



DISCLAIMER

This project was conducted with financial assistance from a grant from the Metropolitan Water District of Southern California (Metropolitan), the U.S. Bureau of Reclamation, the Central Arizona Project, the Southern Nevada Water Authority, the Southern California Gas Company, and the Western Resource Advocates through Metropolitan’s Innovative Conservation Program (ICP). The ICP provides funding for research to help document water savings and reliability of innovative water savings devices, technologies, and strategies. The findings of this project, summarized in this report, are solely from the project proponent.

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ARGO



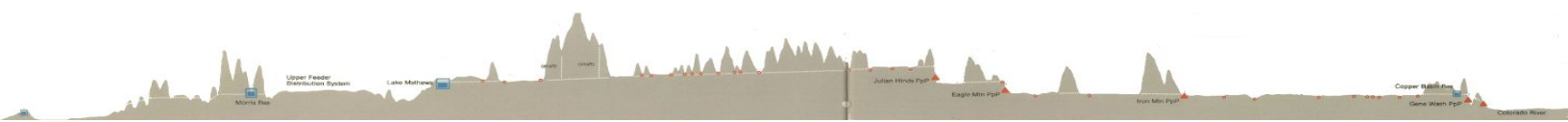
Flip My Lawn

The California-Native Plant Benefit Calculator

Final Report - July 2019

2018 Innovative Conservation Program

ARGO: Applied Research in Government Operations



Executive Summary

Here in California, we can save water, energy, (and some money too) by converting our lawns to beautiful California native landscapes. Flip My Lawn is a publicly available tool designed to help streamline this conversion process. The tool's design was informed by interviews with water conservation professionals at organizations of different sizes, geographies, and relationships to turf removal rebate programs. Using Flip My Lawn, Californians can view localized estimates of the benefits of converting turf in their yards, and then immediately access the localized resources they need to move forward.

To use the tool, users can browse to FlipMyLawn.com and search for their homes to display estimates of the total square footage of lawn available for conversion using remote sensing and aerial imagery. They can then fine tune the default estimates using a simple graphical tool to outline the specific areas they are considering converting. By combining these lawn area estimates with interpolated measurements of local weather conditions from DWR's CIMIS, Flip My Lawn calculates the potential water, carbon, and dollar savings at the parcel-level. The details of our methodology can be found below as well as by following a link from the tool itself.

With these benefit estimates in hand and mind, users will find customized links to local rebates and plant options. They will additionally find links to easily queryable databases of the local nurseries that stock native plants and local landscape contractors that are professionally certified to install and maintain them.

The future direction of Flip My Lawn will follow two parallel paths.

The first: with the user interface and data infrastructure developed and deployed, improved benefit estimates can be straightforwardly integrated to support improved decision making for Flip My Lawn users. Opportunities exist for more localized water and lawn maintenance pricing defaults as well as more customizable irrigation efficiencies. These refinements on the back-end would couple with new tools on the front-end to provide additional context for the turf conversion process, and allow users to tweak the new default estimates as they currently are able to do with lawn area.

The second: California Data Collaborative partners will help encourage adoption of Flip My Lawn by integrating it with their current customer service workflows as well as marketing it directly to customers through other channels such as flyers and social media.

Please find the tool at **FlipMyLawn.com**.

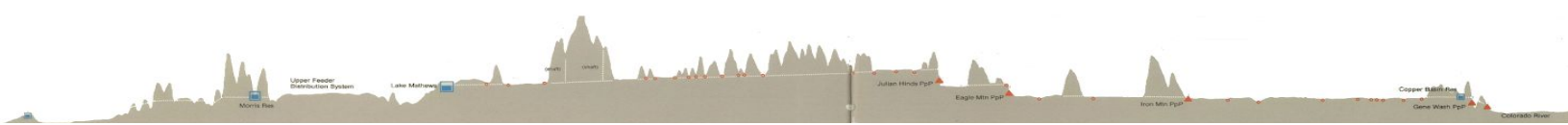
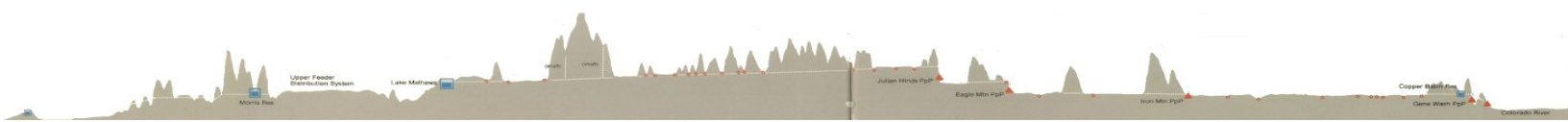


