California Air Resources Board

Co-benefit Assessment Methodology for Water Savings

California Climate Investments Greenhouse Gas Reduction Fund

July 9, 2018

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Section A. Introduction

The goal of California Climate Investments is to reduce greenhouse gas (GHG) emissions and further the objectives of the California Global Warming Solutions Act of 2006, Assembly Bill (AB) 32. The California Air Resources Board (CARB) is responsible for providing guidance on reporting and quantification methods for all State agencies that receive appropriations from the Greenhouse Gas Reduction Fund (GGRF). Guidance includes developing methodologies for estimating GHG emission reductions and other economic, environmental, and public health benefits of projects, referred to as "co-benefits."

The Center for Resource Efficient Communities at the University of California, Berkeley (UC Berkeley), in consultation with CARB staff, developed this Co-benefit Assessment Methodology to estimate water savings for relevant California Climate Investments programs.

Co-benefit Assessment Methodologies are intended for use by administering agencies, project applicants, and/or funding recipients to estimate the outcomes of California Climate Investments. Co-benefit estimates can be used to inform project selection and track results of funded projects. In addition to this methodology, general guidance on assessing California Climate Investment co-benefits is available in CARB's Funding Guidelines for Agencies Administering California Climate Investments (Funding Guidelines) available at http://www.arb.ca.gov/cci-fundingguidelines.

Water Savings Co-benefit Description

Water savings refers to change in the quantity of water consumed as a result of a California Climate Investments project. Water savings is affected by water demand, including water use (the total amount of water withdrawn from its source to be used).

California Climate Investments can cause positive or negative water savings co-benefits. These co-benefits may accrue directly (as a central objective of the project) or indirectly (as a consequence of project activities).

A ***positive*** water savings co-benefit results when a California Climate Investments project increases overall water supplies or their availability by: a) improving water use efficiency via installation of efficiency measures; b) reduced irrigation usage relative to a no-project alternative; or c) otherwise reducing total water use relative to a no-project alternative.

A ***negative*** water savings co-benefit results when a California Climate Investments project reduces overall water supplies or their availability by: a) converting urban, suburban, or populated rural community parcels (developed or undeveloped) into vegetated open spaces that require irrigation above the baseline water use; b) planting trees or other aboveground biomass that requires increased irrigation; or c) otherwise increasing water use relative to a no-project alternative.

Water Savings Co-benefit Project Categories

This Co-benefit Assessment Methodology may apply to California Climate Investments[1] projects that involve:

- Water efficiency measures;
- Urban tree or vegetation planting; and
- Green infrastructure.

California Climate Investments that result in water savings co-benefits fall into three project categories covered by this Co-benefit Assessment Methodology.

Project Category 1. Agricultural Irrigation: Projects that reduce irrigation water use or improve irrigation efficiency. Project could include the installation or modification of an irrigation system that results in a reduction in system pressure or the installation of an irrigation system, scheduling, soil moisture sensors, or other techniques to reduce water use and pumping demand.

Project Category 2. Residential, Commercial, or Institutional Water Efficiency: Projects that produce a positive water savings co-benefit by installing more efficient water appliances or measures in residential, commercial, or institutional facilities (e.g., dishwashers, clothes washers, faucets).

Project Category 3. Urban Landscaping: Projects that impact the water savings co-benefit in urban, suburban, or populated rural community landscapes either positively (e.g., through establishment of green infrastructure specifically intended for water capture and infiltration) or negatively (e.g., through planting of new grass, trees or other vegetation that requires more irrigation than the no-project scenario).

Methodology Development

UC Berkeley developed this Co-benefit Assessment Methodology, consistent with the guiding principles of California Climate Investments. The methodology is developed to:

- Support calculating the applicable co-benefits for individual projects;
- Apply to the project types proposed for funding;
- Provide uniform methods that can be applied statewide and are accessible by all applicants and funding recipients;
- Use existing and proven tools or methods, where available;
- Include the expected period of time for when co-benefits will be achieved; and
- Identify the appropriate data needed to calculate co-benefits.

[1] This list is based off of project types funded by the Greenhouse Gas Reduction Fund as of April 2018 and may be modified as California Climate Investments evolve or expand.

UC Berkeley assessed peer-reviewed literature and consulted with experts, as needed, to identify:

- The direction and magnitude of the co-benefit;
- Project types to which the co-benefit is relevant;
- The limitations of existing empirical literature;
- Existing assessment methods and tools; and
- Knowledge gaps and other issues to consider in developing co-benefit assessment methods.

This work is summarized in a literature review on this co-benefit, which can be found at: www.arb.ca.gov/cci-cobenefits. UC Berkeley also considered ease of use, specifically the availability of project-level inputs from users for the applicable California Climate Investments programs.

CARB released the Draft Water Savings Co-benefit Assessment Methodology for public comment in April 2018. This Final Water Savings Co-benefit Assessment Methodology has been updated to address public comments, where appropriate. CARB staff periodically review each methodology to evaluate its effectiveness and update methodologies to make them more robust, user-friendly, and appropriate to the projects being quantified.

Administering agencies, project applicants, and/or funding recipients estimate GHG emission reductions using CARB GHG Quantification Methodologies. Some of the data used for estimating GHG emission reductions may also be used to estimate water savings co-benefits. CARB anticipates incorporating methods used to estimate the water savings co-benefit into CARB Calculator Tools.

Program Assistance

For assistance with this Co-benefit Assessment Methodology, send questions to: GGRFProgram@arb.ca.gov. For more information on CARB's efforts to support implementation of California Climate Investments, see: www.arb.ca.gov/auctionproceeds.

Section B. Co-benefit Assessment Methods

This section describes how users estimate water savings co-benefits by project category. Overall, the methods for assessing water savings are quantitative, amounting to estimating the change in water use during the project quantification period[2] compared to a no-project scenario.

Additional information about the specific data inputs (e.g., default values and data sources) is provided in Section C. Examples of how to apply the methods and data inputs needed for the various project categories are provided in Appendices A, B, and C.

Project Category 1. Agricultural Irrigation

Project Category 1 includes projects that reduce irrigation water use or improve irrigation efficiency. Project could include the installation or modification of an irrigation system that results in a reduction in system pressure or the installation of an irrigation system, scheduling, soil moisture sensors, or other techniques to reduce water use and pumping demand.

