

A Tool for Urban Water
Conservation:
Automated Weather Network
Evapotranspiration

2005 Southern Region Water Quality Conference

Any
City
USA

City of Norman

Water Conservation Plan 2002



Norman Utilities Authority



When is it time to water?

How We've Been Watering

- Routine
- Time clock schedule
- Grass color change
- When footprints show in the grass

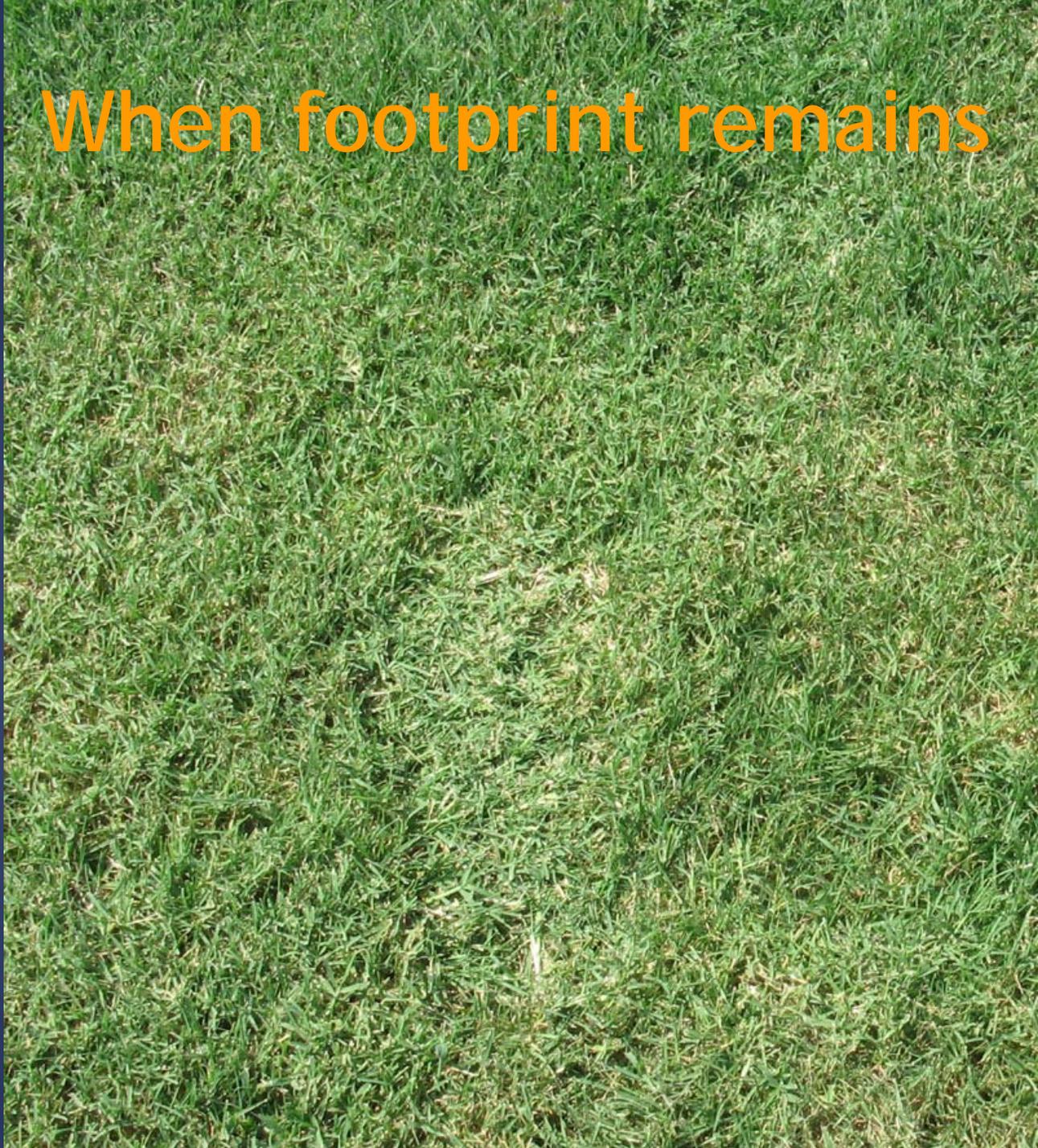
How We Could Water

- Estimate turfgrass water demand by
EVAPOTRANSPIRATION

Water by routine or time clock



When footprint remains



Water when color changes



Evapotranspiration

- “Evapo”ration + “transpiration”
- “Evapo” – Evaporation from soil surface
- “transpiration” – Water from plant leaves
- Evapotranspiration often referred to as “ET”

