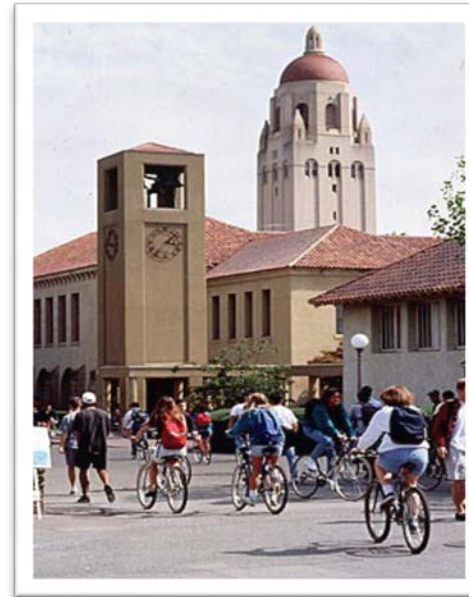# This presentation premiered at WaterSmart Innovations

watersmartinnovations.com

Water Use Report Cards: An Essential Tool for Drought Water Management

WATER SMART INNOVATIONS CONFERENCE
OCTOBER 8, 2015

MADDAUS WATER MANAGEMENT

Chris Matyas, Maddaus Water Management
Jennifer Fitch, Stanford University

Acknowledgments

Team working on Drought Response and Report Cards

Stanford University

> Jennifer Fitch, Julia Nussbaum, Erica Kudyba
>
> Marty Laporte (has since retired from Stanford University)

Maddaus Water Management

> Chris Matyas, Michelle Maddaus, Bill Maddaus

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Overview

1. **STANFORD'S WATER SYSTEM & WATER CONSERVATION PROGRAM**

2. **CURRENT DROUGHT IN CALIFORNIA**

3. **DEVELOPMENT OF REPORT CARD ANALYSIS**

4. **REPORT CARD AUTOMATION**
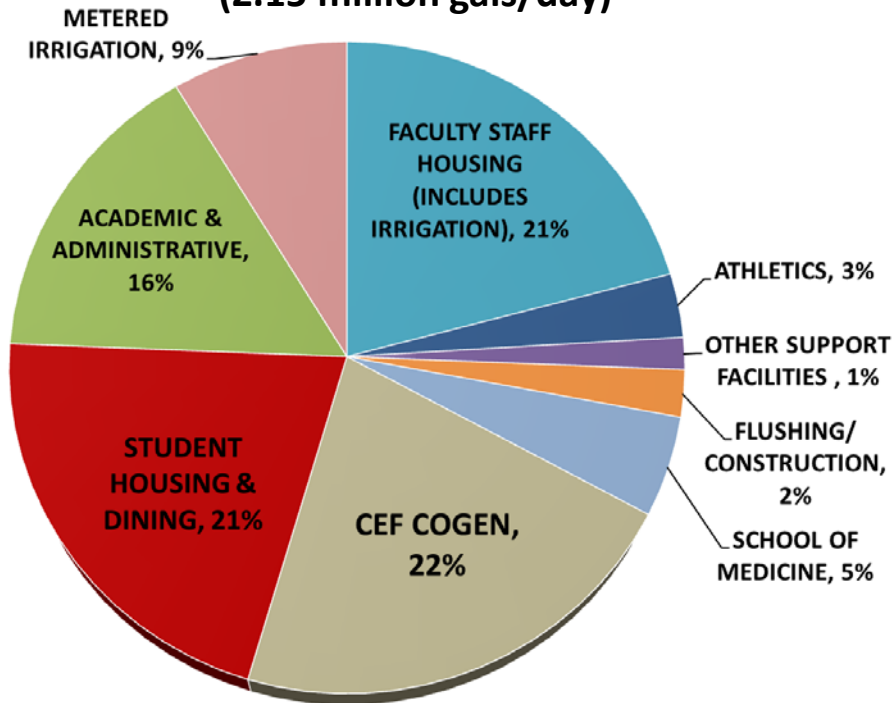
5. **SUMMARY AND RESULTS**

6. **QUESTIONS**

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Stanford University Campus, California

California and San Francisco Bay Area Map

California

Berkeley

San Francisco

San Francisco Bay

Hayward

San Mateo

Pacific Ocean

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Palo Alto

San Jose

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Potable and Non-Potable Water Consumption by Campus Groups

✓ Potable Water: SFPUC, allocation is 3.033 MGD

✓ NON POTABLE WATER: MOSTLY USED FOR CAMPUS IRRIGATION

Stanford University Potable Water Consumption FY2013 (2.15 million gals/day)

- METERED IRRIGATION, 9%
- FACULTY STAFF HOUSING (INCLUDES IRRIGATION), 21%
- ATHLETICS, 3%
- OTHER SUPPORT FACILITIES, 1%
- FLUSHING/CONSTRUCTION, 2%
- SCHOOL OF MEDICINE, 5%
- CEF COGEN, 22%
- STUDENT HOUSING & DINING, 21%
- ACADEMIC & ADMINISTRATIVE, 16%

Stanford University Non-Potable Water Consumption FY2013 (1.23 million gals/day)

