DECEMBER 2022

WATER AND ENERGY SAVINGS ESTIMATES FOR CII LANDSCAPE UPGRADE PROJECTS

Prepared for the Regional Water Authority

Alliance for Water Efficiency

Regional Water Authority
BUILDING ALLIANCES IN NORTHERN CALIFORNIA

ABOUT THE ALLIANCE FOR WATER EFFICIENCY

Alliance for Water Efficiency

The Alliance for Water Efficiency (AWE) is a nonprofit dedicated to the efficient and sustainable use of water across North America. Based in Chicago, AWE advocates for water efficient products and programs, and provides information and assistance on water conservation efforts. AWE works with more than 500-member organizations, providing benefit to water utilities, business and industry, government agencies, environmental and energy advocates, universities, and consumers.

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INTRODUCTION

The Regional Water Authority (RWA) is a joint powers authority representing a group of 22 water providers and over a dozen associates/affiliates in the greater Sacramento region of California. RWA offers a variety of services and programs as part of their Water Efficiency Programs (WEP) with an overall goal of assisting water providers with their communication to customers about the importance of water efficiency and the associated best practices. One WEP program is the Commercial, Industrial, and Institutional (CII) Landscape Upgrades Program. This program offers incentives to CII properties to upgrade their landscape plant material, irrigation systems and equipment, or both. The goal of the program is to reduce water use and improve the water quality of the Lower American River. The program requires 3rd party pre- and post-installation inspections to assess the landscape upgrade potential and ensure the upgrades are installed properly. Each participant is also required to attend a 30-minute landscape maintenance session specifically tailored to their property to help ensure long term landscape health and anticipated water savings are realized.

The program is funded by the Bonneville Environmental Foundation and Procter & Gamble with a budget of $242,000. The budget includes funding for customer incentives, staff and consultant time, savings evaluation, pre and post inspections, and maintenance training development and customer presentations for ten site locations. RWA partnered with WaterWise Consulting, Inc on the pre- and post-installation inspections and with California Water Efficiency Partnership (CalWEP) on providing customers with site maintenance training. Participants were offered between $15,000 and $20,000 in incentive funding per site. The program timeframe was March 2021-December 2022.

In 2022, the Alliance for Water Efficiency reviewed the 10 participant project sites in the CII Landscape Upgrades Program. This report provides summary information about each project site and estimates of water and energy savings stemming from the changes made at each site. The results include water and energy savings estimates for two different scenarios, as well as totals over a 15-year expected lifetime of the project. The two scenarios "Low" and "Medium" reflect that there are a variety of factors that drive water use, especially outdoor water use, which is heavily affected by local weather conditions. The "Low" scenario can be thought of as the most efficient expectation, with the "Medium" being a more moderate expectation, which could be more realistic if hot temperatures and drought persist and/or if the irrigation system is not managed efficiently and effectively. The "Average" water savings reflects the average of the low and medium scenarios' savings estimates and represents the most likely savings estimate to be realized on each site considering the oscillation between weather patterns and periods of state or local mandated drought landscape irrigation restrictions.

METHODOLOGY

Water Savings

A landscape water budget is the amount of supplemental irrigation water a landscape requires based on plant types, the size of the landscape, irrigation equipment, and weather factors including rainfall and evapotranspiration levels. A budget is created for each hydrozone, then summed to a total water budget. A hydrozone is an area of plants that have a similar water requirement, and ideally are within the same irrigation zone to match the common water requirement. For example, low water use plants may only need infrequent irrigation and can be watered through a drip irrigation system which delivers water slowly. Some varieties of turfgrass or annual plants require more water and should be on a different irrigation zone that can meet the higher irrigation needs.

AWE built upon the EPA WaterSense Water Budget Tool for this project. [1] The EPA tool is at an annual scale, so AWE adapted it to create water budgets at a monthly scale. Outdoor water use can by highly seasonal, so it was important to show the variation expected across the year. The monthly timescale also better aligns with water use billing, which typically occurs on a monthly or bimonthly basis.

Here is the core equation used to estimate water use for each site:

$$LWR_H = \frac{1}{DU_{LQ}} \times [(ET_o \times K_L) - R_a] \times A \times C_u$$

LWR_H = landscape water requirement for the hydrozone (gallons per month).

DU_{LQ} = lower quarter distribution uniformity (dimensionless). Distribution uniformity is the measure of uniformity of irrigation water applied over an area. It reflects that irrigation systems are rarely 100 percent efficient (DU = 1) and typically deliver more water than theoretically required by the plant type to account for this reality (by design or by operator practice). A higher DU indicates a more irrigation efficient system and operation.

ET_O = local reference evapotranspiration (inches per month). ET is a combination of the evaporation and transpiration and is the approximate amount of water consumed by the plant. The reference value is typically the ET for a cold season turfgrass. ET data for all three site locations was sourced from the California Irrigation Management Information System [2]

K_L = Landscape coefficient for the highest water-using plant in the hydrozone (dimensionless). This value is what modifies the reference ET to tailor the ET value for the plant type. A lower water use plant will not need as much water as high water use turfgrass, so the coefficient is a value less than 1 and reduces the ET value for the hydrozone.

R_a = Allowable rainfall, set to 25% of the average monthly rainfall. This was calculated by multiplying average monthly rainfall data from U.S Climate Data by 25% for both Sacramento and Folsom. Rainfall data for Fair Oaks was not available, so allowable rainfall values for Folsom, CA were used for the Fair Oaks sites since the two cities border one another. [3]

A = Area of the hydrozone (square feet).

C_u = Conversion factor (0.6233) to get results in gallons per month.

Landscape Water Requirement (LWR) is the amount of supplemental water required by the design of the established landscape. This estimates the amount of irrigation water needed on a monthly basis. The actual day-to-day irrigation schedule will vary depending on the size of the landscape, type of irrigation system, number of zones, customer behavior and type of irrigation controller.

Separate LWRs were calculated for each hydrozone of each site and added together for the total site LWR. Some sites may have landscaping and outdoor water use beyond the projects described here; this analysis is limited to the project area only and may not reflect the total possible outdoor water use for a property.

If different upgrades occurred on a given site, a LWR_H was calculated for each area and added together for a total project LWR. If the project included the addition of hardscaping,

[1] United States Environmental Protection Agency (USEPA). Water Budget Tool, accessed via online download, version 1.04, released June 2020. https://www.epa.gov/watersense/water-budget-tool

[2] California Irrigation Management Information System (CIMIS). California Department of Water Resources. Reference Evapotranspiration Map, prepared in 1999. https://cimis.water.ca.gov/App_Themes/images/etozonemap.jpg

[3] U.S. Climate Data website. https://www.usclimatedata.com/

this area was assumed to have no water requirement. This assumption is only valid if the irrigation system was also modified to only water the planted areas, and no longer waters the area that is now hardscaping.

For each site, a LWR was calculated for the original landscape prior to the landscape upgrades, and two future water savings scenarios: "Low" and "Medium". The "Low" scenario can be thought of as the most efficient expectation of future water use with the upgrades, with the "Medium" being a more moderate expectation, which could be more realistic if hot temperatures and drought persist and/or if the irrigation system is not managed efficiently and effectively.

The water savings is then determined by subtracting each scenario's ("Low" and "Medium") LWR from the original LWR. An average estimate of future water savings is calculated as the average of the Low and Medium scenarios.

A 15-year estimate of total savings over the upgrades' lifetime of each site was calculated by multiplying the annual LWR by 15 years. As part of this calculation, the water savings estimates for years 1 and 2 are discounted by 50 percent for any site that involved a landscape plant material transformation and new plantings. This is because new landscapes require more water during establishment and the methodology is the estimated for fully mature, established landscapes. The higher establishment water use means that water savings will be lower during the first two growing seasons. This is reflected in the 15-year total. The remaining annual estimates for water savings reflect the estimated water use after landscape establishment. For projects that only included irrigation system and/or controller upgrades, the full estimate of savings was used for all 15 years. Water savings results are displayed in Table 2 below.

Energy Savings

Energy is required to capture, move, treat, and deliver water. The related energy intensity, expressed as kilowatts per million gallon (kWh/MG), will vary depending on water source, need for pumping, treatment technologies, and energy sources. In some situations, the embedded energy in a water system is so great that programs to reduce water use are more cost-effective to reduce energy than traditional energy efficiency efforts. [4]

A 15-year estimate of total energy savings over the lifetime of the project was calculated by multiplying the 15-year estimate of total water savings by an energy intensity conversion factor. This creates an estimate of the total energy that would have been needed to transport and treat the water being saved as a result of the sites' landscape upgrades implemented as part of this program. A report was prepared for the Regional Water Authority (RWA) and Sacramento Municipal Utility District (SMUD), which included estimates of energy intensities of urban water suppliers in the Sacramento region. [5] The energy intensities from Table 9 of that report were used for this analysis. Each of the 10 project sites were matched with the applicable factor based on the site location. The following energy intensity conversion factors used to evaluate energy savings:

- 999 kWh/MG for the City of Sacramento
- 968 kWh/MG for the City of Folsom
- 2,287 kWh/MG for Fair Oaks

A 15-year estimate of total greenhouse gas emissions avoided over the lifetime of the project was calculated by multiplying the 15-year estimate of total water savings by a greenhouse gas conversion factor. For the calculations, the greenhouse gas emission conversion factor 4,276 lb CO2/MG, was used as outlined in the Alliance for Water Efficiency Conservation Tracking Tool. [6] The default electricity generation emission factor comes from the US EPA Emissions & Generation Resource Integrated Database (eGRID). [7]

Energy savings results are displayed in Table 3 below.

[4] Edward S Spang et al. The cost effectiveness of energy savings through water conservation: a utility-scale assessment. 2020 Environ. Res. Lett. 15 114031. https://iopscience.iop.org/article/10.1088/1748-9326/abb9de

[5] 2014 AB 32 Water-Energy Assessment and Savings Demonstration Project Report. Prepared for SMUD and RWA by GEI Consultants, Final, October 2014, Project No. 1326390.

[6] Alliance for Water Efficiency. Water Conservation Tracking Tool, version 4.1, 2022. https://www.allianceforwaterefficiency.org/resources/topic/water-conservation-tracking-tool

[7] United States Environmental Protection Agency (USEPA). Emissions & Generation Resource Integrated Database (eGRID), 2021 version, assessed online. https://www.epa.gov/egrid

SUMMARY OF RESULTS

Each project site varied in the size and scope of work completed. Some sites underwent a comprehensive overhaul including a landscape plant material transformation, new irrigation equipment, and a new smart irrigation controller. Others only changed irrigation equipment and/or their irrigation controller. Table 1 below provides an overview of the 10 projects. This report includes individualized summary reports for each project site below. Tables 2 and 3 display the water and energy/greenhouse gas emissions savings estimated to be realized from the landscape upgrades over a 15-year project lifetime. A standalone spreadsheet with all water and energy savings calculations was provided to RWA and will be available to stakeholders on request. Table 4 includes site cost information and gallons saved per dollar spent for each participating site.

There are many ways to approach estimating water savings, and in this case, the team opted to use a landscape water budget methodology. Each project had different levels of information available to assess the impact to water and energy savings. Not all projects had historical water use information available, and if they did, the water usage might not be fully representative as sometimes property owners decrease water use ahead of a landscape project, or in some cases a property changed owners recently and had limited water use data under the new ownership. Additionally, California has been experiencing unprecedented and ongoing drought conditions over the last 7 years, and related messaging and restrictions likely impacted the water use on these landscapes. Finally, because these projects were completed in 2022, there is very little to no "post-project" data at this time. The landscape water budget methodology requires less detailed information and therefore could be applied consistently to all projects. These projects will be revisited in the coming years to assess the difference between the estimates of water savings compared to actual future water use.

TABLE 1: Project Site Summary

Site Number	Site Name	City	Site Type	Landscape Area (Square feet)	Landscape Upgrade Description
1	Small Insurance Business	Folsom	Small Business	1,550	Removed turfgrass, planted drought tolerant native plants, installed hardscape, drip irrigation, and smart controllers
2	Homeowners Association	Sacramento	Homeowners Association	1,850	Removed turfgrass, planted drought tolerant native plants, and installed drip irrigation
3	Small Jewelry Business	Folsom	Small Business	1,650	Removed turfgrass, planted drought tolerant native plants, and installed drip irrigation
4	Small Business Park	Folsom	Small Business	3,820	Removed turfgrass, planted drought tolerant native plants, and installed drip irrigation
5	Place of Worship	Sacramento	Place of Worship	26,000	Installed stream rotors and smart controllers
6	Business Park	Sacramento	Small Business	7,240	Installed stream rotors, drip irrigation and smart controllers
7	Peregrine Park	Sacramento	Public Park	316,000	Installed smart controllers
8	Tanzanite Park	Sacramento	Public Park	724,000	Installed smart controllers
9	Phoenix Park	Fair Oaks	Public Park	1,346,000	Installed smart controllers
10	Fair Oaks Park	Fair Oaks	Public Park	367,100	Installed smart controllers

TABLE 2: Site Landscape Upgrades and Project Lifetime Water Savings Summary

Site Number	Turf Replacement	Irrigation Upgrade (Drip or Rotors)	Smart Controller Installation	15- Year Medium Scenario Water Savings	15- Year Low Scenario Water Savings	15- Year Average Water Savings
1	✓	✓	✓	474,136	622,855	548,496
2	✓	✓		321,733	682,943	502,338
3	✓	✓		280,270	584,155	432,213
4	✓	✓		648,868	1,352,408	1,000,638
5		✓	✓	3,231,078	3,343,324	3,287,201
6		✓	✓	899,731	916,108	907,920
7			✓	27,954,930	29,424,081	28,689,511
8			✓	64,048,638	67,414,689	65,731,663
9			✓	114,659,618	120,887,329	117,773,474
10			✓	31,271,579	32,970,088	32,120,834
Totals	**4**	**6**	**7**	**243,790,581**	**258,197,980**	**250,994,288**

TABLE 3: Project Lifetime Site Greenhouse Gas Reductions and Energy Savings

Site Number	15- Year Average Energy Savings (kWh Avoided)	15 Year Average GHG Reduction (lbs of CO2 Avoided)
1	434	2,345
2	452	2110
3	389	1,815
4	901	4,203
5	2,958	13,806
6	817	3,813
7	25,821	120,496
8	59,158	276,073
9	259,102	494,649
10	70,666	134,908
Totals	**420,698**	**1,054,218**

TABLE 4: Site Landscape Upgrades Costs

Site Number	Total Cost of Project	15- Year Average Water Savings (gallons)	Gallons Saved per Dollar Spent Over Project Lifetime
1	$21,087	548,496	26
2	$14,928	502,338	34
3	$18,729	432,213	23
4	$17,875	1,000,638	56
5	$15,000	3,287,201	219
6	$17,363	907,920	52
7	$16,498	28,689,511	1,739
8	$17,159	65,731,663	3,831
9	$17,730	117,773,474	6,643
10	$16,382	32,120,834	1,961
Totals	**$172,750**	**250,994,288**	**1,493**

SITE REPORTS

SITE REPORTS

SITE #1: Small Insurance Business in Folsom, California

PROJECT SUMMARY: SITE #1

Total Area (square feet) 1,550 sqft

	Before	After
Turfgrass	1,550 sqft	0 sqft
Drought Tolerant Native Plants	0 sqft	950 sqft
Hardscape	0 sqft	600 sqft
Irrigation System	Sprayhead	Drip
Irrigation Controller	Traditional	Smart[1]

Key Results

- The project replaced turfgrass with drought tolerant native plants and hardscape, replaced a sprayhead irrigation system with a dripline irrigation system and replaced a traditional irrigation controller with a smart controller.
- The project is estimated to reduce annual irrigation water requirements by about 33,800 to 44,500 gallons per year, which is a reduction of 67% to 89% from the estimated original landscape irrigation water requirement. On average, the project is expected to reduce water use by about 39,200 gallons per year.
- Over 15 years, the project is estimated to save between approximately 474,100 and 622,900 gallons of water. On average, the project is expected to reduce water use by 78% over 15 years.
- Over 15 years, the project is estimated to save between about 430 and 560 kWh of avoided embedded energy. On average, this is 490 kWh over 15 years.
- Over 15 years, the project is estimated to save between approximately 2,000 and 2,700 pounds of avoided greenhouse gas (GHG) emissions. On average, this is 2,300 pounds over 15 years.