E.T.TM

THE EXTRA-TERRESTRIAL

THE 20TH ANNIVERSARY

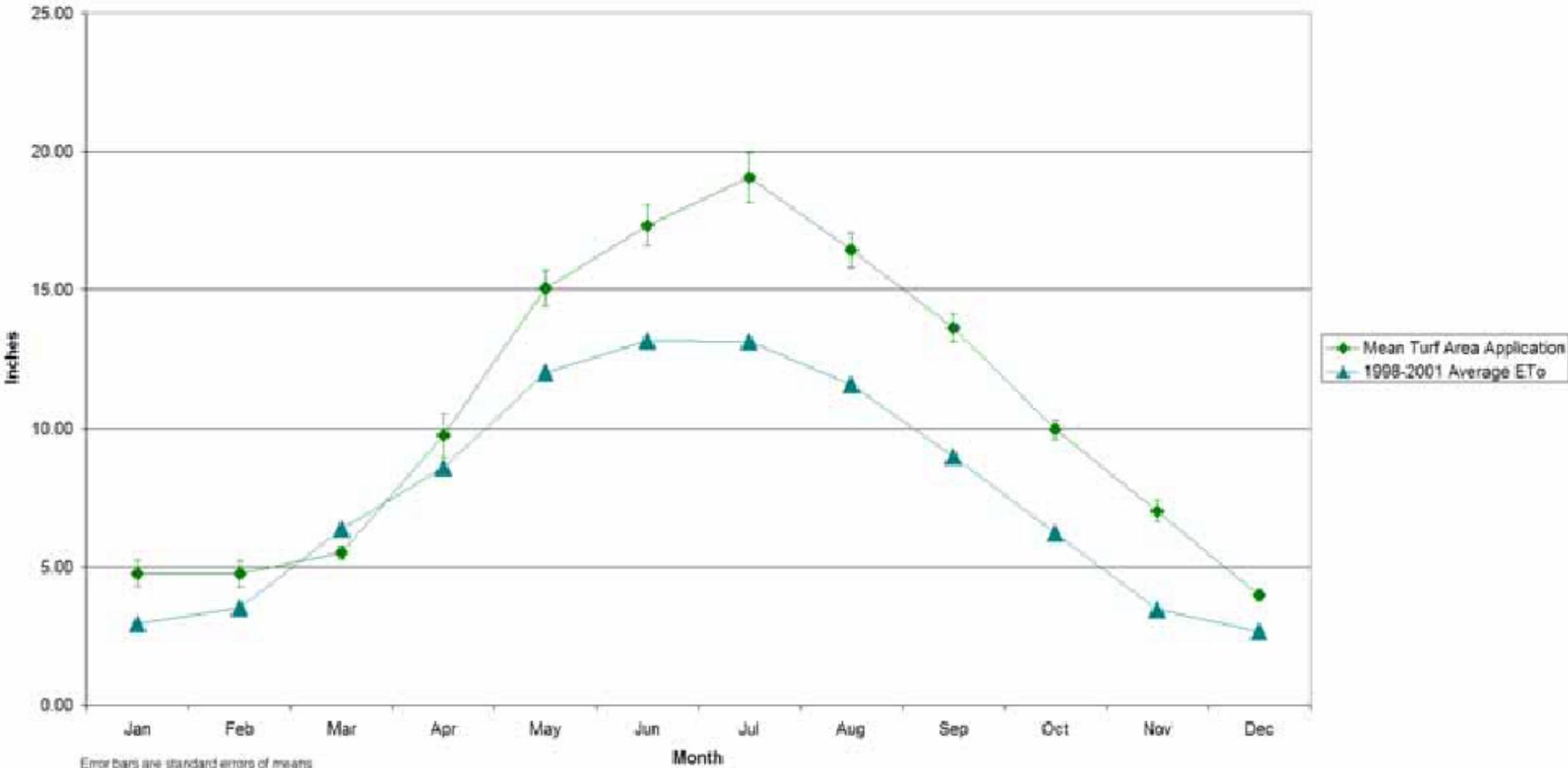


Reference Evapotranspiration

- Based on the American Society of Civil Engineers Reference ET formula
- Calculated from air temperature, relative humidity, wind speed and solar radiation
- Coefficients are used for each plant type to adjust ASCE Reference ET value
- Measured in inches of water loss

Las Vegas - Tall Fescue Turf

FIGURE 7: Monthly Per-Unit Area Application to Turf and Reference Evapotranspirational Demand





WELCOME
to the all-new Agweather site!

ATTENTION NEW USERS!

WxScope Plugin 10.5 Required to use this site.
Download [here](#).

WxScope Plugin 10.5 Released!



[Download Now](#)

The WxScope Plugin will allow you to view near real-time weather data including radar images.

Weather-Related Products for Agriculture and Natural Resources Management

