritage), myclobutanil (Eagle), propiconazole (Banner MAXX, Propiconazole Pro, Fertilome Liquid Systemic Fungicide), and azoxystrobin + propiconazole (Headway).

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utahpests.usu.edu

extension.usu.edu

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Horticulture_Trees_2011-03pr.pdf

Horticulture

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May 2011 Horticulture/Trees/2011-03pr

Propagating Bigtooth Maple

Melody R. Richards, Graduate Student, and ***Larry A. Rupp***, Extension Landscape Horticulture Specialist

Propagating Native Utah Plants

Native plants are playing an increasing role in sustainable landscapes that use fewer resources such as water and fertilizer. Unfortunately, many native plants are not available in the nursery trade, or if they are available they may only be found as seedling plants grown for the reclamation industry. Such plants are high quality and have a valuable role in the reclamation of disturbed sites such as fire-damaged areas. But, these plants by design are

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Horticulture

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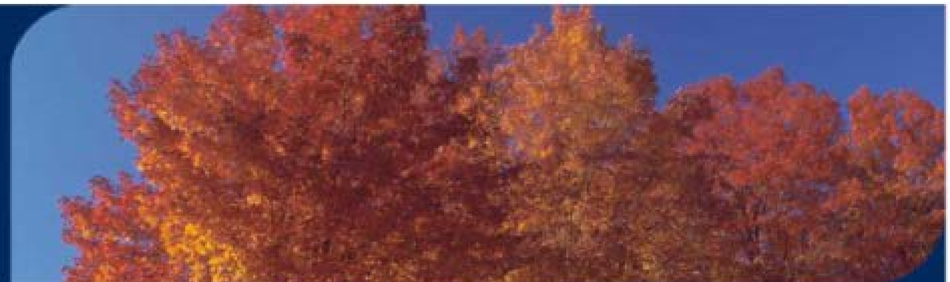

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March 2011

Drought Tolerance

A Database of Irrigation Requirements for Woody Plants of Northern Utah

Compiled by ***Samuel Cook*** and ***Larry A. Rupp***

Plants, Soils, and Climate Department, Utah State University
Logan, Utah

Acknowledgments

UtahState University

+ The database lists all the known references on water use by woody plants adapted to northern Utah.