Scenario Definitions[2] and Results

Original Landscape Water Requirement (LWR): The supplemental irrigation water needed for the property before the landscape transformation. This is the amount of water applied to the landscape beyond what natural rainfall provided.

Medium LWR: The estimated supplemental irrigation water required post-project based on moderate water savings assumptions for the water requirements of the new plants.

This scenario also reflects that climate change and hotter temperatures are expected to drive up water demands for landscapes. Past weather patterns and data used for this analysis might not be reflective of future weather conditions.

Low LWR: The estimated supplemental irrigation water required post-landscape transformation, based on more aggressive assumptions that the plants are mostly low water use, and the property owner or manager maintains an efficient irrigation schedule over time.

WATER AND ENERGY SAVINGS SUMMARY: SITE #1

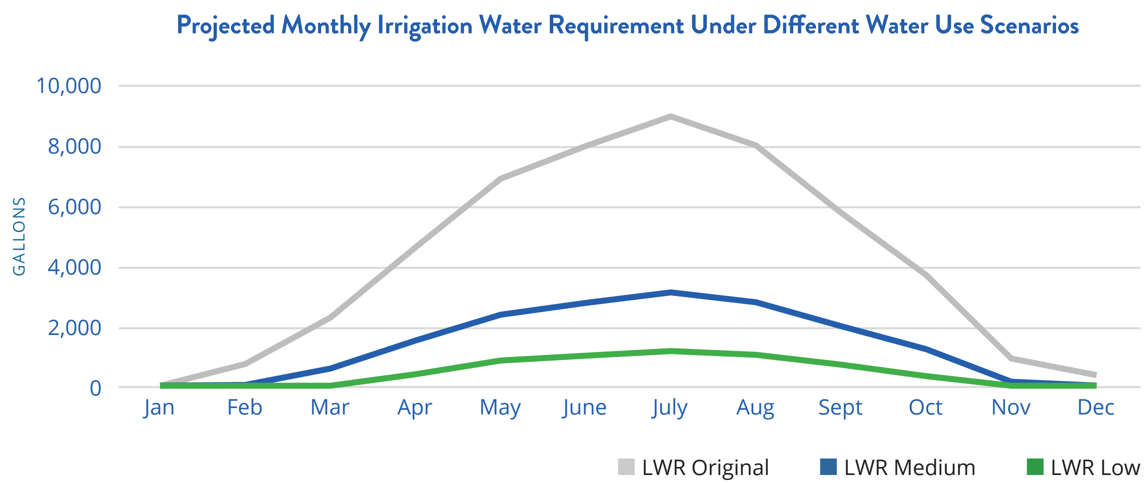
LWR = Landscape Water Requirement, the estimated supplemental irrigation water needed by the landscape

		Annual Water Calculations (gallons)	15 Year Cumulative Water Calculations (gallons)	15 Year Cumulative Percent Reduction from Original LWR	15 Year Cumulative GHG Reduction[3] (lbs of CO2 Avoided)	15 Year Cumulative Energy Savings[4] (kWh Avoided)
Before	Original LWR	50,246	703,446			
After	Medium LWR	16,379	229,310			
	Low LWR	5,756	80,591			
	Medium Savings	33,847	474,136	67%	2,027	427
	Low Savings	44,490	622,855	89%	2,663	561
	Average Savings	39,178	521,151	78%	2,345	494

Water Use   Water Savings   Energy and GHG Savings

Monthly Breakdown of Each Scenario: The graph and table below illustrate the landscape water requirement on a monthly basis for each scenario. These show the amount of supplemental water that is estimated to be needed for irrigation each month.

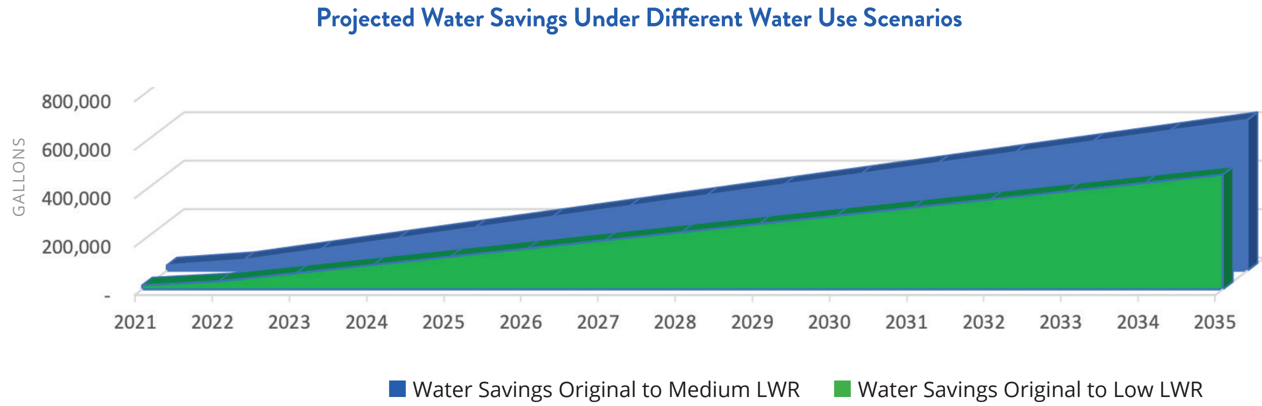
Note: Monthly LWR calculations that generated negative values were represented with a zero.



Projected Monthly Irrigation Water Requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	% Reduction
Monthly ETO (inches/month)	1.55	2.24	3.72	5.10	6.82	7.80	8.68	7.75	5.70	4.03	2.10	1.55	**57.04**	
Allowable Rainfall (inches)	1.11	1.08	1.07	0.46	0.13	0.08	0.03	0.03	0.11	0.34	0.87	0.85	**6.15**	
Original LWR (gallons)	0	722	2,276	4,619	6,906	8,000	8,986	8,019	5,771	3,695	899	353	**50,246**	
Medium LWR (gallons)	0	27	566	1,501	2,360	2,748	3,099	2,765	1,972	1,208	133	0	**16,379**	
Low LWR (gallons)	0	0	0	401	889	1,066	1,227	1,093	742	339	0	0	**5,756**	
Water Savings Original to Medium LWR (gallons)	0	695	1,710	3,118	4,546	5,252	5,887	5,254	3,799	2,487	766	353	**33,867**	67%
Water Savings Original to Low LWR (gallons)	0	722	2,276	4,218	6,017	6,934	7,760	6,926	5,028	3,356	899	353	**44,490**	89%
Average Water Savings (gallons)	0	708	1,993	3,668	5,282	6,093	6,824	6,090	4,414	2,922	833	353	**39,178**	78%

15-year Projected Water Savings Scenarios: The chart below projects landscape water savings by scenario over the next 15 years.[5]



Equations and Variables

$$\text{LWR} = \frac{1}{DU_{LQ}} \times [(ET_O \times K_L) - R_a] \times A \times C_u$$

DULQ = Lower quarter distribution uniformity (0.70 to reflect standard drip irrigation) ETO = Local reference evapotransipration

KL = Landscape coefficient for the type of plant in that hydrozone (0.5 f or medium LWR, 0.2 for low LWR) Ra = Allowable rainfall, designated by WaterSense as 25% of average peak monthly rainfall

A = Area of the hydrozone (square feet)

Cu = Conversion factor (0.6233 for results in gallons/ month)

Notes and Definitions

Landscape Water Requirement (LWR): The amount of supplemental water required by the design of the established landscape. The LWR is calculated by dividing the landscape into hydrozones, determining the LWR for each hydrozone, and then adding these totals together for a total landscape requirement. This is the supplemental irrigation water needed for the property; the amount of water applied to the landscape beyond what natural rainfall provides.

[1] *For properties that installed a smart irrigation controller, the "Medium" and "Low" LWR values were multiplied by 0.85 which reflects a Lawrence Berkeley National Lab study that weather-based irrigation controllers can capture average water savings of 15%.*

[2] *Water savings calculations were estimated for two different scenarios, "Medium" and "Low", to reflect possible variation in types of plants, property owner/manager irrigation decisions, climate change, and weather patterns.*

[3] *Cumulative GHG emissions avoided was calculated by multiplying 15-year water savings by a conversion factor of 4,276 lb/MG, as outlined in the Alliance for Water Efficiency Conservation Tracking Tool.*

[4] *Cumulative energy savings were calculated by multiplying 15-year water savings by a conversion factor of 968 kWh/MG for the City of Folsom, as outlined in the AB 32 Water Energy Assessment and Savings Demonstration Project.*

[5] *15-year totals for projects that included landscape transformations were calculated by reducing or discounting the first two years of savings by 50% to account for establishing the new landscape. New landscapes require more water for plant establishment. After the first two years, the full projected annual savings estimates were used for the remaining 13 years of the 15-year time frame.*

SITE #2: Homeowners Association in Sacramento, California

PROJECT SUMMARY: SITE #2

Total Area (square feet) 1,850 sqft

	Before	After
Turfgrass	1,850 sqft	0 sqft
Drought Tolerant Native Plants	0 sqft	1,850 sqft
Hardscape	0 sqft	0 sqft
Irrigation System	Sprayhead	Drip
Irrigation Controller	N/A	N/A[1]

Key Results

- The project replaced turfgrass with drought tolerant native plants and replaced a sprayhead irrigation system with a dripline irrigation system.
- The project is estimated to reduce annual irrigation water requirements by 23,000 to 49,000 gallons per year, which is a reduction of 37% to 78% from the estimated original landscape irrigation water requirement. On average, the project is expected to reduce water use by about 35,900 gallons per year.
- Over 15 years, the project is estimated to save between 321,700 and 682,900 gallons of water. On average, the project is expected to reduce water use by 57% over 15 years.
- Over 15 years, the project is estimated to save between 290 and 610 kWh of avoided embedded energy. On average, this is 450 kWh over 15 years.
- Over 15 years, the project is estimated to save between 1,400 and 2,900 tons of avoided greenhouse gas (GHG) emissions. On average, this is 2,100 tons over 15 years.

Scenario Definitions[2] and Results

Original Landscape Water Requirement (LWR): The supplemental irrigation water needed for the property before the landscape transformation. This is the amount of water applied to the landscape beyond what natural rainfall provided.

Medium LWR: The estimated supplemental irrigation water required post-project based on moderate water savings assumptions for the water requirements of the new plants. This scenario also reflects that climate change and hotter temperatures are expected to drive up water demands for landscapes. Past weather patterns and data used for this analysis might not be reflective of future weather conditions.

Low LWR: The estimated supplemental irrigation water required post-landscape transformation, based on more aggressive assumptions that the plants are mostly low water use, and the property owner or manager maintains an efficient irrigation schedule over time.

WATER AND ENERGY SAVINGS SUMMARY: SITE #2

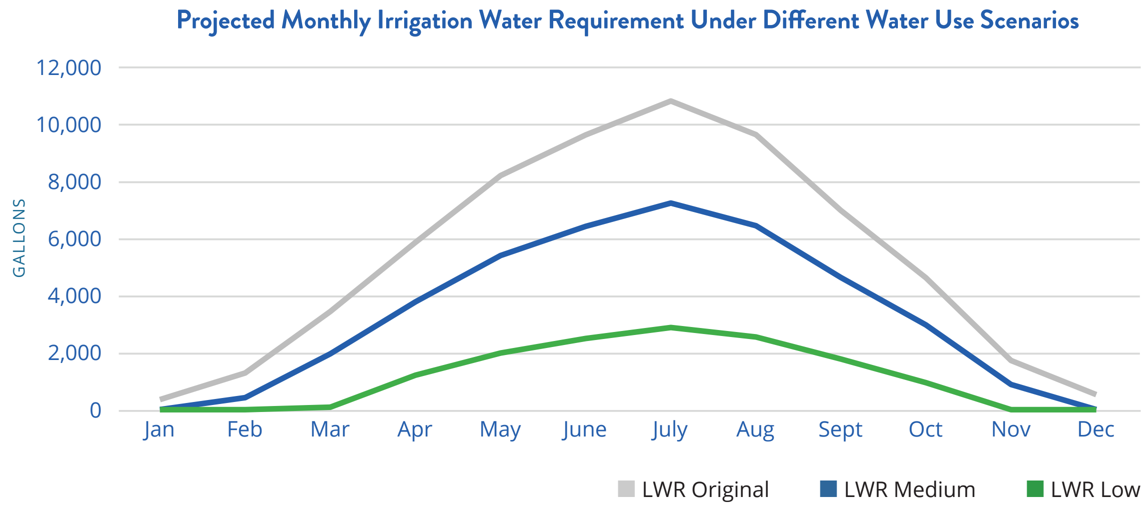
LWR = Landscape Water Requirement, the estimated supplemental irrigation water needed by the landscape

		Annual Water Calculations (gallons)	15 Year Cumulative Water Calculations (gallons)	15 Year Cumulative Percent Reduction from Original LWR	15 Year Cumulative GHG Reduction[3] (lbs of CO2 Avoided)	15 Year Cumulative Energy Savings[4] (kWh Avoided)
Before	Original LWR	62,619	876,665			
After	Medium LWR	39,638	554,932			
	Low LWR	13,837	193,722			
	Medium Savings	22,981	321,733	37%	1,351	290
	Low Savings	48,782	682,943	78%	2,868	615
	Average Savings	35,881	502,338	57%	2,110	452

Water Use · Water Savings · Energy and GHG Savings

Monthly Breakdown of Each Scenario: The graph and table below illustrate the landscape water requirement on a monthly basis for each scenario. These show the amount of supplemental water that is estimated to be needed for irrigation each month.