- HOUSING, 2%
- ATHLETICS - GOLF COURSE, 14%
- ATHLETICS-VARSITY GOLF PRACTICE FIELD, 5%
- ATHLETICS - NOT INCLUDING GOLF COURSE & GOLF PRACTICE FIELD, 24%
- OTHER SUPPORT FACILITIES, 10%
- FLUSHING/CONSTRUCTION, 1%
- SCHOOL OF MEDICINE, 3%
- STUDENT HOUSING & DINING, 11%
- ACADEMIC & ADMINISTRATIVE, 30%

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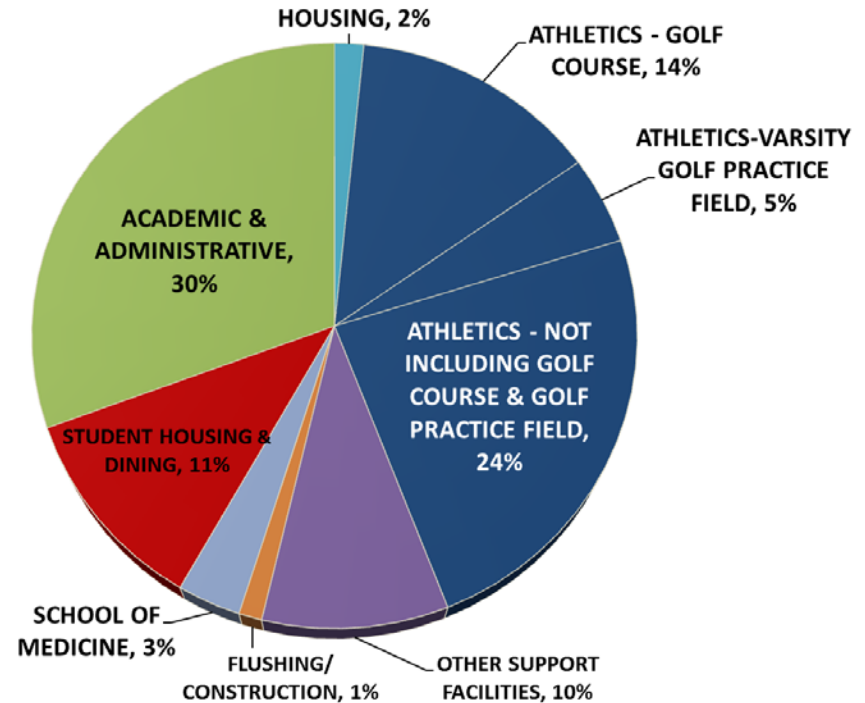
Water Conservation Program at Stanford

- 20+ Different Measures: 2001-2015

Device	Number
Toilets, Showers, Faucets, Urinals	13,000+
Clothes Washers	582
Spray Valves	74
Steam Sterilizers – added water misers (used 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, Demonstration Garden	Numerous

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Conservation is Working!
Water Use Decreasing as Campus Sq. Ft. Increasing

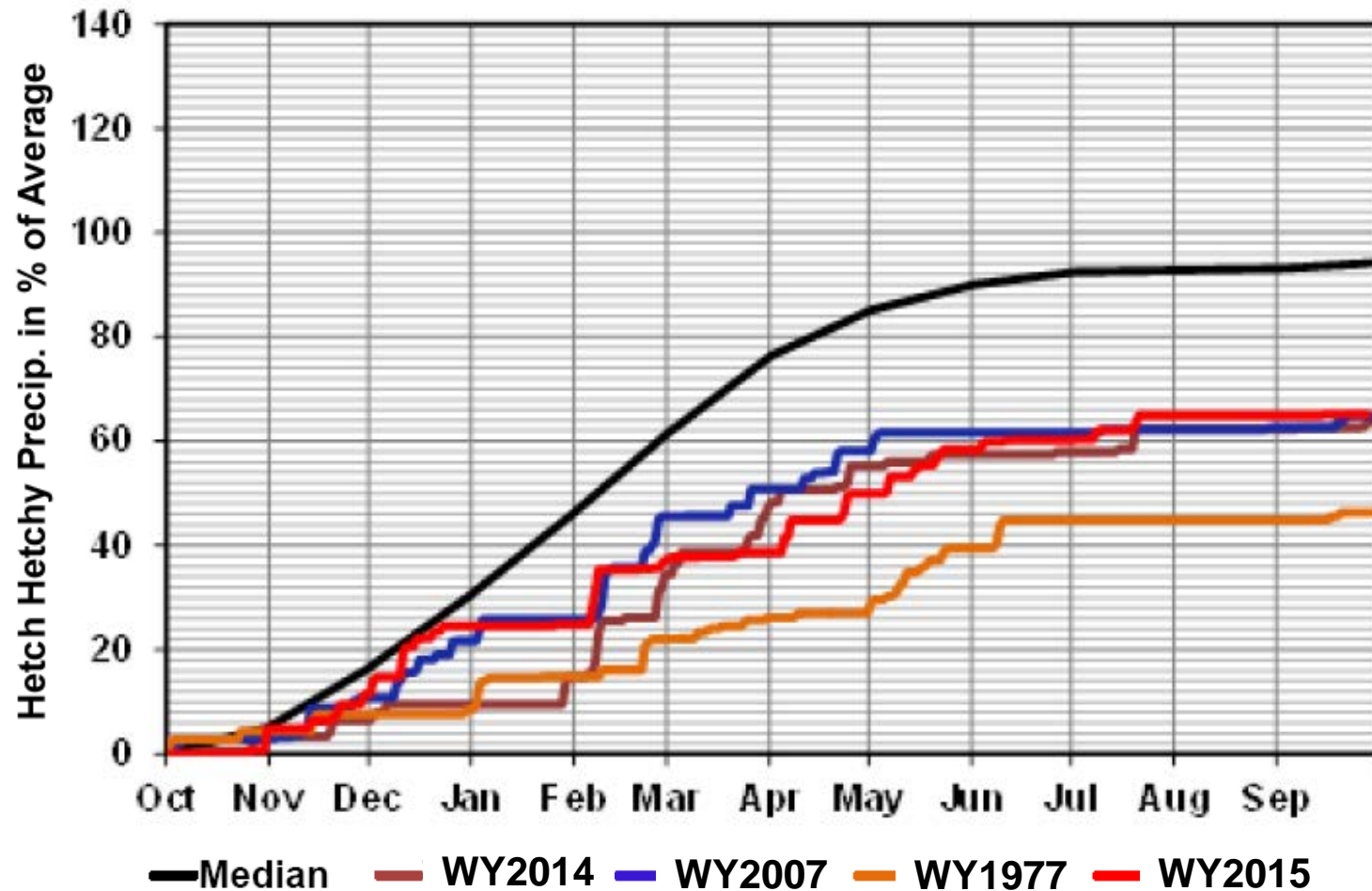**Stanford University Domestic Water Use 2001-2015**