The method for Project Category 1 relies on use of the State Water Efficiency and Enhancement (SWEEP) Irrigation Water Savings Assessment Tool.[3] The formula used to calculate water use in the SWEEP tool is as follows:

$$Percent\ Water\ Savings = 1 - \left(\frac{Water\ Use_{Project}}{Water\ Use_{Baseline}}\right) \quad \text{(Eq. 1)}$$

Or, if reporting in acre-inches per irrigated acre, the output from the tool is multiplied by the project quantification period

$$Water\ Savings = \left(Water\ Use_{Baseline} - Water\ Use_{Project}\right) \times Years \quad \text{(Eq. 2)}$$

- Percent Water Savings = Estimated percent reduction in water use due to project activities (percent reduction)
- Water Savings = Estimated annual reduction in water use due to project activities (acre-inches per irrigated acre)
- Water Use$_{Baseline}$ = Estimated annual water use in the absence of the project given the crop, irrigation system type, and irrigation management (acre-inches per irrigated acre)
- Water Use$_{Project}$ = Estimated annual water use with the project given the crop, irrigation system type, and irrigation management (acre-inches per irrigated acre)
- Years = Length of project quantification period (years)

[2] The project quantification period varies for the different programs and measures and is defined in each of CARB's GHG Quantification Methodologies.
[3] https://www.cdfa.ca.gov/oefi/sweep/docs/IrrigationWaterSavingsAssessmentTool.xls

Project Category 2. Residential, Commercial, or Institutional Water Efficiency

Project Category 2 includes the installation of more efficient water measures in residential, commercial, or institutional facilities (e.g., commercial dishwashers and ice machines, or residential clothes washers) compared to conventional appliances/measures.[4]

The following method should be used to estimate the water savings co-benefit for Project Category 2.

$$Water\ Savings = \left(Water\ Use_{Baseline} - Water\ Use_{Project}\right) \quad \text{(Eq. 3)}$$

Where:

- Water Savings = Estimated reduction in water use during the project quantification period(s) as a result of the project (gallons)
- Water Use = Total estimated water use (baseline or project) during the project quantification period(s) as estimated in Equation 4 (gallons)

$$Water\ Use = (Hot\ Water + Cold\ Water) \quad \text{(Eq. 4)}$$

Where:

- Hot Water = Estimated hot water use (baseline or project) during the project quantification period(s) from applicable CARB GHG Quantification Methodologies and Calculator Tools (gallons)
- Cold Water = Estimated cold water use (baseline or project) during the project quantification period(s) from sources other than CARB GHG Quantification Methodologies, including Equation 5 for high-efficiency toilets (gallons)

$$Cold\ Water_{Toilets} = Gallons\ Per\ Flush \times Flushes\ Per\ Day \times Use\ Days\ Per\ Year \quad \text{(Eq. 5)}$$

Where:

- Gallons Per Flush = Gallons per toilet flush for conventional or new toilet
- Flushes Per Day = 7.4 for residential buildings, 5.9 for commercial or institutional buildings[5]
- Use Days Per Year = 365 for residential buildings, 260 for commercial or institutional buildings

[4] Conventional refers to the federally used, default specifications adopted from the Energy Star Commercial Kitchen Equipment Calculator and Energy Star Qualified Appliance Calculator, developed by the Environmental Protection Agency (EPA) and the Department of Energy (DOE). Pre-existing equipment specifications may pre-date conventional equipment and may not match the provided defaults.
[5] California Energy Commission, Codes and Standards Enhancement (CASE) Initiative Analysis of Standards Proposal *Toilets and Urinals Water Efficiency* (See sections 5.2.1 and 5.2.2).

Project Category 3. Urban Landscaping

Project Category 3 includes projects that impact the water savings co-benefit in urban, suburban, or populated rural community landscapes either positively (e.g., through establishment of green infrastructure specifically intended for water capture and infiltration) or negatively (e.g., through planting of new grass, trees or other vegetation that requires more irrigation than the no-project scenario).

The following method should be used to estimate the water savings co-benefit for Project Category 3.

$$Water\ Savings/Increase = \left(Water\ Use_{Baseline} - Water\ Use_{Project}\right) \times Years \qquad \text{(Eq. 6)}$$

Where:

- Water Savings/Increase = Estimated change in water use during the project quantification period due to project activities (gallons)

  Water savings should be reported as a positive (+) value and water use increase should be reported as a negative (-) value
- Water Use = Annual estimated water use (baseline or project) estimated using Department of Water Resources (DWR) Water Budget Calculator for New and Rehabilitated Residential/Non-Residential Landscapes (gallons per year)
- Years = Length of project quantification period (years)

The formula used to calculate water use in the DWR tool is as follows:

$$Water\ Use = ET_o \times 0.62 \times \left[\left(\frac{PF \times HA}{IE}\right) + SLA\right] \qquad \text{(Eq. 7)}$$

Where:

- ET_O = Annual Evapotranspiration (ET_O) (inches per year)
- PF = Plant Factor (PF) or plant water use factor
- HA = Hydrozone Area (square feet)
- IE = Irrigation Efficiency; minimum = 0.71; spray heads = 0.75; drip = 0.81
- SLA = Special Landscape Area (square feet)
- 0.62 = Conversion Factor (gallons per square foot)

Section C. Data Requirements and Tools

This section describes the data requirements and tools required for the Water Savings Co-benefit Assessment Methodology. Water use is the primary data requirement in the methods above. The estimation tools and resources used to determine the water use data input vary by project category. Table 1 lists the tools by project category.

Table 1. Summary of Applicable Tools/Resources by Project Category

Project Category	Water Use Estimation Tools and Resources
1. Agricultural Irrigation	o SWEEP Irrigation Water Savings Assessment Tool[6]
2. Residential, Commercial, or Institutional Water Efficiency	o Water-Energy Grant Program Calculator Tool[7]
3. Urban Landscaping	o DWR Water Budget Calculator for New and Rehabilitated Residential/Non-Residential Landscapes[8] o Water Use Classification of Landscape Species (WUCOLS) IV online database[9]

Data requirements for each of the project categories and associated tools are provided on the subsequent pages.

When inputs required to estimate water savings are inputs to, or outputs from, a CARB GHG Quantification Methodology or Calculator Tool (e.g., water use), the values used in estimation of GHGs and this co-benefit must be identical.

[6] https://www.cdfa.ca.gov/oefi/sweep/docs/IrrigationWaterSavingsAssessmentTool.xls
[7] www.arb.ca.gov/cci-quantification
[8] https://cadwr.app.box.com/s/5k39tv10u42rp5bn2uebd7fodkxzgve7
[9] http://ucanr.edu/sites/WUCOLS/Plant_Search/

Project Category 1. Agricultural Irrigation

Users estimate water use for Project Category 1 with the State Water Efficiency Program (SWEEP) Irrigation Water Savings Assessment Tool.[10] Annual water savings estimates are provided in the "Water Savings Estimate" tab in both acre-inches per acre, and as a percentage.[11] Estimates of water use for baseline and project scenarios are determined based on user drop-down selections of the following:

- **Predominant soil:** Soil type (e.g., sand, sandy loam, silt, clay). If the user is unsure of the predominant soil type, determine the soil type as identified by the Soil Web, by entering the latitude/longitude location of the farm in the relevant city/county: http://casoilresource.lawr.ucdavis.edu/gmap/
- **Crop:** Crop type (e.g., alfalfa, almonds)
- **Project location:** Baseline meridian, township and range. If necessary, use https://map.dfg.ca.gov/bios/ to help determine these inputs.
- **Irrigation practice:** Irrigation practice (e.g., surface irrigation, drip irrigation, center pivot irrigation)

[10] Flow-meter readings are also acceptable for baseline estimates.