Center for Water Efficient Landscaping

7	Abies	concolor		(Gord. & Glend.) Lindl.	White fir	3	4	20-35" dry, 35-75" wet	Natural history of the p
8	Abies	lasiocarpa		(Hook.) Nutt.	Subalpine fir	3	3	>20"/ year	Review of previous wo
9	Abies	balsamea		(L.) Mill.	Balsam fir	4	5	30-43"/ year	Review of previous wo
10	Abies	concolor		(Gord. & Glend.) Lindl. ex Hildebr.	White fir	1	2	High drought tolerance	Review of previous wo
11	Abies	concolor		(Gord. & Glend.) Lindl.	White fir	3	4	14-27"/ year	Review of previous wo
12	Abies	balsamea		(L.) Mill.	Balsam fir	4	5	Intolerant to drought	Review of previous wo
13	Abies	balsamea		(L.) Mill.	Balsam fir	4	5	Moist to wet	Review of previous wo
14	Abies	concolor		(Gord. & Glend.) Lindl.	White fir	3	4	Dry to moist	Review of previous wo
15	Abies	lasiocarpa		(Hook.) Nutt.	Subalpine fir	3	3	Dry to moist	Review of previous wo
16	Abies	concolor		(Gord. & Glend.) Lindl.	White fir	3	5	Drought tolerant	No documentation
17	Abies	balsamea		(L.) Mill.	Balsam fir	3	5	Low drought tolerance	No documentation
18	Abies	lasiocarpa		(Hook.) Nutt.	Subalpine fir	3	3	Tolerance = PIEN < PICO	Formal research publi
19	Abies	lasiocarpa		(Hook.) Nutt.	Subalpine fir	2	3	Drought tolerant	Review of previous wo
20	Abies	concolor		(Gord. & Glend.) Lindl. ex Hildebr.	White fir	3	5	35"/ year	Review of previous wo
21	Abies	lasiocarpa		(Hook.) Nutt.	Subalpine fir	3	3	Mesic	Natural history of the p
22	Abies	concolor		(Gord. & Glend.) Lindl. ex Hildebr.	White fir	2	3	Drought tolerant	Review of previous wo
23	Abies	concolor		(Gord. & Glend.) Lindl.	White fir	3	4	High to medium use	Review of previous wo
24	Abies	concolor		(Gord. & Glend.) Lindl. ex Hildebr.	White fir	2	3	Drought tolerant	Review of previous wo
25	Abies	balsamea		(L.) Mill.	Balsam fir	4	5	3 (1-3)	Review of previous wo
26	Abies	concolor		(Gord. & Glend.) Lindl.	White fir	3	4	3 (1-3)	Review of previous wo
27	Abies	concolor		(Gord. & Glend.) Lindl. ex Hildebr.	White fir	3	5	Somewhat adaptable to drought	Review of previous wo
28	Abies	concolor		(Gord. & Glend.) Lindl.	White fir	3	4	16-20"+/ year	Review of previous wo
29	Abies	concolor		(Gord. & Glend.) Lindl.	White fir	2	3	18", dry-moist, moderate-good	Review of previous wo
30	Abies	lasiocarpa		(Hook.) Nutt.	Subalpine fir	3	3	Moist, poor tolerance	No documentation
31	Abies	concolor		(Gord. & Glend.) Lindl. ex Hildebr.	White fir	2	4	Medium water use	Review of previous wo
32	Abies	balsamea		(L.) Mill.	Balsam fir	3	5	30"+/ year	Review of previous wo
33	Abies	balsamea		(L.) Mill.	Balsam fir	3	5	13" Minimum, 60" Maximum	Review of previous wo
34	Abies	concolor		(Gord. & Glend.) Lindl.	White fir	3	5	18" Minimum, 80" Maximum	Review of previous wo
35	Abies	concolor		(Gord. & Glend.) Lindl.	White fir	3	5	Medium drought tolerance	Review of previous wo
36	Abies	lasiocarpa		(Hook.) Nutt.	Subalpine fir	2	3	Low drought tolerance	Review of previous wo
37	Abies	lasiocarpa		(Hook.) Nutt.	Subalpine fir	2	4	20" Minimum, 40" Maximum	Review of previous wo
38	Abies	balsamea		(L.) Mill.	Balsam fir	4	5	Moist, well-drained	Review of previous wo
39	Abies	concolor		(Gord. & Glend.) Lindl.	White fir	3	4	Well-drained	Review of previous wo
40	Abies	lasiocarpa		(Hook.) Nutt.	Subalpine fir	3	3	Dry, well-drained	Review of previous wo
41	Abies	concolor		(Gord. & Glend.) Lindl.	White fir	3	4	Drought tolerant	No documentation
42	Abies	concolor		(Gord. & Glend.) Lindl. ex Hildebr.	White fir	2	3	Drought tolerant	Review of previous wo
43	Acer	glabrum		Torr.	Rocky Mountain maple	2	5	9-60"/ year	Review of previous wo
44	Acer	glabrum		Torr.	Rocky Mountain maple	2	4	Dry to mesic	Review of previous wo
45	Acer	grandidentatum		Nutt.	Bigtooth maple	2	3	Drought tolerant	Review of previous wo
46	Acer	glabrum		Torr.	Rocky Mountain maple	2	3	Drought tolerant	Review of previous wo
47	Acer	negundo		L.	Boxelder	2	3	Drought tolerant	Review of previous wo
48	Acer	negundo		L.	Boxelder	2	3	Drought tolerant	Review of previous wo
49	Acer	glabrum		Torr.	Rocky Mountain maple	3	5	Plenty of water	Review of previous wo
50	Acer	grandidentatum		Nutt.	Bigtooth maple	2	4	High heat, medium water	Review of previous wo
51	Acer	grandidentatum		Nutt.	Bigtooth maple	2	3	Low water use	Review of previous wo
52	Acer	ginnala	'Flame'	Maxim.	Amur maple	2	3	Water wise	No documentation
53	Acer	campestre		L.	Field maple	2	4	Medium drought tolerance	Review of previous wo
54	Acer	glabrum		Torr.	Rocky Mountain maple	2	4	Medium drought tolerance	Review of previous wo
55	Acer	pseudoplatanus		L.	Sycamore maple	1	2	High drought tolerance	Review of previous wo
56	Acer	grandidentatum		Nutt.	Bigtooth maple	2	3	Mesic to xeric, < ARTR < PUTR	Formal research publi
57	Acer	negundo		L.	Boxelder	2	4	Mesic to mesic/xeric, < QUER < ARTR	Formal research publi
58	Acer	ginnala		Maxim.	Amur maple	2	3	Drought tolerant	Review of previous wo
59	Acer	negundo		L.	Boxelder	2	3	Drought tolerant	Review of previous wo

