# Understanding your Irrigation System

***March 1, 2021***

***Urban and Small Farm Conference***

***By Mike Pace, USU Extension – Box Elder County***

EXTENSION
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EXTENSION.USU.EDU

# Todays Outline

Determining how much water is needed weekly?

How much water are we applying each time we irrigate?

How uniform is my application?

EXTENSION
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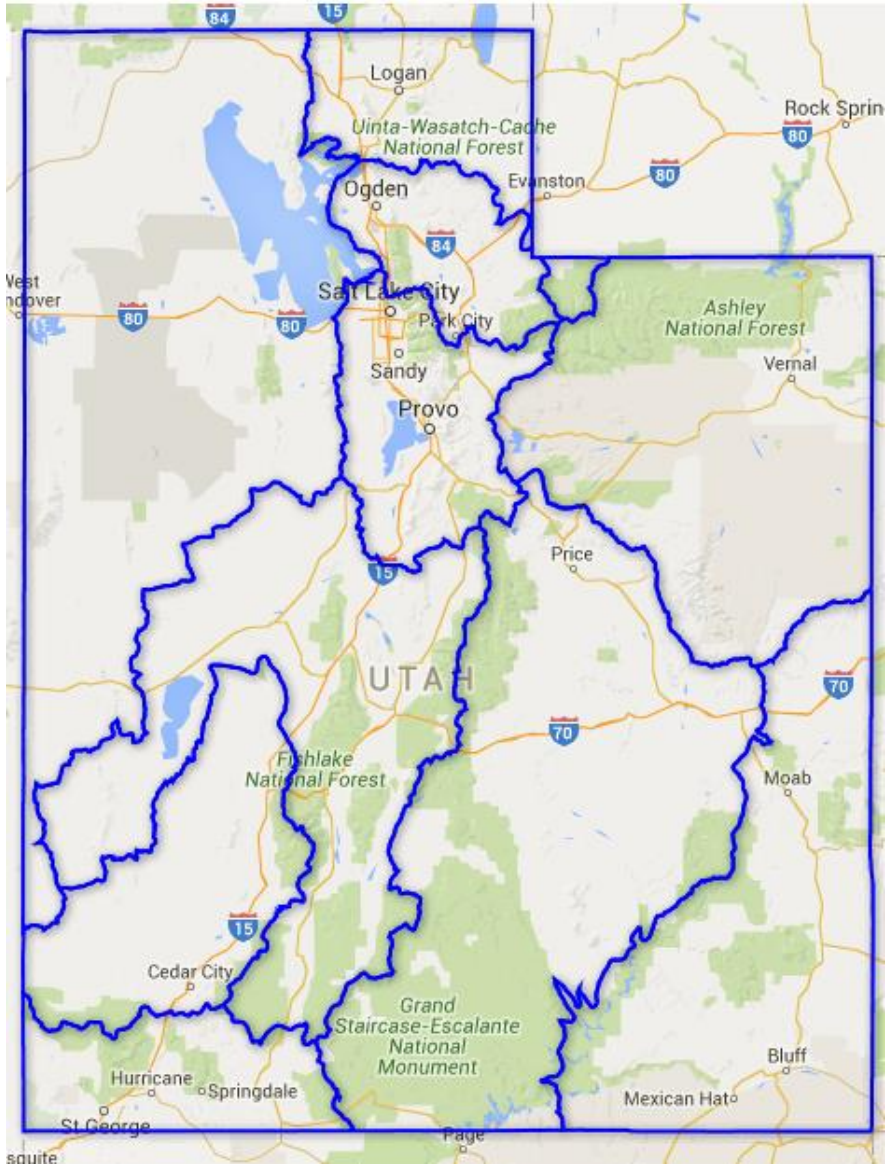
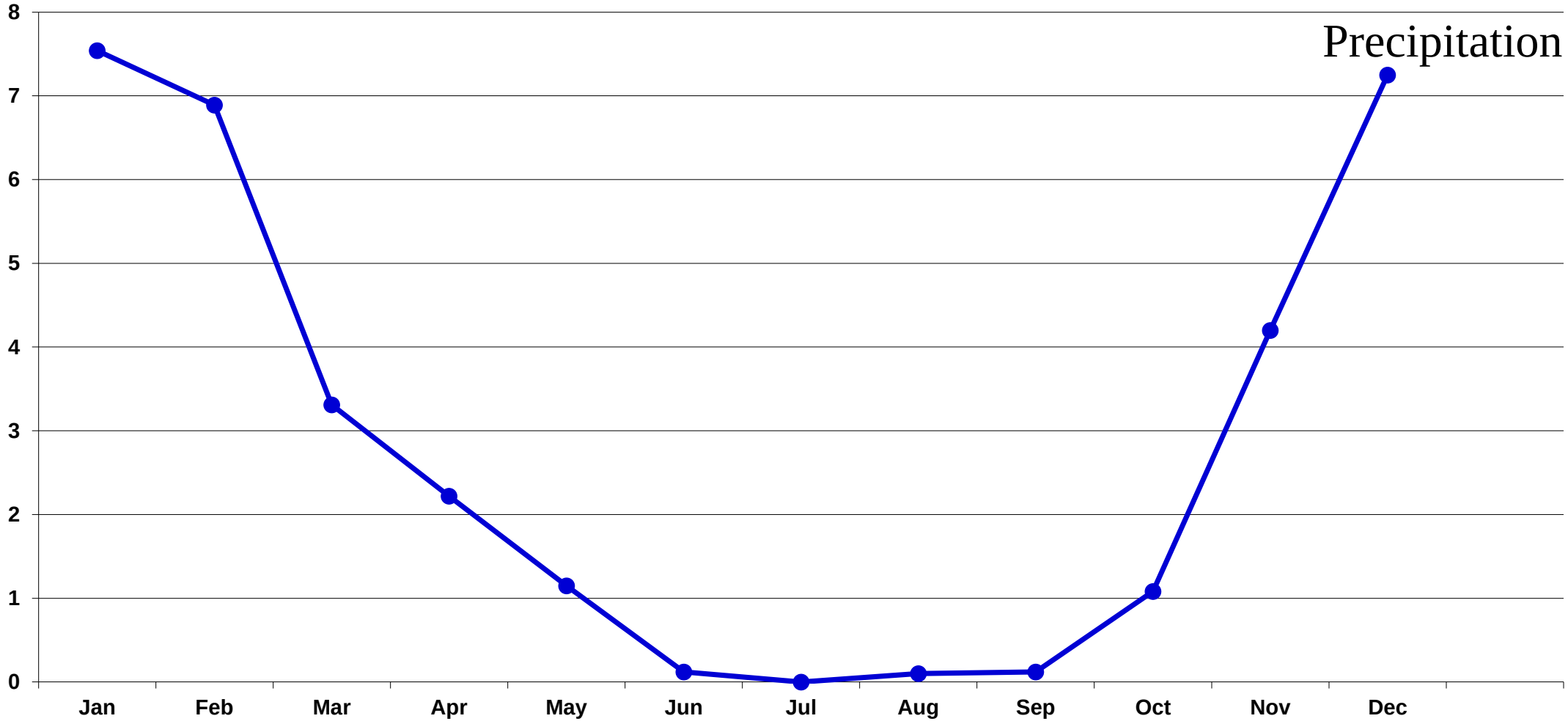
# Utah and Water

- 2nd driest state
- 13” average annual precipitation
- Most in the form of snow in the winter
- Summer deficit