[11] This method assumes that: the systems are properly maintained and designed with all needed facilities in place; soils and slopes under surface irrigation are fairly uniform; and management (including irrigation timing and amount decisions and how systems are operated) is typical. Water provided by effective rainfall and water required for other beneficial uses are not considered because the effect on water savings is unsubstantial as compared to irrigation water applied. For more background information, including assumptions and limitations, see the SWEEP Water Savings Tool.

Project Category 2. Residential, Commercial, or Institutional Water Efficiency

Users estimate water use for Project Category 2 with the Water-Energy Grant Program Calculator Tool.[12] Estimates of water use for "conventional" (baseline) and "new" (project) scenarios use are determined based on the quantity of new appliance/measure to be installed, by type. The tabs are pre-populated with default values and assumptions for each measure. If the defaults are not appropriate, the user can modify them to reflect actual conditions and usage. Table 2 is below is excerpted from the CARB GHG Quantification Methodology for the Water-Energy Grant Program

Table 2. Water-Energy Grant Program Calculator Tool Inputs

Commercial/Institutional Facilities, and Residential Projects Benefiting Disadvantaged Communities	Data Required
Commercial Dishwasher	Number of units, racks washed per day, water heater fuel type, booster water heater fuel type (if applicable), and operating days per year.
Residential Dishwasher	Number of units, type of dishwasher, number of cycles per week, water heater fuel type, rated electricity consumption, and rated water consumption.
Commercial Clothes Washer	Number of units, washer load configuration, average number of loads per week, water heater fuel type, washer capacity, modified energy factor (MEF), water factor (WF), and dryer fuel type.
Residential Clothes Washer (Single- and Multi-Family)	Number of units, configuration, number of loads per week, water heater fuel type, capacity, integrated modified energy factor (IMEF or MEF), integrated water factor (IWF or WF), and dryer fuel type.
Commercial Ice Machine	Number of units, harvest rate, potable water use per 100 pounds of ice, and operating days per year.
Commercial Steam Cooker	Number of units, pounds of food cooked per day per unit, number of pans per unit, operating hours per day, and operating days per year.

[12] The Water-Energy Grant Program Calculator Tool does not include low-flow toilets since there is no water heating involved in toilet use. If a project is installing low-flow toilets in addition to the other measures captured in the Calculator Tool, project applicants may use the equation in Section B for each toilet and add it to the hot water savings estimated by the Calculator Tool.

Table 2: Water-Energy Grant Program Calculator Tool Inputs (cont.)

Commercial/Institutional Facilities, and Residential Projects Benefiting Disadvantaged Communities	Data Required
Commercial Combination Oven	Number of units, pounds of food cooked per day per unit, number of pans per unit, operating hours per day, and operating days per year.
Commercial Pre-Rinse Spray Valve	Number of units, flow rate, operating minutes per day, percentage of hot water used for rinse, and water heater fuel type.
Commercial/Residential Faucet	Number of units, flow rate, minutes used per day, percentage of hot water used, water heater fuel type, number of employees per day (if applicable), and number of guests per day (if applicable).
Commercial/Residential Showerhead	Number of units, flow rate, minutes used per day, percentage of hot water used, water heater fuel type, and number of employees per day (if applicable).

Note that the Calculator Tool is configured to estimate water savings from a single facility. If a single project application involves multiple facility types[13] (such as a restaurant and a hotel), a separate run of the Calculator Tool is required for each facility type.

[13] "Facility type" is defined as a building designated for a particular use or purpose. Different buildings can be of the same facility type. For example, multiple hotel buildings are considered the same facility type, whereas a hotel and a restaurant are two separate facility types.

Project Category 3. Urban Landscaping

Users estimate water use for Project Category 3 with the DWR Water Budget Calculator for New and Rehabilitated Residential/Non-Residential Landscapes. Annual estimated water use in the baseline and project scenarios needs to be estimated by separate runs of the tool. Water use is determined by entering the following user inputs into the "MAWA" and "ETWU" tabs:

- **Project Location (City):** The project location (city) determines the evapotranspiration based on the Reference Evapotranspiration Table in Appendix A of the 2015 DWR Model Water Efficient Landscape Ordinance.[14]
- **Overhead Landscape Area (ft^2):** The overhead landscape area is the landscaped area with an overhead spray irrigation system.
- **Drip Landscape Area (ft^2):** The drip landscape area is the landscaped area with a drip irrigation system.
- **Special Landscape Area (ft^2):** The special landscape area is the portion of the landscaped area that includes recreation areas, areas permanently and solely dedicated to edible plants such as orchards and vegetable gardens, and areas irrigated with recycled water.
- **Hydrozone Area without Special Landscape Areas:** The hydrozone area is the portion of the landscaped area having plants with similar water needs. A hydrozone area may be irrigated or non-irrigated.
- **Plant Factor:** The plant water use type is based on the plant factor or "plant water use factor" (a factor which, when multiplied by evapotranspiration, estimates the amount of water needed by established plants). The plant factor range for low-water-use plants is 0 to 0.3, the plant factor range for moderate-water-use plants is 0.4 to 0.6, and the plant factor range for high-water-use plants is 0.7 to 1.0. To look up the Plant Factor for each landscaping type (plant to be planted), use the WUCOLS IV online database. Select the appropriate city by region and submit. Then search for the plant to be planted by botanical or common name. The corresponding plant factor will be reported under the column "water use" on a range from low-medium-high.

[14] https://www.water.ca.gov/LegacyFiles/wateruseefficiency/docs/MWELO09-10-09.pdf

Appendix A. Example Methods and Data Inputs for Project Category 1

The following is a hypothetical project[15] to demonstrate how the Water Savings Co-benefit Assessment Methodology would be used to estimate the benefits of a SWEEP project in Project Category 1. This example does not include the supporting documentation that may be required of actual project applicants.

Overview of the Proposed Project

The applicant is proposing the following project components:

- Convert an existing high pressure solid set sprinkler system to a low pressure microdrip irrigation system, with increased irrigation water management; and
- Change irrigation water management from IWM Level 1 to IWM Level 2.

The proposed project has the following relevant project features:

- Located in San Bernadino County;
- 100 acre avocado farm;
- Solid Set Undertree sprinkler system irrigation currently used;
- Micro-drip irrigation system proposed;
- Unsure of predominant soil type; and
- The project quantification period is ten years, per the CARB GHG Quantification Methodology.

Methods to Apply

Step 1: Enter the baseline conditions
Enter the baseline conditions in the "Before" tab of the SWEEP Water Savings Tool as shown in Figure 1.[16]

- Enter the number of acres impacted by the project: *100*.
- Select the location (baseline, township, range): *San Bernardino*. If necessary, use https://map.dfg.ca.gov/bios/ to help determine these inputs.
- Select the predominant soil type for the field: *Fine Sandy Loam*.