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Design Motivations and User Interviews

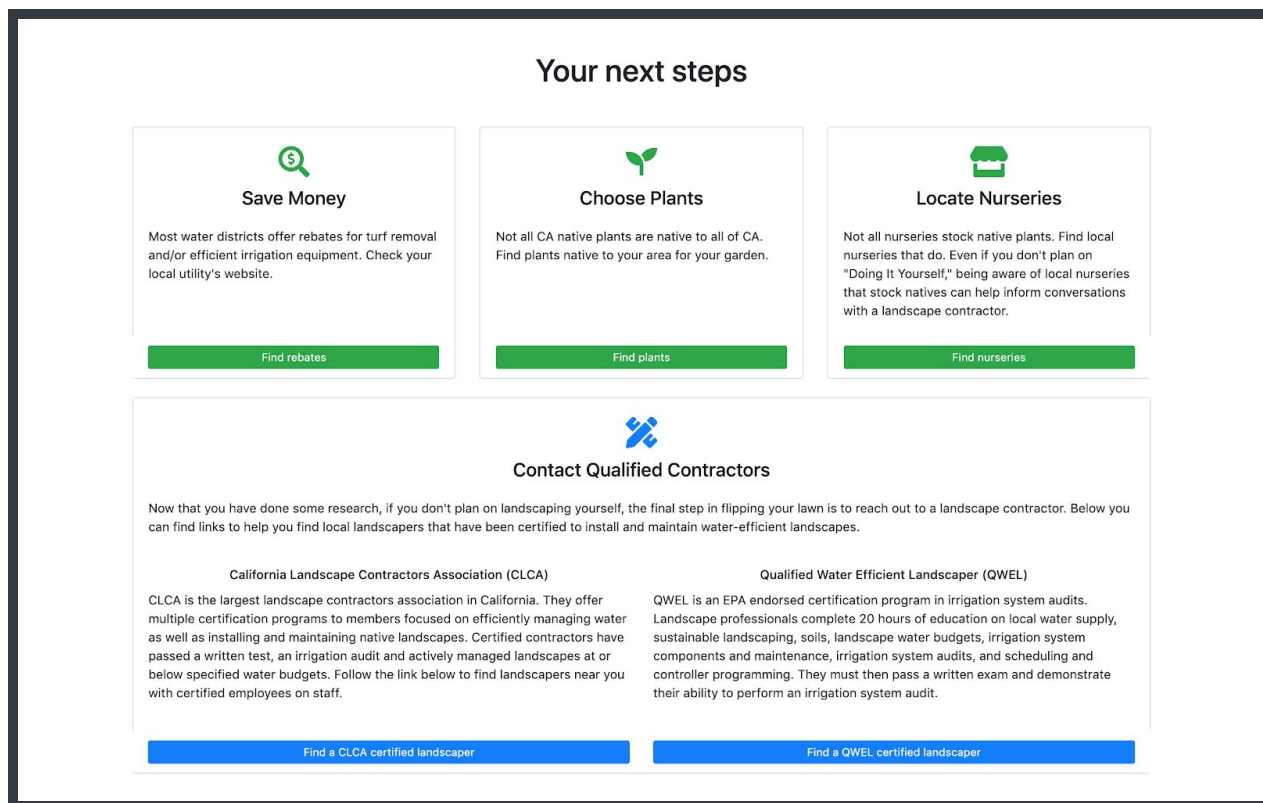
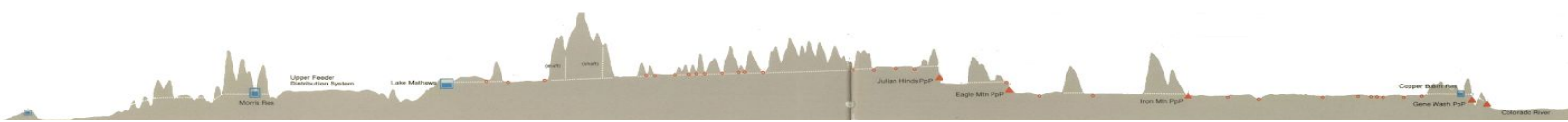


Figure 1. The “Next Steps” section of Flip My Lawn directs users to resources that make landscape change easy.