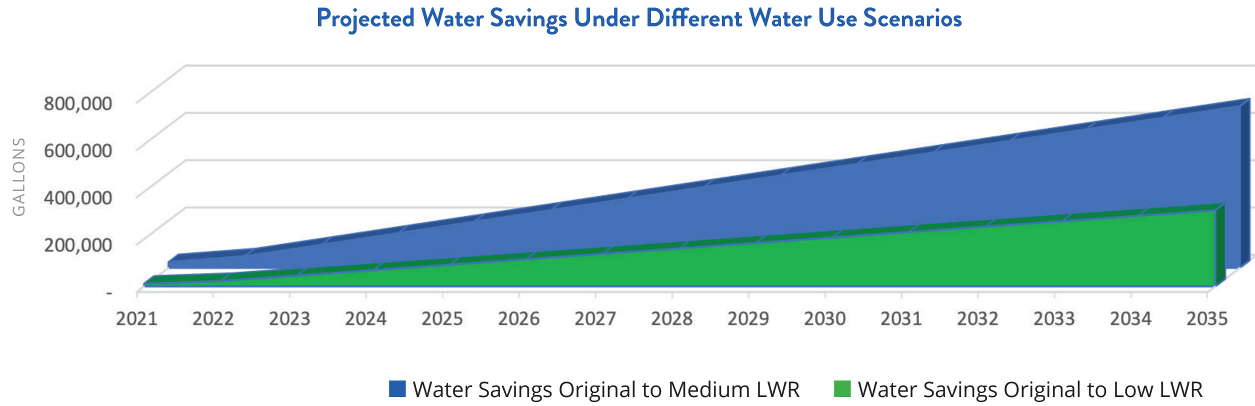
Note: Monthly LWR calculations that generated negative values were represented with a zero.



Projected Monthly Irrigation Water Requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	% Reduction
Monthly ETO (inches/month)	1.55	2.24	3.72	5.10	6.82	7.80	8.68	7.75	5.70	4.03	2.10	1.55	**57.04**	
Allowable Rainfall (inches)	0.91	0.87	0.69	0.29	0.17	0.05	0	0.01	0.07	0.24	0.52	0.81	**4.63**	
Original LWR (gallons)	310	1,243	3,400	5,823	8,168	9,593	10,779	9,602	6,950	4,583	1,685	483	**62,619**	
Medium LWR (gallons)	0	416	1,931	3,727	5,337	6,338	7,149	6,363	4,575	2,928	873	0	**39,638**	
Low LWR (gallons)	0	0	93	1,207	1,967	2,483	2,860	2,533	1,758	936	0	0	**13,837**	
Water Savings Original to Medium LWR (gallons)	310	827	1,468	2,096	2,830	3,255	3,630	3,239	2,374	1,655	812	483	**22,981**	37%
Water Savings Original to Low LWR (gallons)	310	1,243	3,307	4,617	6,201	7,110	7,919	7,069	5,191	3,647	1,685	483	**48,782**	78%
Average Water Savings (gallons)	310	1,035	2,388	3,356	4,515	5,182	5,774	5,154	3,783	2,651	1,249	483	**35,881**	57%

15-year Projected Water Savings Scenarios: The chart below projects landscape water savings by scenario over the next 15 years.[5]



Equations and Variables

$$\text{LWR} = \frac{1}{DU_{LQ}} \times [(ET_O \times K_L) - R_a] \times A \times C_u$$

DULQ = Lower quarter distribution uniformity (0.70 to reflect standard drip irrigation) ETO = Local reference evapotransipration

KL = Landscape coefficient for the type of plant in that hydrozone (0.5 f or medium LWR, 0.2 for low LWR) Ra = Allowable rainfall, designated by WaterSense as 25% of average peak monthly rainfall

A = Area of the hydrozone (square feet)

Cu = Conversion factor (0.6233 for results in gallons/ month)

Notes and Definitions

Landscape Water Requirement (LWR): The amount of supplemental water required by the design of the established landscape. The LWR is calculated by dividing the landscape into hydrozones, determining the LWR for each hydrozone, and then adding these totals together for a total landscape requirement. This is the supplemental irrigation water needed for the property; the amount of water applied to the landscape beyond what natural rainfall provides.

[1] *For properties that installed a smart irrigation controller, the "Medium" and "Low" LWR values were multiplied by 0.85 which reflects a Lawrence Berkeley National Lab study that weather-based irrigation controllers can capture average water savings of 15%.*

[2] *Water savings calculations were estimated for two different scenarios, "Medium" and "Low", to reflect possible variation in types of plants, property owner/manager irrigation decisions, climate change, and weather patterns.*

[3] *Cumulative GHG emissions avoided was calculated by multiplying 15-year water savings by a conversion factor of 4,276 lb/MG, as outlined in the Alliance for Water Efficiency Conservation Tracking Tool.*

[4] *Cumulative energy savings were calculated by multiplying 15-year water savings by a conversion factor of 999 kWh/MG for the City of Sacramento, as outlined in the AB 32 Water Energy Assessment and Savings Demonstration Project.*

[5] *15-year totals for projects that included landscape transformations were calculated by reducing or discounting the first two years of savings by 50% to account for establishing the new landscape. New landscapes require more water for plant establishment. After the first two years, the full projected annual savings estimates were used for the remaining 13 years of the 15-year time frame.*

SITE #3: Small Jewelry Business in Folsom, California

PROJECT SUMMARY: SITE #3

Total Area (square feet) 1,650 sqft

	Before	After
Turfgrass	1,650 sqft	0 sqft
Drought Tolerant Native Plants	0 sqft	1,650 sqft
Hardscape	0 sqft	0 sqft
Irrigation System	Sprayhead	Drip
Irrigation Controller	N/A	N/A[1]

Key Results

- The project replaced turfgrass with drought tolerant native plants and replaced a sprayhead irrigation system with a dripline irrigation system.
- The project is estimated to reduce annual irrigation water requirements by 20,000 to 41,700 gallons per year, which is a reduction of 37% to 78% from the estimated original landscape irrigation water requirement. On average, the project is expected to reduce water use by about 30,800 gallons per year.
- Over 15 years, the project is estimated to save between 280,300 and 584,200 gallons of water. On average, the project is expected to reduce water use by 58% over 15 years.
- Over 15 years, the project is estimated to save between 250 and 530 kWh of avoided embedded energy. On average, this is 390 kWh over 15 years.
- Over 15 years, the project is estimated to save between 1,200 and 2,500 tons of avoided greenhouse gas (GHG) emissions. On average, this is 1,800 tons over 15 years.

Scenario Definitions[2] and Results

Original Landscape Water Requirement (LWR): The supplemental irrigation water needed for the property before the landscape transformation. This is the amount of water applied to the landscape beyond what natural rainfall provided.

Medium LWR: The estimated supplemental irrigation water required post-project based on moderate water savings assumptions for the water requirements of the new plants.

This scenario also reflects that climate change and hotter temperatures are expected to drive up water demands for landscapes. Past weather patterns and data used for this analysis might not be reflective of future weather conditions.

Low LWR: The estimated supplemental irrigation water required post-landscape transformation, based on more aggressive assumptions that the plants are mostly low water use, and the property owner or manager maintains an efficient irrigation schedule over time.

WATER AND ENERGY SAVINGS SUMMARY: SITE #3

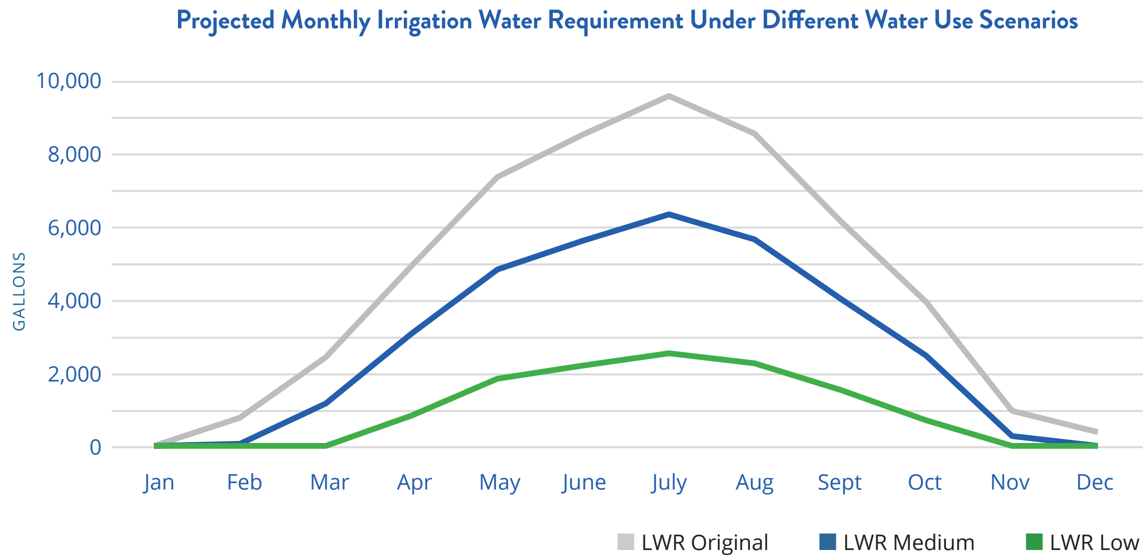
LWR = Landscape Water Requirement, the estimated supplemental irrigation water needed by the landscape

		Annual Water Calculations (gallons)	15 Year Cumulative Water Calculations (gallons)	15 Year Cumulative Percent Reduction from Original LWR	15 Year Cumulative GHG Reduction[3] (lbs of CO2 Avoided)	15 Year Cumulative Energy Savings[4] (kWh Avoided)
Before	Original LWR	53,488	748,830			
After	Medium LWR	33,469	468,560			
	Low LWR	11,762	164,675			
	Medium Savings	20,019	280,270	37%	1,177	252
	Low Savings	41,725	584,155	78%	2,453	526
	Average Savings	30,872	432,213	58%	1,815	389

Water Use | Water Savings | Energy and GHG Savings

Monthly Breakdown of Each Scenario: The graph and table below illustrate the landscape water requirement on a monthly basis for each scenario. These show the amount of supplemental water that is estimated to be needed for irrigation each month.

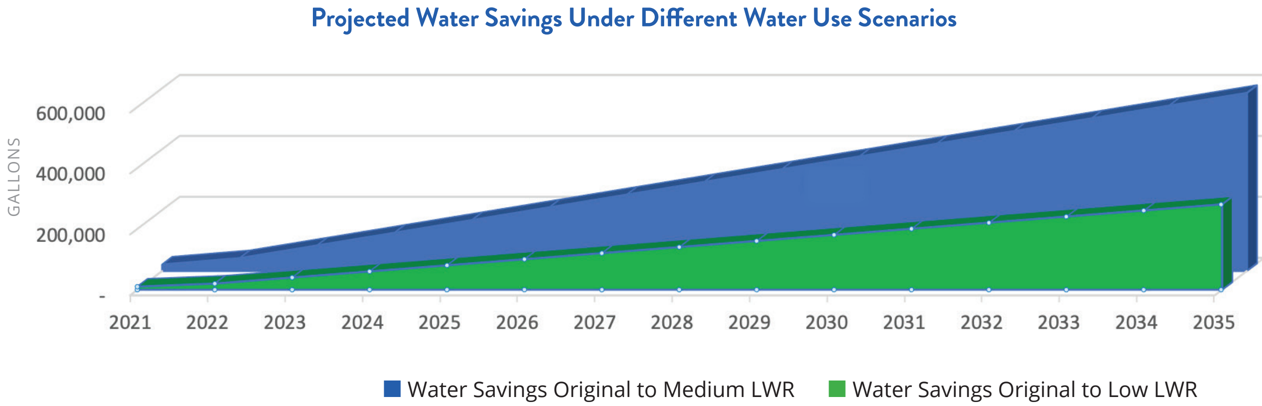
Note: Monthly LWR calculations that generated negative values were represented with a zero.



Projected Monthly Irrigation Water Requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	% Reduction
Monthly ETO (inches/month)	1.55	2.24	3.72	5.10	6.82	7.80	8.68	7.75	5.70	4.03	2.10	1.55	**57.04**	
Allowable Rainfall (inches)	1.11	1.08	1.07	0.46	0.13	0.08	0.03	0.03	0.11	0.34	0.87	0.85	**6.15**	
Original LWR (gallons)	0	768	2,423	4,917	7,352	8,516	9,566	8,536	6,143	3,933	957	376	**53,488**	
Medium LWR (gallons)	0	55	1,157	3,067	4,823	5,616	6,332	5,649	4,029	2,468	272	0	**33,469**	
Low LWR (gallons)	0	0	0	819	1,817	2,178	2,506	2,233	1,517	692	0	0	**11,762**	
Water Savings Original to Medium LWR (gallons)	0	713	1,266	1,850	2,529	2,900	3,234	2,887	2,114	1,465	685	376	**20,019**	37%
Water Savings Original to Low LWR (gallons)	0	768	2,423	4,098	5,535	6,338	7,060	6,303	4,626	3,241	957	376	**41,725**	78%
Average Water Savings (gallons)	0	741	1,845	2,974	4,032	4,619	5,147	4,595	3,370	2,353	821	376	**30,872**	58%

15-year Projected Water Savings Scenarios: The chart below projects landscape water savings by scenario over the next 15 years.[5]



Equations and Variables

$$\text{LWR} = \frac{1}{DU_{LQ}} \times [(ET_O \times K_L) - R_a] \times A \times C_u$$

DULQ = Lower quarter distribution uniformity (0.70 to reflect standard drip irrigation) ETO = Local reference evapotransipration

KL = Landscape coefficient for the type of plant in that hydrozone (0.5 f or medium LWR, 0.2 for low LWR) Ra = Allowable rainfall, designated by WaterSense as 25% of average peak monthly rainfall

A = Area of the hydrozone (square feet)

Cu = Conversion factor (0.6233 for results in gallons/ month)

Notes and Definitions

Landscape Water Requirement (LWR): The amount of supplemental water required by the design of the established landscape. The LWR is calculated by dividing the landscape into hydrozones, determining the LWR for each hydrozone, and then adding these totals together for a total landscape requirement. This is the supplemental irrigation water needed for the property; the amount of water applied to the landscape beyond what natural rainfall provides.

