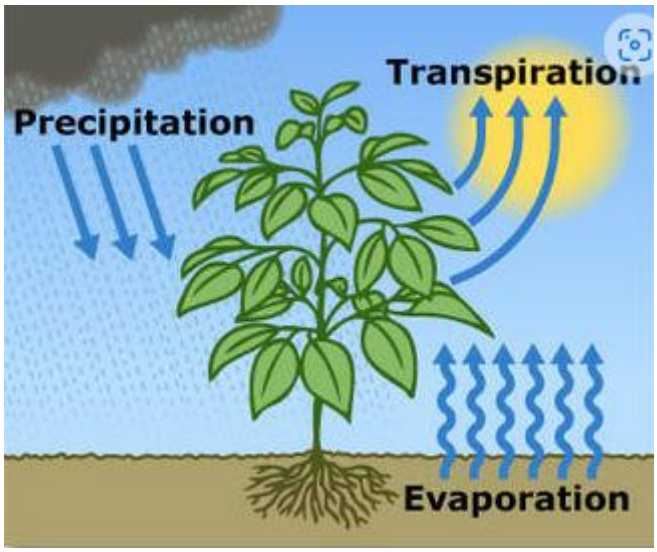
Conserving Irrigation Water



Contents

Dynamically Adjusting Water Requirements 2
Interesting Political Aside 3
Evapotranspiration 4
Required Components 5
Replacing an Existing Sprinkler Controller with the Universal Relay 6
Calculations 7
Example Implementation 8
Example Program Flow 9

Dynamically Adjusting Water Requirements

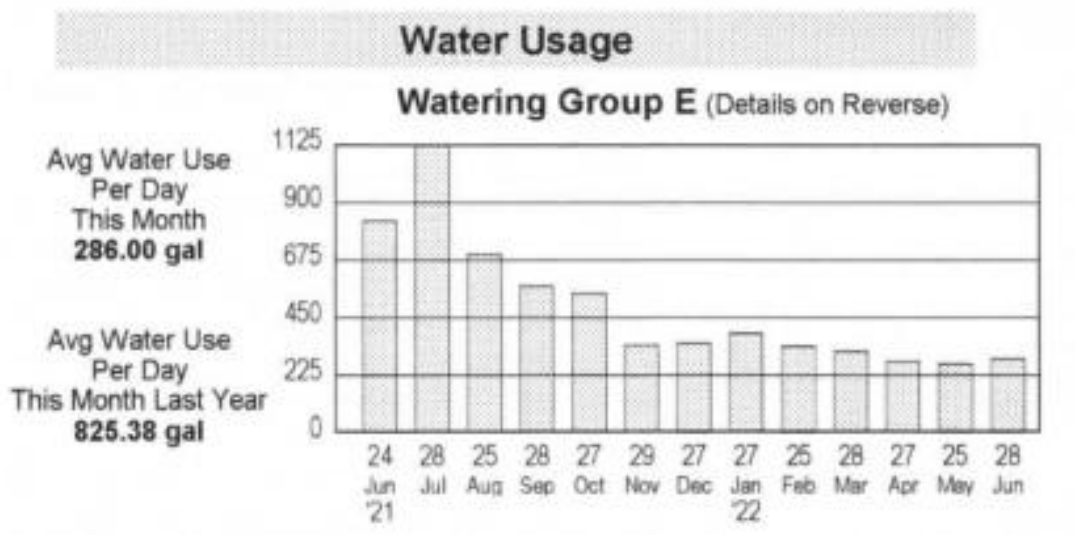
Most homes use a simple sprinkler controller that applies the same amount of water to all of the circuits every day. The homeowner is then responsible to re-program this as the seasons change to stay in compliance with water company rules about which days water can be applied.

This generally results in either too much, or too little water applied every day. In fact, with the same setting it might apply too much water one day, and too little the very next day if it got hotter and windier on the second day!

A much more accurate method is to use a home controller to dynamically alter the amount of water applied every day based on actual weather conditions.

In my application, I have seen my watering times reduced from the recommended 1 hour/day down to about 12 minutes/day in all but extreme heat conditions. This is a significant water savings and my plants are still healthy – they were being overwatered before.

As you can see from our June watering bill, dynamically adjusting the watering time has cut our daily water usage from 825 gal/day to 286 gal/day - **a 65% reduction** and the plants are very healthy!