We knew we were going to be providing water savings and other calculations (see the *How Flip My Lawn Works* section below) but we realized the provision of savings estimates is a means to an end rather than an end in itself. This led us to make an explicit point to frame the savings calculations Flip My Lawn provides as meant to inform and motivate folks to take next steps. And further we aimed to make it as simple as possible to take those next steps from the Flip My Lawn interface itself (see Figure 1).

We were also motivated by thoughts about the successful adoption of the tool. How can Flip My Lawn be designed to smoothly plug into the existing workflows and habits of all who stand to benefit?

To make sure we were providing the appropriate next step prompts as well as choosing the designs that would encourage adoption, we conducted interviews with conservation and customer service professionals. Participants included staff from Eastern Municipal Water District, Coachella Valley Water District, and EGIA. Our interview questions were designed to

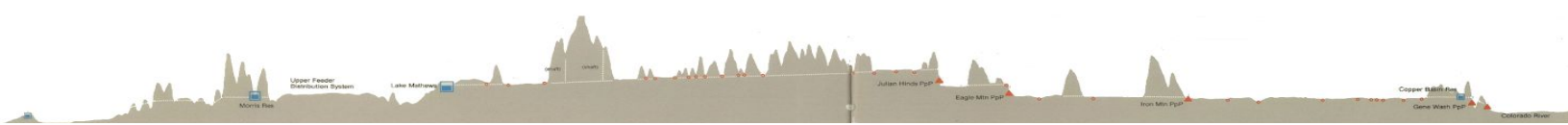


learn about the current workflows and information provided by staff when speaking with customers interested in participating in a turf replacement program. Feedback varied based on many factors including the size of the organization, geography, whether or not the organization runs its own programs, relationships to regional rebate programs, and conservation priorities. That said, there were several common themes that we were able to incorporate into Flip My Lawn.

Our first finding was that many professionals do not deeply discuss the costs and benefits of native plants apart from perhaps water savings and appearance. This excludes many well documented, though harder to quantify benefits. These benefits include reduced maintenance costs with native landscapes, reduced carbon emissions from water processing by utility infrastructure systems, and increased habitats for an abundance and diversity of wildlife such as insects and birds. Reasons for avoiding these discussions were also varied, but sometimes included a lack of knowledge about these second-order effects. This is a use case where the benefit calculator function of Flip My Lawn can aid these professionals in their discussions.

Another reason dollar costs and savings might not currently be discussed in much detail is a fear of being held accountable should the stated benefits not materialize. We have tried to address this concern in the following ways. One way is to focus the language throughout the site on “benefits” broadly rather than savings explicitly. A second is to include an explicit disclaimer at the bottom of the page stating that user of the page do so at their own risk. We also link to the methodology document from the tool and state that calculated values are only estimated.

Many of those we spoke to believe that a substantial percentage of landscape installations are done by contractors. Especially for commercial or wealthier residential customers. However, public agencies are not generally able to recommend specific contracting companies. Because of this, the resources provided to customers often tend to emphasize the “Do It Yourself” approach to turf replacement, leaving those looking for qualified landscapers in a bind and generally turning to word-of-mouth to find a contractor. We address this in Flip My Lawn by directing participants to two potential sources to find pre-qualified landscape contractors skilled in installing and maintaining water efficient landscapes: the Qualified Water Efficiency Landscaper (QWEL) program and the California Landscape Contractors Association (CLCA).



