

**The Texas High Plains  
Evapotranspiration Network  
(TXHPET)**

**User Manual**

developed by

**Dr. Dana Porter, P.E.**

**Thomas Marek, P.E.**

**Dr. Terry Howell, P.E.**

**Leon New, P.E.**

of the

**Texas A&M University System  
Agricultural Research and Extension Centers  
Lubbock & Amarillo, Texas**

**&**

**USDA-ARS Conservation and Production Research Laboratory  
Bushland TX**

**November 2005**

**Version 1.01**

AREC 05-37



## TABLE OF CONTENTS

What is Evapotranspiration? .....	1
What is the Texas High Plains Evapotranspiration (TXHPET) Network? .....	1
The TXHPET Web Site .....	2
Future TXHPET Developments .....	2
Overview of the TXHPET Web Site.....	2
TXHPET Home Page .....	3
Maps .....	5
Station Information .....	6
Hourly Printout.....	7
Daily Weather .....	8
Soil Temperatures .....	9
Daily Fax.....	10
Weather Data .....	11
Select a Location .....	12
Select Information.....	14
Time Range .....	15
Units and Output Format .....	16
Output Format Examples: Data Table .....	17
Output Format Examples: Graphed Data .....	18
Output Format Examples: Text File .....	19
Output Format Examples: Advanced Graphing .....	20
Hourly Weather Data.....	21
Time Range, Units, and Output Format Selection .....	22
Hourly Data Query Example: Selecting Stations, Data Items, and Time Range .....	23
Hourly Data Query Example: Data Table Format .....	24
Hourly Data Query Example: Graphed Data Format .....	25
Hourly Data Query Example: Text File Format .....	26
Credits.....	31
Acknowledgements .....	32
APPENDIX .....	34

## List of Figures

Figure 1. Main home page of the TXHPET network.....	3
Figure 2. TXHPET network “What is ET? web page .....	4
Figure 3. TXHPET network Maps web page. ....	5
Figure 4. Station information page in Maps section of TXHPET network.....	6
Figure 5. TXHPET network data hourly file format.....	7
Figure 6. TXHPET network cumulative daily weather data output format. ....	8
Figure 7. TXHPET network daily soil temperature data output format.....	9
Figure 8. TXHPET network weather data section web page.....	11
Figure 9. TXHPET network daily weather data station location pull-down menu. ....	12
Figure 10. TXHPET network weather data web page. ....	13
Figure 11. TXHPET network weather data parameter selection menu.....	14
Figure 12. TXHPET network date selection menu. ....	15
Figure 13. TXHPET network units selection menu.....	16
Figure 14. TXHPET network data table output format.....	17
Figure 15. TXHPET network data graphed output format. ....	18
Figure 16. TXHPET network text file output format. ....	19
Figure 17. TXHPET network advanced graphics section.....	20
Figure 18. TXHPET network hourly weather data section.....	21
Figure 19. TXHPET network hourly time range selection section .....	22
Figure 20. TXHPET network hourly data selection section. ....	23
Figure 21. TXHPET network hourly data table format.....	24
Figure 22. TXHPET network hourly data graph output format.....	25
Figure 23. TXHPET network text output format.....	26
Figure 24. TXHPET network listserv front end page. ....	27
Figure 25. TXHPET network listserv new user input section.....	28
Figure 26. TXHPET network user station selection page.....	29
Figure 27. Typical e-mail delivery of TXHPET network selected files.....	30
Figure 28. TXHPET network partners section.....	31

# The Texas High Plains Evapotranspiration Network (TXHPET) User Manual

Dana Porter, Thomas Marek, Terry Howell, and Leon New<sup>1</sup>

## What is Evapotranspiration?

Evapotranspiration (or ET) is a combined term that includes evaporation and transpiration, where evaporation represents the loss of moisture from standing water, wet surfaces and moist soil. Transpiration (in simple terms) is the process by which water is moved into the roots, upward through the plant, and out to the atmosphere through the leaves. ET is an estimate of crop water demand. ET is driven primarily by meteorological conditions, including air temperatures, humidity, solar irradiance and wind. These data are acquired through use of specially equipped meteorological “weather” stations. Strategically located meteorological stations comprise the ET networks. Data from these stations are applied to an ET model (equation) to calculate reference crop (well watered grass or alfalfa) ET. Crop-specific coefficient curves are used to derive crop ET from the reference crop ET model.