There are many other ways of doing this besides the one I show here. For example the Southern Nevada Water Authority web site offers rebates on many off-the-shelf solutions - [Smart irrigation controller rebate (snwa.com)]

Interesting Political Aside

It had frustrated me that, as the water level in Lake Mead receded, there appeared to be no attempts to restrict Las Vegas building permits – but there have been attempts to force home owners to remove grass and restrict pools and watering schedules.

While this is still concerning to me, I did not realize "where" the water in Lake Mead was actually going. Surprisingly, to me, Las Vegas is by far the smallest user of water from Lake Mead as seen in the following article:

> Southern Nevada uses least amount of water from Lake Mead (msn.com)

An excerpt of which is shown below:

> "California, it gets the largest share. 4.4 million acre-feet of water is available to California. Arizona gets about 2.8 million acre-feet. The country of Mexico, 1.5 million and us right here in Southern Nevada we get 300,000 acre-feet," Mack said.
>
> In the the Bureau of Reclamation's water use report, it breaks down the exact numbers each entity consumed in 2021.
>
> California: 4,404,727
>
> Arizona: 2,425,736
>
> Nevada: 242,168
>
> Mexico: 1,455,061
>
> Earlier this year the federal government issued the first Tier of water cuts that do affect Arizona and Nevada.

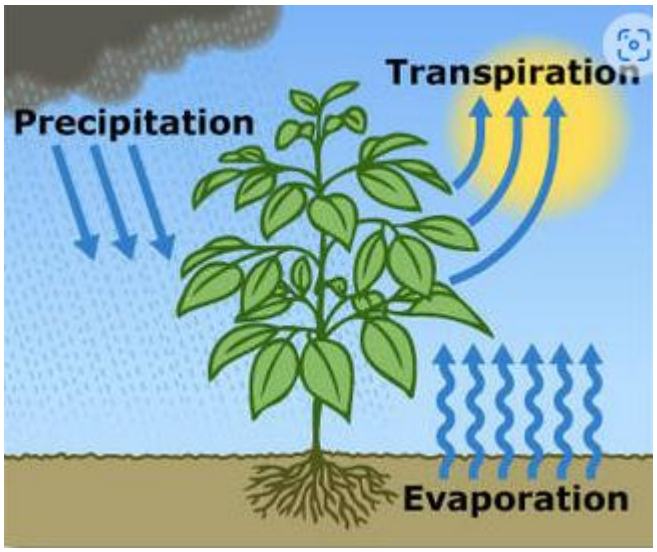
So it really isn't Nevadans that are draining the lake!

Evapotranspiration

Evapotranspiration is basically a measure of how much water is lost from the ground and plants every day due to weather conditions (a full definition can be found here.)

By knowing how much water was lost every day, you can adjust your watering to apply the exact same amount and keep your plants at a constant moisture level. This both, conserves water (by not applying more than is needed), ensures your plants get enough water, and saves money.

Evapotranspiration is generally measured in mm, and is how deep the water would have to be around the base of your plant to replenish the water lost during the day. So if it was 5mm, and your plant occupied roughly one square foot of ground space, you would require a 1 square foot times 5mm volume of water.



Required Components

The calculations required to determine evapotranspiration every day would be too tedious to do by hand, but thankfully the Climacell node provides this information directly to your controller every day automatically from the Tomorrow IO weather service!

Here are the components required to put together a system to automatically adjust irrigation timing for evapotranspiration.

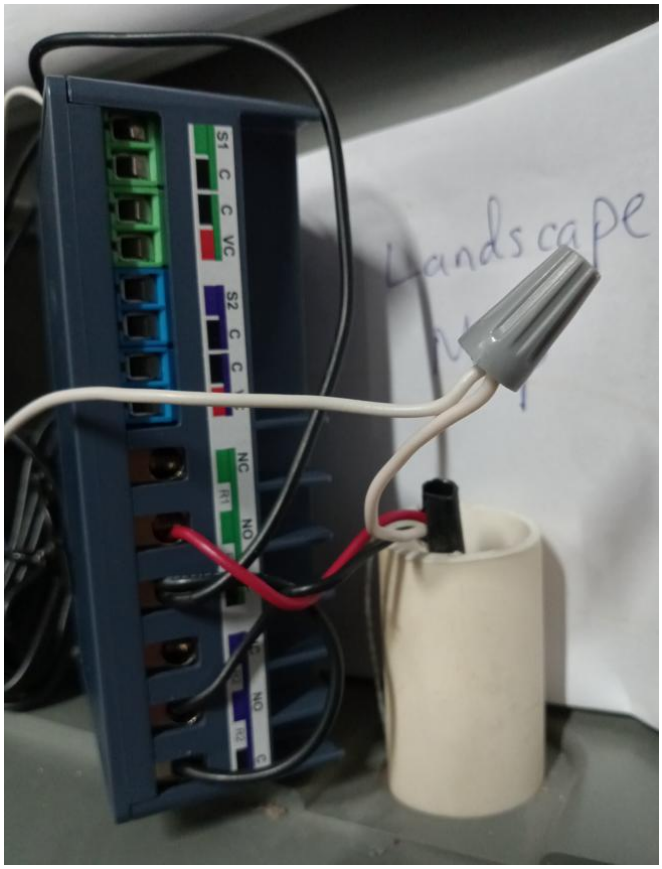
1. Polisy Controller (available here) – quantity 1
2. Zooz 700 Series Z-Wave Universal Relay (available here) – quantity 1 for every 2 sprinkler valves
3. Polisy TimeData software node (available here) – quantity 1
4. Polisy ClimaCell weather software node (available here) – quantity 1

