

# Landscape Water Use Modeling

## For California State University Campuses

### Project Background

California State University (CSU) campuses face a challenge in meeting water reduction goals. One part of this challenge is reducing water usage on landscaped areas. Often, water usage within buildings and water usage for landscape irrigation are not metered separately. This creates a problem in determining where water is being used, and where efficiencies may be realized.

California's updated Model Water Efficient Landscape Ordinance (MWELO) (Governor's Executive Order B-29-15) contains calculations for determining a maximum water allowance for landscaped areas and for determining current estimated water use. The goal of this pilot was to test the feasibility of and develop a methodology for performing these calculations across CSU campuses that do not have separate metering.

Project staff have accurately measured the landscaped areas within the following CSU campuses: Fullerton (CSUF), Northridge (CSUN), and Sacramento (CSUS).

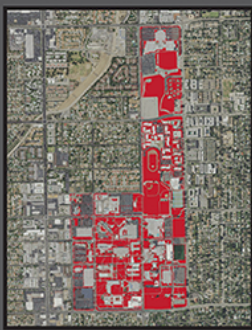
The area of the landscaped areas was then calculated (square feet) and entered into the Department of Water Resources' (DWR) Water Budget Calculator. This calculator was created to assist in determining how much water *should* be used to maintain non-residential landscapes versus the amount of water that *is* being used through the Maximum Applied Water Allowance (MAWA) and Estimated Total Water Use (ETWU) calculations outlined in MWELO.

Geographical Information System (GIS) data of landscaped areas on campus grounds was provided by campuses within the CSU system. Due to time and funding limitations, three of those campuses were chosen for this pilot. Their landscape GIS data was edited for consistency in geometry and attribution using aerial imagery. The landscape GIS data was then used as a basis for performing the calculations necessary to determine the MAWA and ETWU for the landscaped areas of each campus.



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### Task 1 Compile and Analyze Original Data



CSU Northridge



CSU Fullerton



CSU Sacramento



SACRAMENTO  
STATE

### Task 3 Maximum Applied Water Allowance and Estimated Total Water Use

$$MAWA = (ET_o)(0.62)[(0.7 \times LA) + (0.3 \times SLA)]$$

$$ETWU = (ET_o)(0.62)[((PF \times HA)/IE) + SLA]$$

- 0.62 = Conversion Factor (to gallons)
- 0.7 = ET Adjustment Factor (ETAF)
- 0.3 = Additional Water Allowance for SLA

- ET<sub>o</sub> = Reference Evapotranspiration (inches per year)
- LA = Landscape Area including SLA (square feet)
- SLA = Special Landscape Areas (square feet)
- PF = Plant Factor from WUCOLS
- HA = Hydrozone Area (square feet)
- IE = Irrigation Efficiency (minimum 0.71)

#### Standardized Classification Modifiers

Classification	Water Use	Plant Factor
Shrub	Medium	0.5
Turf	High	0.8
Special Landscape Area	SLA	1.0
Trees /w Bare Earth	Medium	0.5
Drought Tolerant Plants	Low	0.2

### Limitations

Since the majority of digitizing was done based off aerial imagery, the accuracy of the study was limited to the resolution and/or timing of these basemaps. Smaller plants or trees are difficult to spot as their fine outlines appear distorted in lower resolution imagery. This issue also affected the landscape classification process. Additionally, these basemap images are temporally static and do not reflect any landscaping changes that take place later than 2014.

Furthermore, the NAIP imagery resolution was of questionable accuracy for distinguishing irrigated vs non-irrigated landscapes. Since the total areas for irrigated/non-irrigated areas could not be reliably measured, the default value (0.75) was applied when calculating the ETWU.