The products on these pages are designed to aid agriculturists in their decision-making process. Data from the Oklahoma Mesonet are employed to create county-specific information. In addition, scientists from Oklahoma State University have "tuned" the models for conditions specific to Oklahoma agriculture.

Select from current/recent weather maps, agricultural and natural resource models, weather forecasts, and related links.

Add the Agweather Link to Your Site



Just save this image and link it to <http://agweather.mesonet.org>.

Turf ET



? INFO

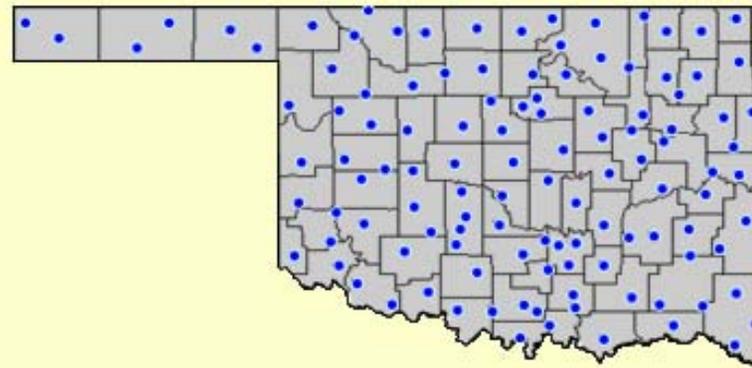
Turf

Product & Links

- [Evapotranspiration](#)
- [Contour 1-Day Avg. 4-in Sod](#)
- [Current Inversion Conditions](#)
- [6-hr Inversion \(lapse rate\)](#)
- [Current Dispersion Map](#)
- [Dispersion Model](#)
- [60-hr NGM MOS Forecast](#)
- [OSU Turfgrass Program](#)
- [OSU Fact Sheet](#)
- [OSU Pest Diagnostics](#)
- [OK Turfgrass Rsrch. Foundation](#)

Evapotranspiration for Turf Grass

Select a station below and make the appropriate changes to the values. Click "Get Data" to get the evapotranspiration table.