How Flip My Lawn Works

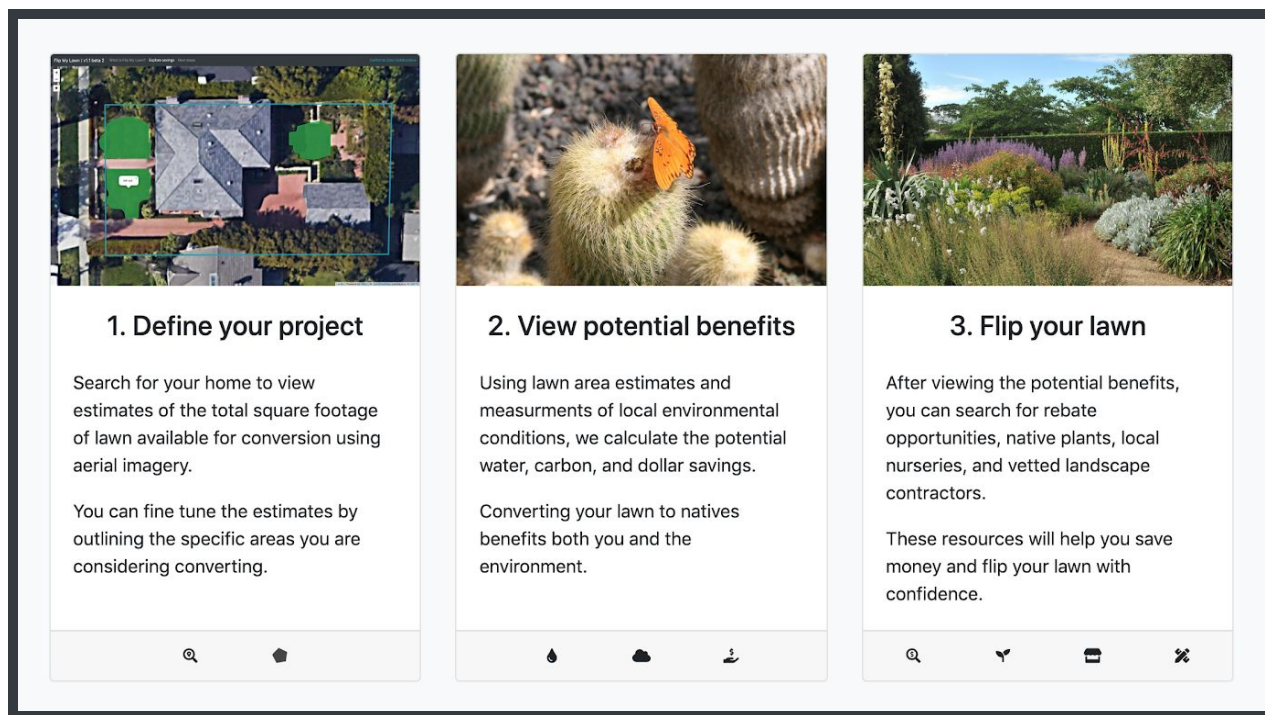


Figure 2. The “How it Works” section explains the purpose and use of Flip My Lawn.

The basic intended flow of Flip My Lawn is sketched out in the brief explanation cards the user sees when she arrives at FlipMyLawn.com (see Figure 2). What is happening under the hood can be found below as well as by following a link from the website itself.

Water Savings

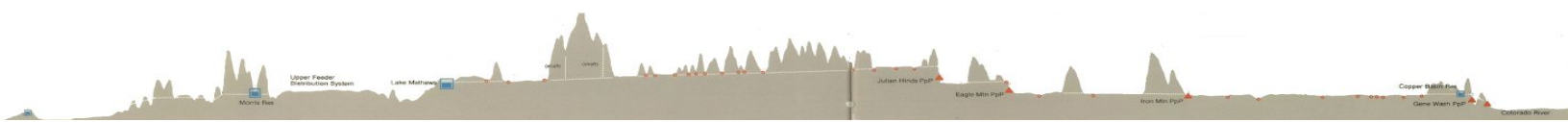
To give a first estimate of potential *gallons of water saved per year*, we have assumed the selected parcel removes 100% of turf (with an ET adjustment factor of 1) and converts it entirely to a CA native plants (with an ET adjustment factor of 0.3). We then use the State’s framework for calculating outdoor water efficiency standards as a conservative estimate of counterfactual outdoor water use. Explicitly,

$$water_savings = turf_usage - CA_native_plants_usage,$$

where

$$turf_usage = 1 * turf_area * PET * C_{ws}$$

$$CA_native_plants_usage = 0.3 * turf_area * PET * C_{ws}$$



Assumptions:

- Our parcel-level *PET* estimates come from interpolations of historical (2000-2015) Spatial CIMIS PET data by Dr. Gonzalo Cortes of University of California, Los Angeles. The tool's backend is modular, enabling the integration of more granular, up to the parcel-level data should that become available.
- C_{ws} is just a necessary unit conversion factor.
- Our default parcel-level *turf_area* measurements come from 2016 NAIP imagery and remote sensing work by Dr. Andrew Marx who was at the time a professor at Claremont Graduate University (now with the University of Southern California), however, users may also draw custom shapes around areas of their lawns they are considering converting (see Figure 3).