2001: 2.7 mgd
2015: 1.89 mgd

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California Drought

Stanford University
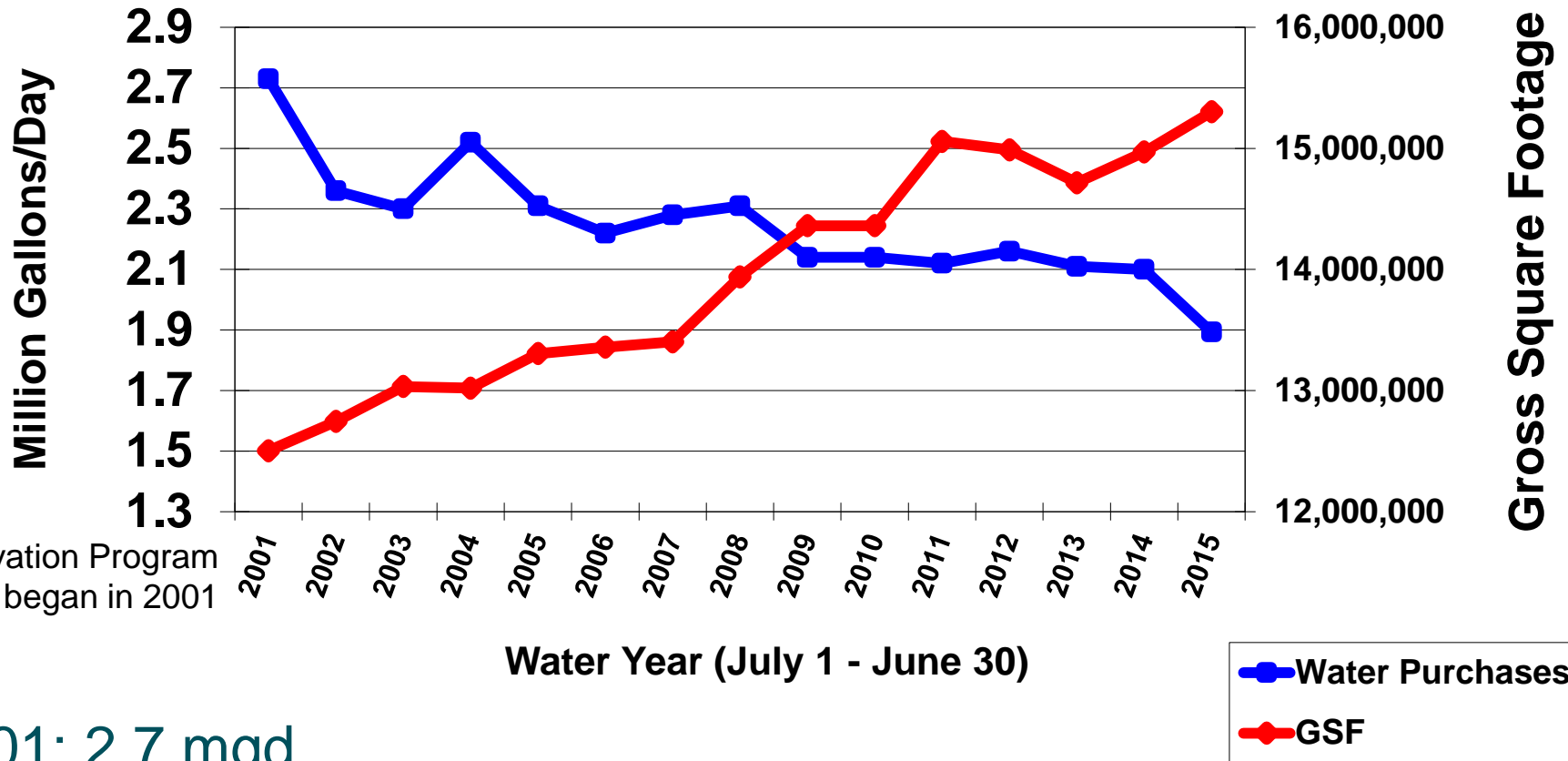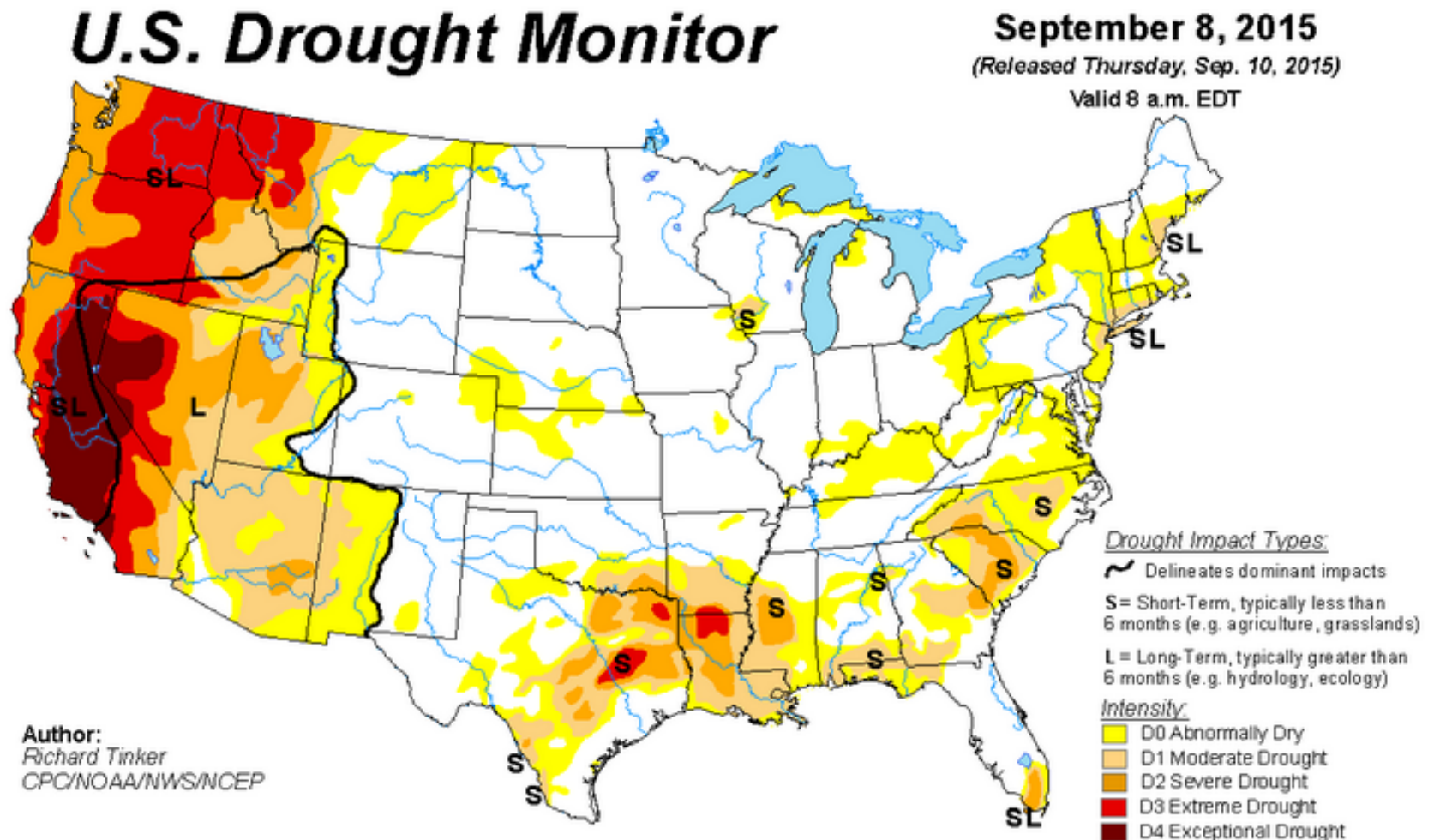
California Drought

Precipitation at Hetch Hetchy - Water Year 2015

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Report Card Development

- VARIOUS DIFFERENT TYPES OF WATER USERS ON CAMPUS MANAGED BY DIFFERENT GROUPS
  - Academic/Institutional buildings
  - Landscape irrigation
  - Student housing and dining
  - Single-family housing
  - School of Medicine
  - Athletic Facilities

- STAFF WHO MANAGED THE SITES WERE OFTEN NOT THE SAME AS THOSE WHO PAYED THE BILLS
  - Site managers did not have access to consistent, ongoing water use data

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Report Card Development Cont.