## What is the Texas High Plains Evapotranspiration (TXHPET) Network?

The **Texas High Plains Evapotranspiration Network** is the result of intensive collaboration and cooperation between the North Plains Evapotranspiration Network and the South Plains Evapotranspiration (ET) Network. The Texas North Plains and South Plains ET Networks are comprised of meteorological stations located throughout the Texas North Plains and South Plains region. The two networks have been effectively combined to form the Texas High Plains ET Network. Under the combined operations, the TXHPET operates 18 meteorological stations located in 15 Texas counties, and regional coverage is estimated at four million irrigated acres. Additional meteorological stations, representing a substantial increase in area coverage, may be added to the TXHPET network in the future. The network disseminates meteorological data, including ET-based crop water use information used by agricultural producers and consultants in irrigation scheduling, on a daily basis. Currently, these data are disseminated primarily through fax and / or on-line web access to over 825 data users per day (approx. 300,000 downloads and faxes annually). While these delivery mechanisms have served a valuable function, they do not represent the updated electronic capabilities afforded by newer data management and delivery technologies.

---

<sup>1</sup> Associate Professor - Irrigation, Texas Cooperative Extension and the Texas Agricultural Experiment Station, Lubbock, Texas, Senior Research Engineer and Superintendent, North Plains Research Field, Texas Agricultural Experiment Station, Amarillo/Etter; Texas, Research Leader, Water Management Unit, USDA-ARS, Bushland, Texas and Professor - Irrigation, Texas Cooperative Extension, Amarillo, Texas.

## **The TXHPET Web Site**

This new web site provides a new database that offers access to meteorological data from all stations in the combined network for the entire period of record. Through database query, users can access any data item(s), from any station(s), for their period of interest. Furthermore, they can select daily data or hourly data and have the data retrieved and displayed in several formats. They can opt to have the data presented in a spreadsheet-friendly data table format, a graphical format, or a text file format for convenient viewing and downloading. Users familiar with the “old”, originally established network file formats of \*.fx or \*.prt daily data can access these formats as well. The new array of data delivery formats and on-line views accommodates preferences of a variety of our audiences and end-users and provides immediate and direct access to the data.

## **Future TXHPET Developments**

Development of the TXHPET network is an ongoing effort by a working group of researchers and extension personnel of several participating and partnering agencies. Our goal is to provide timely, accurate crop water demand data primarily for use in improved irrigation scheduling to enhance water management and promote water conservation.

Meteorological data acquisition and quality assurance / quality control, instrumentation maintenance, technical support, and other related operations are an underlying necessity and must be implemented on a continual basis for the data to be accurate and representative of field conditions. The newly developed TXHPET web site provides a new framework for an advanced data delivery options. Additional educational and reference materials development is underway and these products will be added in the future. Additional meteorological stations/locations are to be added to the network in the near future. Expanded cooperative efforts with other ET networks are also being considered. Furthermore, additional online utilities and data capabilities are planned, pending availability of resources.

## **Overview of the TXHPET Web Site**

Features of the TXHPET network, including examples, are demonstrated in the following figures.

## TXHPET Home Page

The Texas High Plains ET Network website <http://txhighplainset.tamu.edu/> is the focal point for information distribution for the TXHPET. The **Home** page of the website includes links to background information about the networks, essentials of ET, intended audiences, and other related information. Additional tools are planned. Tabs near the top of the page facilitate navigation within the website.

