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Real Time Metering and Internet Tracking for Efficient Landscape Irrigation



Stanford University

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MADDAUS WATER MANAGEMENT

Acknowledgments

Team working on BMP and Metrics Study

Stanford University

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Stanford University Campus, California





- 1. Stanford's Water System & Water Conservation Program
- 2. Landscape BMP, Metrics Study
 - Site Selection
 - Technology and Tools
- 3. Data Collection & Analysis
- 4. Summary & Results
- 5. Questions



Stanford's Potable & Non-potable Water Systems

- ✓ <u>Potable Water:</u> San Francisco Public Utilities Commission (SFPUC), allocation is 3.033 MGD
- ✓ <u>Non Potable Water: (used for most campus irrigation)</u>
 - **1.2 M sqft green areas,**
 - 1 M sqft of shrubs,
 - 580,000 sqft groundcover

✓ Water systems serve daily average campus population of 30,000

✓ Conservation planning provided in 2000 Water Master Plan: necessary to meet campus growth



Potable and Non-Potable Water Consumption by Campus Groups

Potable Water Consumption FY12: 2.16 MGD

Non-potable Water Consumption FY12: 1.18 MGD



Water Conservation Program at Stanford

• Water Conservation & Recycling Master Plan 2001

Goal	Water Savings 2001- 2010	Cost				
Planned	0.58 MGD	\$5.14M				
Actual	0.59 MGD (22% reduction of potable use)	\$2.3M + Rebates from SCVWD				

• 20 Different Measures Since 2001-2012:

Device	Number
Toilets, Showers, Faucets, Urinals	12,433
Clothes Washers	525
Spray Valves	74
Steam Sterilizers (For research equipment sterilization)	66
Various Projects: Vacuum Pump Replacement, Energy Facility Blowdown Reuse, Once Through Cooling Retrofits	Numerous
Landscape – Retrofits to Efficient landscape, ET Controllers, Faculty / Staff Home Landscape Audits, Demo Garden	Numerous

Conservation is Working! Water Use Decreasing as Campus Sqft Increasing



2001: 2.7 mgd 2012: 2.16 mgd



Landscape BMP, Metrics Study - Why do it?

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Large -andscapes Several groups managing campus landscape

Different management styles and levels of water efficiency

Not all areas on ET

 Need new methods and tools to encourage efficiency for the long term

Goals

- Provide facts about consumption
- Develop BMPs and Metrics
- Provide routine feedback about water use
- Identify tools for landscape managers



Large Landscape Site Selection

<u>Goal</u> Select Sites with Similar Physical Characteristics – Focus on Decorative Turf

Comparative Criteria



Landscape and Residential Study Areas Blue = No meter issue Yellow = Leak / Issue



California Irrigation Management Information System (CIMIS) REFERENCE EVAPOTRANSPITRATION



- Landscape site size, acres of turf
- Managing group, and how long have they managed each area?
- How many staff manage each area?
- When and how often is each area fertilized?
- When and how often is each area mowed?
- Approximate age of turf in each area, type of irrigation system, age of infrastructure (e.g., piping)





GIS Polygon Areas – Non-turf



Non-turf Area: 15,293 sqft.

Real-time Monitoring & Reporting Technology









DATA

Existing Utility Meter Database

Campus Weather Data

Site, Turf Size, Field Observations, Site Visits

Photo Documentation

TECHNOLOGY & TOOLS

New Real-Time Water Use Monitoring

Water Use Budget Calculator Developed

Historical Water Use Trends Analysis



Water Budget Calculator

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Image: Stanford university Water Budget Calculator										
Instructions	Locatio	n Oval		View Water Bud	lgets Back to Main	Show Calcs	Print			
Entering a Tree, Groundcover or Shrub Area	Trees, G	o. 1 Groundcover and Shi	rubs							
1) In the top table, enter a name	NO.	Irrigated Area Label	Plant Water Use	Planting Density	Wind and Sun Exposure	Irrigation Efficiency	Planting Area (sq.f	.)		
for the landscaped area in the	1	Shrub		Average	Average	Average	15,295			
Irrigated Area Label column	3	Irrigated Are	ea Label							
	4	the planted a	area. For							
2) Select how much water the	5	example: Lov	w Water Use							
plant type uses (Very Low, Low,	6	Shrubs								
Moderate, High). A table of	7									
recommended values for this	8									
column can be found in the UC	9									
Davis WUCOLS III reference	10									
3) Enter a planting density. The Turfgrass										
density indicates how close the	No.	Irrigated Area Label	Turfgrass Type	Wind Exposure	Percent Shaded	Irrigation Efficiency	Planting Area (sq.f	.)		
plants are together.	1	Turr	Cool Season	Average	5%	Average	156,795			
4) Enterthe wind and our	2									
4) Enter the wind and sun	4									
exposed to sup or wind increase	5									
this value.	6									
	7									
5) Enter an irrigation efficiency.	8									
This can be an indication of how	9									
new the system is or how well it	10									
is maintained and monitored for leaks.						Tota	l 156,799	-		
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Water Budget Calculator