Figure 3. The bright green polygons are areas selected by the user for conversion from grass to native plants allowing for customized benefit estimates.

Carbon Savings

To estimate potential *pounds of carbon saved per year*, we used:

$$carbon_savings = water_savings * energy_per_unit_volume * carbon_per_unit_energy * C_{BI}$$

Assumptions:

- Our *energy_per_unit_volume* assumption is 4000 *kWh/MG* for outdoor (cold) water delivered to end users in southern california. This comes from a 2018 Environmental Research Letters paper¹.
- Our *carbon_per_unit_energy* assumption is 529.9 *lb/MWh*. This comes from the 2016 eGRID database².
- C_{BI} is just a necessary unit conversion factor.

Dollar Savings

To give a first estimate of *20 year net dollar savings*, we used the following:

$$dollar_savings =$$

$$20 * (water_savings * price_per_unit * C_{DS} + maintenance_savings) - (installation_cost - rebate) * turf_area$$

where

$$maintenance_savings = turf_maintenance_cost - native_maintenance_cost$$

Assumptions:

- Our *price_per_unit* assumption is \$52/10ccf, which comes is the median price for 10ccf from 2017 California-Nevada Water Rate Survey³. Ccf is a unit of volume historically used in the water industry. Ccf stands for centum cubic feet and is roughly equal to 748 gallons.
- Our *installation_cost* assumption is \$5.36/ft². This comes from Santa Monica City's "Garden/Garden" study⁴. This considers costs for design; demolition; and soil prep, plants, and mulch. It does not assume other costs from the study like irrigation system

¹ <http://iopscience.iop.org/article/10.1088/1748-9326/aa9b89/meta>

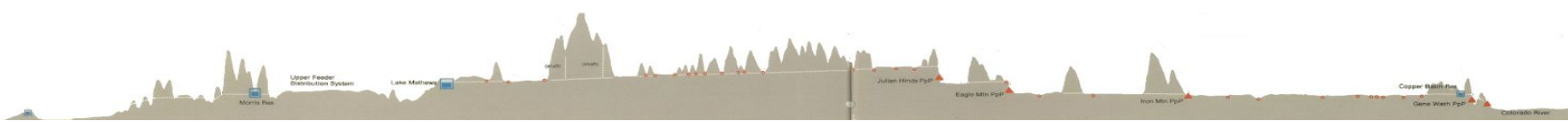
² https://www.epa.gov/sites/production/files/2018-02/documents/egrid2016_summarytables.pdf

³

https://www.dropbox.com/s/vg5abpmqmpumscz/CA-NV_RateSurvey-2017_final.pdf?dl=0%C2%A0%C2%A0

⁴

<https://www.smgov.net/uploadedFiles/Departments/OSE/Categories/Landscape/garden-garden-2013.pdf>



upgrades, installation of urban runoff features (rain catchment, infiltration pit, permeable paving), or any additional aesthetic/display features (boulders, bender board, signage).

- Our *rebate* estimate is $\$2.53/ft^2$. Using the California Data Collaborative⁵ database, we calculated the average total rebate amount per square foot paid to MWD turf rebate customers. This includes local water utility contributions as well as MWD incentives, and spans from May 30, 2014 to June 14, 2016.
- Our *turf_maintenance_cost* assumption is $12 * (\$47.8/10,890ft^2/month)$, which comes from a local business data aggregator⁶.
- Our *native_maintenance_cost* is $.68 * turf_maintenance_cost$. This is an estimate from Santa Monica City's "Garden/Garden" study.
- C_{DS} is just a necessary unit conversion factor.

Rebates

When a user enters their address, we use Google's geocoding service to determine their city. With this city, we are able to make a good guess at the water utility they're serviced by and generate customized links that send them directly to their utility's conservation programs page.

Hyperlocal Native Plants

Similarly to rebates, we can use the selected address to generate a custom link to the California Native Plant Society's hyperlocal native plant database. Since California is a state with incredibly diverse ecosystems, not all CA native plants are native to all of CA. The impressive database is the result of a collaborative 150 year collection and classification effort. Almost 2 million field occurrences of California plant species were used to estimate natural locations for each species. Additional details about this resource can be found on their website⁷.