[1] *For properties that installed a smart irrigation controller, the "Medium" and "Low" LWR values were multiplied by 0.85 which reflects a Lawrence Berkeley National Lab study that weather-based irrigation controllers can capture average water savings of 15%.*

[2] *Water savings calculations were estimated for two different scenarios, "Medium" and "Low", to reflect possible variation in types of plants, property owner/manager irrigation decisions, climate change, and weather patterns.*

[3] *Cumulative GHG emissions avoided was calculated by multiplying 15-year water savings by a conversion factor of 4,276 lb/MG, as outlined in the Alliance for Water Efficiency Conservation Tracking Tool.*

[4] *Cumulative energy savings were calculated by multiplying 15-year water savings by a conversion factor of 968 kWh/MG for the City of Folsom, as outlined in the AB 32 Water Energy Assessment and Savings Demonstration Project.*

[5] *15-year totals for projects that included landscape transformations were calculated by reducing or discounting the first two years of savings by 50% to account for establishing the new landscape. New landscapes require more water for plant establishment. After the first two years, the full projected annual savings estimates were used for the remaining 13 years of the 15-year time frame.*

SITE #4: Small Business Park in Folsom, California

PROJECT SUMMARY: SITE #4

Total Area (square feet) 3,820 sqft

	Before	After
Turfgrass	3,820 sqft	0 sqft
Drought Tolerant Native Plants	0 sqft	3,820 sqft
Hardscape	0 sqft	0 sqft
Irrigation System	Sprayhead	Drip
Irrigation Controller	N/A	N/A[1]

Key Results

- The project replaced turfgrass with drought tolerant native plants and replaced a sprayhead irrigation system with a dripline irrigation system.
- The project is estimated to reduce annual irrigation water requirements by 46,300 to 96,600 gallons per year, which is a reduction of 37% to 78% from the estimated original landscape irrigation water requirement. On average, the project is expected to reduce water use by about 71,474 gallons per year.
- Over 15 years, the project is estimated to save between 648,900 and 1,352,400 gallons of water. On average, the project is expected to reduce water use by 58% over 15 years.
- Over 15 years, the project is estimated to save between 580 and 1,200 kWh of avoided embedded energy. On average, this is 900 kWh over 15 years.
- Over 15 years, the project is estimated to save between 2,700 and 5,700 tons of avoided greenhouse gas (GHG) emissions. On average, this is 4,200 tons over 15 years.

Scenario Definitions[2] and Results

Original Landscape Water Requirement (LWR): The supplemental irrigation water needed for the property before the landscape transformation. This is the amount of water applied to the landscape beyond what natural rainfall provided.

Medium LWR: The estimated supplemental irrigation water required post-project based on moderate water savings assumptions for the water requirements of the new plants.

This scenario also reflects that climate change and hotter temperatures are expected to drive up water demands for landscapes. Past weather patterns and data used for this analysis might not be reflective of future weather conditions.

Low LWR: The estimated supplemental irrigation water required post-landscape transformation, based on more aggressive assumptions that the plants are mostly low water use, and the property owner or manager maintains an efficient irrigation schedule over time.

WATER AND ENERGY SAVINGS SUMMARY: SITE #4

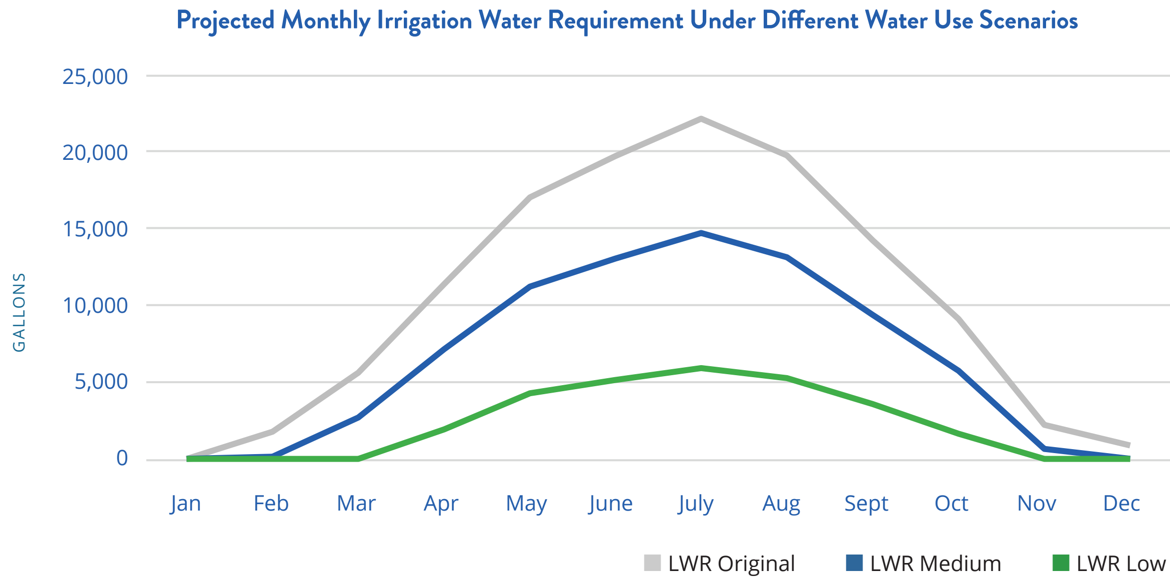
LWR = Landscape Water Requirement, the estimated supplemental irrigation water needed by the landscape

		Annual Water Calculations (gallons)	15 Year Cumulative Water Calculations (gallons)	15 Year Cumulative Percent Reduction from Original LWR	15 Year Cumulative GHG Reduction[3] (lbs of CO2 Avoided)	15 Year Cumulative Energy Savings[4] (kWh Avoided)
Before	Original LWR	123,832	1,733,654			
After	Medium LWR	77,485	1,084,786			
	Low LWR	27,232	381,247			
	Medium Savings	46,348	648,868	37%	2,725	584
	Low Savings	96,601	1,352,408	78%	5,680	1,217
	Average Savings	71,474	1,000,638	58%	4,203	901

Water Use | Water Savings | Energy and GHG Savings

Monthly Breakdown of Each Scenario: The graph and table below illustrate the landscape water requirement on a monthly basis for each scenario. These show the amount of supplemental water that is estimated to be needed for irrigation each month.

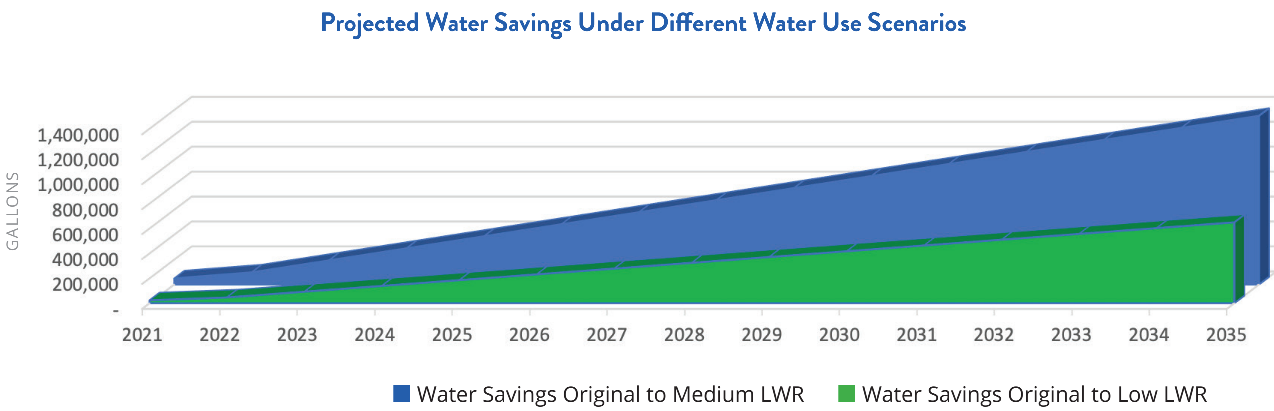
Note: Monthly LWR calculations that generated negative values were represented with a zero.



Projected Monthly Irrigation Water Requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	% Reduction
Monthly ETO (inches/month)	1.55	2.24	3.72	5.10	6.82	7.80	8.68	7.75	5.70	4.03	2.10	1.55	**57.04**	
Allowable Rainfall (inches)	1.11	1.08	1.07	0.46	0.13	0.08	0.03	0.03	0.11	0.34	0.87	0.85	**6.15**	
Original LWR (gallons)	0	1,778	5,610	11,383	17,021	19,717	22,147	19,762	14,222	9,106	2,216	870	**123,832**	
Medium LWR (gallons)	0	128	2,679	7,101	11,165	13,002	14,660	13,079	9,328	5,714	629	0	**77,485**	
Low LWR (gallons)	0	0	0	1,896	4,206	5,043	5,803	5,170	3,512	1,602	0	0	**27,232**	
Water Savings Original to Medium LWR (gallons)	0	1,651	2,931	4,283	5,855	6,715	7,487	6,684	4,893	3,392	1,587	870	**46,348**	37%
Water Savings Original to Low LWR (gallons)	0	1,778	5,610	9,487	12,815	14,674	16,344	14,592	10,710	7,504	2,216	870	**96,601**	78%
Average Water Savings (gallons)	0	1,715	4,271	6,885	9,335	10,694	11,915	10,638	7,802	5,448	1,902	870	**71,474**	58%

15-year Projected Water Savings Scenarios: The chart below projects landscape water savings by scenario over the next 15 years.[5]



Equations and Variables

$$LWR = \frac{1}{DU_{LQ}} \times [(ET_O \times K_L) - R_a] \times A \times C_u$$

DULQ = Lower quarter distribution uniformity (0.70 to reflect standard drip irrigation) ETO = Local reference evapotransipration

KL = Landscape coefficient for the type of plant in that hydrozone (0.5 f or medium LWR, 0.2 for low LWR) Ra = Allowable rainfall, designated by WaterSense as 25% of average peak monthly rainfall

A = Area of the hydrozone (square feet)

Cu = Conversion factor (0.6233 for results in gallons/month)

Notes and Definitions

Landscape Water Requirement (LWR): The amount of supplemental water required by the design of the established landscape. The LWR is calculated by dividing the landscape into hydrozones, determining the LWR for each hydrozone, and then adding these totals together for a total landscape requirement. This is the supplemental irrigation water needed for the property; the amount of water applied to the landscape beyond what natural rainfall provides.

[1] *For properties that installed a smart irrigation controller, the "Medium" and "Low" LWR values were multiplied by 0.85 which reflects a Lawrence Berkeley National Lab study that weather-based irrigation controllers can capture average water savings of 15%.*

[2] *Water savings calculations were estimated for two different scenarios, "Medium" and "Low", to reflect possible variation in types of plants, property owner/manager irrigation decisions, climate change, and weather patterns.*

[3] *Cumulative GHG emissions avoided was calculated by multiplying 15-year water savings by a conversion factor of 4,276 lb/MG, as outlined in the Alliance for Water Efficiency Conservation Tracking Tool.*

[4] *Cumulative energy savings were calculated by multiplying 15-year water savings by a conversion factor of 968 kWh/MG for the City of Folsom, as outlined in the AB 32 Water Energy Assessment and Savings Demonstration Project.*

[5] *15-year totals for projects that included landscape transformations were calculated by reducing or discounting the first two years of savings by 50% to account for establishing the new landscape. New landscapes require more water for plant establishment. After the first two years, the full projected annual savings estimates were used for the remaining 13 years of the 15-year time frame.*

SITE #5: Place of Worship in Sacramento, California

PROJECT SUMMARY: SITE #5

Total Area (square feet) 26,000 sqft

	Before	After
Turfgrass	26,000 sqft	26,000 sqft
Drought Tolerant Native Plants	0 sqft	0 sqft
Hardscape	0 sqft	0 sqft
Irrigation System	Sprayhead	Stream Rotors
Irrigation Controller	Traditional	Smart[1]

Key Results

- The project replaced a sprayhead irrigation system with stream rotors and replaced a traditional irrigation controller with a smart controller.
- The project is estimated to reduce annual irrigation water requirements by about 215,400 to 327,700 gallons per year, which is a reduction of 21% to 32% from the estimated original landscape irrigation water requirement. On average, the project is expected to reduce water use by about 271,500 gallons per year.
- Over 15 years, the project is estimated to save between approximately 3,231,000 and 3,343,000 gallons of water. On average, the project is expected to reduce water use by 21% over 15 years.
- Over 15 years, the project is estimated to save between about 2,900 and 3,000 kWh of avoided embedded energy. On average, this is 2,950 kWh over 15 years.
- Over 15 years, the project is estimated to save between approximately 13,600 and 14,000 pounds of avoided greenhouse gas (GHG) emissions. On average, this is 13,800 pounds over 15 years.

Scenario Definitions[2] and Results

Original Landscape Water Requirement (LWR): The supplemental irrigation water needed for the property before the landscape transformation. This is the amount of water applied to the landscape beyond what natural rainfall provided.

Medium LWR: The estimated supplemental irrigation water required post-project based on moderate water savings assumptions for the water requirements of the new plants.

This scenario also reflects that climate change and hotter temperatures are expected to drive up water demands for landscapes. Past weather patterns and data used for this analysis might not be reflective of future weather conditions.

Low LWR: The estimated supplemental irrigation water required post-landscape transformation, based on more aggressive assumptions that the plants are mostly low water use, and the property owner or manager maintains an efficient irrigation schedule over time.

WATER AND ENERGY SAVINGS SUMMARY: SITE #5

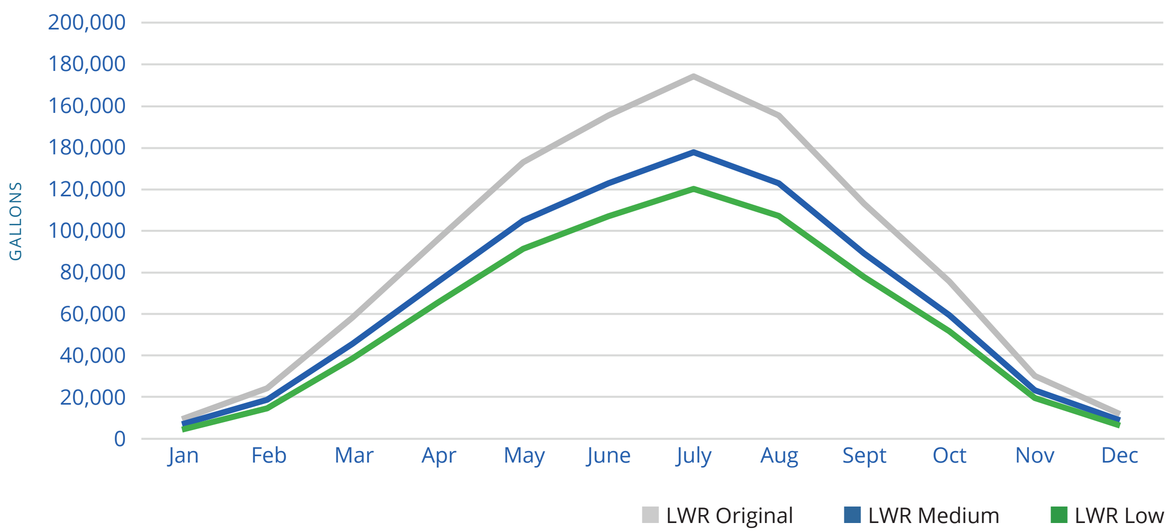
LWR = Landscape Water Requirement, the estimated supplemental irrigation water needed by the landscape

		Annual Water Calculations (gallons)	15 Year Cumulative Water Calculations (gallons)	15 Year Cumulative Percent Reduction from Original LWR	15 Year Cumulative GHG Reduction[3] (lbs of CO2 Avoided)	15 Year Cumulative Energy Savings[4] (kWh Avoided)
Before	Original LWR	1,022,262	15,333,928			
After	Medium LWR	806,857	12,102,850			
	Low LWR	694,611	11,990,604			
	Medium Savings	215,405	3,231,078	21%	13,571	2,908
	Low Savings	327,651	3,343,324	22%	14,042	3,009
	Average Savings	271,528	3,287,201	21%	13,806	2,958

Water Use | Water Savings | Energy and GHG Savings

Monthly Breakdown of Each Scenario: The graph and table below illustrate the landscape water requirement on a monthly basis for each scenario. These show the amount of supplemental water that is estimated to be needed for irrigation each month.