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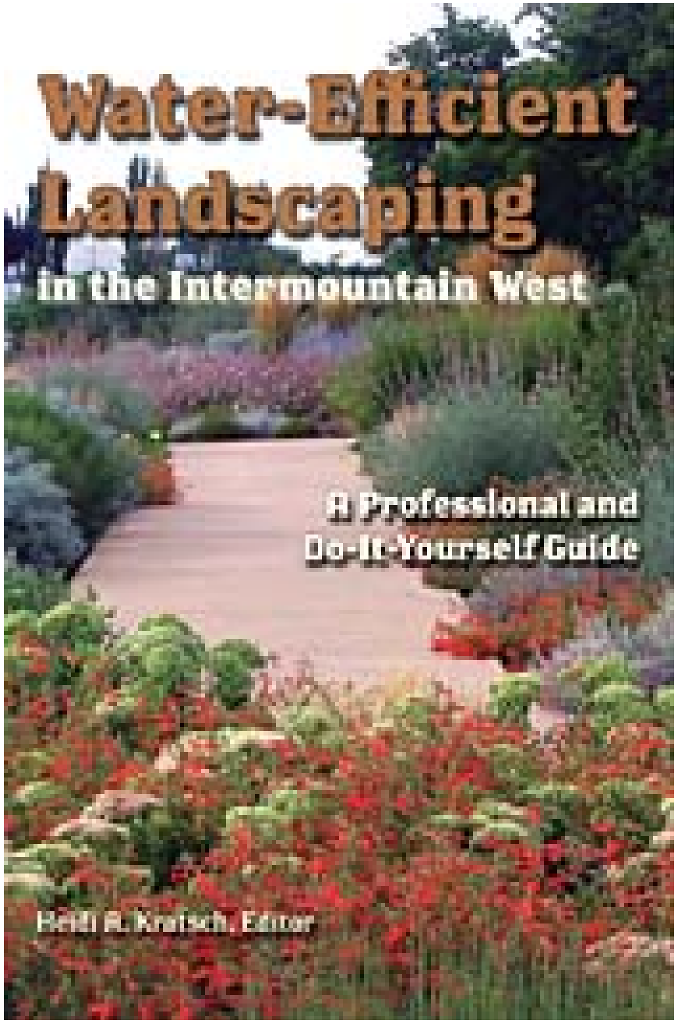