- TO ADDRESS THE INFORMATION GAP, STANFORD WATER EFFICIENCY GROUP DEVELOPED REPORT CARDS THAT WERE SENT TO THE MAJOR GROUPS ON CAMPUS
  - Visual graph for quick overview
  - Thumbs up/down – performance review, evaluated vs. campus goals/mandates

THE REPORT CARDS BECAME AN AVENUE FOR SITE MANAGERS TO TRACK THEIR WATER USE AND COMPARE TO PREVIOUS YEARS USAGE

Single-Family Homes SCRL (Faculty/Staff) - Water Used Indoors & for Landscape Irrigation: January 2013 - July 2014

Faculty/Staff single-family water use was down 18% comparing Feb-July 2013 to 2014 same months. Our goal is at least 15% reduction.
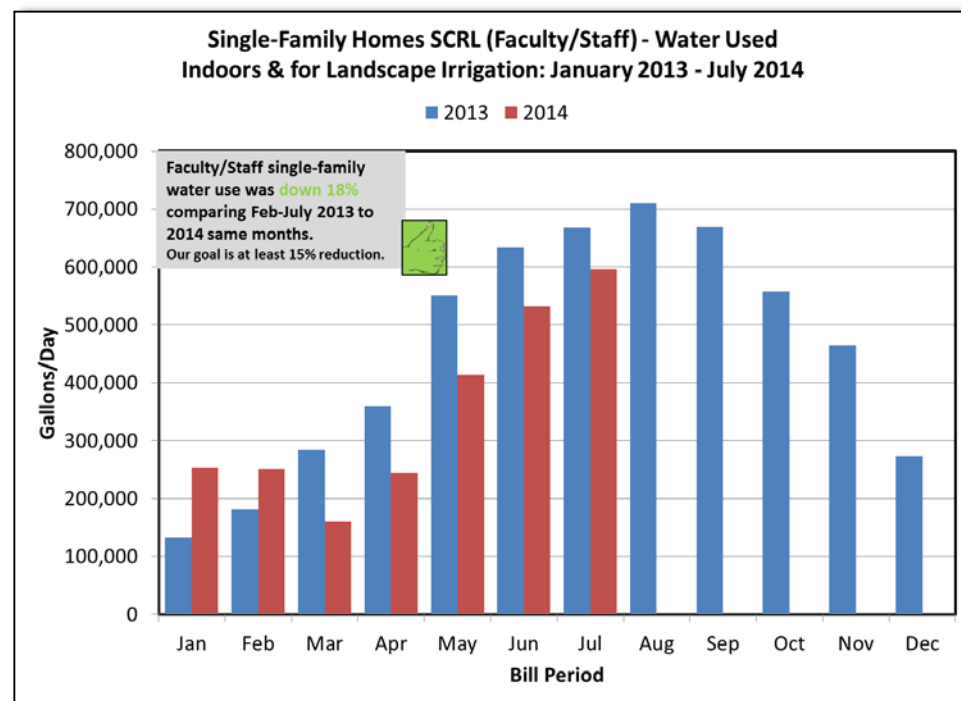
Goals of the Report Card Generator

Water Use Information

- Multiple groups managing campus buildings & landscape

- Different management styles and levels of water efficiency

- Need methods and tools to get water use data/information out

- Manual Report Cards are time consuming & can contain errors from working with large data sets

Goals

- **Provide accurate, reliable water use data**

- **Provide routine and actionable feedback about water use**

- **Establish clear reduction goals and a way to measure success**

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Report Card Reception

- SITE MANAGERS WERE ABLE TO:
  - View water use data on a regular basis
  - See overall trends and identify problem meters
  - Enhance site management

- FEEDBACK:
  - Managers found this tool useful but wanted less lag time (daily/hourly consumption)
  - Some groups wanted more analysis/statistics done
  - Some groups did not like the "judgment factor" of thumbs down

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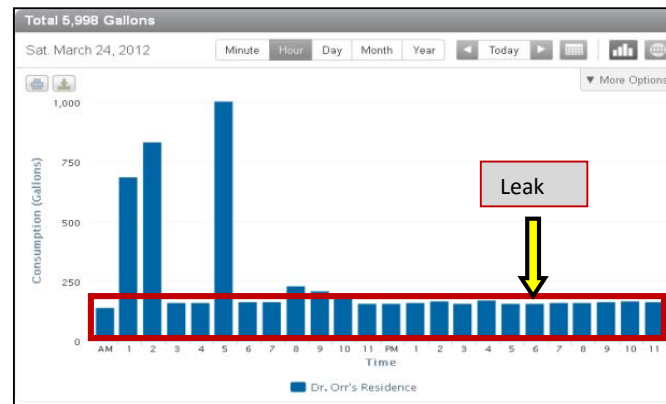
Stanford – Maddaus Partnership

- REPORT CARDS WERE USEFUL BUT THE MANUAL PROCESS WAS TIME-CONSUMING AND THERE WAS A LARGE POSSIBILITY FOR ERRORS WHILE ORGANIZING THE DATA

- CHALLENGES:
  - Time consuming
  - Errors/inaccuracies
  - Timely
  - Difficult to track group changes (i.e. account changes)

- MADDAUS WATER MANAGEMENT INC. DEVELOPED SOFTWARE TO AUTOMATE AND STREAMLINE THE REPORT CARD PROCESS
  - Faster & more accurate
  - More sophisticated/better display
  - Broke water use out by: Domestic Indoor, Domestic Irrigation, & Lake Water Irrigation
  - Included consumption data for each meter each month
    - Able to drill down into the details & find problem meters