Mesonet Site

Grass Type

Season Start Date

Get Turf Grass Data

Warm and Cool Season Turf



? INFO

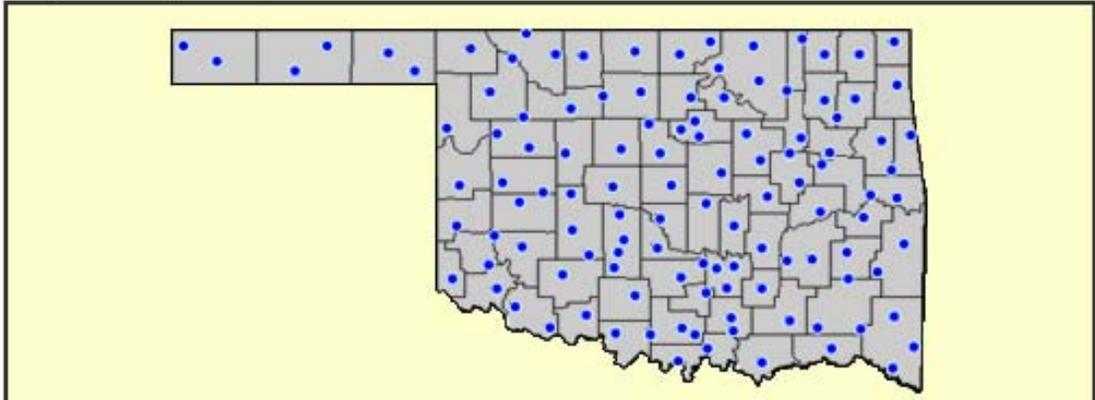
Turf ▼

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Evapotranspiration for Turf Grass

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Mesonet Site ▼

Grass Type ▼

Season Start Date ▼ ▼ ▼

Warm-Season Turf ET (Ninnekah)

Evapotranspiration for turf for Ninnekah

Station	Date	Number of Days	Evapotranspiration (inch)	Accumulated Evapotranspiration (inch)	Rainfall (inch)	Accumulated Rainfall (inch)	Water Balance (inch)
NINN	2005-05-24	1	0.20	0.20	0.00	0.00	-0.20
NINN	2005-05-23	2	0.19	0.39	0.00	0.00	-0.39
NINN	2005-05-22	3	0.22	0.61	0.00	0.00	-0.61
NINN	2005-05-21	4	0.20	0.80	0.00	0.00	-0.80
NINN	2005-05-20	5	0.17	0.98	0.00	0.00	-0.98
NINN	2005-05-19	6	0.15	1.13	0.00	0.00	-1.13
NINN	2005-05-18	7	0.15	1.29	0.00	0.00	-1.29
NINN	2005-05-17	8	0.18	1.47	0.00	0.00	-1.47
NINN	2005-05-16	9	0.15	1.62	0.00	0.00	-1.62
NINN	2005-05-15	10	0.10	1.72	0.00	0.00	-1.72
NINN	2005-05-14	11	0.15	1.88	0.23	0.23	-1.65
NINN	2005-05-13	12	0.10	1.98	0.77	1.00	-0.98

Cool-Season Turf ET (Ninnekah)

Evapotranspiration for turf for Ninnekah

Station	Date	Number of Days	Evapotranspiration (inch)	Accumulated Evapotranspiration (inch)	Rainfall (inch)	Accumulated Rainfall (inch)	Water Balance (inch)
NINN	2005-05-24	1	0.26	0.26	0.00	0.00	-0.26
NINN	2005-05-23	2	0.25	0.51	0.00	0.00	-0.51
NINN	2005-05-22	3	0.30	0.81	0.00	0.00	-0.81
NINN	2005-05-21	4	0.26	1.07	0.00	0.00	-1.07
NINN	2005-05-20	5	0.23	1.30	0.00	0.00	-1.30
NINN	2005-05-19	6	0.20	1.51	0.00	0.00	-1.51
NINN	2005-05-18	7	0.20	1.71	0.00	0.00	-1.71
NINN	2005-05-17	8	0.24	1.95	0.00	0.00	-1.95
NINN	2005-05-16	9	0.20	2.15	0.00	0.00	-2.15
NINN	2005-05-15	10	0.14	2.29	0.00	0.00	-2.29
NINN	2005-05-14	11	0.20	2.49	0.23	0.23	-2.26
NINN	2005-05-13	12	0.14	2.63	0.77	1.00	-1.63