Replacing an Existing Sprinkler Controller with the Universal Relay

Basically you need to gut your existing sprinkler controller box (or buy a new empty one) and populate it with the Zooz 700 Series Z-Wave Universal Relay and a 24VAC transformer as shown below (the power strip is not needed.) If you have more than two valves you can put multiple Relays in the box.

You then need to:

- Wire the transformer 24VAC into the screw connections on top of the relay
- Wire the two 'C' (common) relay connections onto one side of the 24VAC
- Wire the sprinkler valve common wire to the other side of the 24VAC
- Wire each of the two 'NO' (normally open) relay connections to the activation wires coming from each of the two sprinkler valves.



Calculations

This example assumes that desert landscaping is being watered. The idea would be the same for grass, although it takes a few extra steps to determine the gallons/hour for an oscillating sprinkler.

Assuming that each of your plants ends up with one or more bubblers that, when combined, provide roughly 1 gallon/hour per square foot of plant base (not the trunk, but the area of ground that the foliage/roots covers.)

To figure out how long the bubblers need to be run in order to deliver 1mm of water over each square foot of plant base:

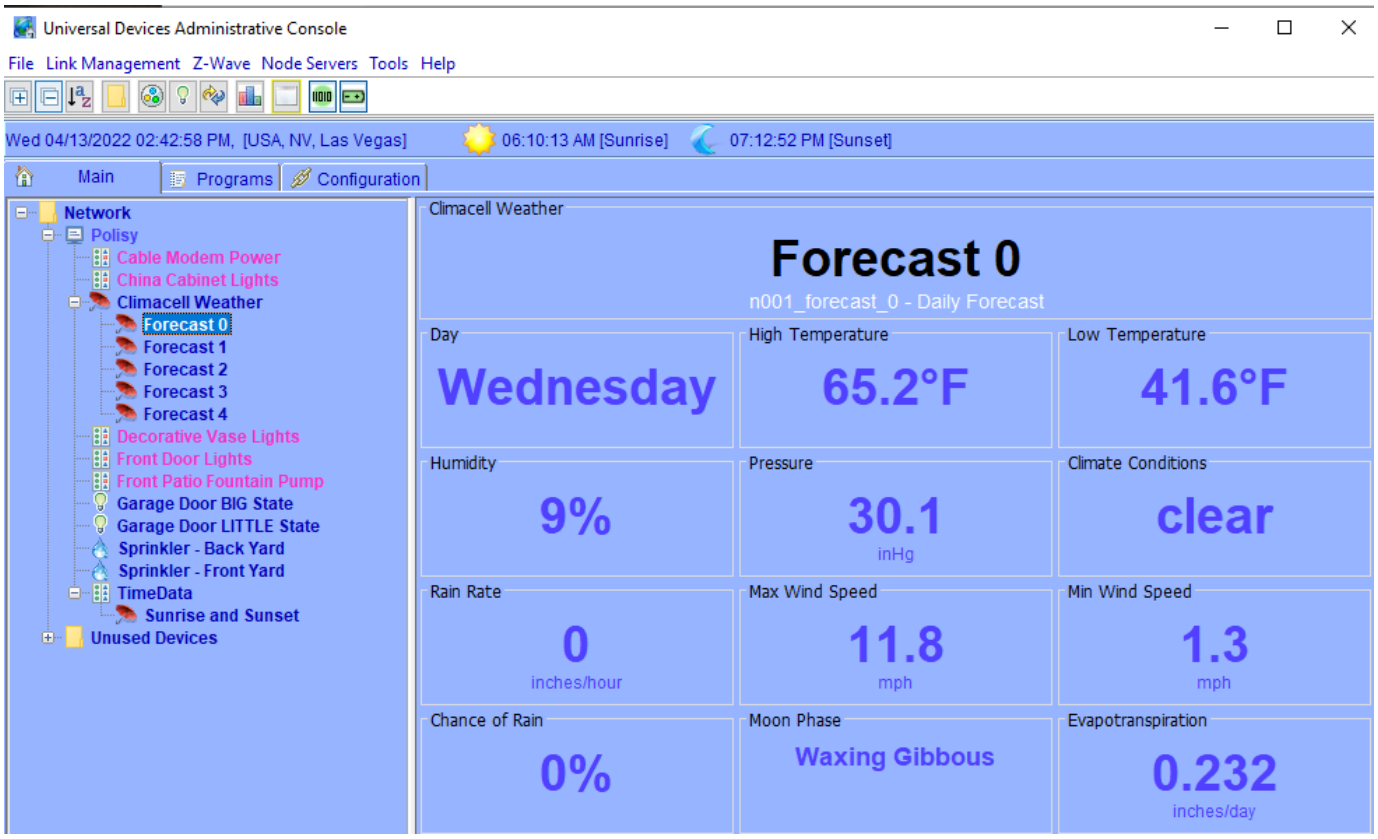
- 1 gallon of water has a volume of 231 cubic inches. Dividing 231 cubic inches by 144 square inches (one square foot) results in one gallon of water applied over 1 square foot will cover it with a depth of 1.6042" inches (or 40.7467mm) of water.
- Since it takes 1 hour to cover each square foot of plant base with 40.7467mm of water, it will take 88.3507 seconds (or 1 minute and 29 seconds) to cover each square foot of plant base with 1mm of water.