Unintended Benefits

- REPORT CARDS DEVELOPED FOR CONSERVATION BUT WERE USED FOR A VARIETY OF OTHER TASKS:
  - Tracking
  - Realizing water savings from rebate projects
  - Identifying problem meters
  - Determining rate projections/budgeting
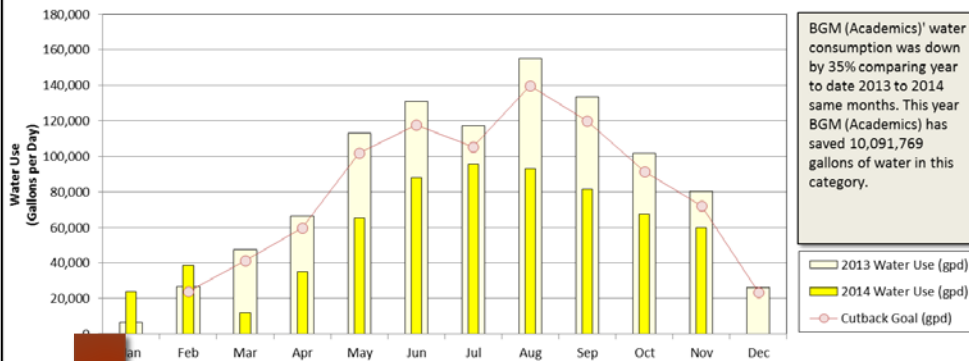 - Quick reference for data lookup or to answer questions
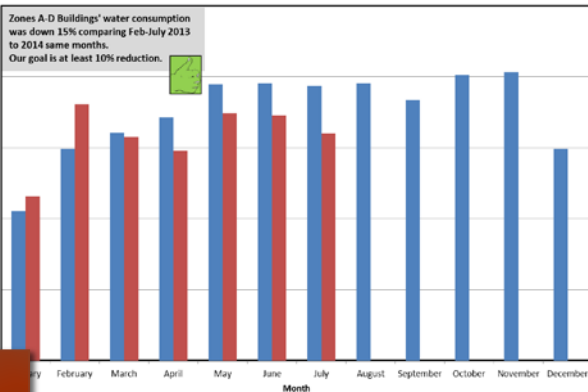
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Report Card Evolution

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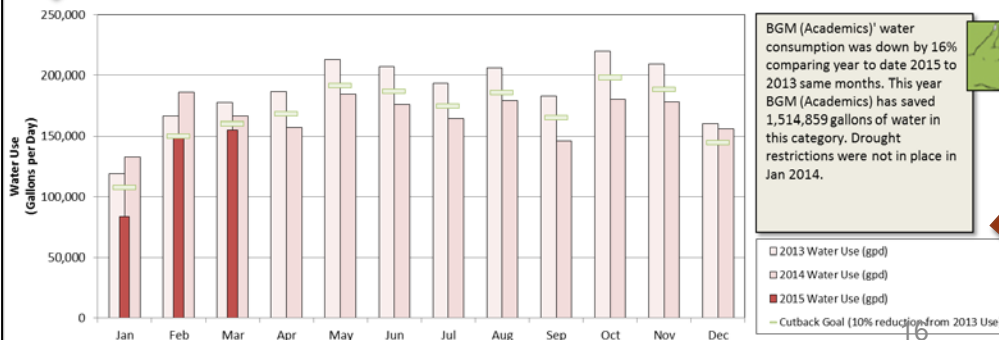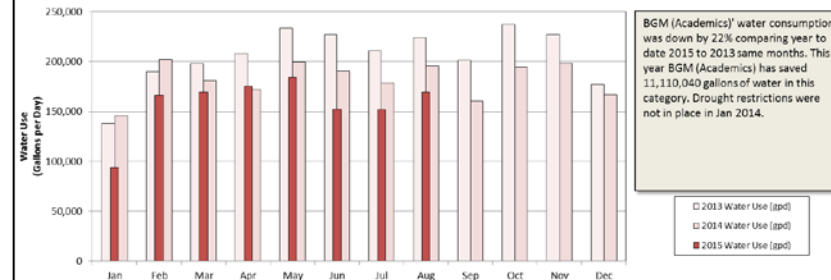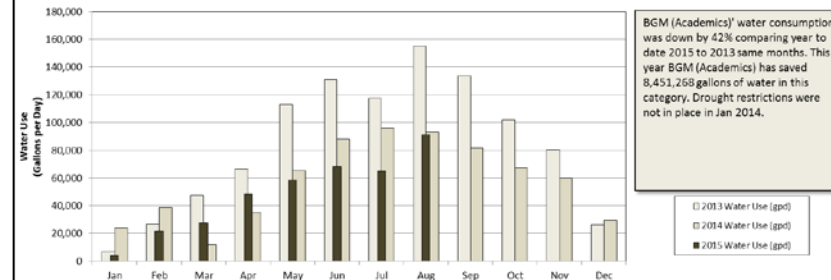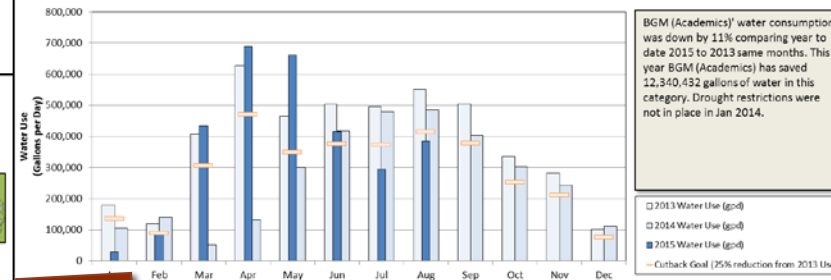
Water Report Cards –
Software Engineering Perspective