0.0 inches ET deficit



-0.40 inches ET deficit



-0.69 inches ET deficit



-1.15 inches ET deficit



-1.46 inches ET deficit



Bermudagrass Lawn



ET deficit -1.46



ET deficit 0.0



Grass Blades



ET deficit -1.46



ET deficit 0.0



ET deficit -1.1 inches



Zoysia



Bermuda



Fescue ET deficit -0.18 vs. -1.14



ET deficit -0.18



ET deficit -1.14

Fescue ET deficit -1.14 in shade vs. -1.47 in sun



ET deficit -1.47



ET deficit -1.14



ET Irrigation Recommendations

Grass	High Maintenance	Moderate Maintenance	Low Maintenance
Bermuda	-0.5	-1.0	-1.5
Zoysia	-0.5	-0.75	-1.0
Tall Fescue	-0.5	-0.75	-1.0
Kentucky Blue Grass	-0.5	-0.75	-1.0
Perennial Rye	-0.5	-0.5	-0.75

Why an ET deficit of -0.5 inch?

Science behind watering
recommendations

Available Water

- Rooting depth
 - Turfgrass: 6 inches
 - Annuals and Perennials: 12 – 18 inches
 - Shrubs and trees: 12 - 24 inches
- Soil type
- Soil compaction

Soil Water Holding Capacity

Soil Type	Water in 6 inches of soil
Sand	0.48
Loamy Sand	0.66
Sandy Loam	0.72
Loam	0.90
Silt Loam	1.08
Silty Clay Loam	0.96
Clay Loam	0.90
Sandy Clay Loam	0.84
Silty Clay	0.78
Clay	0.72
Sandy Clay	0.66

Warm-Season Turf ET (Skiatook)

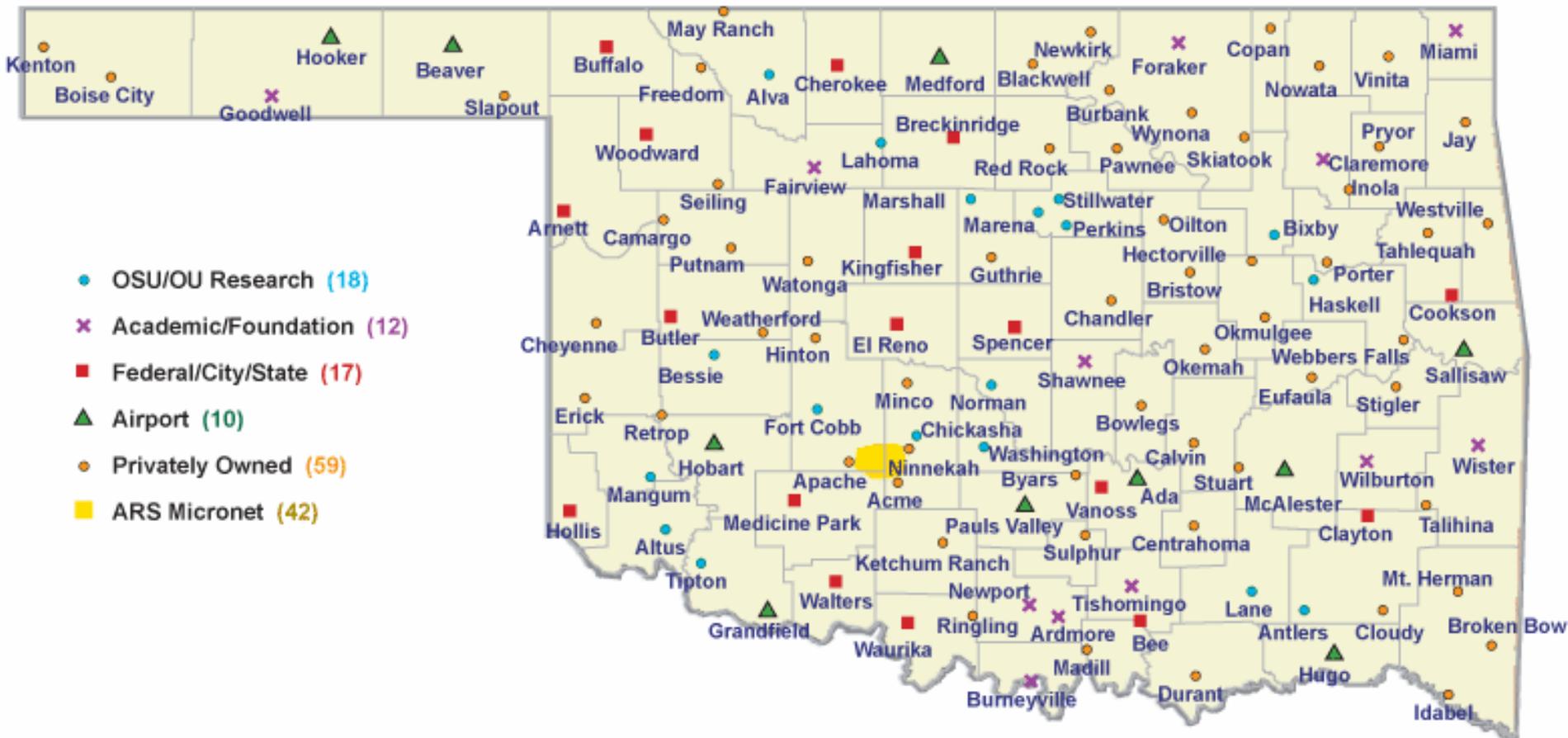
Evapotranspiration for turf for Skiatook