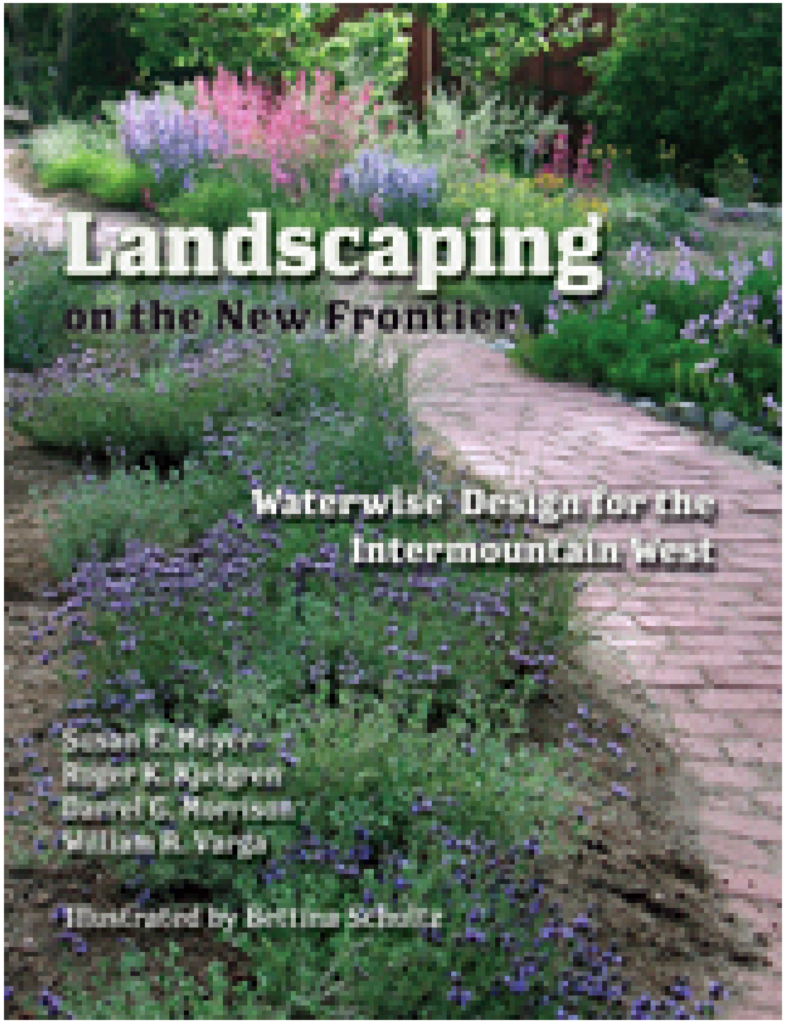

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COMBINATIONS FOR CONSERVATION

RECOMMENDED PLANT GROUPINGS FOR LOW-WATER LANDSCAPES

Center for Water Efficient Landscaping

UtahState University

COMBINATIONS FOR CONSERVATION

It has been said that in an urban environment, the constructed landscapes found throughout the community become the environment. As such, they are as critical to our quality of life as any natural environment. They are also critical to the quality of environmental factors such as clean water, reduced heat island effects, food for pollinators, our mental well-being and more. For many years the landscapes created in the communities of the Intermountain west were artificially supported by copious amounts of irrigation water. These landscapes have been welcome retreats from the native cold desert we call home, and as long as we have had plenty of cheap water they have been easy to justify.

The combination of increased population throughout the state and potentially deepening drought cycles, coupled with a finite water supply are making us re-examine water use by Utah landscapes. Since these landscapes use roughly 65% of our treated drinking water, they are the obvious first choice for conservation. There is nothing wrong with that, as long as we realize the key to landscape water conservation is not to eliminate landscaping, but to do it more wisely so that we retain the quality of life desired while reducing excessive water use.

The purpose of this guide is to provide options for landscape plantings that are functional, attractive, and desirable; yet are also water-wise. The approach is different than many guides. Rather than focus on individual plants and what they require from and add to a landscape, this guide focuses on small groupings of plants that together are greater than the sum of the parts. It is somewhat analogous to developing a wardrobe. While it is entirely possible to purchase separate items of clothing and then mix and match them to get the desired result, it is probably easier and more effective to buy all the components of an ensemble together so that the shoes, socks, belt, shirt, and coat all work together in an attractive and functional combination. As a result, rather than recommending that a single plant be added to a landscape, the guide recommends groups of three-four plants that fit together well and accomplish the desired purpose.

The groupings or combinations in this guide are not based on any strict criteria beyond the goal of being water-wise. This has resulted in broad spectrum of combinations based on a wide range of criteria.

ECOLOGICAL COMBINATIONS

In nature, there are combinations of plants that are synergistic and well as competitive. Synergistic plants perform better together than either could individually. An extreme example would be Indian paintbrush and sagebrush. The paintbrush is hemi-parasitic and depends on its association with the sage for nutrients. In turn, at least from a landscape perspective, the paintbrush adds a welcome splash of color to the gray sage. Ecological combinations are based on what we find in nature with the assumption that if they naturally group together and do well, then that would carry over to the landscape. So plants common to an ecological niche, such as a desert climate with full sun and minimal precipitation would be grouped separately from those native to a stream bank in the bottom of a shady canyon. Such groupings should also reduce the situation where one plant out-competes its neighbors and eventually overshadows them entirely.

AESTHETIC CONSIDERATIONS

Some combinations in the guide are based simply on the fact that they look good together. Virtually everyone has been in a situation where they have seen a particular combination of plants that is striking for its beauty. Whether based on color, texture, size, or a combination of all traits, the common thread is that together they look good. This is not to say that these combinations won't work ecologically. It is just that some of the plants may not be natives or normally found together in nature, even though they have the same requirements for growth.