- SOFTWARE PROCESS

- INSIGHTS

- DIFFICULTIES & BENEFITS

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Implementation

STANFORD'S GOALS

- Reduce Person Hours
- Increase Accuracy
- Automatically Account for Changes in Billing Data
- Export to Excel
- Handle Big Data (Or at least Medium Data)
- Increase Delivery Speed
- Design Flexibility

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Digging for Requirements

1. WHO ARE THE USERS?
2. HOW MUCH DATA IS THERE?
3. HOW OFTEN WILL THE SOFTWARE BE USED?
4. WHAT TYPE OF PLATFORM DO YOU NEED?
5. WHAT TYPE OF OUTPUT DO YOU NEED?
6. WHEN DO YOU NEED THE SOFTWARE?
7. HOW MUCH DO YOU WANT TO SPEND?
8. HOW LONG IS THE PAYBACK PERIOD?

"Don't Gather Requirements Dig for them"
– *The Pragmatic Programmer*

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Design Choices

WINDOWS DESKTOP APPLICATION

- Small Set of Users
- Rapid Software Development Tools Readily Available
- Leverage Microsoft Office Libraries

SIMPLE FREE DATABASE USED

- SQLite – Small, Public Domain, Free and Good for Datasets less than 1GB.
- Separate Database a Requirement due to Billing System Changes

IMPORT AND EXPORT TO EXCEL

- Transparency – As a Means of Testing
- Easier to check data and verify software outputs

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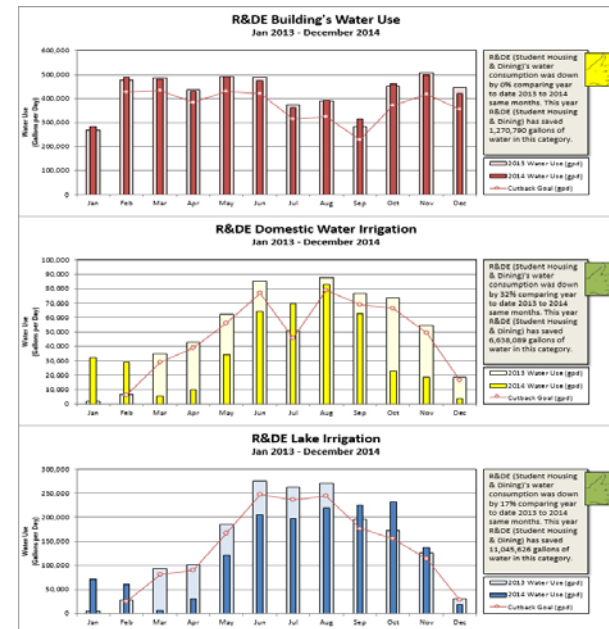
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Features

SIMPLE USER INTERFACE

AUTOMATED TESTING

- Test Early, Test Often, Test Automatically
- Code and Data

FLEXIBLE ARCHITECTURE

- There are No Final Decisions
- New Ideas Come Along Regularly

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Accuracy

- GRAPHS – SIMPLE ERROR CHECKING
- REDUCE MANUAL MISTAKES.
  - Almost anything a person can do in Excel can be done via code
  - Key is to make software take over repetitive tasks
- AUTOMATED TESTING
  - Import Software Data Tests
  - Export Software Data Tests

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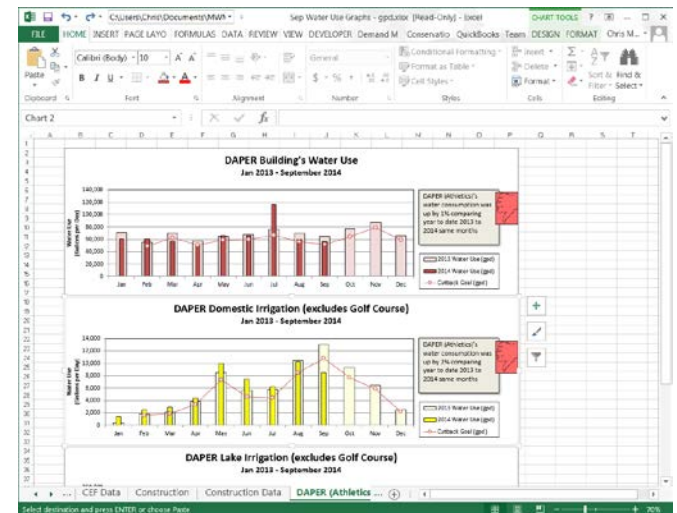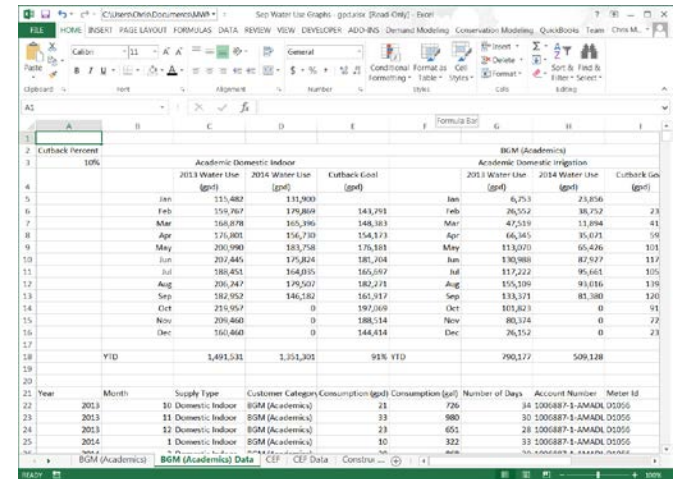
Why Software Was the Correct Solution