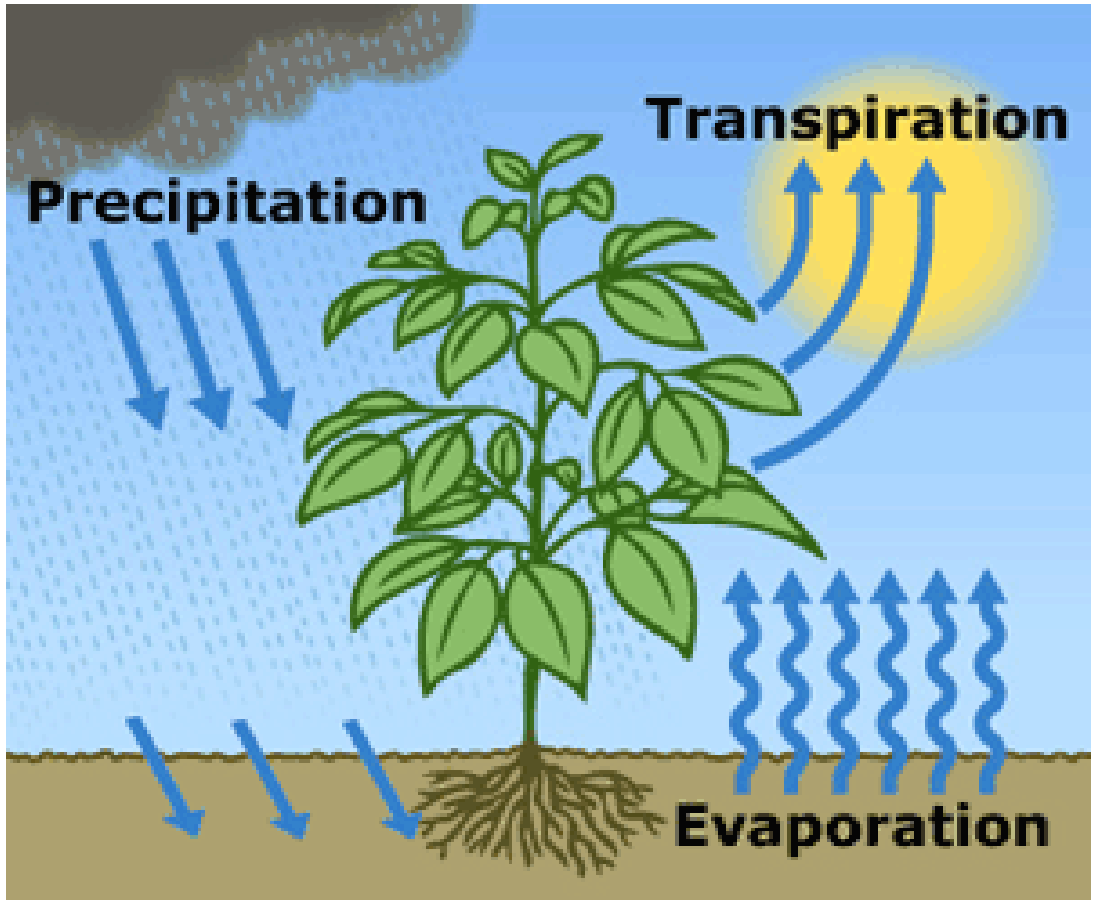
# Precipitation and ET



# Evapotranspiration (ET)

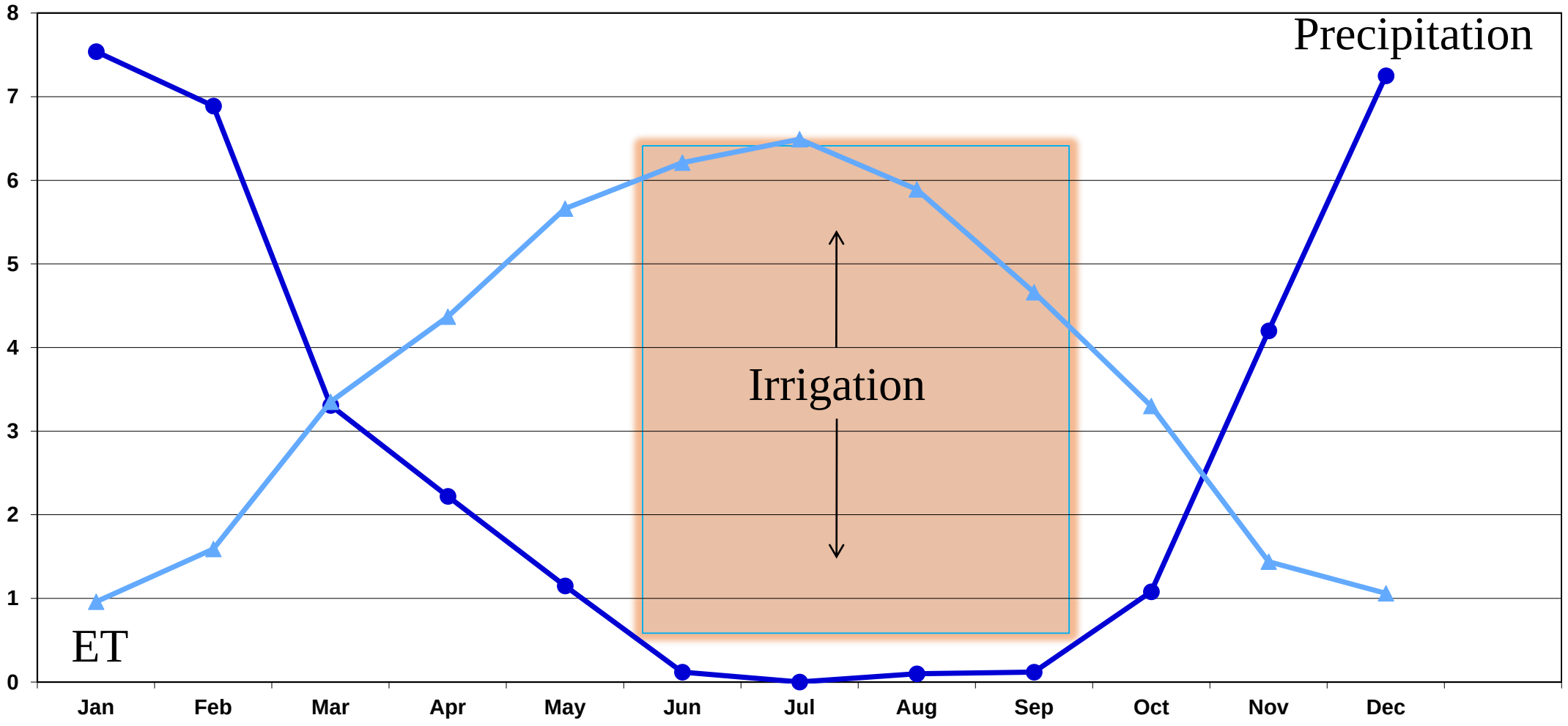
Water loss from farm due to weather and plant factors

- Evaporation from soil and plant surfaces
- Transpiration by plants (people sweat, plants transpire)
- **ET** = a reference point for plant water use based on a cool season grass 4-6" tall




http://water.usgs.gov/edu

# Irrigation and ET



# How is ET calculated?

## Weather Stations

Wind speed

Solar input

High & low temperature

Soil temp

Rain fall


Wind direction

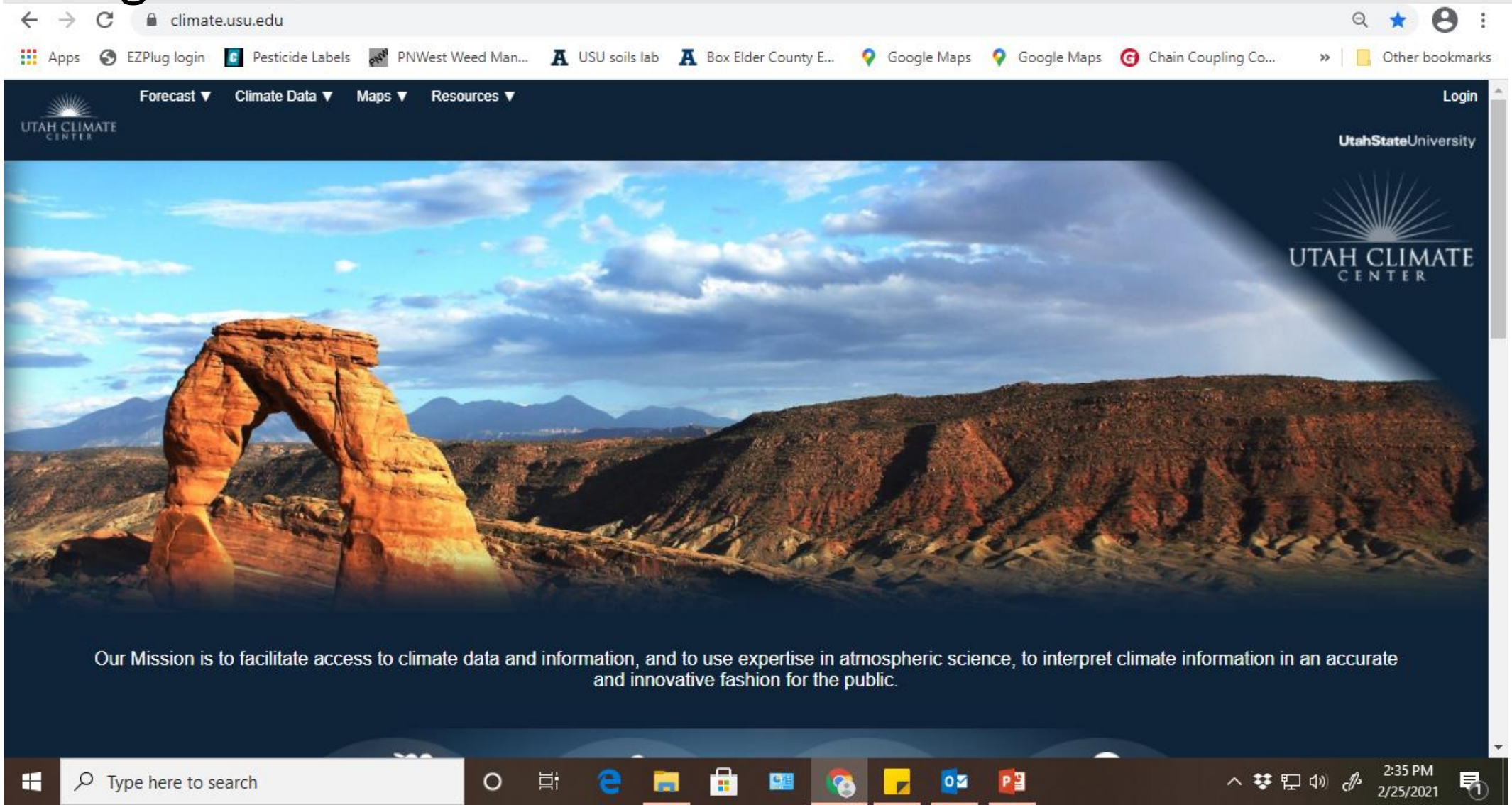
Humidity

Solar power panel

https://www.orchardandvine.net/topics/orchard/

# Where to find ET information?

## Google “Utah Climate Center” or Climate.usu.edu



# Utah Climate Center

**SALT LAKE CITY INTL AP, UT**
Monthly Total Reference Evapotranspiration in inches
Period of record: 1948-2016 Elevation: 4225.07 feet Latitude: 40.7781 Longitude: -111.969

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1992 | 0.76 | 1.50 | 2.89 | 4.66 | 6.30 | 7.16 | 7.60 | 7.07 | 4.74 | 2.90 | 1.03 | 0.71 | 47.32 |
| 1993 | 0.70 | 0.94 | 2.40 | 3.55 | 5.82 | 5.98 | 7.02 | 6.61 | 4.66 | 2.60 | 1.22 | 0.85 | 42.35 |
| 1994 | 1.06 | 1.30 | 2.86 | 3.90 | 6.08 | 7.81 | 8.73 | 7.49 | 5.01 | 2.49 | 0.98 | 0.76 | 48.47 |
| 1995 | 0.93 | 1.75 | 2.60 | 3.53 | 4.75 | 6.24 | 7.91 | 7.19 | 4.84 | 2.81 | 1.63 | 0.98 | 45.16 |
| 1996 | 0.94 | 1.28 | 2.79 | 3.94 | 5.51 | 7.73 | 8.35 | 7.43 | 4.51 | 2.89 | 1.43 | 0.87 | 47.67 |
| 1997 | 0.90 | 1.21 | 3.00 | 3.70 | 6.18 | 6.69 | 7.67 | 6.94 | 4.53 | 2.87 | 1.43 | 0.70 | 45.82 |
| 1998 | 1.12 | 1.19 | 2.33 | 3.32 | 5.17 | 5.64 | 7.75 | 6.79 | 4.45 | 2.39 | 1.35 | 0.78 | 42.28 |
| 1999 | 0.99 | 1.42 | 2.80 | 3.18 | 4.99 | 6.59 | 7.80 | 6.52 | 4.40 | 3.06 | 1.69 | 0.79 | 44.23 |
| 2000 | 0.97 | 1.47 | 2.43 | 4.23 | 5.78 | 7.14 | 8.25 | 6.84 | 4.27 | 2.48 | 0.84 | 0.74 | 45.44 |
| 2001 | 0.66 | 1.14 | 2.56 | 3.58 | 6.11 | 7.12 | 7.87 | 6.98 | 4.98 | 2.86 | 1.36 | 0.60 | 45.82 |
| 2002 | 0.72 | 1.02 | 2.27 | 3.92 | 5.79 | 7.33 | 8.36 | 6.91 | 4.28 | 2.42 | 1.20 | 0.89 | 45.11 |
| 2003 | 1.18 | 1.12 | 2.53 | 3.64 | 5.79 | 6.87 | 8.60 | 6.75 | 4.54 | 3.14 | 0.96 | 0.81 | 45.93 |
| 2004 | 0.53 | 0.86 | 2.99 | 3.78 | 5.45 | 6.80 | 7.78 | 6.45 | 4.51 | 2.48 | 1.15 | 0.79 | 43.57 |
| 2005 | 0.81 | 1.24 | 2.40 | 3.68 | 5.36 | 6.39 | 8.33 | 6.75 | 4.59 | 2.68 | 1.27 | 0.80 | 44.30 |
| 2006 | 0.92 | 1.30 | 2.26 | 3.98 | 5.94 | 7.48 | 8.30 | 6.72 | 4.39 | 2.46 | 1.37 | 0.77 | 45.89 |
| 2007 | 0.66 | 1.34 | 2.85 | 3.98 | 6.25 | 7.65 | 8.40 | 6.95 | 4.68 | 2.61 | 1.49 | 0.62 | 47.48 |
| 2008 | 0.66 | 1.25 | 2.35 | 3.66 | 5.40 | 7.01 | 8.20 | 7.02 | 4.57 | 2.68 | 1.30 | 0.75 | 44.85 |
| 2009 | 0.85 | 1.30 | 2.46 | 3.52 | 5.77 | 6.16 | 7.88 | 6.90 | 4.93 | 2.31 | 1.44 | 0.52 | 44.04 |
| 2010 | 0.77 | 1.21 | 2.50 | 3.61 | 4.70 | 6.65 | 7.91 | 6.73 | 5.10 | 2.79 | 1.15 | 0.73 | 43.85 |
| 2011 | 0.69 | 1.19 | 2.36 | 3.00 | 4.49 | 6.39 | 7.33 | 6.95 | 4.72 | 2.72 | 1.25 | 0.77 | 41.86 |
| 2012 | 1.02 | 1.35 | 2.98 | 4.34 | 5.76 | 7.68 | 7.90 | 6.98 | 4.76 | 2.83 | 1.48 | 0.78 | 47.86 |
| 2013 | 0.49 | 0.94 | 2.62 | 3.58 | 5.85 | 7.81 | 8.24 | 6.94 | 4.33 | 2.57 | 1.45 | 0.59 | 45.41 |
| 2014 | 0.85 | 1.53 | 2.89 | 3.96 | 5.70 | 6.83 | 7.95 | 6.20 | 4.59 | 3.04 | 1.35 | 0.94 | 45.83 |
| 2015 | 0.95 | 1.65 | 3.21 | 4.00 | 4.83 | 7.57 | 7.24 | 6.63 | 4.73 | 2.87 | 1.28 | 0.80 | 45.76 |
| 2016 | 0.73 | 1.41 | 2.68 | - | - | - | - | - | - | - | - | - | - |
| Average* | 0.81 | 1.27 | 2.51 | 3.78 | 5.64 | 7.02 | 8.09 | 6.94 | 4.68 | 2.78 | 1.31 | 0.76 | 45.59 |

M For monthly values, superscript M indicates 1 to 9 daily observations are missing and a monthly value is calculated from available data. For annual values, superscript M indicates 1 or more months during the year had 1 to 9 missing observations and an annual value is calculated from available data.