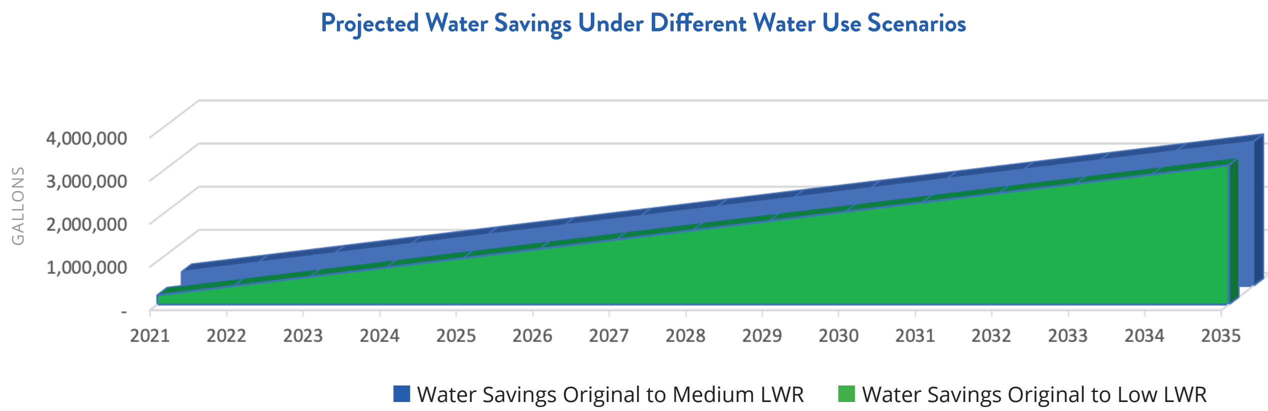
Projected Monthly Irrigation Water Requirement Under Different Water Use Scenarios



Projected Monthly Irrigation Water Requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	% Reduction
Monthly ETO (inches/month)	1.55	2.24	3.72	5.10	6.82	7.80	8.68	7.75	5.70	4.03	2.10	1.55	**57.04**	
Allowable Rainfall (inches)	0.91	0.87	0.69	0.29	0.17	0.05	0	0.01	0.07	0.24	0.52	0.81	**4.63**	
Original LWR (gallons)	8,228	23,050	57,057	94,555	131,791	154,267	173,128	154,267	111,882	74,459	28,921	10,658	**1,022,262**	
Medium LWR (gallons)	6,494	18,193	45,034	74,631	104,020	121,761	136,647	121,761	88,307	58,770	22,827	8,413	**806,857**	
Low LWR (gallons)	3,444	13,785	37,714	64,595	90,600	106,411	119,566	106,510	77,090	50,839	18,695	5,362	**694,611**	
Water Savings Original to Medium LWR (gallons)	1,734	4,857	12,023	19,924	27,770	32,506	36,481	32,506	23,575	15,690	6,094	2,246	**215,405**	21%
Water Savings Original to Low LWR (gallons)	4,784	9,265	19,343	29,960	41,191	47,855	53,561	47,757	34,792	23,620	10,227	5,296	**327,651**	32%
Average Water Savings (gallons)	3,259	7,061	15,683	24,942	34,481	40,181	45,021	40,132	29,184	19,655	8,160	3,771	**271,528**	27%

15-year Projected Water Savings Scenarios: The chart below projects landscape water savings by scenario over the next 15 years.[5]



Equations and Variables

$$\text{LWR} = \frac{1}{DU_{LQ}} \times [(ET_O \times K_L) - R_a] \times A \times C_u$$

DULQ = Lower quarter distribution uniformity (0.70 to reflect standard drip irrigation) ETO = Local reference evapotranspiration

KL = Landscape coefficient for the type of plant in that hydrozone (0.5 f or medium LWR, 0.2 for low LWR) Ra = Allowable rainfall, designated by WaterSense as 25% of average peak monthly rainfall

A = Area of the hydrozone (square feet)

Cu = Conversion factor (0.6233 for results in gallons/ month)

Notes and Definitions

Landscape Water Requirement (LWR): The amount of supplemental water required by the design of the established landscape. The LWR is calculated by dividing the landscape into hydrozones, determining the LWR for each hydrozone, and then adding these totals together for a total landscape requirement. This is the supplemental irrigation water needed for the property; the amount of water applied to the landscape beyond what natural rainfall provides.

[1] For properties that installed a smart irrigation controller, the "Medium" and "Low" LWR values were multiplied by 0.85 which reflects a Lawrence Berkeley National Lab study that weather-based irrigation controllers can capture average water savings of 15%.

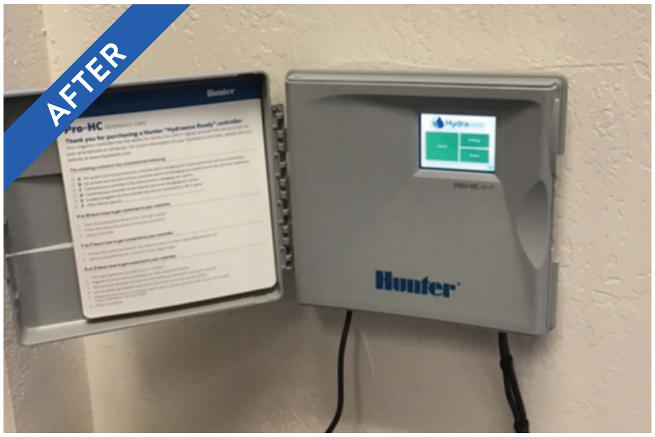
[2] Water savings calculations were estimated for two different scenarios, "Medium" and "Low", to reflect possible variation in types of plants, property owner/manager irrigation decisions, climate change, and weather patterns.

[3] Cumulative GHG emissions avoided was calculated by multiplying 15-year water savings by a conversion factor of 4,276 lb/MG, as outlined in the Alliance for Water Efficiency Conservation Tracking Tool.

[4] Cumulative energy savings were calculated by multiplying 15-year water savings by a conversion factor of 999 kWh/MG for the City of Sacramento, as outlined in the AB 32 Water Energy Assessment and Savings Demonstration Project.

[5] 15-year totals for projects that included landscape transformations were calculated by reducing or discounting the first two years of savings by 50% to account for establishing the new landscape. New landscapes require more water for plant establishment. After the first two years, the full projected annual savings estimates were used for the remaining 13 years of the 15-year time frame.

SITE #6: Business Park in Sacramento, California



PROJECT SUMMARY: SITE #6

Total Area (square feet) 7,240 sqft

	Before	After
Turfgrass	7,240 sqft	7,240 sqft
Drought Tolerant Native Plants	0 sqft	0 sqft
Hardscape	0 sqft	0 sqft
Irrigation System	Sprayhead	Stream Rotors and Drip
Irrigation Controller	Traditional	Smart1

Key Results

- The project replaced a sprayhead irrigation system with stream rotors and dripline irrigation and replaced a traditional irrigation controller with a smart controller.
- The project is estimated to reduce annual irrigation water requirements by about 60,000 to 76,300 gallons per year, which is a reduction of 21% to 27% from the estimated original landscape irrigation water requirement. On average, the project is expected to reduce water use by about 68,200 gallons per year.
- Over 15 years, the project is estimated to save between approximately 900,000 and 916,100 gallons of water. On average, the project is expected to reduce water use by 21% over 15 years.
- Over 15 years, the project is estimated to save between about 800 and 820 kWh of avoided embedded energy. On average, this is 810 kWh over 15 years.
- Over 15 years, the project is estimated to save between approximately 3,780 and 3,850 pounds of avoided greenhouse gas (GHG) emissions. On average, this is 3,815 pounds over 15 years.

Scenario Definitions[2] and Results

Original Landscape Water Requirement (LWR): The supplemental irrigation water needed for the property before the landscape transformation. This is the amount of water applied to the landscape beyond what natural rainfall provided.

Medium LWR: The estimated supplemental irrigation water required post-project based on moderate water savings assumptions for the water requirements of the new plants.

This scenario also reflects that climate change and hotter temperatures are expected to drive up water demands for landscapes. Past weather patterns and data used for this analysis might not be reflective of future weather conditions.

Low LWR: The estimated supplemental irrigation water required post-landscape transformation, based on more aggressive assumptions that the plants are mostly low water use, and the property owner or manager maintains an efficient irrigation schedule over time.

WATER AND ENERGY SAVINGS SUMMARY: SITE #6

LWR = Landscape Water Requirement, the estimated supplemental irrigation water needed by the landscape

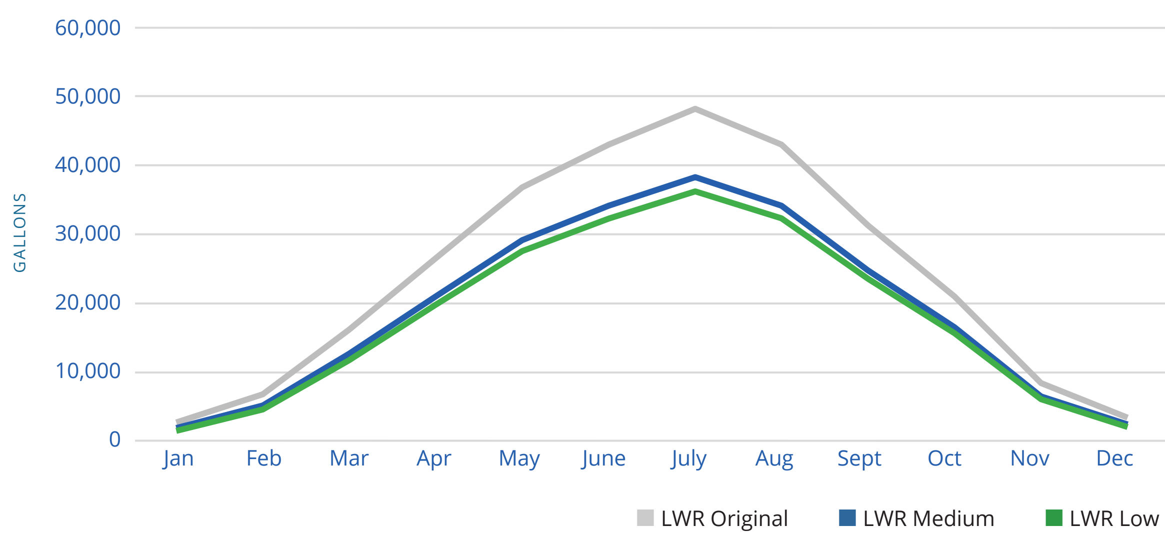
		Annual Water Calculations (gallons)	15 Year Cumulative Water Calculations (gallons)	15 Year Cumulative Percent Reduction from Original LWR	15 Year Cumulative GHG Reduction[3] (lbs of CO2 Avoided)	15 Year Cumulative Energy Savings[4] (kWh Avoided)
Before	Original LWR	284,661	4,269,909			
After	Medium LWR	224,679	3,370,178			
	Low LWR	208,301	3,353,801			
	Medium Savings	59,982	899,731	21%	3,779	810
	Low Savings	76,360	916,108	21%	3,848	824
	Average Savings	68,171	907,920	21%	3,813	817

Water Use | Water Savings | Energy and GHG Savings

Monthly Breakdown of Each Scenario: The graph and table below illustrate the landscape water requirement on a monthly basis for each scenario. These show the amount of supplemental water that is estimated to be needed for irrigation each month.

Note: Monthly LWR calculations that generated negative values were represented with a zero.