Station	Date	Number of Days	Evapotranspiration (inch)	Accumulated Evapotranspiration (inch)	Rainfall (inch)	Accumulated Rainfall (inch)	Water Balance (inch)
SKIA	2005-05-23	1	0.13	0.13	0.22	0.22	0.09
SKIA	2005-05-22	2	0.16	0.29	0.00	0.22	-0.07
SKIA	2005-05-21	3	0.15	0.44	0.00	0.22	-0.22
SKIA	2005-05-20	4	0.15	0.59	0.00	0.22	-0.37
SKIA	2005-05-19	5	0.14	0.73	0.70	0.92	0.19
SKIA	2005-05-18	6	0.14	0.87	0.00	0.92	0.05
SKIA	2005-05-17	7	0.15	1.02	0.00	0.92	-0.10
SKIA	2005-05-16	8	0.13	1.16	0.00	0.92	-0.24
SKIA	2005-05-15	9	0.12	1.27	0.00	0.92	-0.35
SKIA	2005-05-14	10	0.14	1.41	0.56	1.48	0.07
SKIA	2005-05-13	11	0.07	1.48	0.42	1.90	0.42
SKIA	2005-05-12	12	0.13	1.61	0.00	1.90	0.29



Oklahoma Mesonet Tower

The world's most data rich weather monitoring network



The Oklahoma Mesonet



A joint effort between -
Oklahoma State University
and
University of Oklahoma

Provides 110 plus
environmental monitoring
stations statewide.





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California CIMIS

CIMIS

CALIFORNIA IRRIGATION MANAGEMENT INFORMATION SYSTEM
DEPARTMENT OF WATER RESOURCES
OFFICE OF WATER USE EFFICIENCY

WELCOME

INFO CENTER

DATA

RESOURCE CENTER

MY CIMIS

General

Events

System News

FAQs

CIMIS Staff

Upcoming Events

Non-ideal site program

New CIMIS Web Site

My CIMIS

Current System News

Welcome

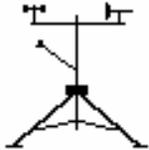
CIMIS Overview

The California Irrigation Management Information System (CIMIS) is a program in the Office of Water Use Efficiency (OWUE), California Department of Water Resources (DWR) that manages a network of over 120 automated weather stations in the state of California. CIMIS was developed in 1982 by the California Department of Water Resource and the University of California at Davis to assist California's irrigators manage their water resources efficiently. Efficient use of water resources benefits Californians by saving water, energy, and money. [\(more...\)](#)

CIMIS Data Uses

Irrigate like a Pro

Arizona AZMET



Arizona Cooperative Extension

The word "AZMET" in a bold, green, sans-serif font. Above it is a red arrow pointing to the right with the text "Arizona Cooperative Extension" above the arrow.