\- For monthly values, a hyphen indicates 10 or more daily observations are missing and a monthly value is not calculated. For annual values, a hyphen indicates that one or more months during the year had a missing monthly value and no annual value is calculated.

* The last row of the table gives average monthly values. To eliminate bias caused by missing observations, averages are obtained from daily observation rather than by averaging monthly values. The average annual value is obtained from the 12 monthly average values.

Climate.usurf.usu.edu

Monthly ET averages = inches / day

https://climate.usu.edu

climate.usu.edu

Apps | EZPlug login | Pesticide Labels | PNWest Weed Man... | USU soils lab | Box Elder County E... | Google Maps | Google Maps | Chain Coupling Co... | Other bookmarks

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UTAH CLIMATE CENTER

UtahStateUniversity

- Utah Agweather
- Utah TRAPs
- Fruit Growth Models
- Peter Sinks
- Freeze Dates
- Water Years


Our Mission is to facilitate access to climate data and information, and to use expertise in atmospheric science, to interpret climate information in an accurate and innovative fashion for the public.

https://climate.usu.edu/mchd/index.php

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2/25/2021

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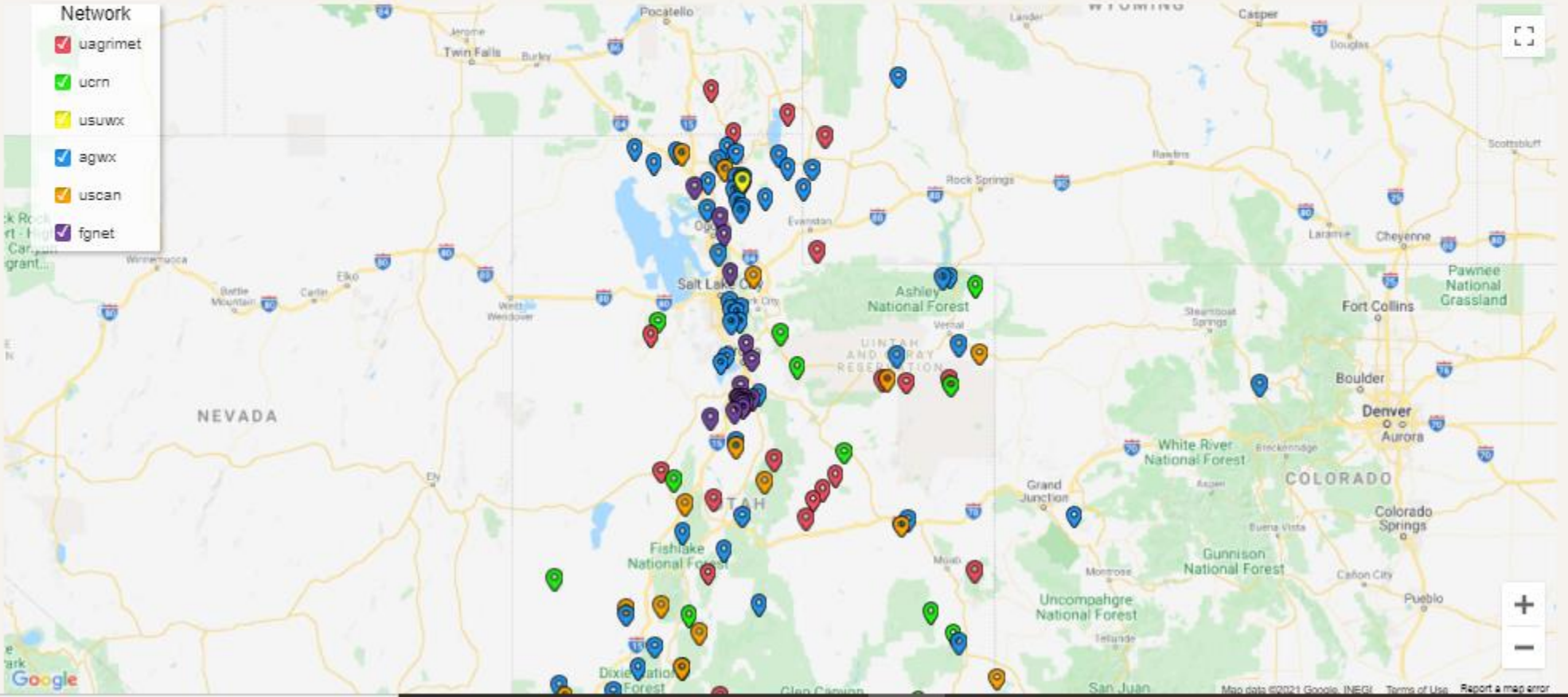
USUWX ▼ USCAN ▼ FGNET ▼

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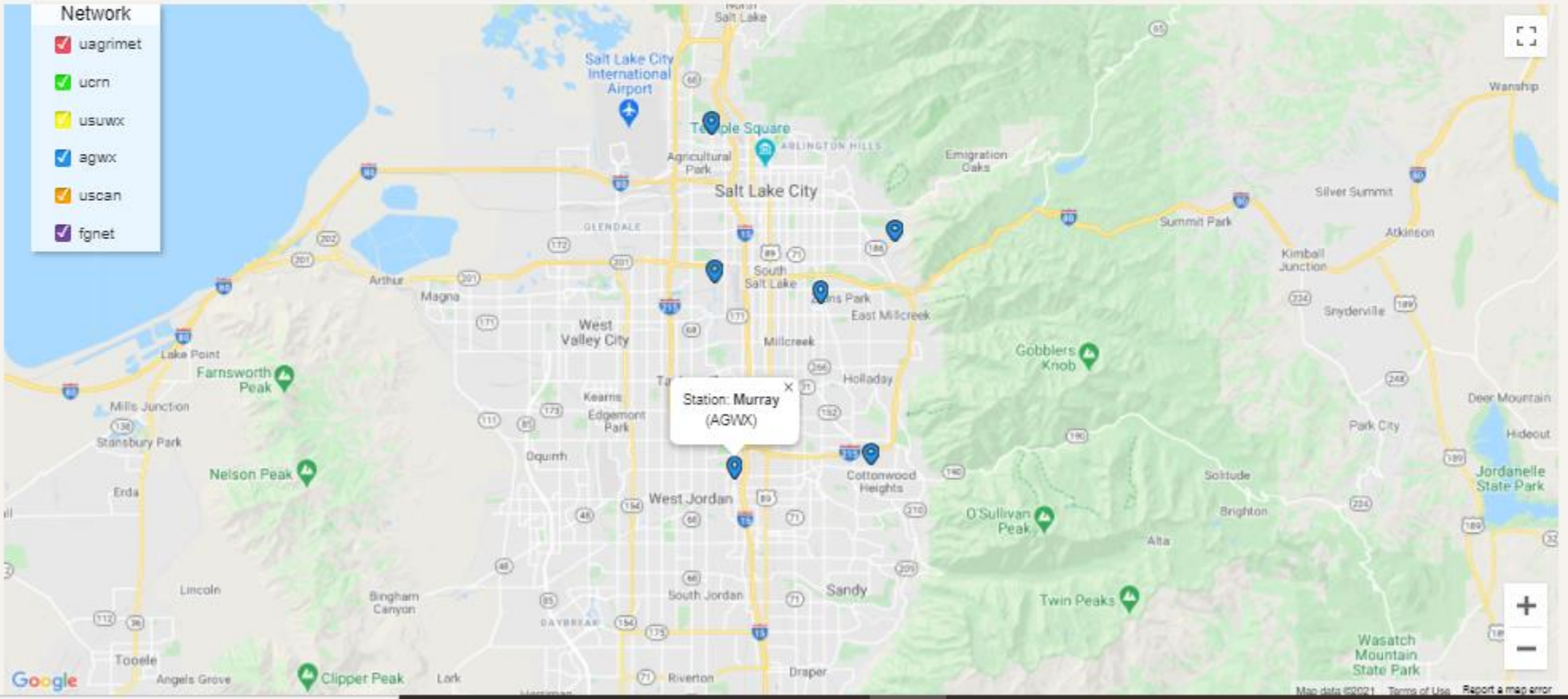
USUWX ▼ USCAN ▼ FGNET ▼

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https://climate.usu.edu/mchd/da

climate.usu.edu/mchd/dashboard/dashboard.php?network=AGWX&station=1138094&units=E&showgraph=0&

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# Murray

**Thursday 11:15 AM**

32°F

min: 21° max: 32°

**Current Wind**

SE
1.0 mph

**Location:** 40.6313°, -111.92°
**Elevation:** 4290 ft.
**Last Updated:** Thursday , 02/25 11:15 AM **MST**

Quickview Data | AGWX

| Precipitation | |
|---|---|
| Today | This Week |
| 0.00 | 0.080 |

METRIC | ENGLISH

## Data Charts

Change Month

Temperature & Dew Point | Relative Humidity | Wind Speed | Precipitation | Solar | Evapotranspiration | Soil | Wind Rose

### Temperature & Dew Point

Type here to search

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2/25/2021

https://climate.usu.edu/mchd/da

climate.usu.edu/mchd/dashboard/dashboard.php?network=AGWX&station=1138094&units=E&showgraph=0&

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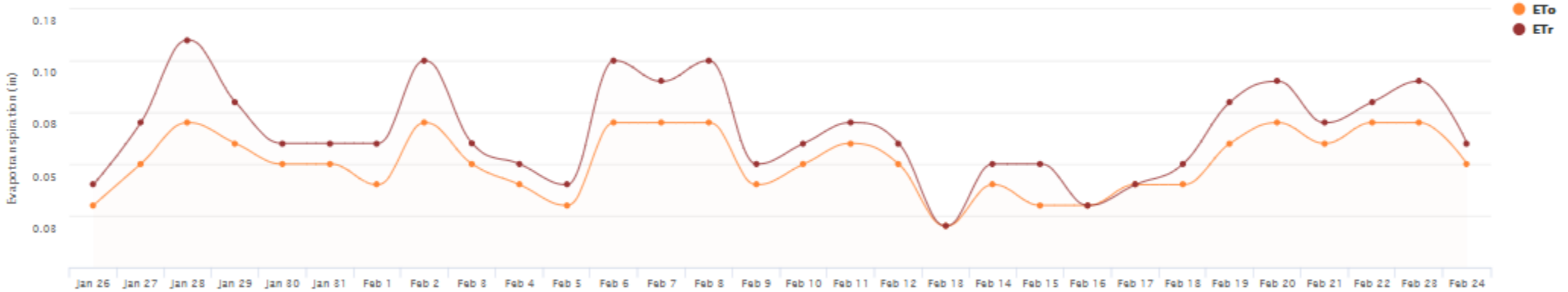
## Evapotranspiration

Hourly | Daily

Murray (AGWX)