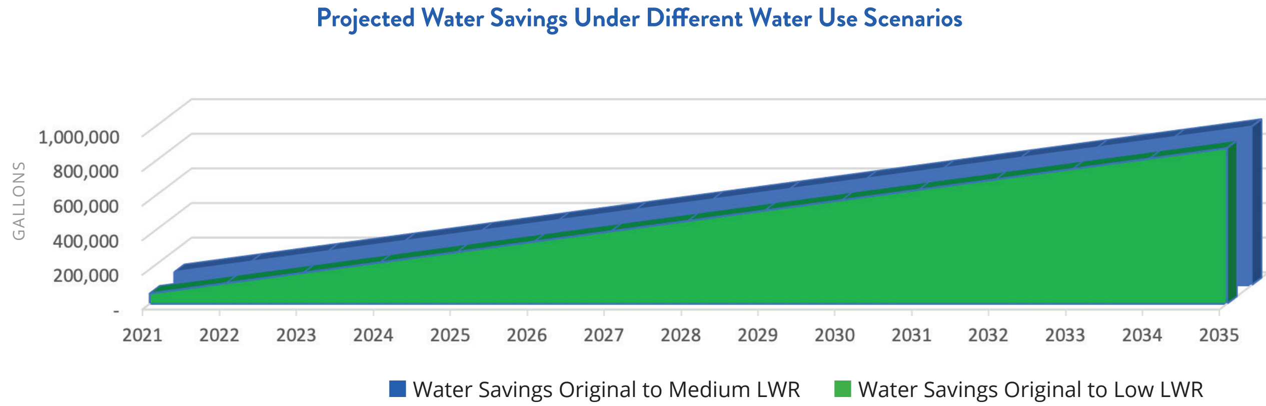
Projected Monthly Irrigation Water Requirement Under Different Water Use Scenarios



Projected Monthly Irrigation Water Requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	% Reduction
Monthly ETO (inches/month)	1.55	2.24	3.72	5.10	6.82	7.80	8.68	7.75	5.70	4.03	2.10	1.55	**57.04**	--
Allowable Rainfall (inches)	0.91	0.87	0.69	0.29	0.17	0.05	0	0.01	0.07	0.24	0.52	0.81	**4.63**	--
Original LWR (gallons)	1,128	4,516	12,355	21,161	29,681	34,861	39,170	34,893	25,255	16,655	6,124	1,757	**227,556**	--
Medium LWR (gallons)	2,291	6,418	15,888	26,330	36,699	42,957	48,209	42,957	31,155	20,734	8,053	2,968	**284,661**	-
Low LWR (gallons)	1,808	5,066	12,540	20,782	28,966	33,906	38,051	33,906	24,590	16,365	6,356	2,343	**224,679**	-
Water Savings Original to Medium LWR (gallons)	1,033	4,134	11,310	19,371	27,169	31,911	35,856	31,940	23,118	15,246	5,606	1,608	**208,301**	21%
Water Savings Original to Low LWR (gallons)	483	1,352	3,348	5,548	7,733	9,052	10,158	9,052	6,565	4,369	1,697	625	**59,982**	27%
Average Water Savings (gallons)	871	1,819	3,963	6,254	8,631	10,049	11,256	10,034	7,301	4,929	2,072	993	**68,171**	24%

15-year Projected Water Savings Scenarios: The chart below projects landscape water savings by scenario over the next 15 years.[5]



Equations and Variables

$$\text{LWR} = \frac{1}{DU_{LQ}} \times [(ET_O \times K_L) - R_a] \times A \times C_u$$

DULQ = Lower quarter distribution uniformity (0.70 to reflect standard drip irrigation) ETO = Local reference evapotransipration

KL = Landscape coefficient for the type of plant in that hydrozone (0.5 f or medium LWR, 0.2 for low LWR) Ra = Allowable rainfall, designated by WaterSense as 25% of average peak monthly rainfall

A = Area of the hydrozone (square feet)

Cu = Conversion factor (0.6233 for results in gallons/ month)

Notes and Definitions

Landscape Water Requirement (LWR): The amount of supplemental water required by the design of the established landscape. The LWR is calculated by dividing the landscape into hydrozones, determining the LWR for each hydrozone, and then adding these totals together for a total landscape requirement. This is the supplemental irrigation water needed for the property; the amount of water applied to the landscape beyond what natural rainfall provides.

[1] *For properties that installed a smart irrigation controller, the "Medium" and "Low" LWR values were multiplied by 0.85 which reflects a Lawrence Berkeley National Lab study that weather-based irrigation controllers can capture average water savings of 15%.*

[2] *Water savings calculations were estimated for two different scenarios, "Medium" and "Low", to reflect possible variation in types of plants, property owner/manager irrigation decisions, climate change, and weather patterns.*

[3] *Cumulative GHG emissions avoided was calculated by multiplying 15-year water savings by a conversion factor of 4,276 lb/MG, as outlined in the Alliance for Water Efficiency Conservation Tracking Tool.*

[4] *Cumulative energy savings were calculated by multiplying 15-year water savings by a conversion factor of 999 kWh/MG for the City of Sacramento, as outlined in the AB 32 Water Energy Assessment and Savings Demonstration Project.*

[5] *15-year totals for projects that included landscape transformations were calculated by reducing or discounting the first two years of savings by 50% to account for establishing the new landscape. New landscapes require more water for plant establishment. After the first two years, the full projected annual savings estimates were used for the remaining 13 years of the 15-year time frame.*

SITE #7: Peregrine Public Park in Sacramento, California

PROJECT SUMMARY: SITE #7

Total Area (square feet) 316,000 sqft

	Before	After
Turfgrass	316,000 sqft	316,000 sqft
Drought Tolerant Native Plants	0 sqft	0 sqft
Hardscape	0 sqft	0 sqft
Irrigation System	Sprayhead	Sprayhead
Irrigation Controller	Traditional	Smart[1]

Key Results

- The project replaced a traditional irrigation controller with a smart controller.
- The project is estimated to reduce annual irrigation water requirements by about 1,864,000 to 3,333,000 gallons per year, which is a reduction of 15% to 27% from the estimated original landscape irrigation water requirement. On average, the project is expected to reduce water use by about 2,598,000 gallons per year.
- Over 15 years, the project is estimated to save between approximately 27,955,000 and 29,242,000 gallons of water. On average, the project is expected to reduce water use by 15% over 15 years.
- Over 15 years, the project is estimated to save between about 25,200 and 26,500 kWh of avoided embedded energy. On average, this is 25,800 kWh over 15 years.
- Over 15 years, the project is estimated to save between approximately 117,400 and 123,600 pounds of avoided greenhouse gas (GHG) emissions. On average, this is 120,500 pounds over 15 years.

Scenario Definitions[2] and Results

Original Landscape Water Requirement (LWR): The supplemental irrigation water needed for the property before the landscape transformation. This is the amount of water applied to the landscape beyond what natural rainfall provided.

Medium LWR: The estimated supplemental irrigation water required post-project based on moderate water savings assumptions for the water requirements of the new plants.

This scenario also reflects that climate change and hotter temperatures are expected to drive up water demands for landscapes. Past weather patterns and data used for this analysis might not be reflective of future weather conditions.

Low LWR: The estimated supplemental irrigation water required post-landscape transformation, based on more aggressive assumptions that the plants are mostly low water use, and the property owner or manager maintains an efficient irrigation schedule over time.

WATER AND ENERGY SAVINGS SUMMARY: SITE #7

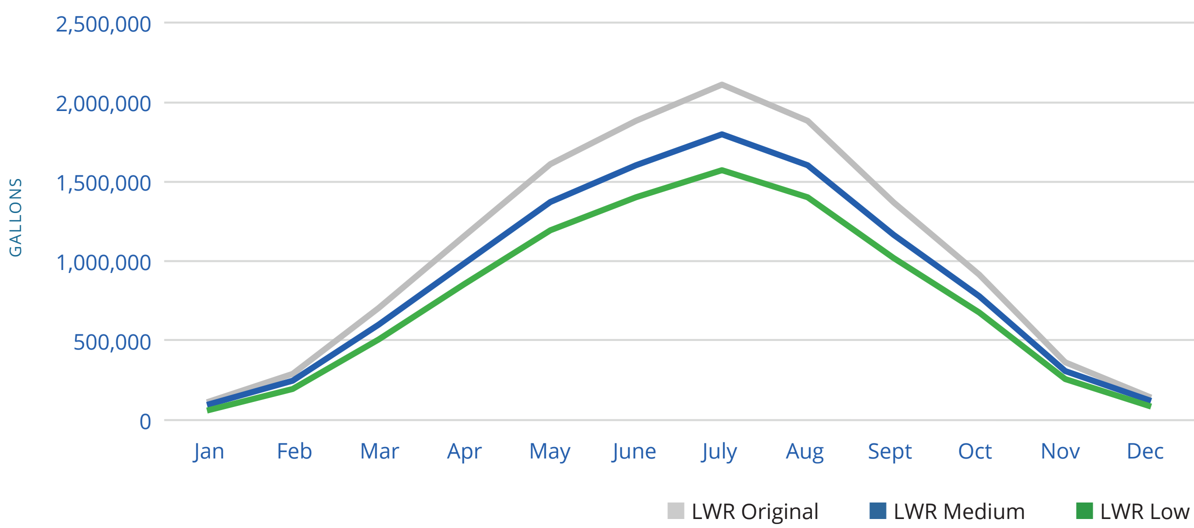
LWR = Landscape Water Requirement, the estimated supplemental irrigation water needed by the landscape

		Annual Water Calculations (gallons)	15 Year Cumulative Water Calculations (gallons)	15 Year Cumulative Percent Reduction from Original LWR	15 Year Cumulative GHG Reduction[3] (lbs of CO2 Avoided)	15 Year Cumulative Energy Savings[4] (kWh Avoided)
Before	Original LWR	12,424,413	186,366,201			
After	Medium LWR	10,560,751	158,411,271			
	Low LWR	9,091,591	156,942,110			
	Medium Savings	1,863,662	27,954,930	15%	117,411	25,159
	Low Savings	3,332,823	29,424,091	16%	123,581	26,482
	Average Savings	2,598,242	28,689,511	15%	120,500	25,821

Water Use   Water Savings   Energy and GHG Savings

Monthly Breakdown of Each Scenario: The graph and table below illustrate the landscape water requirement on a monthly basis for each scenario. These show the amount of supplemental water that is estimated to be needed for irrigation each month.

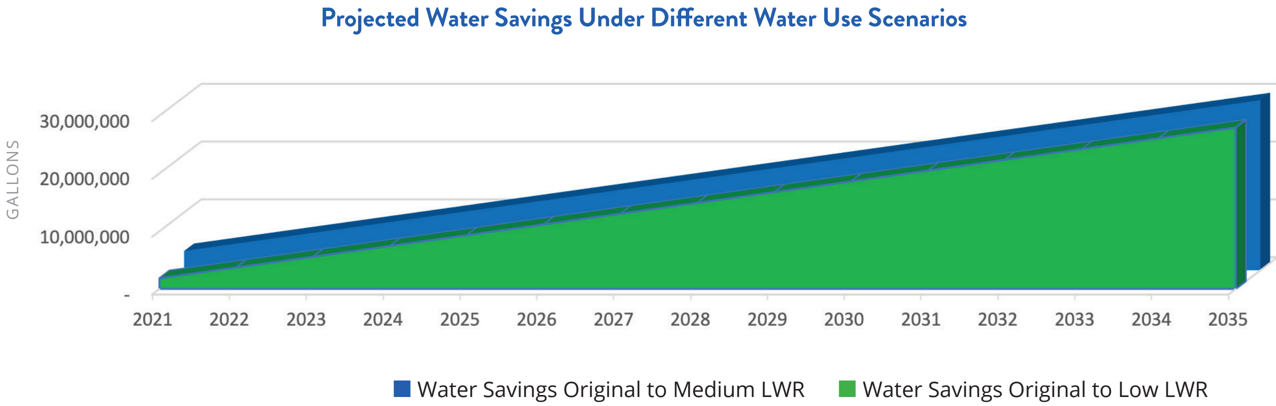
Projected Monthly Irrigation Water Requirement Under Different Water Use Scenarios



Projected Monthly Irrigation Water Requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	% Reduction
Monthly ETO (inches/month)	1.55	2.24	3.72	5.10	6.82	7.80	8.68	7.75	5.70	4.03	2.10	1.55	**57.04**	--
Allowable Rainfall (inches)	0.91	0.87	0.69	0.29	0.17	0.05	0	0.01	0.07	0.24	0.52	0.81	**4.63**	--
Original LWR (gallons)	1,128	4,516	12,355	21,161	29,681	34,861	39,170	34,893	25,255	16,655	6,124	1,757	**227,556**	--
Medium LWR (gallons)	2,291	6,418	15,888	26,330	36,699	42,957	48,209	42,957	31,155	20,734	8,053	2,968	**284,661**	-
Low LWR (gallons)	1,808	5,066	12,540	20,782	28,966	33,906	38,051	33,906	24,590	16,365	6,356	2,343	**224,679**	-
Water Savings Original to Medium LWR (gallons)	1,033	4,134	11,310	19,371	27,169	31,911	35,856	31,940	23,118	15,246	5,606	1,608	**208,301**	21%
Water Savings Original to Low LWR (gallons)	483	1,352	3,348	5,548	7,733	9,052	10,158	9,052	6,565	4,369	1,697	625	**59,982**	27%
Average Water Savings (gallons)	871	1,819	3,963	6,254	8,631	10,049	11,256	10,034	7,301	4,929	2,072	993	**68,171**	24%

15-year Projected Water Savings Scenarios: The chart below projects landscape water savings by scenario over the next 15 years.[5]



Equations and Variables

$$\text{LWR} = \frac{1}{DU_{LQ}} \times [(ET_O \times K_L) - R_a] \times A \times C_u$$

DULQ = Lower quarter distribution uniformity (0.70 to reflect standard drip irrigation) ETO = Local reference evapotransipration

KL = Landscape coefficient for the type of plant in that hydrozone (0.5 f or medium LWR, 0.2 for low LWR) Ra = Allowable rainfall, designated by WaterSense as 25% of average peak monthly rainfall

A = Area of the hydrozone (square feet)

Cu = Conversion factor (0.6233 for results in gallons/ month)

Notes and Definitions

Landscape Water Requirement (LWR): The amount of supplemental water required by the design of the established landscape. The LWR is calculated by dividing the landscape into hydrozones, determining the LWR for each hydrozone, and then adding these totals together for a total landscape requirement. This is the supplemental irrigation water needed for the property; the amount of water applied to the landscape beyond what natural rainfall provides.

[1] *For properties that installed a smart irrigation controller, the "Medium" and "Low" LWR values were multiplied by 0.85 which reflects a Lawrence Berkeley National Lab study that weather-based irrigation controllers can capture average water savings of 15%.*

[2] *Water savings calculations were estimated for two different scenarios, "Medium" and "Low", to reflect possible variation in types of plants, property owner/manager irrigation decisions, climate change, and weather patterns.*

[3] *Cumulative GHG emissions avoided was calculated by multiplying 15-year water savings by a conversion factor of 4,276 lb/MG, as outlined in the Alliance for Water Efficiency Conservation Tracking Tool.*

[4] *Cumulative energy savings were calculated by multiplying 15-year water savings by a conversion factor of 999 kWh/MG for the City of Sacramento, as outlined in the AB 32 Water Energy Assessment and Savings Demonstration Project.*

[5] *15-year totals for projects that included landscape transformations were calculated by reducing or discounting the first two years of savings by 50% to account for establishing the new landscape. New landscapes require more water for plant establishment. After the first two years, the full projected annual savings estimates were used for the remaining 13 years of the 15-year time frame.*

SITE #8: Tanzanite Public Park in Sacramento, California

PROJECT SUMMARY: SITE #8

Total Area (square feet) 724,000 sqft

	Before	After
Turfgrass	724,000 sqft	724,000 sqft
Drought Tolerant Native Plants	0 sqft	0 sqft
Hardscape	0 sqft	0 sqft
Irrigation System	Sprayhead	Sprayhead
Irrigation Controller	Traditional	Smart[1]

Key Results

- The project replaced a traditional irrigation controller with a smart controller.
- The project is estimated to reduce annual irrigation water requirements by about 4,270,000 to 7,636,000 gallons per year, which is a reduction of 15% to 27% from the estimated original landscape irrigation water requirement. On average, the project is expected to reduce water use by about 5,953,000 gallons per year.
- Over 15 years, the project is estimated to save between approximately 64,049,000 and 67,415,000 gallons of water. On average, the project is expected to reduce water use by 15% over 15 years.
- Over 15 years, the project is estimated to save between about 57,600 and 60,700 kWh of avoided embedded energy. On average, this is 59,200 kWh over 15 years.
- Over 15 years, the project is estimated to save between approximately 269,000 and 283,100 pounds of avoided greenhouse gas (GHG) emissions. On average, this is 276,000 pounds over 15 years.