  Since the applicant is unsure of the predominant soil type, determine the soil type as identified by the Soil Web, by entering the lat/long of the farm location in San Bernardino: http://casoilresource.lawr.ucdavis.edu/gmap/ as shown in Figure 2.
- Select the principal crop currently planted in the proposed SWEEP project area: A*vocado*.

[15] The hypothetical project has not undergone verification of any program requirements; all assumptions about location type and features are for demonstration purposes only.
[16] The user may also choose to manually calculate the estimated water savings if using actual measured baseline water use from flowmeter reading.

- Select the appropriate baseline irrigation practice that captures the baseline on-farm irrigation practice used on the proposed project acreage: *SPRINKLER IRR. (Solid Set Undertree).*

Figure 1. Screenshot of example input for "Before" tab on the SWEEP Irrigation Water Savings Assessment tool

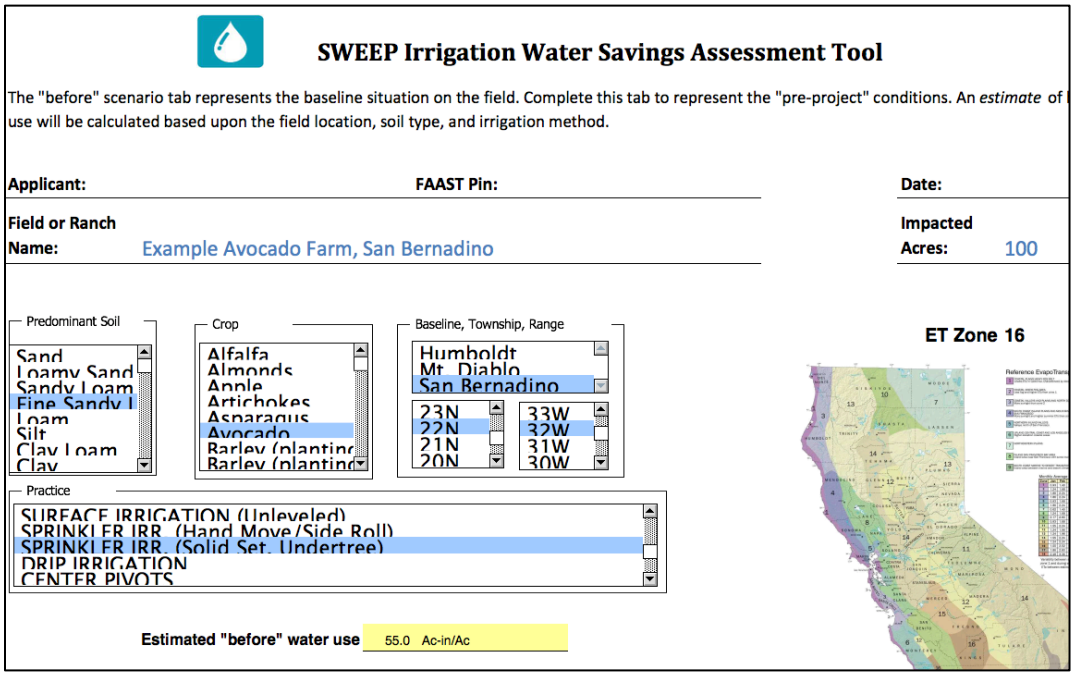
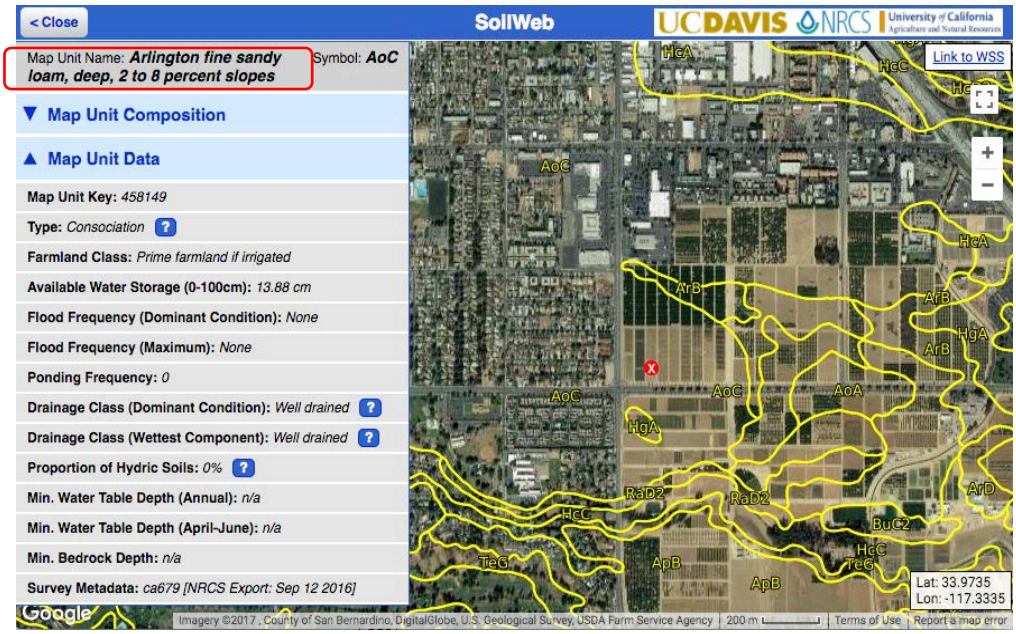