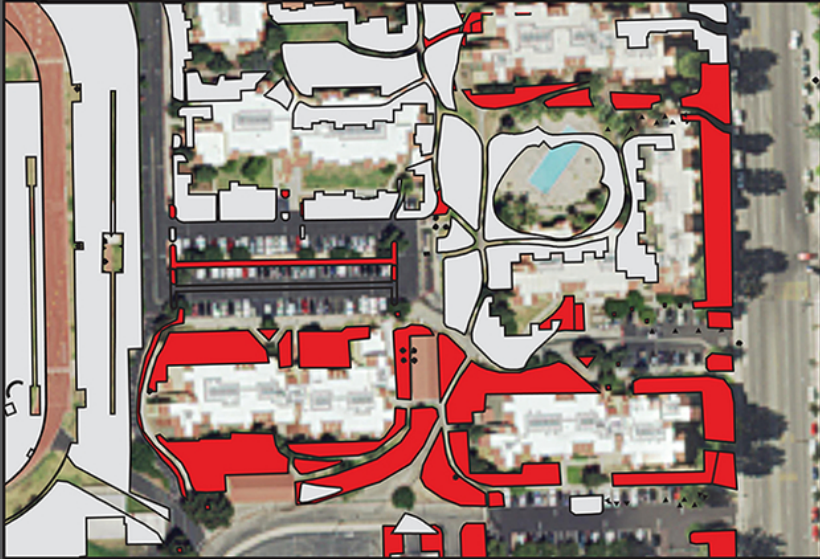
### Task 2 (a) Digitizing and Updating

The base high-resolution imagery used for landscape delineation was the National Agriculture Imagery Program (NAIP) 2014 imagery for California. Additional imagery, such as color infrared imagery, Google Maps Streetview, and Bing Maps online oblique imagery were also used as ancillary information to assist in decision-making during the mapping process.



Aerial/CIR  
imagery helps  
identify organic  
plant life and  
differentiate  
it from artificial  
materials.

#### Landscape Updates



Original Landscape Data

New Landscape

### Task 2 (b) Standardized Classification System

The original landscape data for the three campuses in this study each used a unique classification system that was highly generalized. To create classification consistencies across campuses, the Center for Geographical Studies developed a standardized classification system and applied it across each campus.

Additional considerations were given to areas of artificial turf or drought tolerant vegetation, as these require less water to sustain. Arboretums and botanical gardens were also observed and classified as requiring a greater water cost.

Classification	Includes...
Shrub	Vegetation within planter(s).
Turf	Grass (non-sports field).
Special Landscape Area	Edible plants, recreation, arboretums/gardens.
Trees w/ Bare Earth	Trees with bare earth underneath canopy. Note: Treed areas with grass underneath were classified as turf.
Drought Tolerant Plants	Unidentified or unknown plant types.

#### Landscape Reclassifications



Shrub

Turf

Other/Unknown

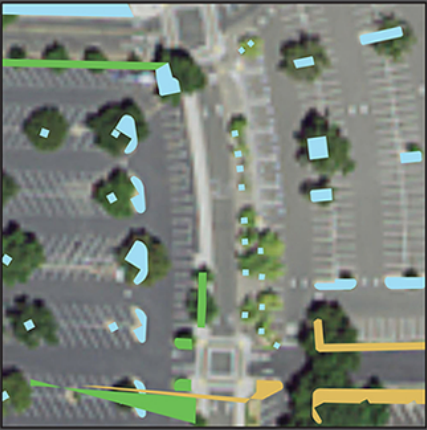
Special Landscape Area

Trees w/ Bare Earth

### Task 4 Compile Finalized Geodatabase of Standardized Landscape Data



Field Name	Description
Orig_Landscapetype	Original Classification of landscape types as present in the source data.
LandscapeType	Classification of landscape types.
Comments	Comments regarding the delineation and/or classification of features.
WaterUse	Description of plant water use type.
PlantFactor	Plant factor value from WUCOLS. When multiplied by Eto, estimates the amount of water needed by plants.
Area_sqft	Total area of features in square feet.



Smaller landscape areas,  
such as individual tree  
planters, are often  
obscured in low  
resolution imagery.