Scenario Definitions[2] and Results

Original Landscape Water Requirement (LWR): The supplemental irrigation water needed for the property before the landscape transformation. This is the amount of water applied to the landscape beyond what natural rainfall provided.

Medium LWR: The estimated supplemental irrigation water required post-project based on moderate water savings assumptions for the water requirements of the new plants.

This scenario also reflects that climate change and hotter temperatures are expected to drive up water demands for landscapes. Past weather patterns and data used for this analysis might not be reflective of future weather conditions.

Low LWR: The estimated supplemental irrigation water required post-landscape transformation, based on more aggressive assumptions that the plants are mostly low water use, and the property owner or manager maintains an efficient irrigation schedule over time.

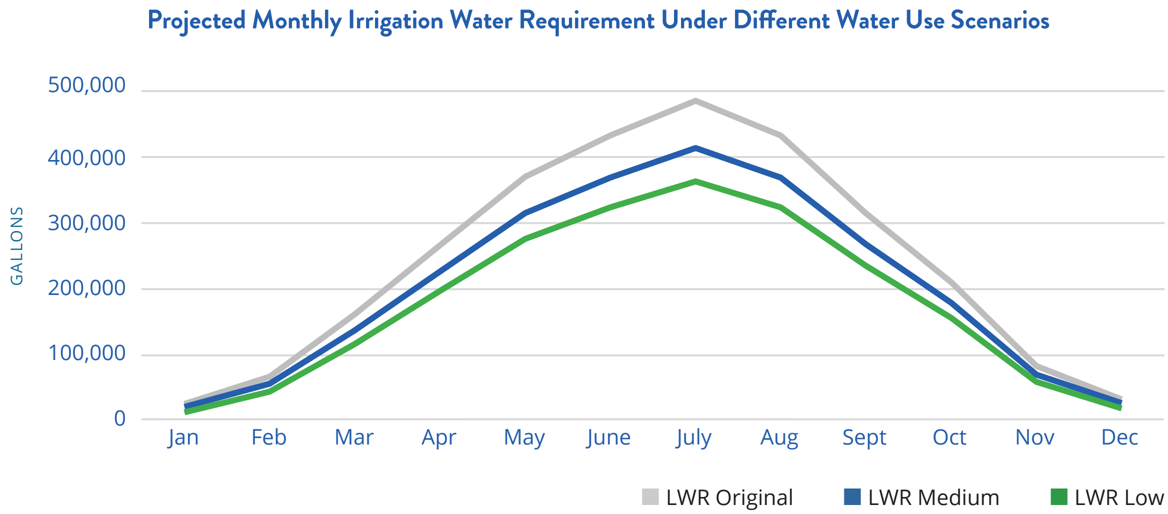
WATER AND ENERGY SAVINGS SUMMARY: SITE #8

LWR = Landscape Water Requirement, the estimated supplemental irrigation water needed by the landscape

		Annual Water Calculations (gallons)	15 Year Cumulative Water Calculations (gallons)	15 Year Cumulative Percent Reduction from Original LWR	15 Year Cumulative GHG Reduction[3] (lbs of CO2 Avoided)	15 Year Cumulative Energy Savings[4] (kWh Avoided)
Before	Original LWR	28,466,061	426,990,917			
After	Medium LWR	24,196,152	362,942,279			
	Low LWR	20,830,100	359,576,228			
	Medium Savings	4,269,909	64,048,638	15%	269,004	57,644
	Low Savings	7,635,961	67,414,689	16%	283,142	60,673
	Average Savings	5,952,935	65,731,663	15%	276,073	59,158

Water Use   Water Savings   Energy and GHG Savings

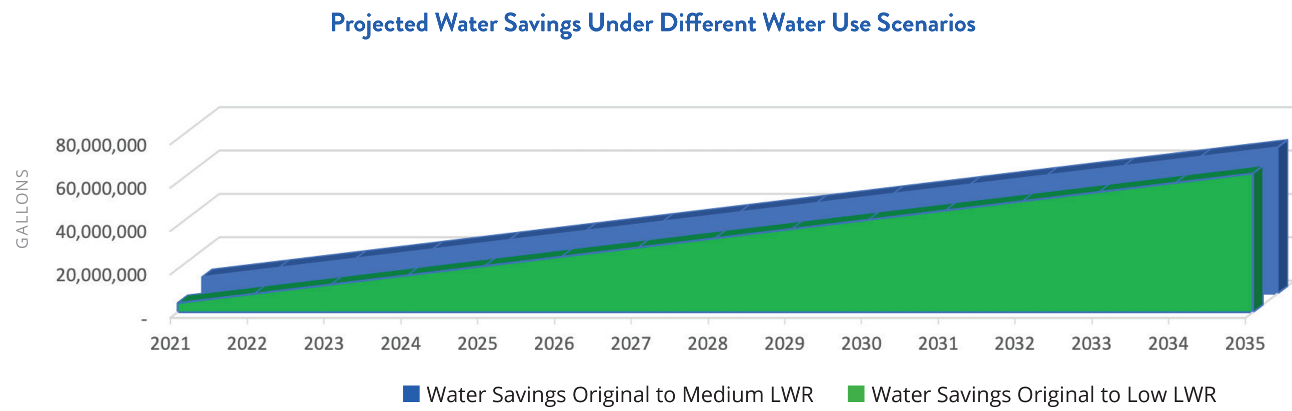
Monthly Breakdown of Each Scenario: The graph and table below illustrate the landscape water requirement on a monthly basis for each scenario. These show the amount of supplemental water that is estimated to be needed for irrigation each month.



Projected Monthly Irrigation Water Requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	% Reduction
Monthly ETO (inches/month)	1.55	2.24	3.72	5.10	6.82	7.80	8.68	7.75	5.70	4.03	2.10	1.55	**57.04**	
Allowable Rainfall (inches)	0.91	0.87	0.69	0.29	0.17	0.05	0	0.01	0.07	0.24	0.52	0.81	**4.63**	
Original LWR (gallons)	229,106	641,844	1,588,815	2,632,982	3,669,860	4,295,736	4,820,944	4,295,736	3,115,493	2,073,408	805,342	296,796	**28,466,061**	
Medium LWR (gallons)	194,740	545,567	1,350,493	2,238,035	3,119,381	3,651,375	4,097,802	3,651,375	2,648,169	1,762,397	684,541	252,277	**24,196,152**	
Low LWR (gallons)	103,271	413,380	1,130,967	1,937,073	2,716,918	3,191,081	3,585,577	3,194,031	2,311,800	1,524,578	560,615	160,808	**20,830,100**	
Water Savings Original to Medium LWR (gallons)	34,366	96,277	238,322	394,947	550,479	644,360	723,142	644,360	467,324	311,011	120,801	44,519	**4,269,909**	15%
Water Savings Original to Low LWR (gallons)	125,835	228,464	457,847	695,909	952,942	1,104,655	1,235,367	1,101,704	803,693	548,830	244,727	135,988	**7,635,961**	27%
Average Water Savings (gallons)	80,100	162,370	348,085	545,428	751,710	874,508	979,254	873,032	635,509	429,921	182,764	90,254	**5,952,935**	21%

15-year Projected Water Savings Scenarios: The chart below projects landscape water savings by scenario over the next 15 years.[5]



Equations and Variables

$$\text{LWR} = \frac{1}{DU_{LQ}} \times [(ET_O \times K_L) - R_a] \times A \times C_u$$

DULQ = Lower quarter distribution uniformity (0.70 to reflect standard drip irrigation) ETO = Local reference evapotransipration

KL = Landscape coefficient for the type of plant in that hydrozone (0.5 f or medium LWR, 0.2 for low LWR) Ra = Allowable rainfall, designated by WaterSense as 25% of average peak monthly rainfall

A = Area of the hydrozone (square feet)

Cu = Conversion factor (0.6233 for results in gallons/ month)

Notes and Definitions

Landscape Water Requirement (LWR): The amount of supplemental water required by the design of the established landscape. The LWR is calculated by dividing the landscape into hydrozones, determining the LWR for each hydrozone, and then adding these totals together for a total landscape requirement. This is the supplemental irrigation water needed for the property; the amount of water applied to the landscape beyond what natural rainfall provides.

[1] *For properties that installed a smart irrigation controller, the "Medium" and "Low" LWR values were multiplied by 0.85 which reflects a Lawrence Berkeley National Lab study that weather-based irrigation controllers can capture average water savings of 15%.*

[2] *Water savings calculations were estimated for two different scenarios, "Medium" and "Low", to reflect possible variation in types of plants, property owner/manager irrigation decisions, climate change, and weather patterns.*

[3] *Cumulative GHG emissions avoided was calculated by multiplying 15-year water savings by a conversion factor of 4,276 lb/MG, as outlined in the Alliance for Water Efficiency Conservation Tracking Tool.*

[4] *Cumulative energy savings were calculated by multiplying 15-year water savings by a conversion factor of 999 kWh/MG for the City of Sacramento, as outlined in the AB 32 Water Energy Assessment and Savings Demonstration Project.*

[5] *15-year totals for projects that included landscape transformations were calculated by reducing or discounting the first two years of savings by 50% to account for establishing the new landscape. New landscapes require more water for plant establishment. After the first two years, the full projected annual savings estimates were used for the remaining 13 years of the 15-year time frame.*

SITE #9: Phoenix Public Park in Fair Oaks, California

PROJECT SUMMARY: SITE #9

Total Area (square feet) 1,346,000 sqft

	Before	After
Turfgrass	1,346,000 sqft	1,346,000 sqft
Drought Tolerant Native Plants	0 sqft	0 sqft
Hardscape	0 sqft	0 sqft
Irrigation System	Sprayhead	Sprayhead
Irrigation Controller	Traditional	Smart[1]

Key Results

- The project replaced a traditional irrigation controller with a smart controller.
- The project is estimated to reduce annual irrigation water requirements by about 7,644,000 to 13,871,700 gallons per year, which is a reduction of 15% to 27% from the estimated original landscape irrigation water requirement. On average, the project is expected to reduce water use by about 10,758,000 gallons per year.
- Over 15 years, the project is estimated to save between approximately 114,660,000 and 120,887,000 gallons of water. On average, the project is expected to reduce water use by 15% over 15 years.
- Over 15 years, the project is estimated to save between about 252,300 and 266,000 kWh of avoided embedded energy. On average, this is 259,100 kWh over 15 years.
- Over 15 years, the project is estimated to save between approximately 481,600 and 507,700 pounds of avoided greenhouse gas (GHG) emissions. On average, this is 494,600 pounds over 15 years.

Scenario Definitions[2] and Results

Original Landscape Water Requirement (LWR): The supplemental irrigation water needed for the property before the landscape transformation. This is the amount of water applied to the landscape beyond what natural rainfall provided.

Medium LWR: The estimated supplemental irrigation water required post-project based on moderate water savings assumptions for the water requirements of the new plants.

This scenario also reflects that climate change and hotter temperatures are expected to drive up water demands for landscapes. Past weather patterns and data used for this analysis might not be reflective of future weather conditions.

Low LWR: The estimated supplemental irrigation water required post-landscape transformation, based on more aggressive assumptions that the plants are mostly low water use, and the property owner or manager maintains an efficient irrigation schedule over time.

WATER AND ENERGY SAVINGS SUMMARY: SITE #9

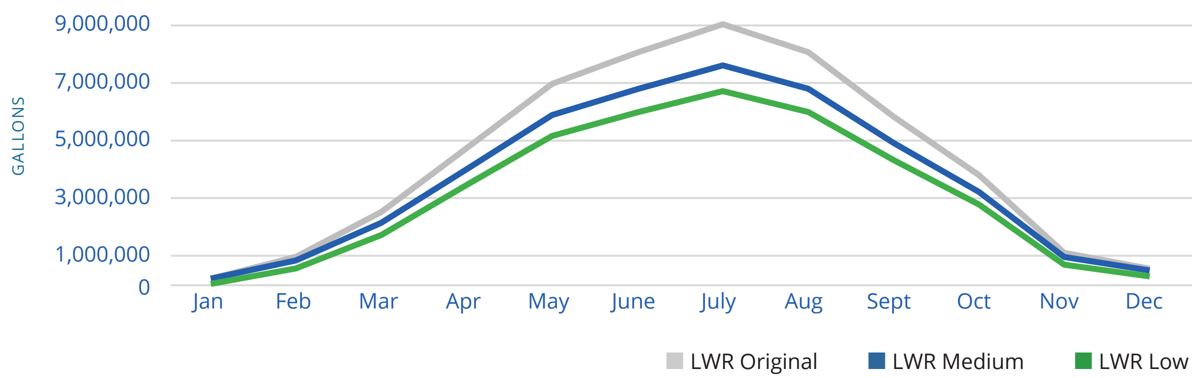
LWR = Landscape Water Requirement, the estimated supplemental irrigation water needed by the landscape

		Annual Water Calculations (gallons)	15 Year Cumulative Water Calculations (gallons)	15 Year Cumulative Percent Reduction from Original LWR	15 Year Cumulative GHG Reduction[3] (lbs of CO2 Avoided)	15 Year Cumulative Energy Savings[4] (kWh Avoided)
Before	Original LWR	50,959,830	764,397,457			
After	Medium LWR	43,315,856	649,737,838			
	Low LWR	37,088,146	643,510,128			
	Medium Savings	7,643,975	114,659,618	15%	481,570	252,251
	Low Savings	13,871,685	120,887,329	16%	507,727	265,952
	Average Savings	10,757,830	117,773,474	15%	494,649	259,102

Water Use | Water Savings | Energy and GHG Savings

Monthly Breakdown of Each Scenario: The graph and table below illustrate the landscape water requirement on a monthly basis for each scenario. These show the amount of supplemental water that is estimated to be needed for irrigation each month.