Figure 2. Screenshot of example input for Soil Web application

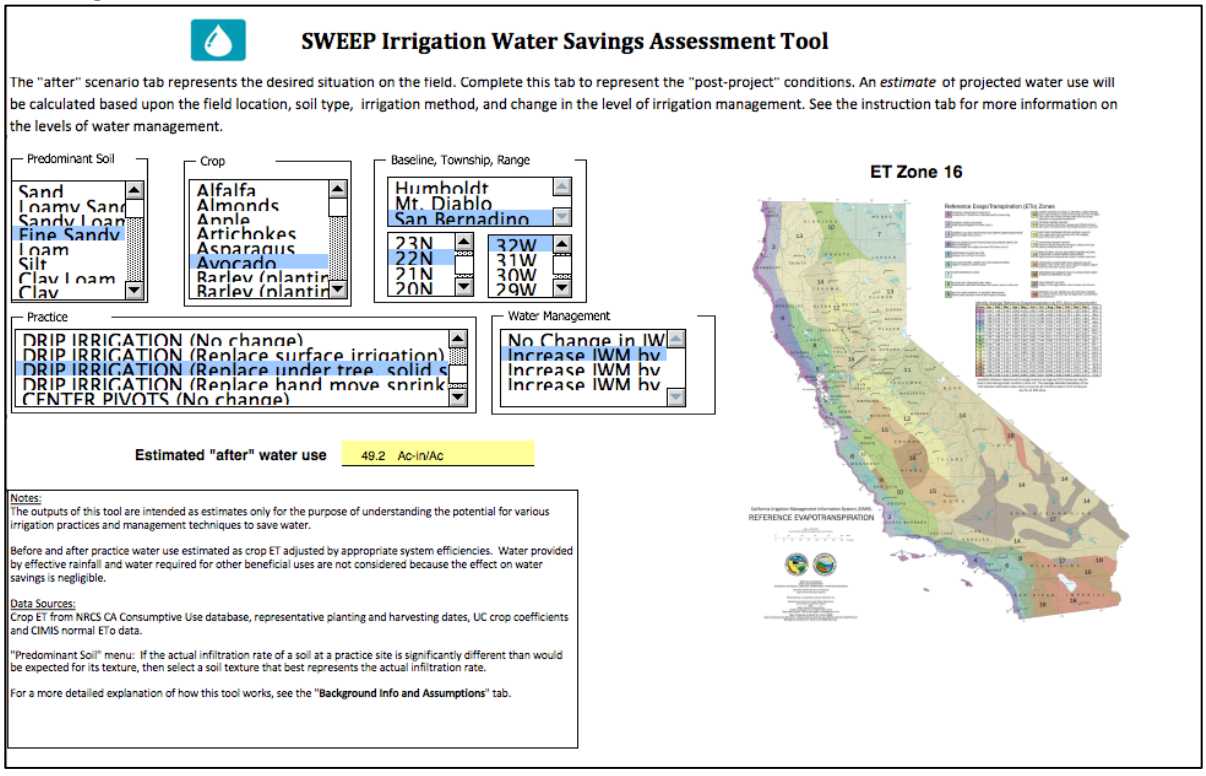


An estimated "before" water use is displayed at the bottom of the tab: *55 ac-in / ac.*

Step 2: Enter the project scenario conditions
Enter the project scenario conditions in the "After" tab of the SWEEP Water Savings Tool as shown in Figure 3.

- Enter the number of acres impacted by the project: *100*.
- Select the location (baseline, township, range): *San Bernadino*
- Select the predominant soil type for the field from a list of options as described above in Step 1: *Fine Sandy Loam*.
- Select the principal crop that will be planted in the proposed SWEEP project area: *Avocado*. Note that a crop change during project implementation may be captured here.
- Select the appropriate irrigation practice that captures the desired change in practice on the proposed project acreage: *DRIP IRR. (Replace Solid Set Undertree)*
- Select the appropriate change in Irrigation Water Management: *Increase IWM by 1 level*

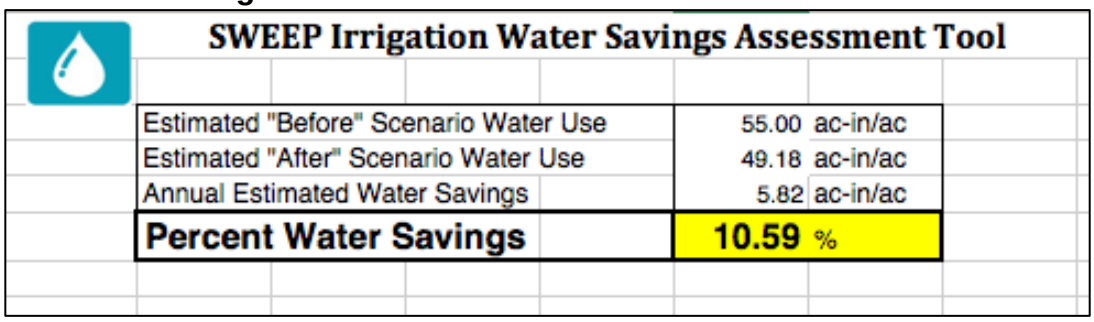
Figure 3. Screenshot of example input for "After" tab on the SWEEP Irrigation Water Savings Assessment tool



An estimated "after" water use is displayed at the bottom of the tab: 49.2 *ac-in / ac.*

Step 3: Report water savings
Report the project water savings as the percent reduction displayed on the "Water Savings Estimate" tab as shown in Figure 4.

Figure 4. Screenshot of example output from "Results" tab on the SWEEP Irrigation Water Savings Assessment tool



Or, if reporting in acre-inches per irrigated acre, use the tool outputs and Equation 2.

$$Water\ Savings = \left(Water\ Use_{Baseline} - \ Water\ Use_{Project}\right) \times Years \qquad \text{(Eq. 2)}$$

$$= (55\ ac - in/ac - \ 49.18\ ac - in/ac) \times 10\ years$$

$$= 58.2\ ac - in/ac$$

In this example, it is estimated that the project would result in water savings of 10.59% or a total of 58.2 acre inches per irrigated acre during the ten-year project quantification period.

Appendix B. Example Methods and Data Inputs for Project Category 2

The following is a hypothetical project[17] to demonstrate how the Water Savings Co-benefit Assessment Methodology would be used to estimate the benefits of a Water-Energy project in Project Category 2. This example does not include the supporting documentation that may be required of actual project applicants.

Overview of the Proposed Project

The applicant is proposing the following project components:

- Install multiple water-energy efficient measures in multiple hotel facilities (replacing old, inefficient measures):
    - 8 commercial, under-counter low-temperature dishwashers;
    - 10 commercial laundromat clothes washers; and
    - 50 commercial, batch remote condensing unit ice machines.

The proposed project has the following relevant project features:

- Project quantification periods, as determined by CARB GHG Quantification Methodologies are as follows:
    - Commercial, under-counter low-temperature dishwashers: ten years;
    - Commercial laundromat clothes washers: seven years; and
    - Commercial, batch remote condensing unit ice machines: eight years.

Methods to Apply

Step 1: Enter specifications for each replacement measure
Enter the specific details for each replacement measure using the Commercial Inputs tab of the DWR Water-Energy Grant Program Calculator Tool[8] (.xlsm) as shown in Figure 5.

Step 2: Report water savings
Report the project water savings as displayed on the "Water Savings Estimate" tab as shown in Figure 6.

In this example, it is estimated that the project would result in water savings of 523,273 gallons during the seven- to ten-year project quantification period.

[17] The hypothetical project has not undergone verification of any program requirements; all assumptions about location type and features are for demonstration purposes only.

Figure 5. Screenshot of example input for "Commercial Inputs" tab on the DWR Water-Energy Grant Program Calculator Tool

Commercial/Institutional Inputs (1)

Please enter the quantities of the new measure(s) proposed for replacement. Enter the project data for the new measure if known or use the defaults provided.

To see more detail on the formulas and values used in this CARB GHG calculator or to modify additional default assumptions, click on the blue tabs for the applicable project measures at the bottom of the page.

