Major Water Conservation Initiative: New Approach Developed for First California Statewide Irrigated Landscape Analysis

WaterSmart Innovations Conference

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*Online, September 2020*
Overview of Presentation

• Background to Program
• Technical Approach
• Output Datasets
• Using the Data
• Questions/Discussion
Background
California Statewide Urban Irrigated Landscape Program
Water Budget Targets

• Need an equitable way of assessing urban water use
• Recognize the efficiency of water use
• Water Use Objective customized to each district
  • Population
  • Landscape area
  • Potential Evapotranspiration
    • $ET_0$
  • Adjust with local variances where important
Conservation Programs

• SBX 7-7 20% by 2020 Method 2:
  - 55 gallons per capita per day Indoor Residential
  - Outdoor Water Use (Model Water Efficient Landscape Ordinance) (MWELO)
    • Landscape area x ET₀ x factor
    • 10% reduction in Commercial, Institutional and Industrial (CII) Water Use

• Executive Order B-37-16
  - Calls for 5 state agencies to develop recommendations for long term water conservation framework
  - Specifically calls for water budget target approach

• SB 606/AB 1668
  - 4 Sections
  - Section: Water Use Objectives
Water Use Objectives:

Indoor Residential Budget
\{55 \text{ gal/person day}\}

+ 

Outdoor Irrigation Budget
\{\text{Landscape area} \times ET_0 \times \text{factor}\}

+ 

Distribution System Water Loss Budget

= 

Annual Water Use Objective

• Compliance based on overall objective - do not have to comply with individual budgets

• Compliance based on service area average - not individual parcel
Need to Understand Landscape Area

- Phase 1: Method investigation
- Phase 2a: Analysis of 2 districts
- Phase 2b: Assessing 17 districts
- Phase 3: Assess remaining water districts
- Total number of districts = 400
- ~16,000 square miles of urban landscape
Estimating Irrigated Landscape Area

California Statewide Urban Irrigated Landscape Program
Classification Key

• Irrigated
  • Lawns
  • Shrubs and trees
  • Ground cover in irrigated areas (mulch/soil)

• Irrigable not Irrigated
  • Dry lawns
  • Dry landscaping that has evidence of irrigation

• Not Irrigable
  • Structures, roads, sidewalks, impervious
  • Undeveloped land
  • Open Water

• Special Cases
  • Horse Corals
  • Artificial Turf
Overall Progress to Completion

Percent Complete of Total
(403 Districts & 16,000 Square Miles)

- Model Approved
- Mask Completed
- Initial Classification

<table>
<thead>
<tr>
<th></th>
<th>Number of Districts</th>
<th>Area (sq mi)</th>
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<tbody>
<tr>
<td>Model Approved</td>
<td>50%</td>
<td>75%</td>
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<tr>
<td>Mask Completed</td>
<td>75%</td>
<td>75%</td>
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<tr>
<td>Initial Classification</td>
<td>75%</td>
<td>75%</td>
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</table>
Acquire Digital Imagery and Ancillary Data

• Define Water District AOI: Now have 400 defined AOIs
• Aerial Imagery: 1 ft, 4 band, collected mid summer 2018
• Parcel Data: Consolidated County data for whole state with land use descriptions
  • Single Family Residential (SFR)
  • Multi-family Residential (MFR)
• Licensed data
Landscape Area Estimates Modeling Process

**Imagery Segmentation:** Using 4-band imagery, self-similar regions of pixels are grouped together to create features (super-pixel objects).
Landscape Area Estimates Modeling Process

**Initial Land Cover Classification:** Features are assessed and classified using advanced machine learning techniques.
Landscape Area Estimates Modeling Process

**Network Creation:** Parcels are networked based on similarity of cover classes and parcel attributes.
Landscape Area Estimates Modeling Process

**Derived Land Masks:** Undeveloped lands, agriculture, and horse corrals are manually captured by human photo interpreters in order to ensure correct classification in the LAE project.
Landscape Area Estimates Modeling Process

**Training Data:** The most highly connected parcels in the network are selected as reference data, and manually digitized to establish relationship between land cover and land use.
Landscape Area Estimates Modeling Process

**Final Land Cover Classification:** A unique model is tuned to the specific parameters of the district using training data, and features are assessed and classified using advanced machine learning techniques.
Assessing the Accuracy of the Model Classification

- A unique model for each district is used to classify super-pixel objects.
- Accuracy assessment is performed on every district.
- Model results are compared to a manually digitized validation classification for each super-pixel object and assessed using a confusion matrix.
Confusion Matrices

Confusion matrices are a powerful way to visualize the performance of a classification model.

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<tr>
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<th>A</th>
<th>B</th>
<th>C</th>
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<tbody>
<tr>
<td>Model Prediction</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>A</td>
<td>True Positive A</td>
<td>Error BA</td>
<td>Error CA</td>
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<tr>
<td>B</td>
<td>Error AB</td>
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<tr>
<td>C</td>
<td>Error AC</td>
<td>Error BC</td>
<td>True Positive C</td>
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Accuracies

• Goal: 95% agreement with independent assessment over the district

• System designed to avoid bias, so final area can be used as guidance for allowance with confidence

• Results from 17 Phase 2B Districts
## Distribution of Irrigation Status Class

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<tr>
<th>Water District</th>
<th>II</th>
<th>INI</th>
<th>NI</th>
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<tr>
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<tr>
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<td>2.12</td>
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<td>23.22</td>
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<td>19.24</td>
<td>9.06</td>
<td>71.69</td>
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<td>District 5</td>
<td>19.38</td>
<td>4.39</td>
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<td>District 6</td>
<td>27.7</td>
<td>5.64</td>
<td>66.66</td>
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<td>District 7</td>
<td>25.73</td>
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<td>69.31</td>
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<td>72.67</td>
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<td>District 17</td>
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<td>96.03</td>
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### Mean 2B Class Composition

- **II**: 18.5% (76.9% of total)
- **INI**: 4.6% (4.6% of total)
- **NI**: 76.87% (76.87% of total)

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<thead>
<tr>
<th></th>
<th>II</th>
<th>INI</th>
<th>NI</th>
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<tr>
<td>Mean</td>
<td>18.50</td>
<td>4.64</td>
<td>76.87</td>
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<tr>
<td>SD</td>
<td>9.15</td>
<td>3.11</td>
<td>11.26</td>
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Estimates at a Parcel Basis

PARCEL STATUS (sq. ft.):
- IRRIGABLE IRRIGATED (II)
- IRRIGABLE NOT IRRIGATED (INI)
- NOT-IRRIGABLE (NI)
Deliverables as part of the Program

• Aggregated irrigated and irrigable landscape area estimates for single family and multi-family parcels – csv and shapefile output of irrigated area, irrigable not irrigated and non-irrigable area

• A subset of validation parcels – fully classified parcels used by QSI to ensure model accuracy meets contract specifications

• Parcel level estimates

• Summary reports for each water district outlining methods and metadata
Output Datasets and How they Can be Used

California Statewide Urban Irrigated Landscape Program
Analyzes total water allocation at the parcel level, in compliance with the new DWR standards.

Spots water use trends.

Tracks and manages over allocation users within each district.

Identifies targeted land classifications types like high turf areas for effective rebating.

Will aid in upcoming DWR reporting requirements.
Consistent Over-Users

Identify customers that are over applying water month after month

Ability to see over-water users in your district
Additional Comments/Questions?

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