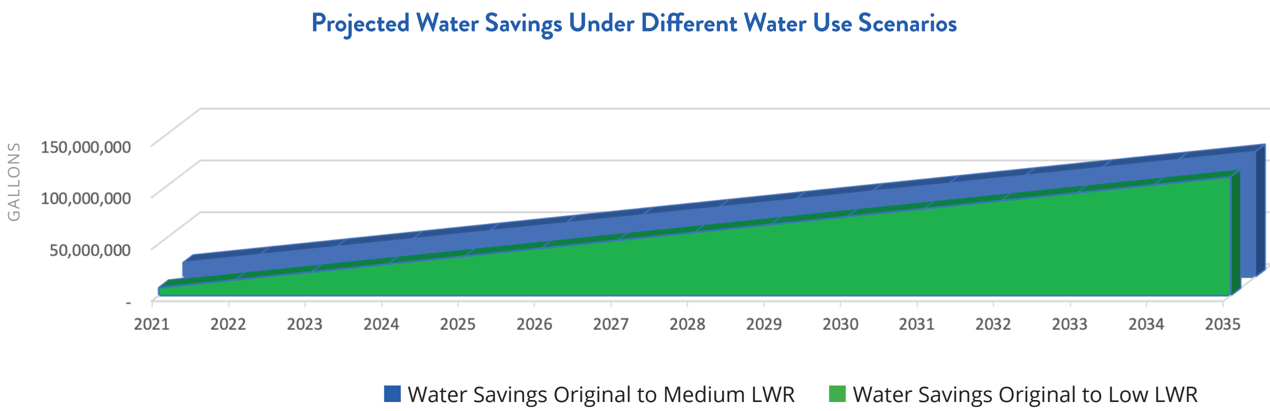
Projected Monthly Irrigation Water Requirement Under Different Water Use Scenarios



Projected Monthly Irrigation Water Requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	% Reduction
Monthly ETO (inches/month)	1.55	2.24	3.72	5.10	6.82	7.80	8.68	7.75	5.70	4.03	2.10	1.55	**57.04**	
Allowable Rainfall (inches)	1.11	1.08	1.07	0.46	0.13	0.08	0.03	0.03	0.11	0.34	0.87	0.85	**6.15**	
Original LWR (gallons)	164,566	915,759	2,456,867	4,669,145	6,877,551	7,954,003	8,923,972	7,963,684	5,746,888	3,728,863	1,051,929	506,604	**50,959,830**	
Medium LWR (gallons)	139,881	778,395	2,088,337	3,968,773	5,845,918	6,760,903	7,585,376	6,769,131	4,884,855	3,169,533	894,140	430,613	**43,315,856**	
Low LWR (gallons)		532,644	1,680,215	3,409,250	5,097,693	5,905,162	6,633,090	5,918,875	4,259,506	2,727,400	663,748	260,562	**37,088,146**	
Water Savings Original to Medium LWR (gallons)	24,685	137,364	368,530	700,372	1,031,633	1,193,100	1,338,596	1,194,553	862,033	559,329	157,789	75,991	**7,643,975**	15%
Water Savings Original to Low LWR (gallons)	164,566	383,115	776,653	1,259,895	1,779,857	2,048,842	2,290,882	2,044,808	1,487,382	1,001,462	388,181	246,042	**13,871,685**	27%
Average Water Savings (gallons)	94,625	260,239	572,591	980,133	1,405,745	1,620,971	1,814,739	1,619,680	1,174,708	780,396	272,985	161,016	**10,757,830**	21%

15-year Projected Water Savings Scenarios: The chart below projects landscape water savings by scenario over the next 15 years.[5]



Equations and Variables

$$\text{LWR} = \frac{1}{DU_{LQ}} \times [(ET_O \times K_L) - R_a] \times A \times C_u$$

DULQ = Lower quarter distribution uniformity (0.70 to reflect standard drip irrigation) ETO = Local reference evapotranspiration

KL = Landscape coefficient for the type of plant in that hydrozone (0.5 f or medium LWR, 0.2 for low LWR) Ra = Allowable rainfall, designated by WaterSense as 25% of average peak monthly rainfall

A = Area of the hydrozone (square feet)

Cu = Conversion factor (0.6233 for results in gallons/ month)

Notes and Definitions

Landscape Water Requirement (LWR): The amount of supplemental water required by the design of the established landscape. The LWR is calculated by dividing the landscape into hydrozones, determining the LWR for each hydrozone, and then adding these totals together for a total landscape requirement. This is the supplemental irrigation water needed for the property; the amount of water applied to the landscape beyond what natural rainfall provides.

[1] *For properties that installed a smart irrigation controller, the "Medium" and "Low" LWR values were multiplied by 0.85 which reflects a Lawrence Berkeley National Lab study that weather-based irrigation controllers can capture average water savings of 15%.*

[2] *Water savings calculations were estimated for two different scenarios, "Medium" and "Low", to reflect possible variation in types of plants, property owner/manager irrigation decisions, climate change, and weather patterns.*

[3] *Cumulative GHG emissions avoided was calculated by multiplying 15-year water savings by a conversion factor of 4,276 lb/MG, as outlined in the Alliance for Water Efficiency Conservation Tracking Tool.*

[4] *Cumulative energy savings were calculated by multiplying 15-year water savings by a conversion factor 2,287 kWh/MG for Fair Oaks, as outlined in the AB 32 Water Energy Assessment and Savings Demonstration Project.*

[5] *15-year totals for projects that included landscape transformations were calculated by reducing or discounting the first two years of savings by 50% to account for establishing the new landscape. New landscapes require more water for plant establishment. After the first two years, the full projected annual savings estimates were used for the remaining 13 years of the 15-year time frame.*

SITE #10: Fair Oaks Public Park in Fair Oaks, California

PROJECT SUMMARY: SITE #10

Total Area (square feet) 367,100 sqft

	Before	After
Turfgrass	367,100 sqft	367,100 sqft
Drought Tolerant Native Plants	0 sqft	0 sqft
Hardscape	0 sqft	0 sqft
Irrigation System	Sprayhead	Sprayhead
Irrigation Controller	Traditional	Smart[1]

Key Results

- The project replaced a traditional irrigation controller with a smart controller.
- The project is estimated to reduce annual irrigation water requirements by about 2,085,000 to 3,783,300 gallons per year, which is a reduction of 15% to 27% from the estimated original landscape irrigation water requirement. On average, the project is expected to reduce water use by about 2,934,000 gallons per year.
- Over 15 years, the project is estimated to save between approximately 37,271,600 and 32,970,000 gallons of water. On average, the project is expected to reduce water use by 15% over 15 years.
- Over 15 years, the project is estimated to save between about 68,800 and 72,500 kWh of avoided embedded energy. On average, this is 70,700 kWh over 15 years.
- Over 15 years, the project is estimated to save between approximately 131,300 and 138,500 pounds of avoided greenhouse gas (GHG) emissions. On average, this is 134,900 pounds over 15 years.

Scenario Definitions[2] and Results

Original Landscape Water Requirement (LWR): The supplemental irrigation water needed for the property before the landscape transformation. This is the amount of water applied to the landscape beyond what natural rainfall provided.

Medium LWR: The estimated supplemental irrigation water required post-project based on moderate water savings assumptions for the water requirements of the new plants.

This scenario also reflects that climate change and hotter temperatures are expected to drive up water demands for landscapes. Past weather patterns and data used for this analysis might not be reflective of future weather conditions.

Low LWR: The estimated supplemental irrigation water required post-landscape transformation, based on more aggressive assumptions that the plants are mostly low water use, and the property owner or manager maintains an efficient irrigation schedule over time.

WATER AND ENERGY SAVINGS SUMMARY: SITE #10

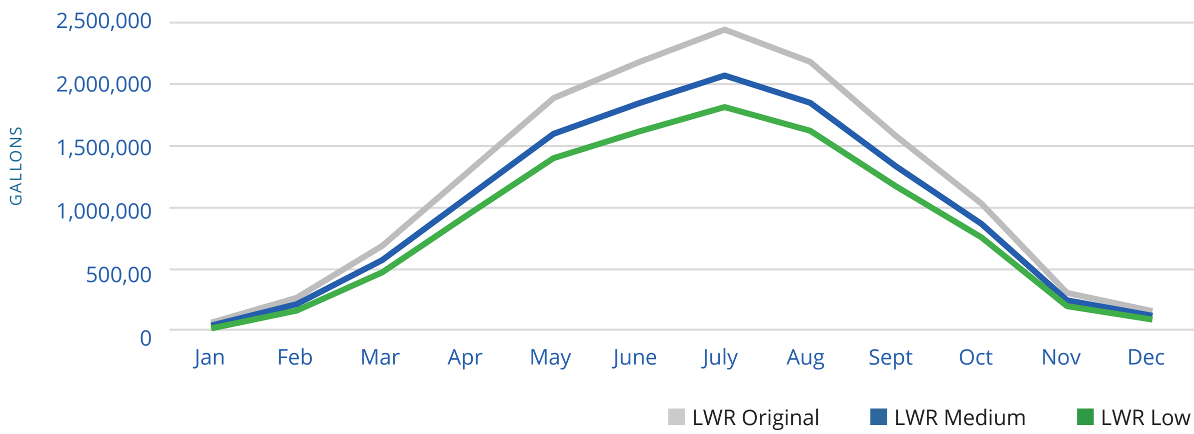
LWR = Landscape Water Requirement, the estimated supplemental irrigation water needed by the landscape

		Annual Water Calculations (gallons)	15 Year Cumulative Water Calculations (gallons)	15 Year Cumulative Percent Reduction from Original LWR	15 Year Cumulative GHG Reduction[3] (lbs of CO2 Avoided)	15 Year Cumulative Energy Savings[4] (kWh Avoided)
Before	Original LWR	13,898,480	208,477,196			
After	Medium LWR	11,813,708	177,205,617			
	Low LWR	10,115,199	175,507,108			
	Medium Savings	2,084,772	31,271,579	15%	131,341	68,797
	Low Savings	3,783,280	32,970,088	16%	138,474	72,534
	Average Savings	2,934,026	32,120,834	15%	134,908	70,666

Water Use · Water Savings · Energy and GHG Savings

Monthly Breakdown of Each Scenario: The graph and table below illustrate the landscape water requirement on a monthly basis for each scenario. These show the amount of supplemental water that is estimated to be needed for irrigation each month.

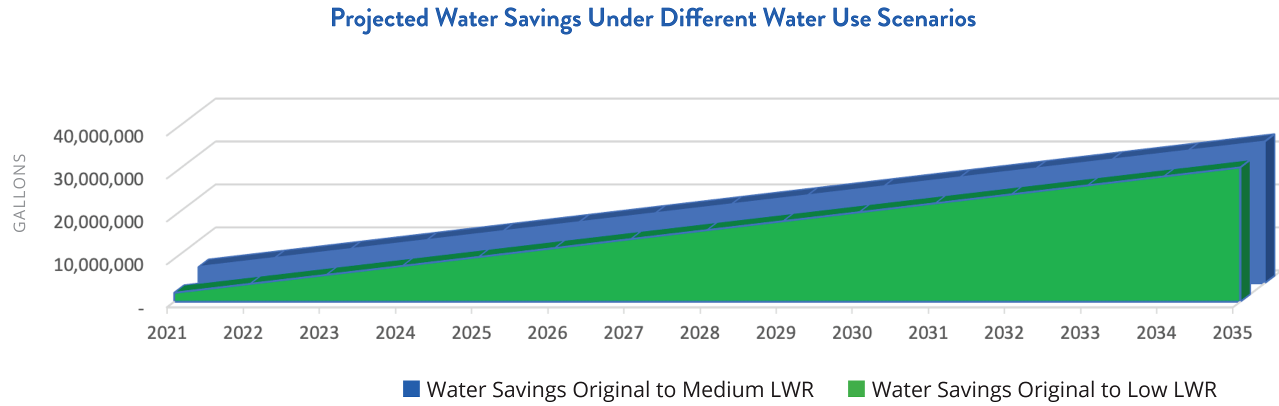
Projected Monthly Irrigation Water Requirement Under Different Water Use Scenarios



Projected Monthly Irrigation Water Requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	% Reduction
Monthly ETO (inches/month)	1.55	2.24	3.72	5.10	6.82	7.80	8.68	7.75	5.70	4.03	2.10	1.55	**57.04**	--
Allowable Rainfall (inches)	1.11	1.08	1.07	0.46	0.13	0.08	0.03	0.03	0.11	0.34	0.87	0.85	**6.15**	--
Original LWR (gallons)	44,883	249,759	670,071	1,273,435	1,875,742	2,169,327	2,433,871	2,171,967	1,567,372	1,016,988	286,897	138,168	**13,898,480**	--
Medium LWR (gallons)	38,150	212,295	569,561	1,082,420	1,594,381	1,843,928	2,068,790	1,846,172	1,332,266	864,440	243,862	117,443	**11,813,708**	-
Low LWR (gallons)	-	145,270	458,252	929,819	1,390,314	1,610,539	1,809,069	1,614,279	1,161,712	743,855	181,027	71,064	**10,115,199**	-
Water Savings Original to Medium LWR (gallons)	6,732	37,464	100,511	191,015	281,361	325,399	365,081	325,795	235,106	152,548	43,035	20,725	**2,084,772**	15%
Water Savings Original to Low LWR (gallons)	44,883	104,489	211,820	343,616	485,428	558,789	624,801	557,689	405,660	273,133	105,870	67,104	**3,783,280**	27%
Average Water Savings (gallons)	25,808	70,976	156,165	267,316	383,395	442,094	494,941	441,742	320,383	212,840	74,452	43,915	**2,934,026**	21%

15-year Projected Water Savings Scenarios: The chart below projects landscape water savings by scenario over the next 15 years.[5]



Equations and Variables

$$LWR = \frac{1}{DU_{LQ}} \times [(ET_O \times K_L) - R_a] \times A \times C_u$$

DULQ = Lower quarter distribution uniformity (0.70 to reflect standard drip irrigation) ETO = Local reference evapotranspiration

KL = Landscape coefficient for the type of plant in that hydrozone (0.5 f or medium LWR, 0.2 for low LWR) Ra = Allowable rainfall, designated by WaterSense as 25% of average peak monthly rainfall

A = Area of the hydrozone (square feet)

Cu = Conversion factor (0.6233 for results in gallons/month)

Notes and Definitions

Landscape Water Requirement (LWR): The amount of supplemental water required by the design of the established landscape. The LWR is calculated by dividing the landscape into hydrozones, determining the LWR for each hydrozone, and then adding these totals together for a total landscape requirement. This is the supplemental irrigation water needed for the property; the amount of water applied to the landscape beyond what natural rainfall provides.

[1] *For properties that installed a smart irrigation controller, the "Medium" and "Low" LWR values were multiplied by 0.85 which reflects a Lawrence Berkeley National Lab study that weather-based irrigation controllers can capture average water savings of 15%.*

[2] *Water savings calculations were estimated for two different scenarios, "Medium" and "Low", to reflect possible variation in types of plants, property owner/manager irrigation decisions, climate change, and weather patterns.*

[3] *Cumulative GHG emissions avoided was calculated by multiplying 15-year water savings by a conversion factor of 4,276 lb/MG, as outlined in the Alliance for Water Efficiency Conservation Tracking Tool.*

[4] *Cumulative energy savings were calculated by multiplying 15-year water savings by a conversion factor 2,287 kWh/MG for Fair Oaks, as outlined in the AB 32 Water Energy Assessment and Savings Demonstration Project.*

[5] *15-year totals for projects that included landscape transformations were calculated by reducing or discounting the first two years of savings by 50% to account for establishing the new landscape. New landscapes require more water for plant establishment. After the first two years, the full projected annual savings estimates were used for the remaining 13 years of the 15-year time frame.*