REDUCED PERSON HOURS

GENERATING ONE MONTH'S REPORTS:

Manual Process	Software Generator
~40-60 hours / month	~4-6 hours

INITIAL INVESTMENT

Time To Develop Initial Version of the Software
~70 hours

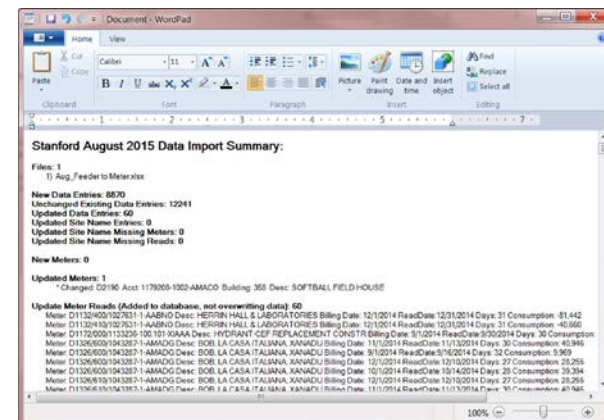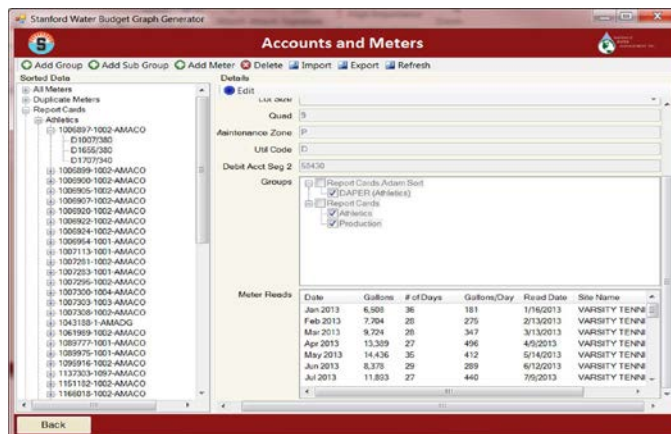PAYBACK WAS ALMOST IMMEDIATE

Difficulties & Unexpected Benefits

- DIFFICULTIES
  - BILLING SYSTEM CHANGES
  - EXCEL FILE SIZE LIMITS AND SPEED LIMITATIONS
  - DATA CONSISTENCY
    - Construction Projects

- UNEXPECTED BENEFITS
  - IMPROVEMENT TO PROCESS
  - SPRINGBOARD FOR OTHER PROJECTS
    - Leverage Organized Data

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Summary and Results

1.   WATER REPORT CARDS:

- Developed out of a need to communicate with building & landscape managers
- Gave site managers actionable information
- Encouraged and received site manager involvement

2.   Automating the Process:

- Drastically decrease person hours to produce
- Increased accuracy and consistency with automated testing
- Flexible for future improvements
- Increased Delivery Speed
- Leading to other unexpected benefits

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Questions?

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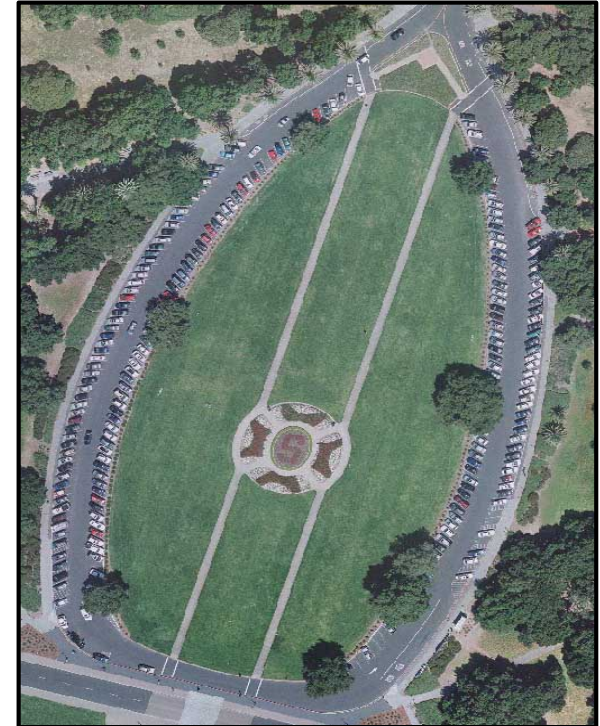
Stanford's Water Efficiency Website:
http://lbre.stanford.edu/sem/Water_Efficiency

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