The Arizona Meteorological Network

The Arizona Meteorological Network (AZMET) provides meteorological data and weather-based information to agricultural and horticultural interests operating in southern and central Arizona. Meteorological data is collected from a network of automated weather stations located in both rural and urban production settings. Meteorological data collected by AZMET include temperature (air and soil), humidity, solar radiation, wind (speed and direction), and precipitation. AZMET also provides a variety of computed variables, including heat units (degree-days), chill hours, and reference crop evapotranspiration (ET_o). AZMET data are summarized in a variety of formats, including several ready-to-use summaries that use English units, and comma-delimited ASCII text files that can be imported into most database and spreadsheet programs. Special reports generated by AZMET include the Phoenix Area Turf Water Use Report and Weekly Cotton Advisories (generated Mondays from February through August). AZMET began operating on Jan 1 1987 ; we have no data prior to this date.

!! -- [New : Phoenix Lawn Watering Guide](#) -- !!

Create Irrigation Schedules For Your Lawn

**Yesterday's
Weather
Summary**

**Phoenix Area
Turf Water Use
Report**

**Northern Arizona
Irrigation
Management**



NERON

NOAA's Environmental Real-Time Observation Network

OVERVIEW

HISTORY

SITES

INSTRUMENTS

DATA

Eagle Lake, ME

Latest 10/24/2005 7:55 pm EDT

41.4°F

Wind: --

6-Hour Snowfall: --

24-Hour Snowfall: --

6-Hr. Snow Depth: --

24-Hr. Snow Depth: --

River Stage: --

Yesterday 10/23/2005

Total Rainfall: 0.00 in.

Maximum Temp: 43.0°F

Minimum Temp: 37.1°F

Average Wind: --



Click on map to choose a different site.



Click on a new site.



Or select a site from the list.

Choose Site...



DONE

NERON Instruments

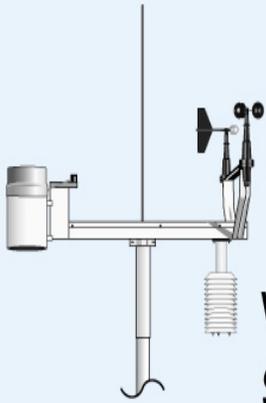
CURRENT

- Air temperature
- Rainfall

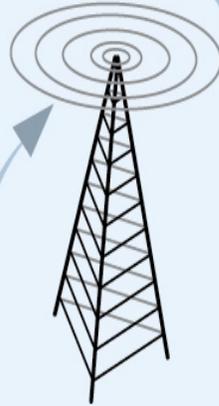
ADDITIONAL for EVAPOTRANSPIRATION

- Relative Humidity
- Wind Speed
- Solar Radiation

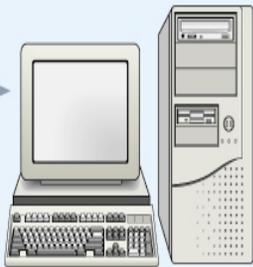
Weather Reach Service Provider



Weather Station



Paging System

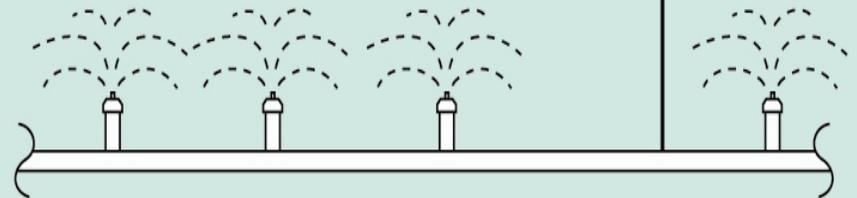
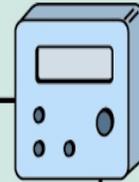