By running the bubblers for 1 minute and 29 seconds for every mm of evapotranspiration, we can accurately apply the correct amount of water to each plant.

Example Implementation

Here is an example implementation (using the Polisy controller and Climacell weather node – note the "TimeData" node is also required at a cost of $10 to get the current month.)

The following screen shows the Climacell weather data being reported, with the Evapotranspiration in the bottom right corner. Note that this appears for each day in the five day forecast – not in the current conditions.

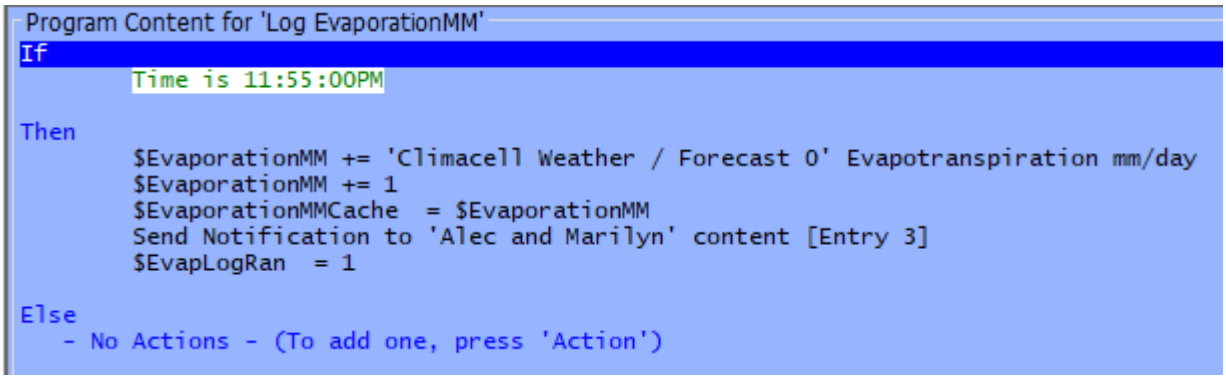


This implementation will do the following:

- Automatically adjust watering days and times based on season
- Automatically accumulate daily evapotranspiration until sprinklers are actually run
- Automatically accumulate daily rain accumulation until sprinklers are actually run
- Automatically adjust sprinkler run time based on accumulated evapotranspiration and rain accumulation

Example Program Flow

The following screen shows the logic required to record the evapotranspiration every night just before midnight.



The Climacell weather site updates the Evapotranspiration (and all other forecast) value all day long based upon changing weather conditions.

To get an accurate reading, you should check just before midnight. Note that the logic adds one extra mm here to over-compensate for any lost fractional mm values for safety.