Dishwasher						
Input Data		Project Data				
Dishwasher Temp	Dishwasher Type	Quantity	Racks washed per day	Building water heater fuel type	Booster water heater fuel type	Operating days per year
Low Temperature	Under Counter	8	75	Natural Gas	N/A	365
	Stationary Single Tank Door	0	280	Natural Gas	N/A	365
	Single Tank Conveyor	0	400	Natural Gas	N/A	365
	Multi Tank Conveyor	0	600	Natural Gas	N/A	365
High Temperature	Under Counter	0	75	Natural Gas	Natural Gas	365
	Stationary Single Tank Door	0	280	Natural Gas	Natural Gas	365
	Single Tank Conveyor	0	400	Natural Gas	Natural Gas	365
	Multi Tank Conveyor	0	600	Natural Gas	Natural Gas	365
	Pot, Pan, and Utensil	0	280	Natural Gas	Natural Gas	365

Clothes washer								
Input Data	Project Data							
Facility Type	Quantity	Clothes washer load configuration	Average number of loads per week	Building water heater fuel type	Clothes washer capacity (cubic feet)	Clothes washer modified energy factor (MEF)	Clothes washer water factor (WF)	Fuel Type of Dryer
Laundromat	10	Front-loading	42.1	Natural Gas	3.40	2.20	4.50	Electric

Ice Machine					
Input Data		Project Data			
Ice Machine Type	Ice Machine Category	Quantity	Harvest rate (pounds ice per day)	Potable water use (gallon per 100 pounds ice)	Operating days per year
Batch	Ice Making Head	0	650	18.3	365
	Remote Condensing Unit	50	1,150	18.0	365
	Self Contained Unit	0	170	19.5	365

Figure 6. Screenshot of example output from "Results Summary" tab on the DWR Water-Energy Grant Program Calculator Tool

Commercial/Institutional and Residential Results Summary

Commercial/Institutional										
	Quantity	Annual Savings				Assumed equipment lifetime (years)	Project Savings			
		Electricity (kWh)	Gas (therms)	Water (gallons)	Emissions reduction (Metric Tons of CO2e)		Electricity (kWh)	Gas (therms)	Water (gallons)	Emissions reduction (Metric Tons of CO2e)
Total Project GHG Emission Reductions and Other Savings	68	55,475	1,212	523,273	23	-	447,354	11,256	4,348,245	195

Appendix C. Example Methods and Data Inputs for Project Category 3

The following is a hypothetical project[18] to demonstrate how the Water Savings Co-benefit Assessment Methodology would be used to estimate the benefits of a Urban Greening project in Project Category 3. This example does not include the supporting documentation that may be required of actual project applicants.

Overview of the Proposed Project

The applicant is proposing the following project components:

- Strategically plant 50 trees to shade an elementary school;
- Landscape the area to replace existing grass with wood chips; and
- Convert irrigation system from overhead to drip.

The proposed project has the following relevant project features:

- Located in Burbank, Los Angeles County;
- Area to be landscaped is 20,000 ft^2;
- Current type of irrigation is overhead;
- New project irrigation is drip;
- Area is currently landscaped with turfgrass (*Zoysia tenuifolia*), plant factor (PF) unknown;
- Trees to be planted are blackwood acacia, (*Acacia melanoxylon*), PF = 0.2; and
- There are no Special Landscape Areas (recreational area, area permanently and solely dedicated to edible plants, and area irrigated with recycled water).

Methods to Apply

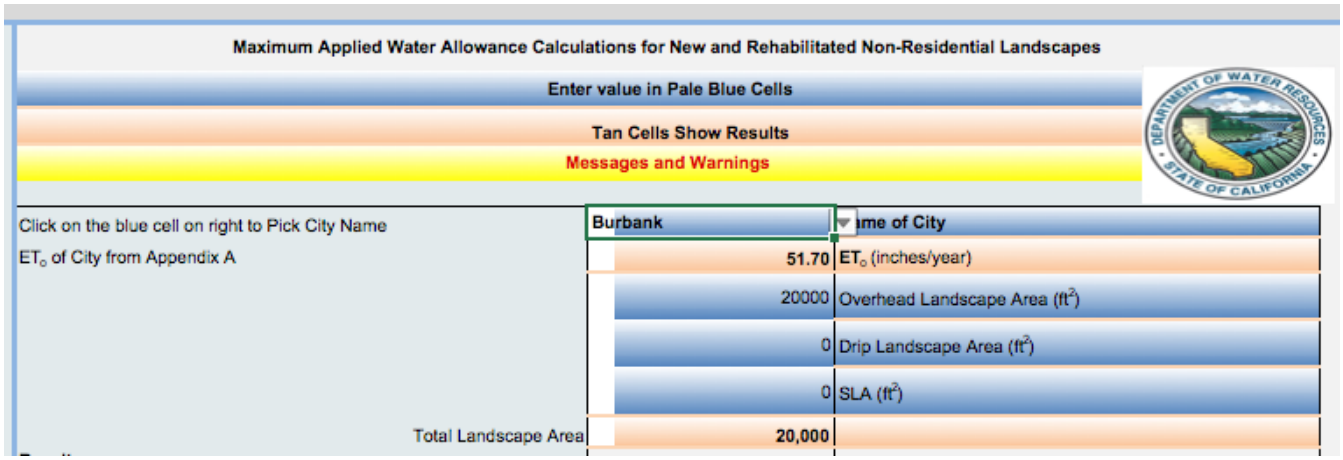
Step 1: Enter the baseline conditions
Step 1a: Enter the baseline conditions in the MAWA tab of the DWR Water Budget Calculator for New and Rehabilitated Residential/Non-Residential Landscapes

- Name of City: *Burbank*, which will automatically look up the Reference Evapotranspiration (ET_O).
- Landscaped area based on the baseline type of irrigation: *20,000 ft^2, Overhead Landscape Area*

See the MAWA tab in Figure 7.

[18] The hypothetical project has not undergone verification of any program requirements; all assumptions about location type and features are for demonstration purposes only.

Figure 7. Screenshot of example input for DWR Water Budget Calculator, baseline scenario, MAWA Tab



Maximum Applied Water Allowance Calculations for New and Rehabilitated Non-Residential Landscapes

Enter value in Pale Blue Cells

Tan Cells Show Results

Messages and Warnings

Click on the blue cell on right to Pick City Name	Burbank	ıme of City
ET_o of City from Appendix A	51.70	ET_o (inches/year)
	20000	Overhead Landscape Area (ft^2)
	0	Drip Landscape Area (ft^2)
	0	SLA (ft^2)
Total Landscape Area	20,000	

Step 1b: Enter the baseline conditions in the ETWU tab of the DWR Water Budget Calculator for New and Rehabilitated Residential/Non-Residential Landscapes

- Hydrozone Area: *20,000 ft²*
  Enter the area in the row that matches the appropriate baseline Plant Factor: *0.5 (as determined below*) and irrigation system: *Overhead Spray*

See the ETWU tab in Figure 8.