FUNCTIONALITY IN A COMMON NICHE

One of the challenges of landscape design is fitting plants to the varied micro-climates found in a landscape. Every home has a sunny southern exposure and a shady northern one. They may also have steep slopes, poor soils, partial shade, or other characteristics. Some of the groupings in this guide are based on their fit to such micro-climates. For example, a micro-climate may be characterized as being shady and dry. Selection of a group of plants that fit such an environment insures that they will all prosper rather than compete for space and resources.

Within each combination, the guide also explains the characteristics and needs of the individual plants. Further, in the back of the guide is a list of potential substitutes in the event that a particular plant is unavailable. But, again the focus is not on the individual, but rather the group as a whole. The guide will also provide incidental information about the group such as how much water does it really need? Is it attractive to pollinators? How hardy are the plants?

While the guide provides information on a number of combinations, designing plant use for an entire landscape is beyond its scope. This does not mean that the reader could not group various combinations together with effective results, and in fact such groupings can be a very effective way to expand this information to the larger landscape. But, the focus of the guide remains on simple combinations that can be effective in the landscape. To return to the wardrobe analogy, we are not trying to develop the attire for an entire wedding party, we just want to make sure that the guest in the corner has slacks, shirt, and a jacket that fit and match.

Lastly, this guide is designed to help the home gardener go beyond adding a single plant to a landscape, or a number of single plants, to adding a wisely chosen group of 2-3 plants that will complete a segment of the landscape. Most of all, it is designed to promote landscapes that conserve water while conserving our quality of life.

CURB APPEAL

BOSNIAN PINE • BLUE MIST SPIREA • 'AUTUMN JOY' SEDUM •KENTUCKY BLUE GRASS

KENTUCKY BLUE GRASS IN THE LOW WATER LANDSCAPE

Kentucky blue grass is often vilified as a water hog, but it is often over watered and requires much less water than it generally receives. While Kentucky blue grass does needs more irrigation than other turf types, it doesn't need much more. Reducing amount of turf to a practical amount and watering it efficiently would drastically cut back on the amount of water used in the landscape. Plus, if you need to really conserve water in the summer, it can tolerate extended periods of no or little irrigation. It will go brown, but its not dead.

You don't have to completely get rid of your lawn to conserve water in the western landscape. Simply, reduce the amount of lawn and water it efficiently. The planting bed that is watered separately from the lawn area. The turf grass will need to be watered more frequently than the planting beds, but water it when the soil drys out. With deep, infrequent watering the roots will be more developed and better adapted to drought. The Bosnian pine provides a dark green backdrop for the fall blooming blue spirea, and the succulent pink sedum. The lawn in this design is minimal, but it draws the eye into the planting.

PLANTING AND CARE

Hydrozoning is an important concept when using plants with differing water requirements.

KENTUCKY BLUE GRASS

Poa pratensis

Kentucky bluegrass excels in sunny locations and can withstand heavy traffic. It has long season deep green color.

BOSNIAN PINE (sun)

Pinus heldreichii

Bosnian pine is slow-growing pine that is adapted to low-water landscapes. It has dark green finely texture needles and a nice pyramidal shape. Size: 40' tall x 10 feet wide
Zones: 6-8

BLUE MIST SPIREA

Caryopteris x clandonensis

Blue mist spirea has clusters of blue to purple flowers in late summer when little else is blooming. The transparent seed capsules are attractive throughout winter.
Size: 3-4' tall & wide.
Zones: 5-10

'AUTUMN JOY' STONECROP

Sedum 'Autumn Joy'

Stonecrops are tough plants that require very little water and maintenance. The compact, rounded form of the stonecop is reason enough for including in the landscape, but it the fall the mounds turn a deep pink. The rust colored seedheads make a nice winter silohuette if left and cut back in the spring.
Size: 1-3' tall & wide
Zones: 3-11

+ Slow the Flow Water Check Program

On average, program participants save 25,570 gallons of water annually, reducing the amount of water applied to landscapes by 8%.

Salt Lake City Public Utilities

Average annual savings (in thousands of gallons): **64**

Cumulative savings (in thousands of gallons): **1,141,384**

Cumulative $ saved per household: **$729.27**

Total cumulative $ saved: **$1,700,662.26**

Sandy City

Average annual savings (in thousands of gallons): **111**

Cumulative savings (in thousands of gallons): **773,365**

Cumulative $ saved per household: **$2,153.67**

Total cumulative $ saved: **$1,871,542.38**

+ Thanks very much….

Center for Water Efficient Landscaping

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UtahState University