

Model for Water Savings from Smart Irrigation Controllers For Single Family Homes

Developed by Heather Rose, Fall 2019

Water savings by reducing irrigation demand.

$$\text{Water Savings} \left(\frac{\text{Af}}{\text{year}} \right) = [P_{\text{rain}} + P_{\text{freeze}} + P_{\text{high-wind}} + (P_{\text{rain}} \times S_{\text{retention}})] [GPCD_{\text{res}} - GPCD_{\text{indoor}}] \times [H \times CpH_{\text{avg}}] \times \frac{365 \text{ days}}{\text{year}} \times \frac{1 \text{ Acrefoot}}{325,851 \text{ gal}}$$

Terms

P_{rain} = Percent of the year it rains and region receives at or above 0.125" of rainfall

(Rachio Brand controller's default for rain skip)

P_{freeze} = Percent of the year it freezes in region and temperatures reach at or below 32F

(Rachio Brand controller's default for freeze skip)

$P_{\text{high-wind}}$ = Percent of the year windspeeds in region reach or exceed 20 mph

(Rachio Brand controller's default for high wind skip)

$S_{\text{retention}}$ = Soil moisture retention, = days of water retention after rain event with 0.125"

$GPCD_{\text{res}}$ = Average single family gallons per person per day for region.

Data available from Texas Water Development Board.

$$GPCD_{\text{indoor}} = \frac{137.7 \frac{\text{gal}}{\text{house,day}} (\text{DeOreo 2016})}{2.63 \frac{\text{capita}}{\text{house}} (\text{US Census Bureau 2019})} = 52.36 \text{ gallons per person per day for indoor water use}$$

H = number of households participating

CpH_{avg} = Average capita per Household = 2.63 (US Census Bureau 2019)

*Savings should not exceed 50% (EPA estimation)

Model does not account for:

- Leak detection feature
- Shade factor (based on individual home)
- Slope factor (based on individual home)
- Seasonal shift, as GPCD was taken as an annual average
- Users overriding smart features

Resources:

Austin-Recent Annual Temperatures, Rain & Snow. CurrentResults.com

Available at: <https://www.currentresults.com/Yearly-Weather/USA/TX/Austin/recent-annual-austin-temperature-precipitation.php>

DeOreo, William (2016). *Residential End Uses of Water.* Water Research Foundation.

<https://www.waterrf.org/research/projects/residential-end-uses-water-version-2>

EPA. *Irrigation Controllers.* Available at:

<https://www.epa.gov/watersense/irrigation-controllers>

Regional Weather Information

<https://www.bestplaces.net/climate/>

Texas A&M Agrilife Research. *Irrigation Training Program.*

Available at: <http://irrigationtraining.tamu.edu/south-texas/scheduling/soil-moisture/>

Texas Water Development Board. *Regional Water Planning Data.*

<https://www.twdb.texas.gov/waterplanning/data/rwp-database/index.asp>

US Census Bureau (2019)

<https://www.census.gov/quickfacts/fact/table/US/HCN010212>