Figure 8. Screenshot of example input for DWR Water Budget Calculator, baseline scenario, ETWU Tab

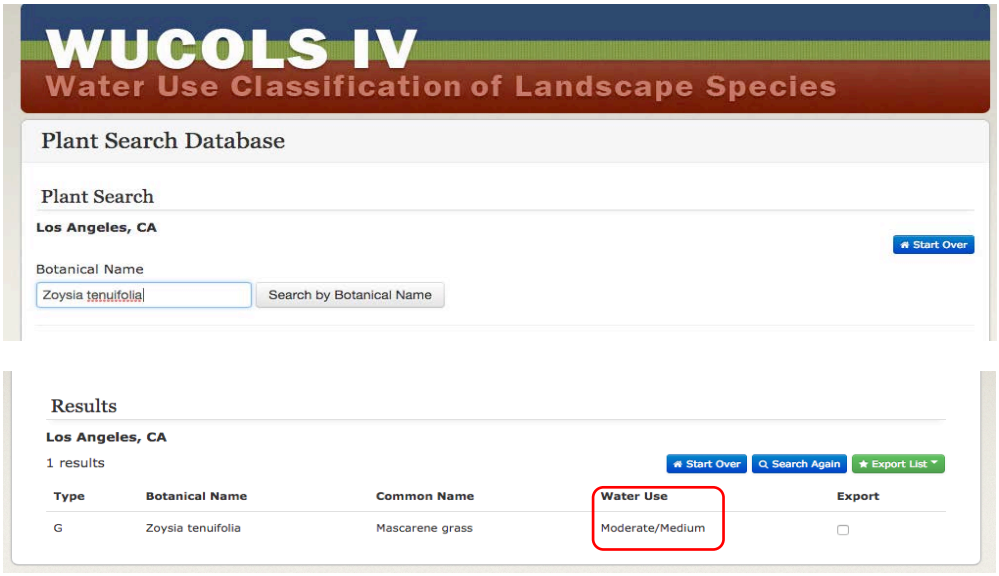
Irrigation Efficiency Default Value for overhead 0.75 and drip 0.81.

Plant Water Use Type	Plant Factor
Very Low	0 - 0.1
Low	0.2 - 0.3
Medium	0.4 - 0.6
High	0.7 - 1.0
SLA	1.0

Hydrozone	Select System From the Dropdown List click on cell below	Plant Water Use Type (s) (low, medium, high)	Plant Factor (PF)	Hydrozone Area (HA) (ft^2) Without SLA	Irrigation Efficiency (IE)	(PF x HA (ft^2))/IE
Zone 1	Overhead Spray	High	0.70	-	0.75	0
Zone 2	Overhead Spray	Medium	0.50	20,000	0.75	13,333
Zone 3	Overhead Spray	Medium	0.40	-	0.75	0
Zone 4	Drip	Low	0.30	-	0.81	0
Zone 5	Drip	Low	0.30	-	0.81	0
Zone 6	Drip	Low	0.20	-	0.81	0
Zone 7						

Step 1c: Look up the Plant Factor for the baseline landscaping type (*turfgrass, or Zoysia tenuifolia*), using the WUCOLS IV online database as shown in Figure 9.

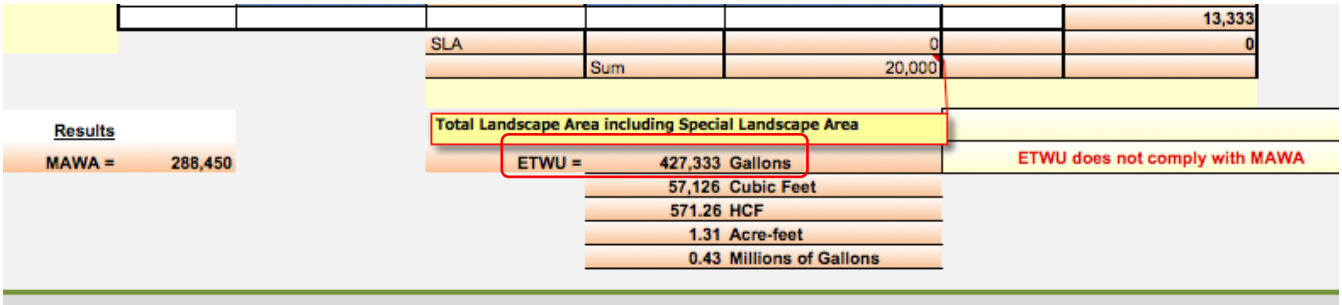
Figure 9. Screenshot of example input for WUCOLS IV



Plan Factor (PF) = medium (0.5)

Step 2: Note the Water Use$_{Baseline}$ (representing the baseline scenario), which will be automatically calculated in the DWR Water Budget Calculator as "ETWU" and shown in Figure 10.

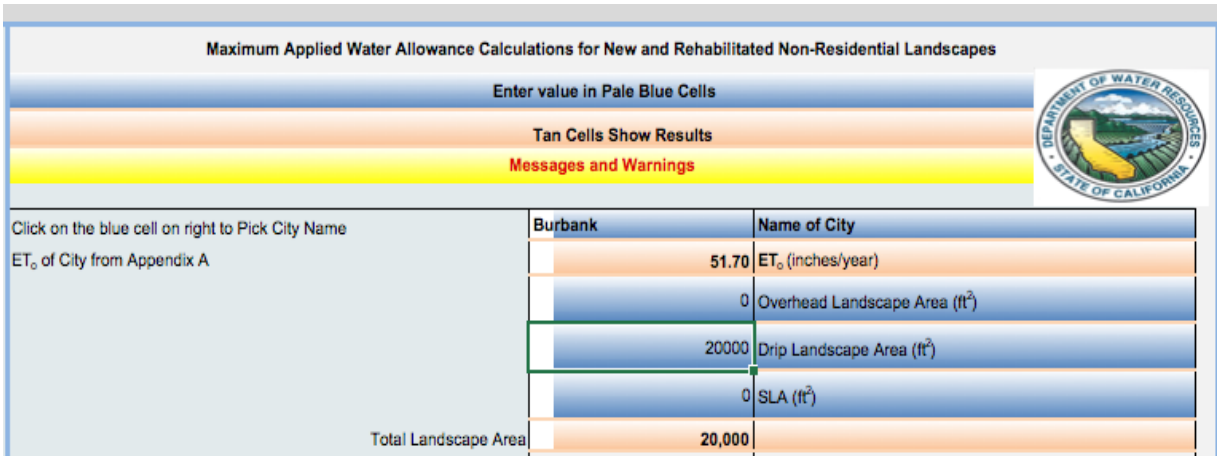
Figure 10. Screenshot of example output from DWR Water Budget Calculator, baseline scenario, ETWU Tab



$$Water\ Use_{Baseline} = 427{,}333\ gallons$$

Step 3: Enter the project scenario conditions
Step 3a: Change the MAWA tab landscaped area to the project scenario type of irrigation: *20,000 ft², Drip Landscape Area* as shown in Figure 11.