Daily




## Downloads

07/10/2020 07/24/2020

Minute Hourly Daily

1138094-dly-repor....csv

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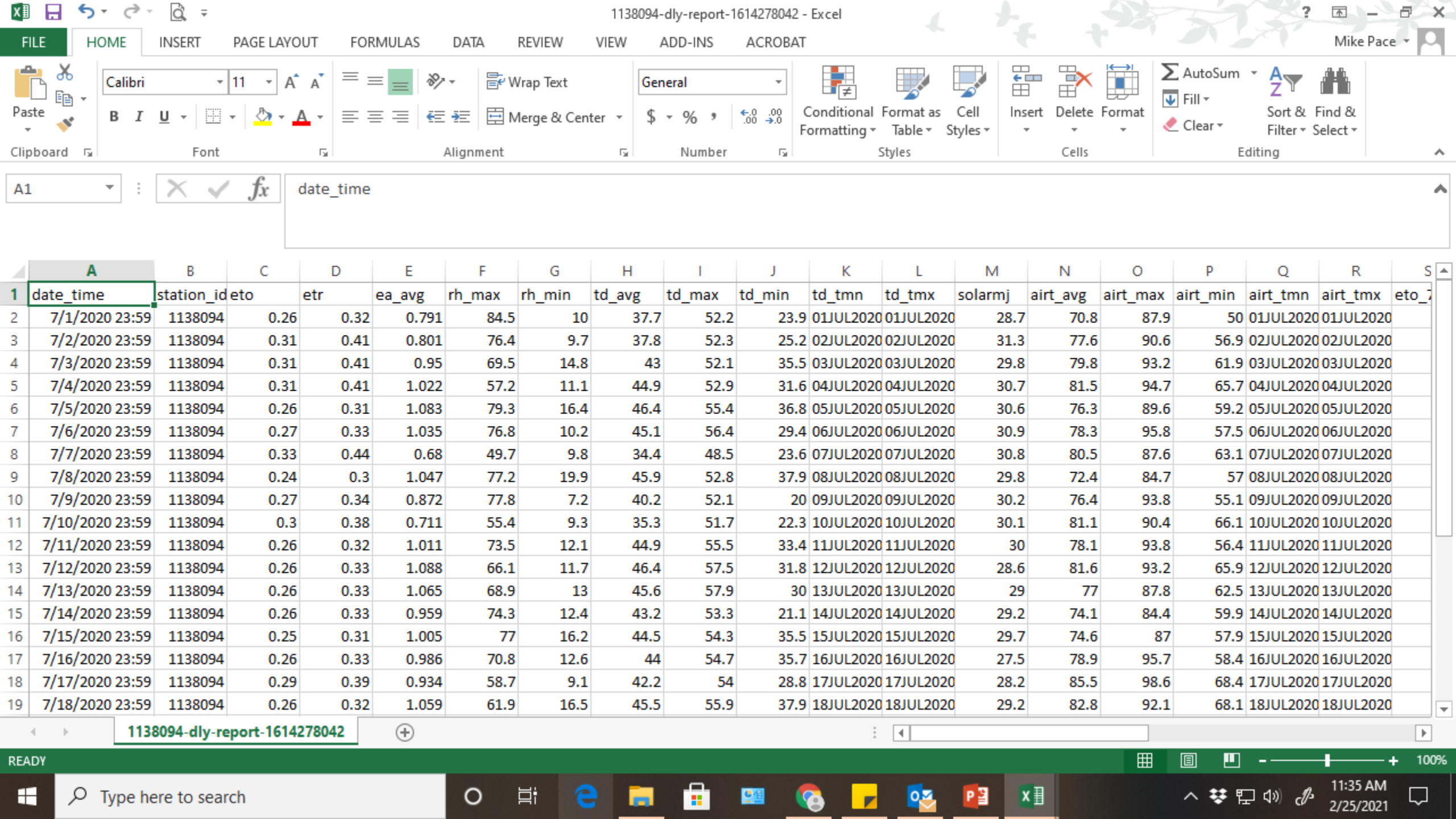

1138094-dly-report-1614278042 - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW ADD-INS ACROBAT Mike Pace

Paste Clipboard Calibri 11 Font Wrap Text Merge & Center Alignment General Number Conditional Formatting Format as Table Cell Styles Styles Insert Delete Format Cells AutoSum Fill Clear Sort & Filter Find & Select Editing

A1 date_time

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | date_time | station_id | eto | etr | ea_avg | rh_max | rh_min | td_avg | td_max | td_min | td_tmn | td_tmx | solarmj | airt_avg | airt_max | airt_min | airt_tmn | airt_tmx | eto_ |
| 2 | 7/1/2020 23:59 | 1138094 | 0.26 | 0.32 | 0.791 | 84.5 | 10 | 37.7 | 52.2 | 23.9 | 01JUL2020 | 01JUL2020 | 28.7 | 70.8 | 87.9 | 50 | 01JUL2020 | 01JUL2020 | |
| 3 | 7/2/2020 23:59 | 1138094 | 0.31 | 0.41 | 0.801 | 76.4 | 9.7 | 37.8 | 52.3 | 25.2 | 02JUL2020 | 02JUL2020 | 31.3 | 77.6 | 90.6 | 56.9 | 02JUL2020 | 02JUL2020 | |
| 4 | 7/3/2020 23:59 | 1138094 | 0.31 | 0.41 | 0.95 | 69.5 | 14.8 | 43 | 52.1 | 35.5 | 03JUL2020 | 03JUL2020 | 29.8 | 79.8 | 93.2 | 61.9 | 03JUL2020 | 03JUL2020 | |
| 5 | 7/4/2020 23:59 | 1138094 | 0.31 | 0.41 | 1.022 | 57.2 | 11.1 | 44.9 | 52.9 | 31.6 | 04JUL2020 | 04JUL2020 | 30.7 | 81.5 | 94.7 | 65.7 | 04JUL2020 | 04JUL2020 | |
| 6 | 7/5/2020 23:59 | 1138094 | 0.26 | 0.31 | 1.083 | 79.3 | 16.4 | 46.4 | 55.4 | 36.8 | 05JUL2020 | 05JUL2020 | 30.6 | 76.3 | 89.6 | 59.2 | 05JUL2020 | 05JUL2020 | |
| 7 | 7/6/2020 23:59 | 1138094 | 0.27 | 0.33 | 1.035 | 76.8 | 10.2 | 45.1 | 56.4 | 29.4 | 06JUL2020 | 06JUL2020 | 30.9 | 78.3 | 95.8 | 57.5 | 06JUL2020 | 06JUL2020 | |
| 8 | 7/7/2020 23:59 | 1138094 | 0.33 | 0.44 | 0.68 | 49.7 | 9.8 | 34.4 | 48.5 | 23.6 | 07JUL2020 | 07JUL2020 | 30.8 | 80.5 | 87.6 | 63.1 | 07JUL2020 | 07JUL2020 | |
| 9 | 7/8/2020 23:59 | 1138094 | 0.24 | 0.3 | 1.047 | 77.2 | 19.9 | 45.9 | 52.8 | 37.9 | 08JUL2020 | 08JUL2020 | 29.8 | 72.4 | 84.7 | 57 | 08JUL2020 | 08JUL2020 | |
| 10 | 7/9/2020 23:59 | 1138094 | 0.27 | 0.34 | 0.872 | 77.8 | 7.2 | 40.2 | 52.1 | 20 | 09JUL2020 | 09JUL2020 | 30.2 | 76.4 | 93.8 | 55.1 | 09JUL2020 | 09JUL2020 | |
| 11 | 7/10/2020 23:59 | 1138094 | 0.3 | 0.38 | 0.711 | 55.4 | 9.3 | 35.3 | 51.7 | 22.3 | 10JUL2020 | 10JUL2020 | 30.1 | 81.1 | 90.4 | 66.1 | 10JUL2020 | 10JUL2020 | |
| 12 | 7/11/2020 23:59 | 1138094 | 0.26 | 0.32 | 1.011 | 73.5 | 12.1 | 44.9 | 55.5 | 33.4 | 11JUL2020 | 11JUL2020 | 30 | 78.1 | 93.8 | 56.4 | 11JUL2020 | 11JUL2020 | |
| 13 | 7/12/2020 23:59 | 1138094 | 0.26 | 0.33 | 1.088 | 66.1 | 11.7 | 46.4 | 57.5 | 31.8 | 12JUL2020 | 12JUL2020 | 28.6 | 81.6 | 93.2 | 65.9 | 12JUL2020 | 12JUL2020 | |
| 14 | 7/13/2020 23:59 | 1138094 | 0.26 | 0.33 | 1.065 | 68.9 | 13 | 45.6 | 57.9 | 30 | 13JUL2020 | 13JUL2020 | 29 | 77 | 87.8 | 62.5 | 13JUL2020 | 13JUL2020 | |
| 15 | 7/14/2020 23:59 | 1138094 | 0.26 | 0.33 | 0.959 | 74.3 | 12.4 | 43.2 | 53.3 | 21.1 | 14JUL2020 | 14JUL2020 | 29.2 | 74.1 | 84.4 | 59.9 | 14JUL2020 | 14JUL2020 | |
| 16 | 7/15/2020 23:59 | 1138094 | 0.25 | 0.31 | 1.005 | 77 | 16.2 | 44.5 | 54.3 | 35.5 | 15JUL2020 | 15JUL2020 | 29.7 | 74.6 | 87 | 57.9 | 15JUL2020 | 15JUL2020 | |
| 17 | 7/16/2020 23:59 | 1138094 | 0.26 | 0.33 | 0.986 | 70.8 | 12.6 | 44 | 54.7 | 35.7 | 16JUL2020 | 16JUL2020 | 27.5 | 78.9 | 95.7 | 58.4 | 16JUL2020 | 16JUL2020 | |
| 18 | 7/17/2020 23:59 | 1138094 | 0.29 | 0.39 | 0.934 | 58.7 | 9.1 | 42.2 | 54 | 28.8 | 17JUL2020 | 17JUL2020 | 28.2 | 85.5 | 98.6 | 68.4 | 17JUL2020 | 17JUL2020 | |
| 19 | 7/18/2020 23:59 | 1138094 | 0.26 | 0.32 | 1.059 | 61.9 | 16.5 | 45.5 | 55.9 | 37.9 | 18JUL2020 | 18JUL2020 | 29.2 | 82.8 | 92.1 | 68.1 | 18JUL2020 | 18JUL2020 | |

1138094-dly-report-1614278042

READY 100%

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# ET data from Utah Climate Center – July 2020

## July 1-7, 2020

| date_time | eto | etr |
|---|---|---|
| 7/1/2020 23:59 | 0.26 | 0.32 |
| 7/2/2020 23:59 | 0.31 | 0.41 |
| 7/3/2020 23:59 | 0.31 | 0.41 |
| 7/4/2020 23:59 | 0.31 | 0.41 |
| 7/5/2020 23:59 | 0.26 | 0.31 |
| 7/6/2020 23:59 | 0.27 | 0.33 |
| 7/7/2020 23:59 | 0.33 | 0.44 |
| | 2.05 | 2.63 |

**eto 2.05 / 7 days = 0.29 inch per day**

**etr 2.63 / 7 days = 0.37 inch per day**

## July 2020

| Date – time | eto | etr |
|---|---|---|
| 7/26/2020 23:59 | 0.24 | 0.30 |
| 7/27/2020 23:59 | 0.23 | 0.28 |
| 7/28/2020 23:59 | 0.25 | 0.31 |
| 7/29/2020 23:59 | 0.24 | 0.29 |
| 7/30/2020 23:59 | 0.24 | 0.29 |
| 7/31/2020 23:59 | 0.27 | 0.34 |
| **Total** | **8.01** | **10.13** |

**eto July total 8.01 / 31 days = 0.26**

**etr July total 10.13 / 31 days = 0.32**

**24 year average for July = 8.09**

# Seasonal Affects and ET

| Month | inches/month | inches/day |
|---|---|---|
| April | 3.78 | .13 |
| May | 5.69 | .19 |
| June | 7.02 | .24 |
| July | 8.09 | .27 |
| August | 6.94 | .23 |
| September | 4.69 | .16 |
| October | 2.78 | .10 |