The custom link Flip My Lawn generates leads users directly to information on plants that are native to, and thus naturally suited for, their area.

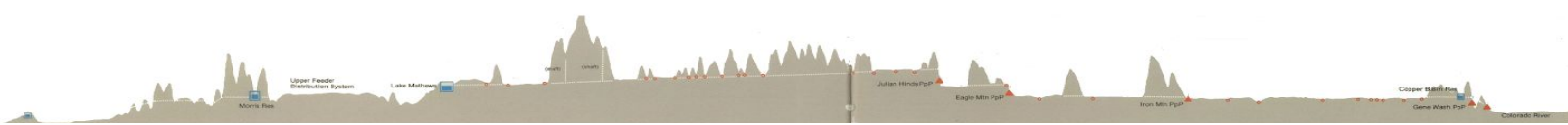
Native Plant Nurseries

Not all nurseries stock native plants, and although not everyone will plan on a DIY turf conversion, being aware of local nurseries that stock natives can help inform conversations with landscape contractors.

⁵ <http://californiadatacollaborative.org/>

⁶ <https://lawn-care.promatcher.com/cost/los-angeles-ca-lawn-care-costs-prices.aspx>

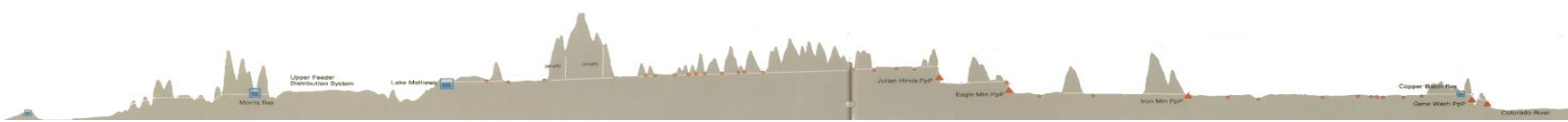
⁷ <https://calscape.org/about.php>



The California Native Plant Society also maintains a database of native plant nurseries, which we link out to as well. From here, users can find local nurseries stocked with a variety of beautiful and hardy native plants.

Qualified Contractors

We included links to easily queryable databases of landscape contractors for two different certification organizations, QWEL and CLCA. CLCA has a more robust certification process and their inclusion was the result of an explicit endorsement from water agency conservation staff. We include a brief description of each association and allow users to choose. Following these links, users can search for local vetted contractors and reach out with the knowledge gathered using Flip My Lawn.



Future Direction

The future direction of Flip My Lawn will follow two parallel paths.

The first: with the user interface and data infrastructure developed and deployed, improved benefit estimates can be straightforwardly integrated to support improved decision making for Flip My Lawn users. Opportunities exist for more localized water and lawn maintenance pricing defaults as well as more customizable irrigation efficiencies. These refinements on the back-end would couple with new tools on the front-end to provide additional context for the turf conversion process, and allow users to tweak the new default estimates as they currently are able to do with lawn area.

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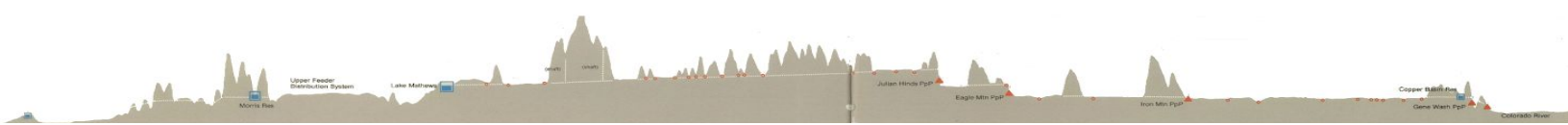
Improving Benefit Estimates

Designers of benefit calculator tools for non-professionals often face a trade-off between simplicity and accuracy. The more inputs asked of the user, the more accurate calculations can be, but the more friction there will be between arriving at the tool and taking the next steps. Flip My Lawn addresses this trade-off by emphasizing the optimistic nature of our estimates and electing to keep certain inputs *under-the-hood*, relying on measures of central tendency like averages and medians. This reduces inputs from the user to their home address and refinements of a default lawn area measurement from remote sensing--that they can provide using a simple point-and-click graphical tool. The user can get sufficiently informed and inspired to move forward without leaving their seat so to speak.