Figure 11. Screenshot of example input for DWR Water Budget Calculator, project scenario, MAWA tab



Maximum Applied Water Allowance Calculations for New and Rehabilitated Non-Residential Landscapes

Enter value in Pale Blue Cells

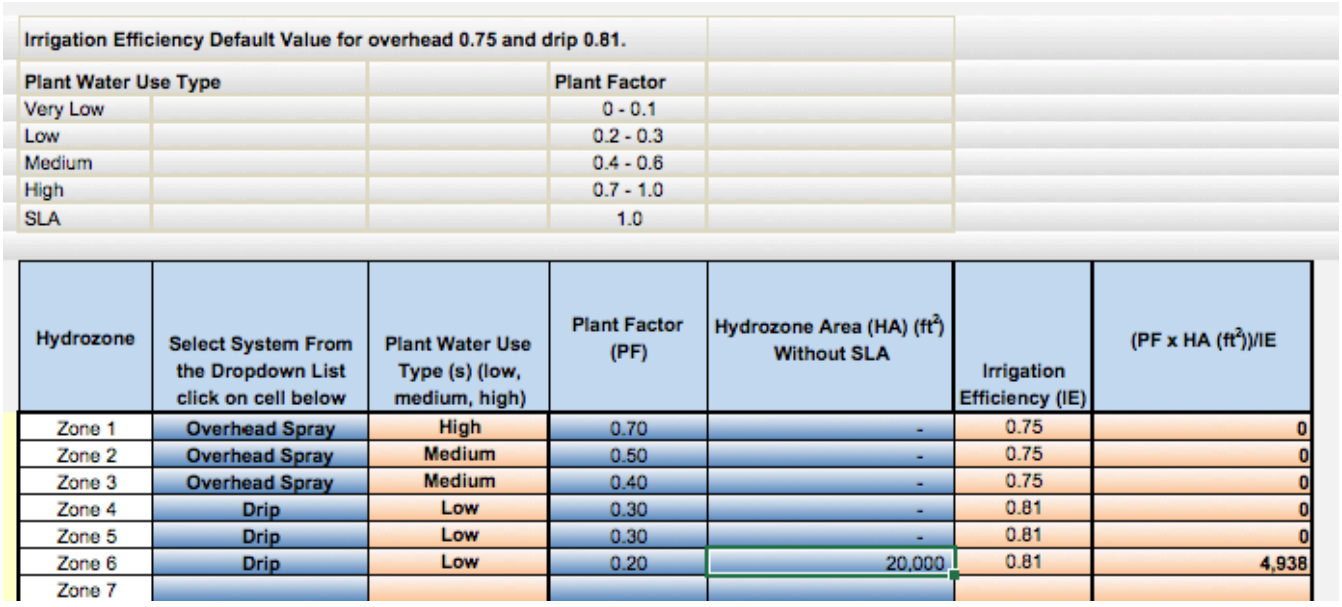
Tan Cells Show Results

Messages and Warnings

Click on the blue cell on right to Pick City Name	Burbank	Name of City
ET_o of City from Appendix A	51.70	ET_o (inches/year)
	0	Overhead Landscape Area (ft^2)
	20000	Drip Landscape Area (ft^2)
	0	SLA (ft^2)
Total Landscape Area	20,000	

Step 3b: Change the ETWU tab Hydrozone Area (HA) to the project scenario conditions: *20,000 ft²*, for the appropriate Plant Factor (*0.2*) and irrigation system (*Drip*) in the project scenario as shown in Figure 12.

Figure 12. Screenshot of example input for DWR Water Budget Calculator, project scenario, ETWU tab



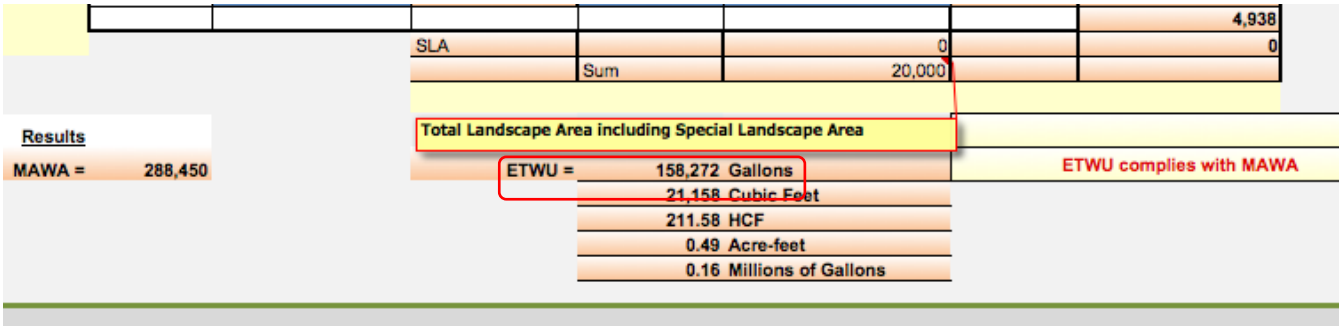
Irrigation Efficiency Default Value for overhead 0.75 and drip 0.81.

Plant Water Use Type	Plant Factor
Very Low	0 - 0.1
Low	0.2 - 0.3
Medium	0.4 - 0.6
High	0.7 - 1.0
SLA	1.0

Hydrozone	Select System From the Dropdown List click on cell below	Plant Water Use Type (s) (low, medium, high)	Plant Factor (PF)	Hydrozone Area (HA) (ft^2) Without SLA	Irrigation Efficiency (IE)	(PF x HA (ft^2))/IE
Zone 1	Overhead Spray	High	0.70	-	0.75	0
Zone 2	Overhead Spray	Medium	0.50	-	0.75	0
Zone 3	Overhead Spray	Medium	0.40	-	0.75	0
Zone 4	Drip	Low	0.30	-	0.81	0
Zone 5	Drip	Low	0.30	-	0.81	0
Zone 6	Drip	Low	0.20	20,000	0.81	4,938
Zone 7						

Step 4: Note the Water Use$_{Project}$ (representing the project scenario), which will be automatically calculated in the DWR Water Budget Calculator as "ETWU" and shown in Figure 13.

Figure 13. Screenshot of example output from DWR Water Budget Calculator, project scenario, ETWU Tab



$$Water\ Use_{Project} = 158{,}272\ gallons$$

Step 5: Calculate water savings using Equation 6

$$Water\ Savings/Increase = \left(Water\ Use_{Baseline} - Water\ Use_{Project}\right) \times Years \qquad \text{(Eq. 6)}$$

$$= (427{,}333\ gallons - 158{,}272\ gallons) \times 40\ years$$

$$= 10{,}762{,}440\ gallons$$

In this example, it is estimated that the project would result in water savings of nearly 10.8 million gallons during the 40-year project quantification period.

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