* ET changes with temperature changes

Utah Climate Center - Utah State | https://climate.usu.edu/mchd/da

climate.usu.edu/mchd/dashboard/dashboard.php?network=AGWX&station=1294641&units=E&showgraph=0&

Apps | EZPlug login | Pesticide Labels | PNWest Weed Man... | USU soils lab | Box Elder County E... | Google Maps | Google Maps | Chain Coupling Co... | Other bookmarks

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UTAH CLIMATE CENTER

UtahStateUniversity

# Pump6200

Thursday 02:45 PM

37°F

min: 17° max: 39°

Current Wind

SE
1.8 mph

Location: 40.6379°, -111.832°
Elevation: 4462 ft.
Last Updated: Thursday , 02/25 02:45 PM MST

Quickview Data | AGWX

| Precipitation | |
|---|---|
| Today | This Week |
| 0.00 | 0.340 |

METRIC | ENGLISH

## Data Charts

Change Month

1138094-dly-repor....csv

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2/25/2021

Utah Climate Center - Utah State | https://climate.usu.edu/mchd/da

climate.usu.edu/mchd/dashboard/dashboard.php?network=AGWX&station=1294641&units=E&showgraph=0&

Apps | EZPlug login | Pesticide Labels | PNWest Weed Man... | USU soils lab | Box Elder County E... | Google Maps | Google Maps | Chain Coupling Co... | Other bookmarks

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Change Month

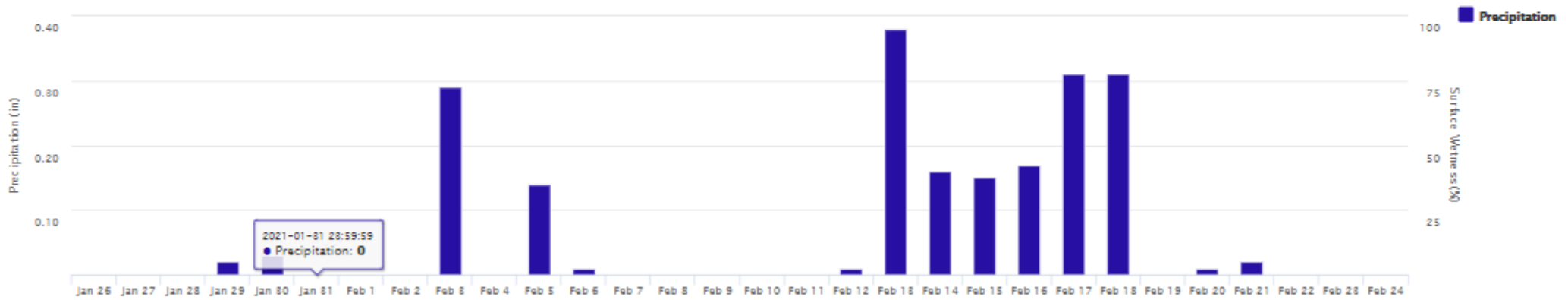
Temperature & Dew Point | Relative Humidity | Wind Speed | Precipitation | Solar | Evapotranspiration | Soil | Wind Rose | Turf Soil

## Precipitation

Minute | Hourly | Daily

Pump6200 (AGWX)

Daily




## Downloads

02/18/2021 02/25/2021

1138094-dly-repor....csv

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2:53 PM 2/25/2021

https://health.wusf.usf.edu/health-news-florida

# Which system is best for me?

https://fdp.com.pk/

https://www.123rf.com/

https://www.agrotechnomarket.com/2016/10/furrow-irrigation-for-vegetable-garden.html


257,340
2.50"
214,450
3.00"
207,530
3.10"
171,5
.75"

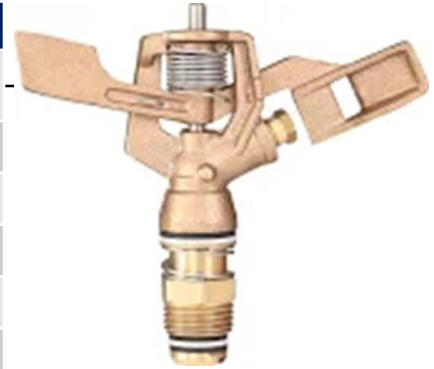

Lakemont

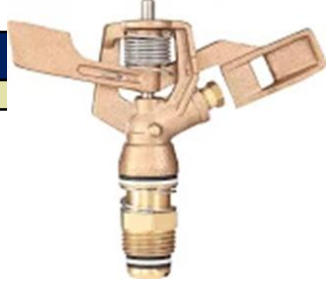
# How much water am I applying?

- Nozzle size
- Pressure (psi)
- In row and between row spacing

# Figuring impact sprinkler application rates

| NOZZLE DISCHARGE – GALLONS PER MINUTE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Nozzle Diameter in Inches | | | | | | | |
| **PSI** | 3/32 | 1/8 | 9/64 | 5/32 | 11/64 | 3/16 | 13/64 | 7/32 |
| **20** | 1.17 | 2.09 | 2.65 | 3.26 | 3.92 | 4.69 | 5.51 | 6.37 |
| **25** | 1.31 | 2.34 | 2.96 | 3.64 | 4.38 | 5.25 | 6.16 | 7.13 |
| **30** | 1.44 | 2.56 | 3.26 | 4.01 | 4.83 | 5.75 | 6.80 | 7.86 |
| **35** | 1.55 | 2.77 | 3.50 | 4.31 | 5.18 | 6.21 | 7.30 | 8.43 |
| **40** | 1.66 | 2.96 | 3.74 | 4.61 | 5.54 | 6.64 | 7.80 | 9.02 |
| **45** | 1.76 | 3.13 | 3.99 | 4.91 | 5.91 | 7.03 | 8.30 | 9.60 |
| **50** | 1.85 | 3.30 | 4.18 | 5.15 | 6.19 | 7.41 | 8.71 | 10.10 |
| **55** | 1.94 | 3.46 | 4.37 | 5.39 | 6.48 | 7.77 | 9.12 | 10.50 |
| **60** | 2.03 | 3.62 | 4.50 | 5.65 | 6.80 | 8.12 | 9.56 | 11.05 |
| **65** | 2.11 | 3.77 | 4.76 | 5.87 | 7.06 | 8.45 | 9.92 | 11.45 |
| **70** | 2.19 | 3.91 | 4.96 | 6.10 | 7.34 | 8.78 | 10.32 | 11.95 |
| **75** | 2.27 | 4.05 | 5.12 | 6.30 | 7.58 | 9.08 | 10.66 | 12.32 |
| **80** | 2.35 | 4.18 | 5.29 | 6.52 | 7.84 | 9.39 | 11.02 | 12.74 |
| **85** | 2.42 | 4.31 | 5.45 | 6.71 | 8.07 | 9.67 | 11.35 | 13.11 |
| **90** | 2.49 | 4.43 | 5.61 | 6.91 | 8.31 | 9.95 | 11.69 | 13.51 |
| **95** | 2.56 | 4.56 | 5.76 | 7.09 | 8.53 | 10.2 | 11.99 | 13.86 |
| **100** | 2.63 | 4.67 | 5.91 | 7.29 | 8.76 | 10.5 | 12.32 | 14.23 |





# Sprinkler Application Rates

## In./hr.=96.24 *gallons per minute(gpm)/area (ft^2)

## Efficiencies (70-80 percent)

| AVERAGE APPLICATION RATE – INCHES PER HOUR<br>Gallons Per Minute From Each Sprinkler | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Spacing Feet** | **2 gpm** | **3 gpm** | **4 gpm** | **5 gpm** | **6 gpm** | **7 gpm** | **8 gpm** | **9 gpm** | **10 gpm** | **12 gpm** |
| **20x20** | .48 | .72 | .96 | 1.20 | 1.44 | 1.70 | 1.93 | 2.16 | 2.40 | |
| **20x30** | .32 | .48 | .64 | .80 | .96 | 1.12 | 1.28 | 1.43 | 1.60 | 1.93 |
| **30x40** | .24 | .36 | .48 | .60 | .72 | .84 | .96 | 1.08 | 1.20 | 1.45 |
| **30x30** | .21 | .32 | .43 | .54 | .64 | .75 | .88 | .96 | 1.07 | 1.28 |
| **30x40** | .16 | .24 | .32 | .40 | .48 | .56 | .64 | .72 | .80 | .95 |
| **30x50** | .13 | .19 | .25 | .32 | .38 | .45 | .51 | .58 | .64 | .76 |
| **40x40** | .12 | .18 | .24 | .30 | .36 | .42 | .48 | .54 | .60 | .72 |
| **40x50** | .10 | .14 | .19 | .24 | .29 | .34 | .38 | .43 | .48 | .58 |
| **40x60** | | .12 | .16 | .20 | .24 | .28 | .32 | .36 | .40 | .48 |

# July 1-7, 2020

| date_time | eto | etr |
|---|---|---|
| 7/1/2020 23:59 | 0.26 | 0.32 |
| 7/2/2020 23:59 | 0.31 | 0.41 |
| 7/3/2020 23:59 | 0.31 | 0.41 |
| 7/4/2020 23:59 | 0.31 | 0.41 |
| 7/5/2020 23:59 | 0.26 | 0.31 |
| 7/6/2020 23:59 | 0.27 | 0.33 |
| 7/7/2020 23:59 | 0.33 | 0.44 |
| | 2.05 | 2.63 |

**2.05 / 7 = 0.29**

**2.63 / 7 = 0.37**

# Soil water holding capacity

- **Saturation**
  all soil pores are full of water
- **Field Capacity**
  water in macropores after gravity drains (plant available water)
- **Permanent Wilting Point**
  small film of water around soil particles (not available to plants)