The following screen shows the logic required to record the daily rainfall.

```
Program Content for 'Log RainMM'
If
   - No Conditions - (To add one, press 'Schedule' or 'Condition')

Then
        $RainSampleMM += 'Climacell Weather' Rain Rate mm/hr
        Repeat 5 times
           Wait  10 minutes
           $RainSampleMM += 'Climacell Weather' Rain Rate mm/hr
        Repeat 1 times
           $RainSampleMM /= 6
           $RainMM += $RainSampleMM
           $RainSampleMM  = 0

Else
   - No Actions - (To add one, press 'Action')
```

This will periodically accumulate rain accumulation data for the next hour and update RainMM.

This must be started from another thread (since it waits for about 50 minutes doing the data collection) to prevent it from being terminated when the starting condition is no longer true.

Doing this every 10 minutes is more accurate than once an hour because the rain can start and stop during the hour and if it is only checked once an hour there is a bigger chance that zero rain will be recorded. Checking every 10 minutes is good enough. Checking every 5 minutes would be the fastest practical - because the weather data is only updated every 5 minutes.

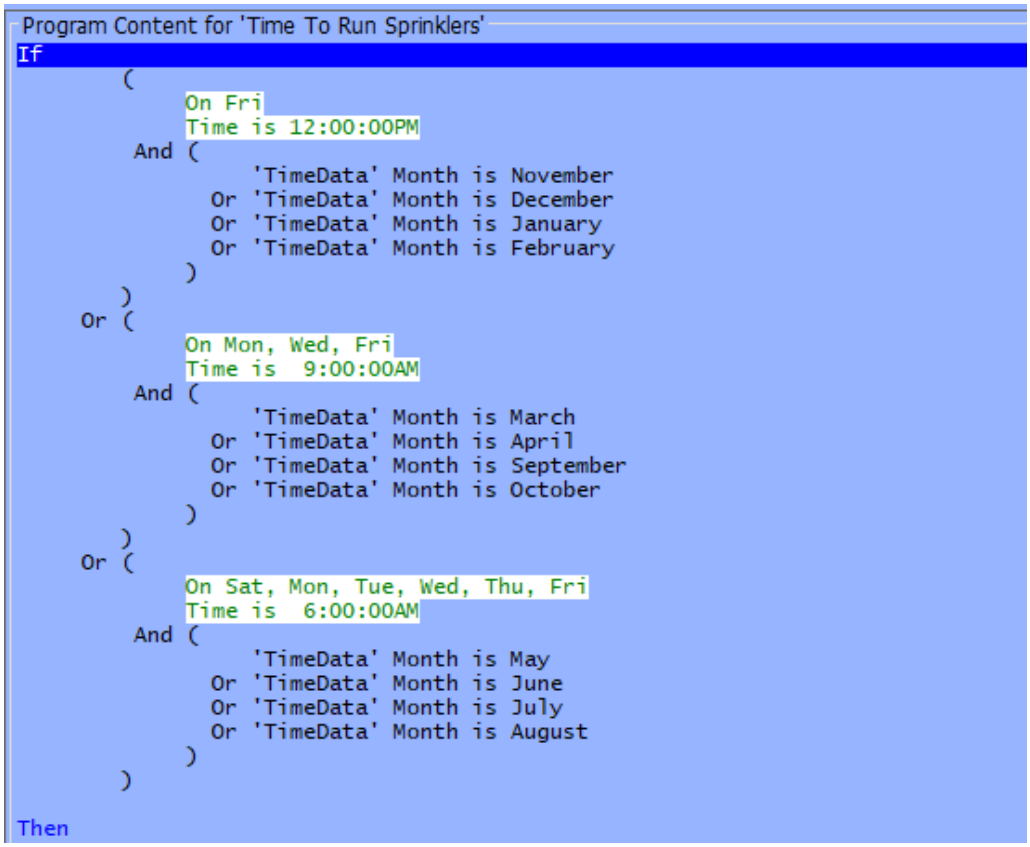
To run the above logic once every hour in its own thread you can simply add something like the following.

```
Program Content for 'Time To Log RainMM'
If
        'TimeData' Minute is 0 minute

Then
        Run Program 'Log RainMM' (Then Path)

Else
   - No Actions - (To add one, press 'Action')
```

The following screen shows the logic necessary to only water on the allowed days for each season.



And here is the logic to adjust the bubbler valve time to apply the amount of water specified by the cumulative evapotranspiration (minus rainfall) reported by the weather node for every day since the last watering cycle.