If, after using Flip My Lawn in their day-to-day interactions with customers, the conservation staff at the agencies we collaborate with develop an interest in bringing some of the inputs out from under-the-hood, the current design pattern--providing a default estimate based solely on home address and allow user to refine inputs if the spirit moves them--can be redeployed. Below we outline how other inputs that are currently averaged under the hood could be both more localized and dynamic.

Customized Irrigation Efficiency

As stated in the *How Flip My Lawn Works* section, to estimate water savings we use a 0.3 ETAF for California native plants. This implies a 100% irrigation efficiency (IE), with IE explicitly defined as water beneficially used divided by the amount of water applied. However, should the added complexity be desired, we could of course allow users to refine this optimistic



estimate by allowing them to choose among types of outdoor irrigation systems. Different irrigation efficiencies can be associated with different irrigation systems and could be used to alter the optimistic ETAF adjustment factor accordingly. As an example, the City of Santa Rosa assigned irrigation efficiencies of 75% for overhead spray devices and 81% for drip systems in a 2016 ordinance based on measurements and estimates of irrigation system characteristics and management practices⁸.

Localized Water Pricing

To estimate dollar savings, we used the median price for 10ccf from the 2017 California-Nevada Water Rate Survey. However, as water prices vary throughout the state, there is an opportunity for further refinement here. Determining localized water prices has historically been an time-intensive manual process. However, the California Data Collaborative has already developed the machine-readable Open Water Rate Specification (OWRS)⁹ to alleviate this exact challenge, and bring clean water pricing data to analysts and software tools like Flip My Lawn.

With all the building blocks already in place, Flip My Lawn could use the user's home address to predict the local water utility (allowing the user to refine the prediction), use OWRS to calculate a localized price per unit, and in turn give a more localized savings estimate.

Localized Maintenance Cost Savings Estimates

In addition water prices and irrigation efficiency, estimates of cost savings from reduced lawn maintenance could be further localized. Using the zip code provided associated with the entered home address--provided by the Google geocoder--Flip My Lawn could pull timely, localized lawn maintenance costs from the free service, Homewyse.¹⁰

Encouraging Adoption

Our strategy for encouraging adoption is straightforward. We have an influential network of water professionals that also stand to benefit from the success of Flip My Lawn. We plan to leverage this network to get Flip My Lawn in front of users who could use it. Below we highlight opportunities for co-marketing partnerships with members of this network.

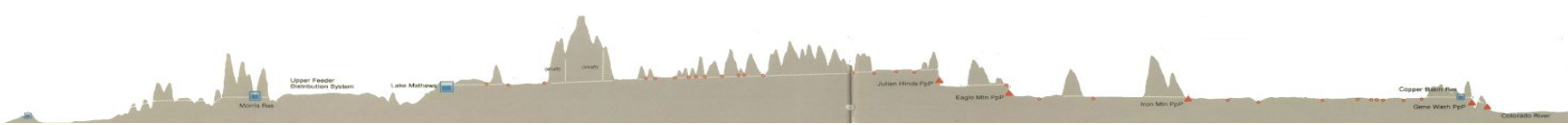
Innovative Conservation Program Partner Network

The ICP network includes: Metropolitan Water District of South California in concert with the U.S. Bureau of Reclamation (USBR), Southern Nevada Water Authority (SNWA), the Central

⁸ <http://www.qcode.us/codes/santarosa/revisions/4058.pdf>

⁹ <https://github.com/California-Data-Collaborative/Open-Water-Rate-Specification>

¹⁰ https://www.homewyse.com/services/cost_to_maintain_lawn.html



Arizona Project (CAP), the Southern California Gas Company (SoCalGas) and Western Resource Advocates. As the organization that financially supported the design and development of Flip My Lawn, there is a great potential for pooling marketing efforts with these groups.

California Native Plant Society

After providing savings estimates, Flip My Lawn directs users to CNPS databases of local plants and nurseries. CNPS provided design feedback during the development stage of the tool and also participates at CaDC workshops. We are leveraging this partnership to mutual benefit.

Qualified Contractors

We also link to associations that vet and certify landscape contractors (QWEL and CLCA). Our CaDC member agency contacts teach the certification courses and we will lean on those relationships.

California Data Collaborative

Finally, California Data Collaborative holds multiple workshops per year and a large annual conference with hundreds of water professional attendees historically, as well as distributes content on fliers and social media.