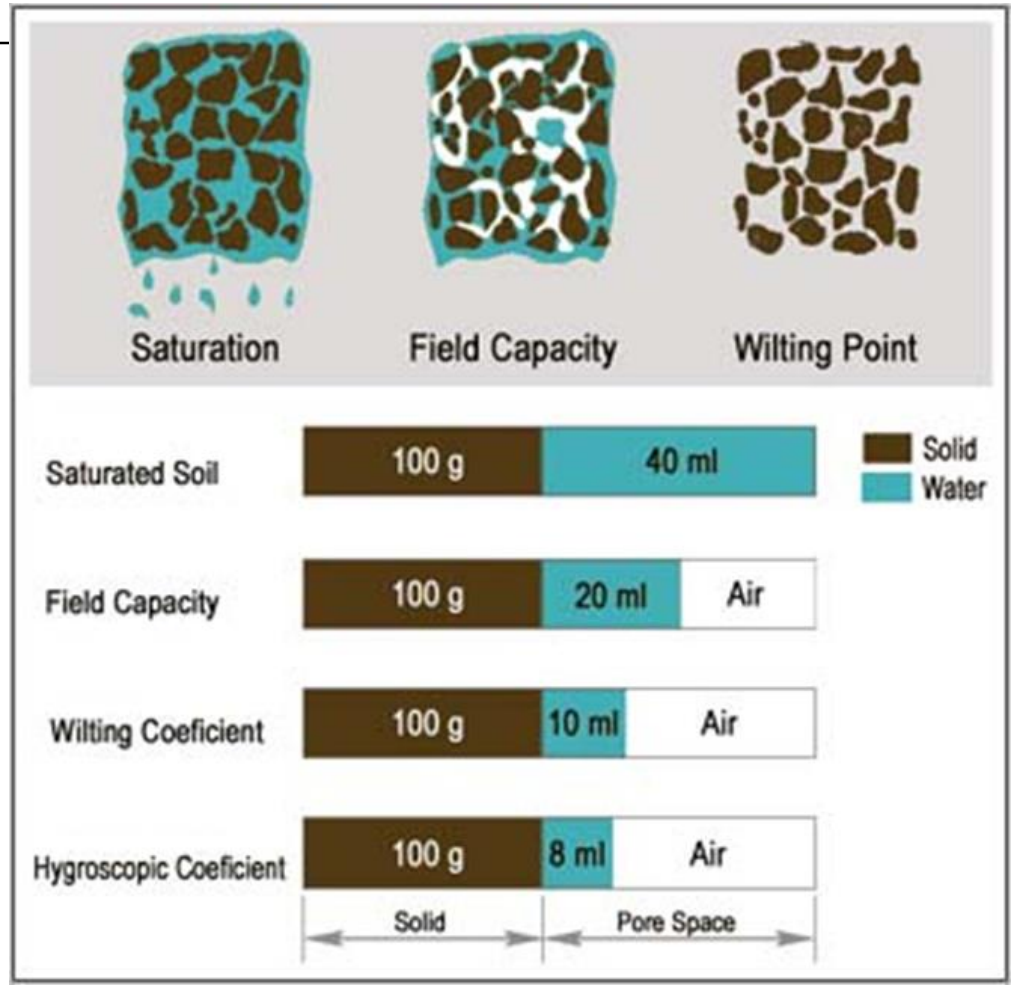
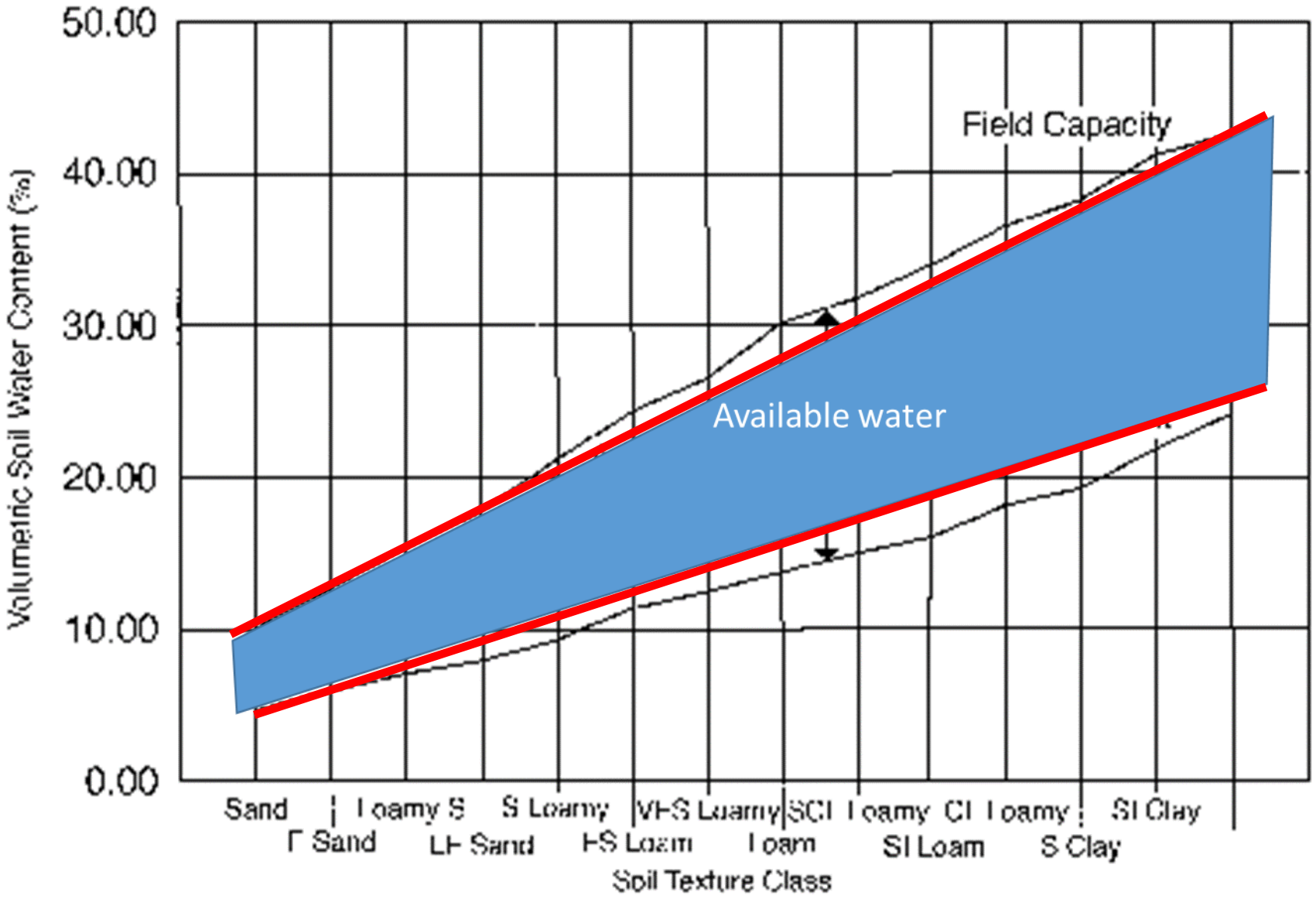



Illustration Courtesy http://www.landfood.ubc.ca/soil200

# Available Soil Water vs. Texture




Graph courtesy http://cru.cahe.wsu.edu

# Figuring Drip Tape Application Rates

| | |
|---|---|
| Max. Pressure | 15 PSI |
| Diameter | 5/8" |
| Wall Thickness | 8 mil |
| Emitter Spacing | 8 inch |
| Flow Rate | 0.34 GPM/100' |
| Length | 2,000 Feet |

Toro Aqua-Traxx® - 5/8", 8 mil, 8 inch, 0.34 GPM/100', 2,000 Feet - EA5080834-200

# Irrigation in the Pacific Northwest

Washington State University Extension | Oregon State University Extension | University of Idaho Extension



## Drip Line Rate

The drip line application rate is specific to your irrigation system and shouldn't change, so take a note of it. This constant rate is multiplied by all future irrigation set times to give the net application depths for those sets. Use this form to calculate the water application rate of drip irrigation lines (tape, tubing) given the flow rate from individual emitters, a constant spacing of the emitters along the drip line, and a constant spacing between the drip lines. Learn more about the units used on this page.

"Drip Line Rate Calculator – Washington State University

Emitter flow rate:

.25 gph

Spacing between emitters in the tubing or tape:

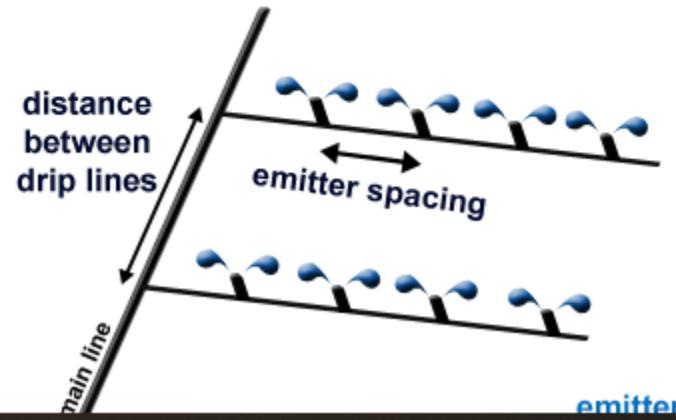
4 in

Distance between drip lines:

8 in

Calculate

Application Rate:



Home
Mobile
Irrigation Calculators
Popular
Drip Line Rate
Sprinkler Application Rate
Nozzle Requirements
Water Application Rate
Pipeline Pressure Loss
Irrigation Management Calculators
Drip
Sprinkler
Center Pivot
Residential
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Emitter flow rate:

gpm

gph
lph
gpm
lps

Spacing between emitters in t ng or tape:

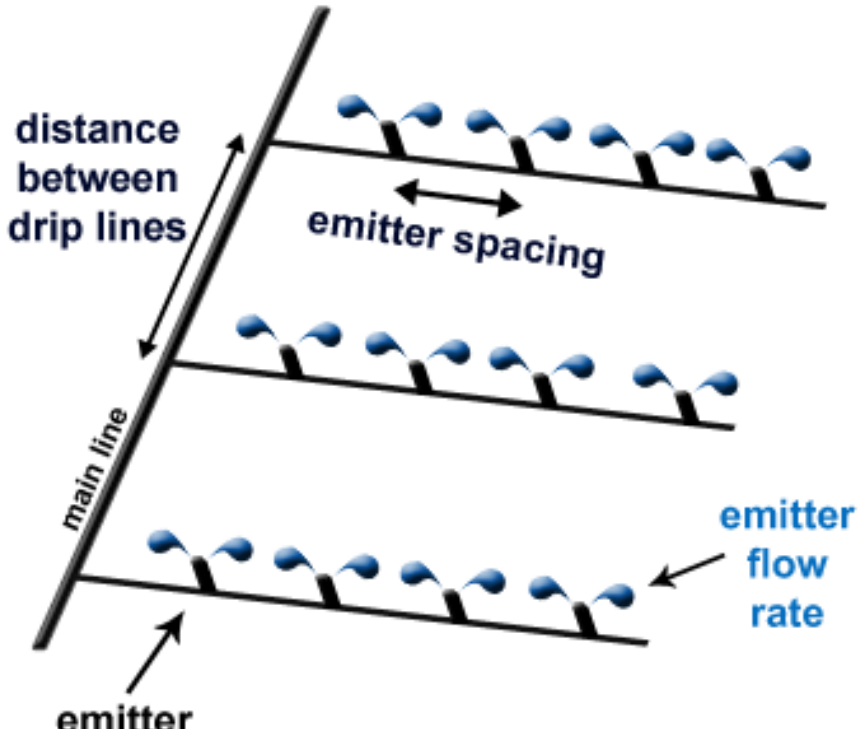
Distance between drip lines:

in

Calculate

Application Rate:

in/hr



Home
Mobile
Irrigation Calculators
Popular
Drip Line Rate
Sprinkler Application Rate
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Emitter flow rate:

gpm

Spacing between emitters in the tubing or tape:

in

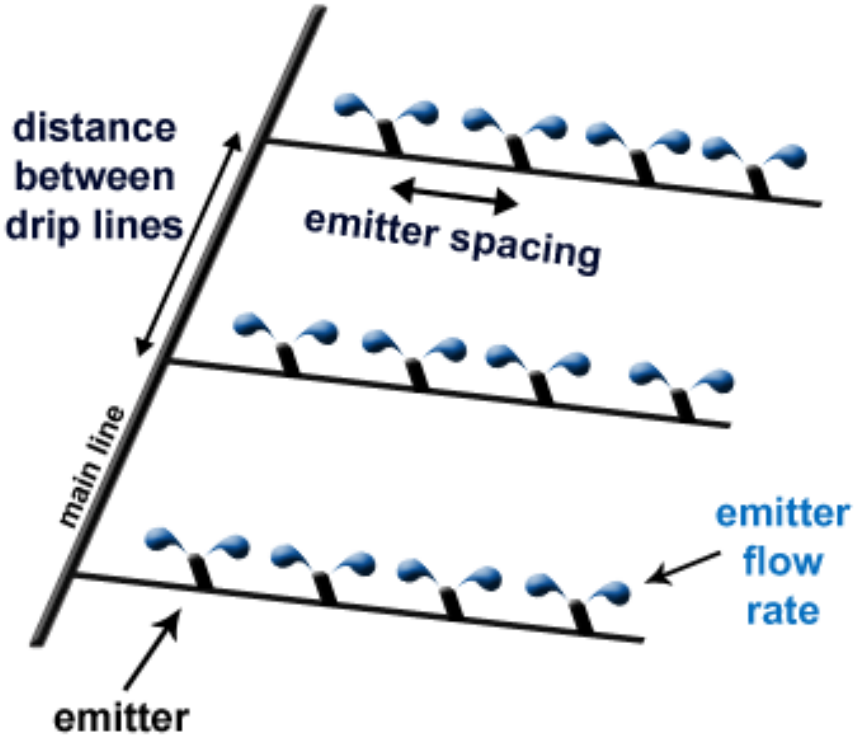
- in
- ft
- mm
- cm
- m

Distance between drip lines:

Calculate

Application Rate:

in/hr



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Emitter flow rate:

.25 gph

Spacing between emitters in the tubing or tape:

4 in

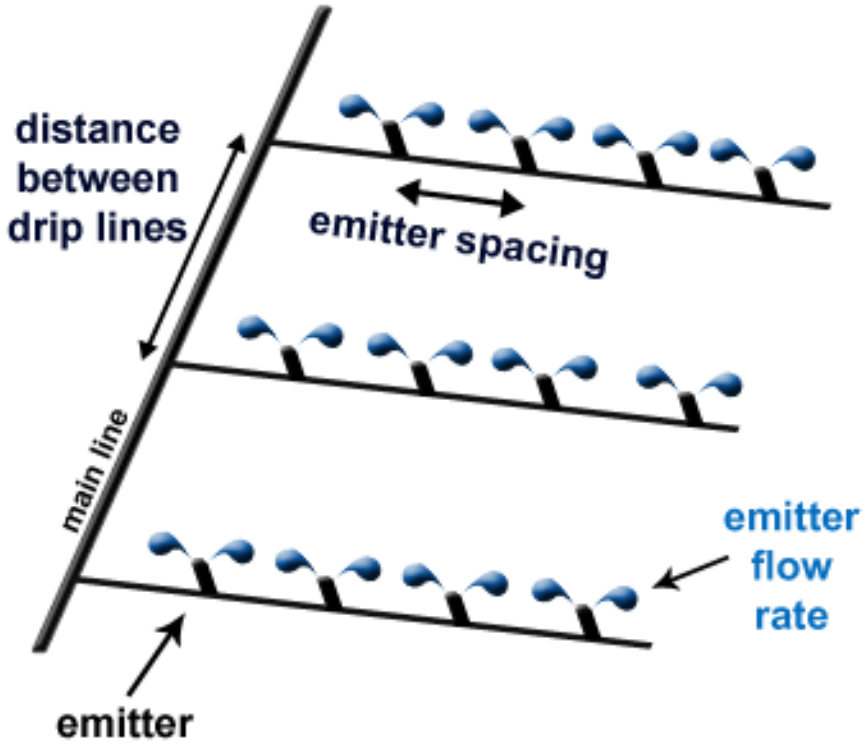
Distance between drip lines:

8 in

Calculate

Application Rate:

1.805 in/hr



emitters, a constant spacing of the emitters along the drip line, and a constant spacing between the drip lines. Learn more about the units used on this page.

Emitter flow rate:

.40 gph

Spacing between emitters in the tubing or tape:

8 in

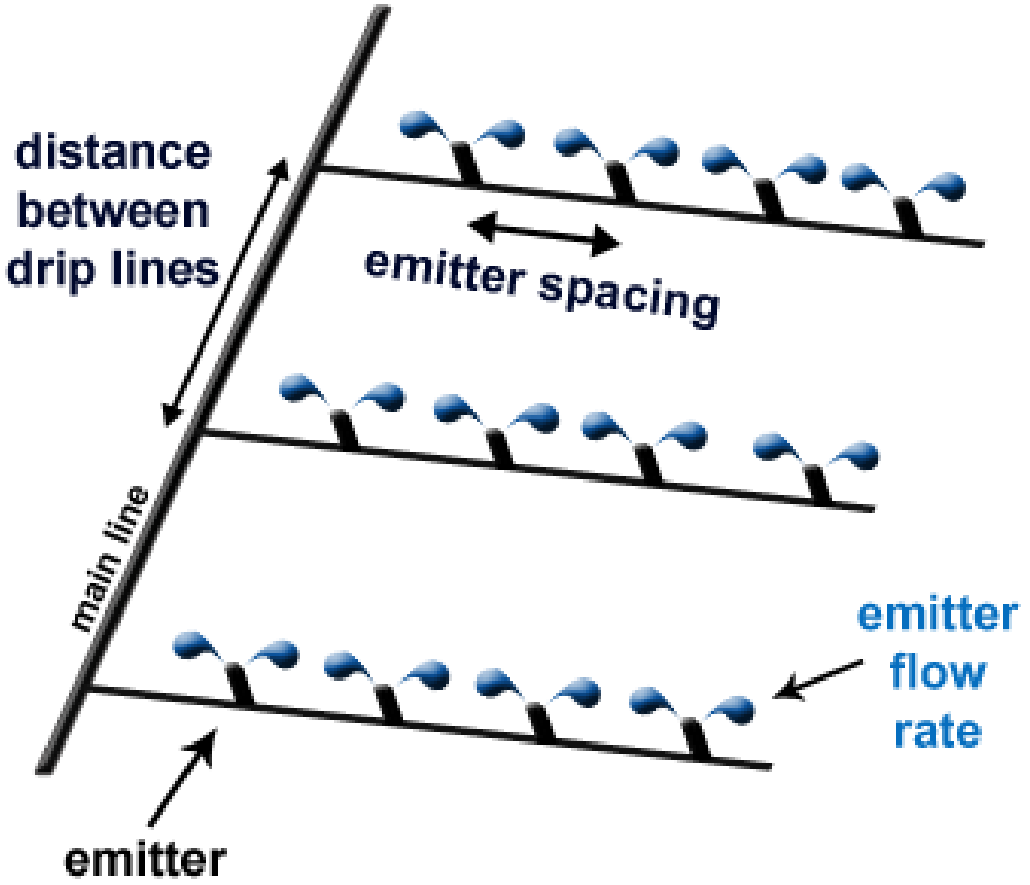
Distance between drip lines:

30 in

Calculate

Application Rate:

0.385 in/hr




## The Equation

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Drip Line Rate
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Drip
Sprinkler
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Residential
General Design Calculators
Water Measurement Calculators
Chemigation
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Use this first form to determine the effective application rate of sprinklers spaced at uniform distances from each other. This is particularly applicable to hand-move, or wheel-line, irrigation systems. The pressure is measured at the sprinkler nozzle. The head spacing is the distance between sprinkler heads along the water line, and the line spacing is the distance between lines in the field. If there is just one line being moved and the spray patterns overlay, as is typical for hand-move or wheel-line, then the actual application rate will be lower but the given number will be useful to determine set times. Learn more about the units used on this page.

## Nozzle Flow Rate and Effective Application Rate

Nozzle Diameter:

[ ] [in ▾]

Pressure:

[ ] [psi ▾]

Head Spacing:

[ ] [ft ▾]

Line Spacing:

[ ] [ft ▾]

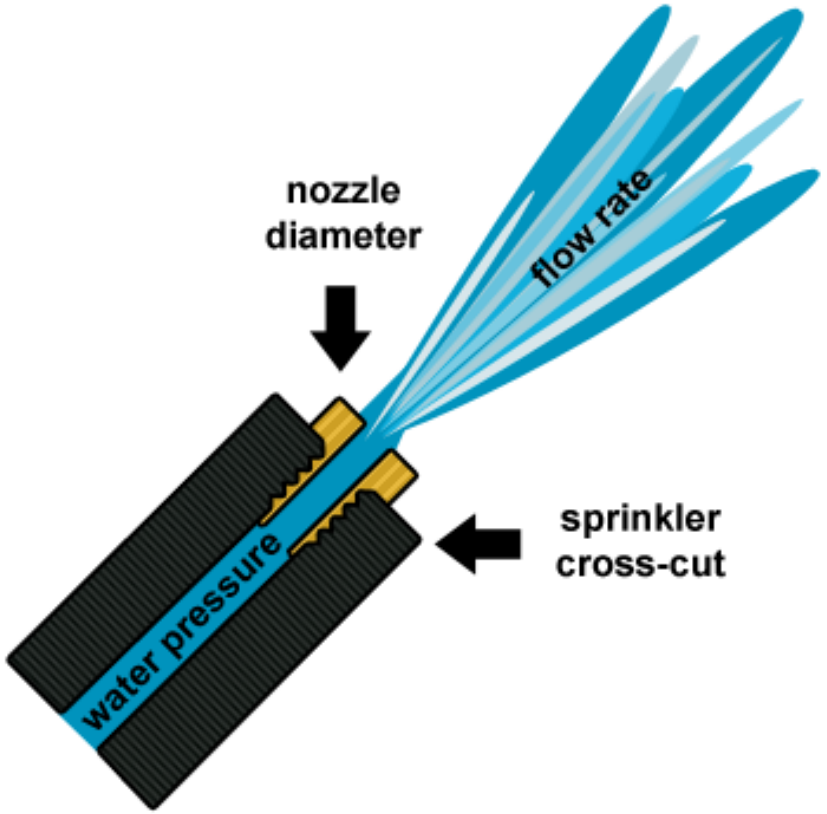
Sprinkler Efficiency:

[70] %

[Calculate]

Nozzle Flow Rate:

[ ] [gpm ▾]



# Nozzle Flow Rate and Effective Application Rate

Nozzle Diameter:

5 32nds in

Pressure:

54 psi

Head Spacing:

30 ft

Line Spacing:

40 ft

Sprinkler Efficiency:

70 %

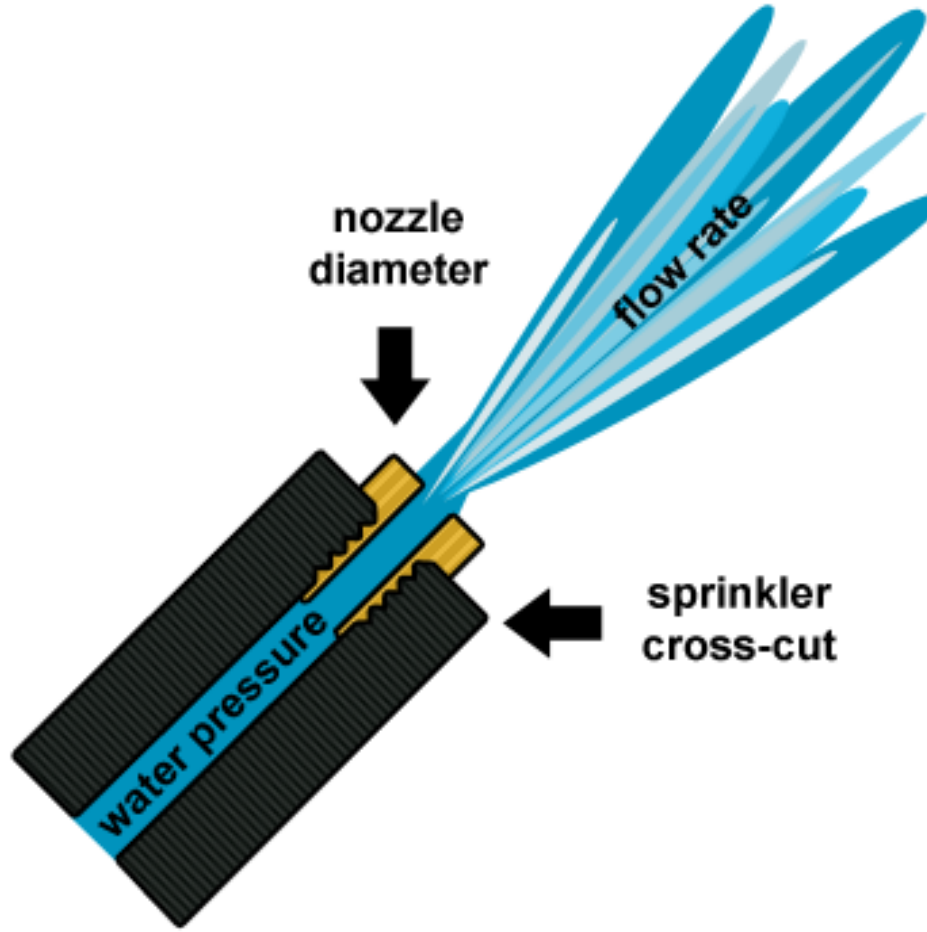
Calculate

Nozzle Flow Rate:

5.19 gpm

Effective Application Rate:

0.291 in/hr



# Increasing Uniformity

- Upgrade irrigation system
- Replace sprinklers, gaskets, and fix leaks
- Improve irrigation system uniformity (minimize deep percolation)
- Level fields to uniform and proper grade (when practical)
- Adjust furrow or border flow rate

EXTENSION.USU.EDU

EXTENSION
UtahStateUniversity

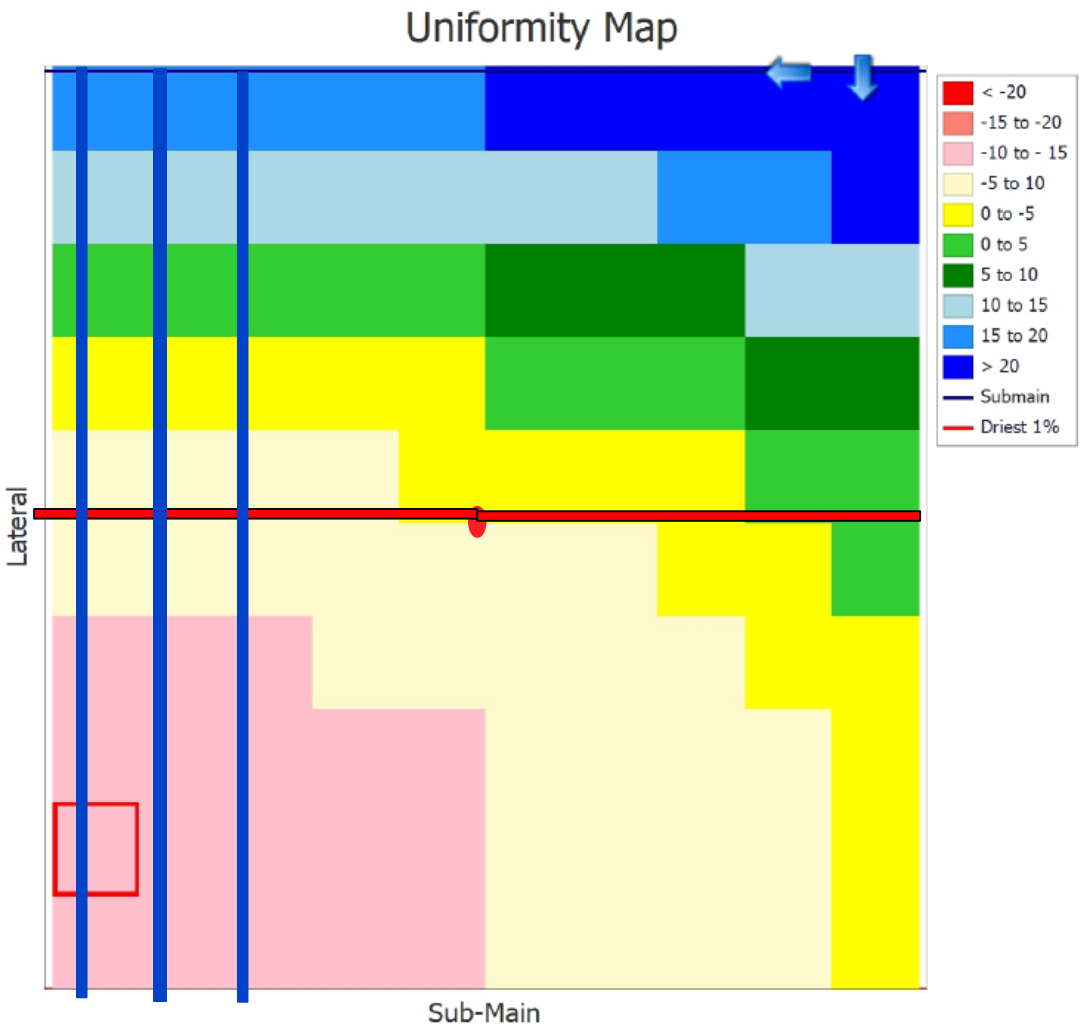
# Increasing Uniformity

- Upgrade irrigation system
- Replace sprinklers, gaskets, and fix leaks
- Improve irrigation system uniformity (minimize deep percolation)

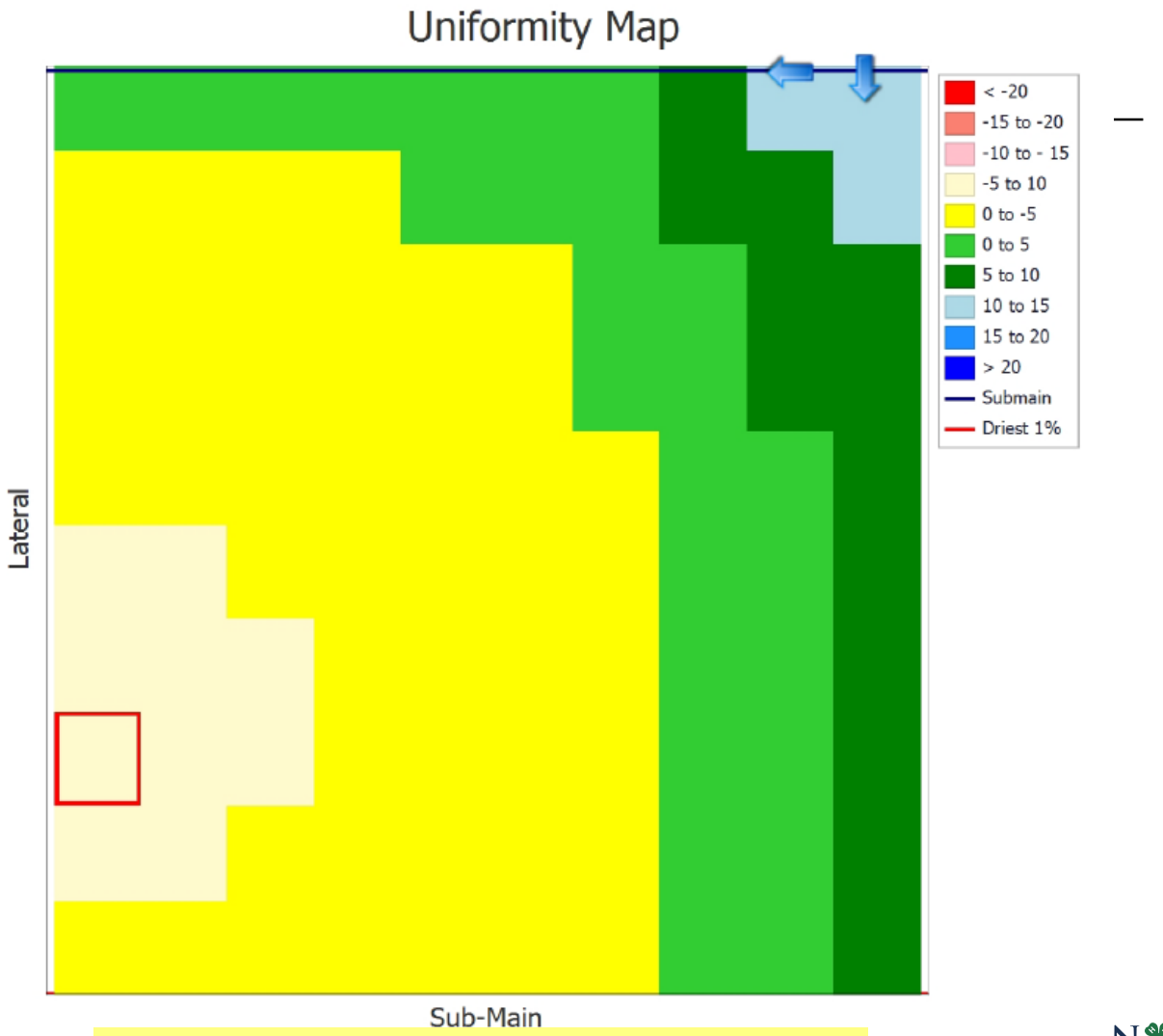
https://aboveallsprinklers.com/

http://ddhranch.com/life-lessons/

# Drip Designs - No design is perfect.



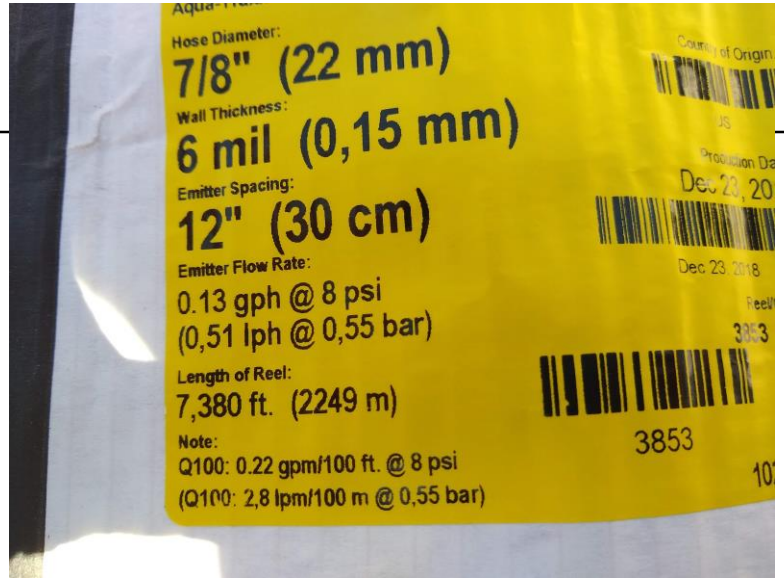

5/8” tape Emission Uniformity of 85%




7/8” tape Emission Uniformity of 91%

# Improving irrigation system uniformity

| Part Number | Spacing | | gph | | Exponent | Requirement |
|---|---|---|---|---|---|---|
| | in | cm | @ 8 psi | @ 10 psi | | mesh (micron) |
| **0.13 gph emitter** | | | | | | |
| EAXxx0467 | 4 | 10 | 0.13 | 0.15 | 0.5 | 120 (125) |
| EAXxx0644 | 6 | 15 | 0.13 | 0.15 | | |
| EAXxx0834 | 8 | 20 | 0.13 | 0.15 | | |
| EAXxx1222 | 12 | 30 | 0.13 | 0.15 | | |
| EAXxx1617 | 16 | 40 | 0.13 | 0.15 | | |
| EAXxx1814 | 18 | 45 | 0.13 | 0.15 | | |
| EAXxx2411 | 24 | 60 | 0.13 | 0.15 | | |




Drip Emitter Flow Rate v. Pressure

| | Pressure (psi) | discharge (gph) | % of 8 psi discharge | % change from 8 psi discharge |
|---|---|---|---|---|
| -2 psi | 6 | 0.113 | 87% | -13% |
| -1 psi | 7 | 0.122 | 94% | -6% |
| **Label** | **8** | **0.130** | **100%** | **0%** |
| +1 psi | 9 | 0.138 | 106% | 6% |
| +2 psi | 10 | 0.145 | 112% | 12% |
| **Range** | **4** | **0.033** | **25%** | **25%** |

# Sprinkler Uniformity Test

# Flood Irrigation

# Conclusion

Know and understand your irrigation system.

Learn how to find the ETo for your area.

Determine how much water you need to apply based on your irrigation schedule.

Understand how much water you apply each time you irrigate.

Test the application uniformity of your system and make the proper adjustments.

EXTENSION

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http://extension.usu.edu/boxelder/