Weather Reach Server

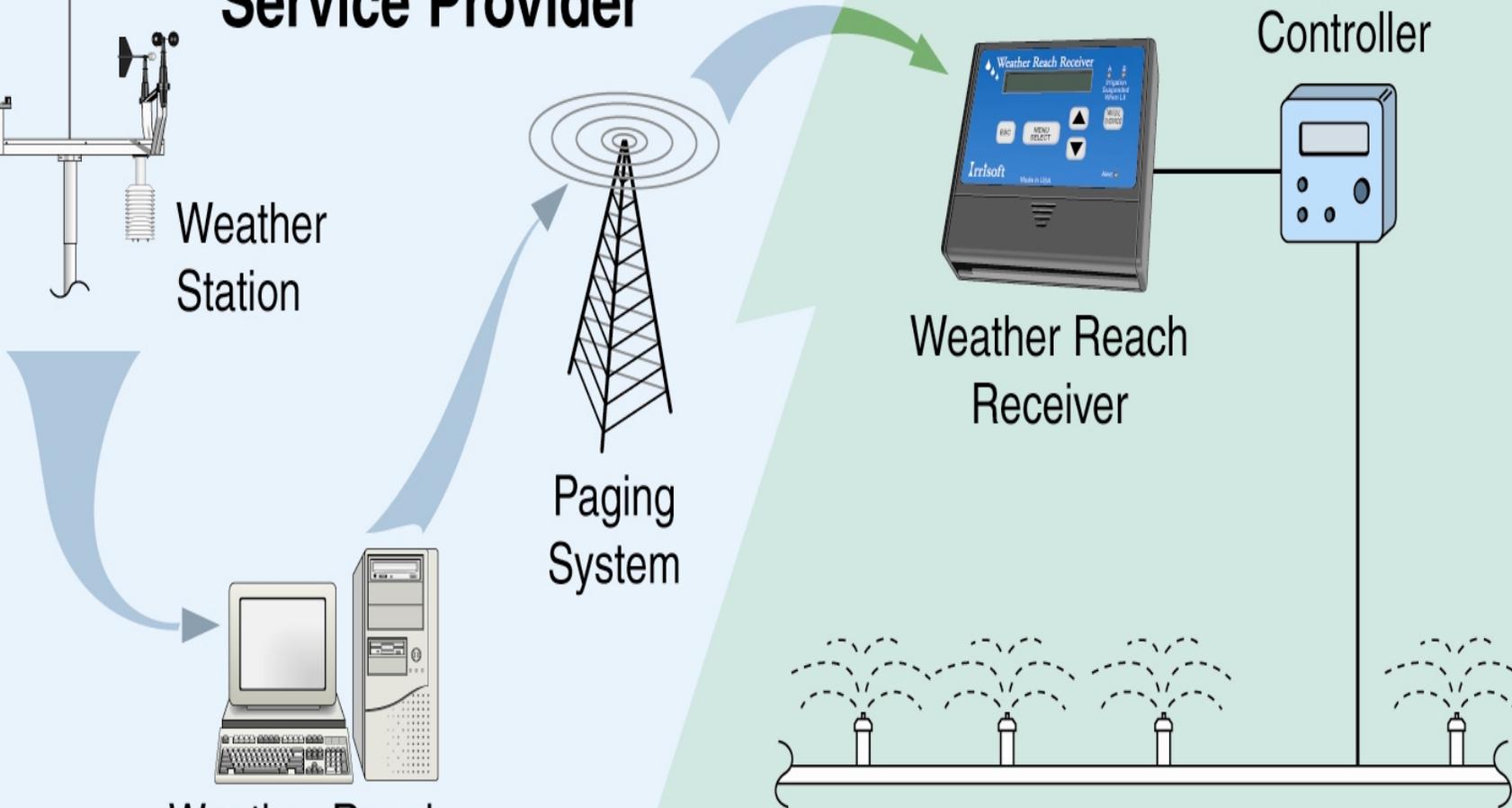


Weather Reach Receiver

Irrigation Controller



Your Irrigation System



ET Irrigation Controller Manufacturers

- Aqua Conservs, Inc.
- Calsense
- ET Water
- HydroPoint Data Systems, Inc. - WeatherTrak
- Irrisoft - WeatherReach
- Rain Master – RME Eagle
- Water Conservation Systems, Inc.
- WeatherSet

THANK YOU!

**May 2006 be
a year of blessing
for you and your family!**