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37 38 39	leaks. 6) Enter the square footage of the	Water Bu	udget Year(s)	2005-2011									
40 41 42	Entering a Turfgrass Area	1.00	Calculated Water Budget (gallons)*	Five Year Average (gallons)		1 200 000 .	Calculat Five Year	ed Wate r Averag	r Budg e Wat	get vs. er Use	_		
43 44 45	1) In the bottom table, enter the name for the irrigated area.	Jan Feb Mar	36,215 107,843 252,344	35,647 43,943 168,428		1,000,000 ·					-		
46 47 48 49 50	2) Select if the turf is warm or cool season grass. For example bermuda grass is a warm season grass and bluegrass is a cool	Apr May Jun Jul Aug	399,531 672,542 790,574 788,201 674,507	393,559 726,294 837,810 870,778 974,504	silons	800,000 - 600,000 ·					Five Yea Water U	r Average se	
51 52 53 54	season grass. 3) Enter a wind exposure indicating if the area is sheltered	Sep Oct Nov Dec	591,624 412,909 239,829 18,186	702,112 388,519 172,388 40,091	ö	400,000 - 200,000 ·	~				Budget		
55 56 57	or exposed to the wind. 4) Enter a percentage value indicating how much of the turf is	Total	4,984,305 *Based on five year average (if avail	5,354,073 able) of historical water use		0 -	par cer war wer	Bay her his	AUB GER	OC NON DEC	-		
58 59 60 61	shaded from the sun for a majority of the day. 5) Enter an irrigation efficiency.		Spring (Mar,Apr,May): Summer (Jun,Jul,Aug): Fall (Sep,Oct,Nov):	No Change 16% 1%						- v v			
62	ty										町 100% —		▶ [] -(+)
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Weekly Water Report for Landscape Manager

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Units: gal	Last 7 Days	5	Last 30 Days		
Barnacle Details	Daily Average	Total	Daily Average	Total	
Manzanita Field-Serra & Campus Drive East, Manzanita Field, Stanford, CA Meter: L1660, Hersey MVR 2" Installed Apr 14, 2011	7,859	55,015	7,071	212,133	
Stanford University Oval, Campus Dr E, Stanford, CA Meter: L1172, Badger Turbo 450 RTR 3" Installed Mar 29, 2011	18,267	127,866	18,587	557,608	
Lomita Mall, Stanford, CA Meter: L1522, Hersey MHR 2" Installed Apr 14, 2011	6,294	44,057	5,797	173,910	
Bing Nursery School, 850 Escondido Road, Stanford, CA Meter: D1947, Badger T-200 ADE 2" Installed Apr 06, 2011	8,688	60,817	8,221	246,631	
Li Ka Shing Center for Learning (LKSC), 291 Campus Drive, Stanford, CA Meter: L1718, Badger T-450 3" Installed Apr 06, 2011	6,850	47,952	6,763	202,875	
Stanford Campus Recreation Assn., 875 Bowdoin Lane, Stanford, CA Meter: D1233, Badger Turbo 200 RTR 2" Installed Apr 06, 2011	6,407	44,846	7,179	215,377	
Arrillaga Recreation Center, 341 Galvez, Stanford, CA Meter: L1688, Badger T-200 2" Installed Apr 15, 2011 Continuous flow today: None Continuous flow this week: 31 gal/day average Continuous flow today: last week	31,526	220,679	31,371	941,115	

Leak Detection

✓ Constant water use indicates a leak



small consistent use is a leak

Daily water use, ET Site June 2011,

Avg. temperature, precipitation

Note the <u>irrigation reduced</u> after rain

● Barnacle C Historical ▼ Edit Daily for June 2011 6/12/2011 D Dav 🗹 Ava, Temperature 60k Max Temperature Precipitation 50 k Historical Averages Water Budget (Gallons) Avg. 40k Temp. 69 °F 0.8 Consumption 30 k 0.6 20 k 0.4 10k 0.2 0k 3 7 9 11 13 Date

📕 Stanford University Oval — Avg. Temperature — Precipitation

Daily water Use NON-ET Site: June 2011, Avg. temperature, precipitation *Note irrigation NOT reduced*

after rain



Monthly water use, ET Site: Water budget, historical avg., temperature, precipitation

Monthly water use, NON-ET Site:

Water budget, historical avg., avg temperature, precipitation



Comparison: 2011 use to 2012 use With Water Budget and Historical Use Overlays



New Weather-Based Irrigation Controller installed in May 2012. Projected savings of 2.1 Mgal/yr for ~4 acres of irrigated landscape

Best Management Practices and Metrics Developed from this Study



water use for previous year.

Consumption Ruler

Water use per acre – Sites ranked from lowest to highest



Leak Ruler

Gallons of water used due to leaks (from July 2011 to July 2012)



Since Site 5 installed an ET controller in May 2012, they now get real-time alerts about leaks and are quick to respond.

Summary and Results

- **1.** Long-term success requires an integrated approach:
 - ✓ Landscape managers willing to take time to do things differently
 - ✓ New technology and tools to illustrate <u>how the controller settings</u> translate to water use.
- 2. Real-time monitoring technology & water budgets provide factual information for successful changes in irrigation management.
 - ✓ <u>Hourly water use data is a good tool for identifying/verifying leaks</u>.
 - ✓ <u>Daily water use</u> data illustrates ET controllers <u>respond faster to</u> <u>weather events</u> than manually operated controllers.



Summary and Results, Cont.

- 3. However, ET controllers are not accepted by all customers.
- 4. Tools need to be <u>fast and easy to use</u>.
- 5. Continuity is important: weekly reports, other communication about site water use is helpful to keep priming managers to take <u>action</u>. Small steps and patience yields successful results.
- 6. Development of useful metrics, BMPs require persistence, iterative verification:
 - ✓ using real-time water use data
 - ✓ understanding site characteristics
 - ✓ communicating with site managers & customers
 - ✓ fine-tuning the irrigation to local conditions.







Questions?

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