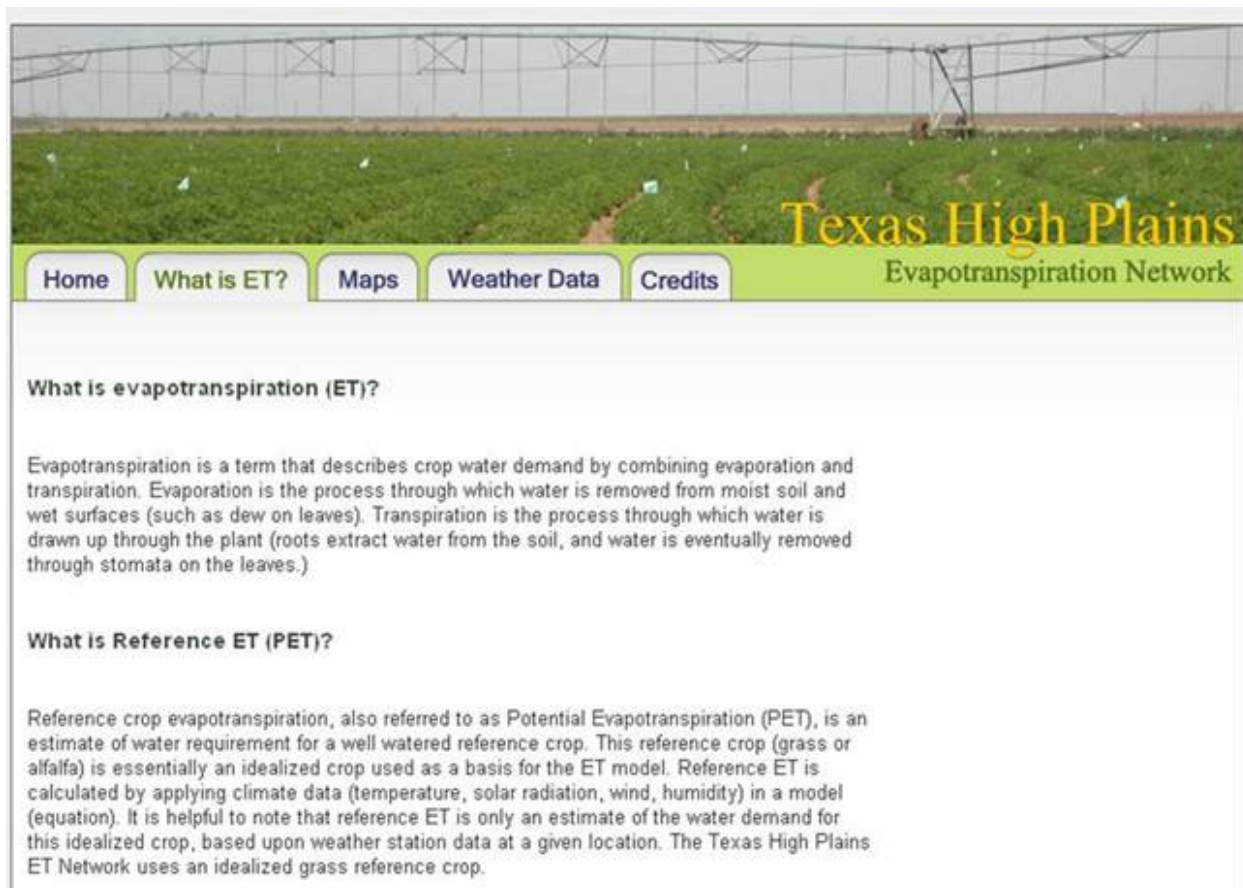
The screenshot shows the main home page of the TXHPET network. At the top, there is a banner image of a large-scale center pivot irrigation system over a green field. Below the image is a navigation bar with five tabs: "Home", "What is ET?", "Maps", "Weather Data", and "Credits". To the right of the tabs, the text "Texas High Plains Evapotranspiration Network" is displayed in a stylized font.

The main content area begins with a heading "Welcome to the Texas High Plains ET Network". Below this is a section titled "What is the Texas High Plains Evapotranspiration Network?" which contains a paragraph explaining the network's purpose and history. This is followed by a section titled "Organization and Operation" and another titled "Data Users", both containing descriptive text. At the bottom of the page, a footer contains the text: "Conditions of Use | Legal Notices | Contact Us", "©2005 Texas A&M University System", and "Agriculture Program".

Figure 1. Main home page of the TXHPET network.

## What is ET?

The “**What is ET?**” tab directs the user to background information and additional crop water use information sources. Additional materials and educational resources will be placed on this page in the near future.



**Figure 2. TXHPET network “What is ET? web page**



## Maps

The **Maps** page indicates where stations are located and the coverage area. Additional station locations will be added soon, thereby increasing our coverage area and improving data coverage within our service area.

From the **Maps** page, the user can access information from a specific meteorological station by clicking on a station location or selecting a station from the list to the right of the map. Additional mapping tools are planned, pending resource availability.

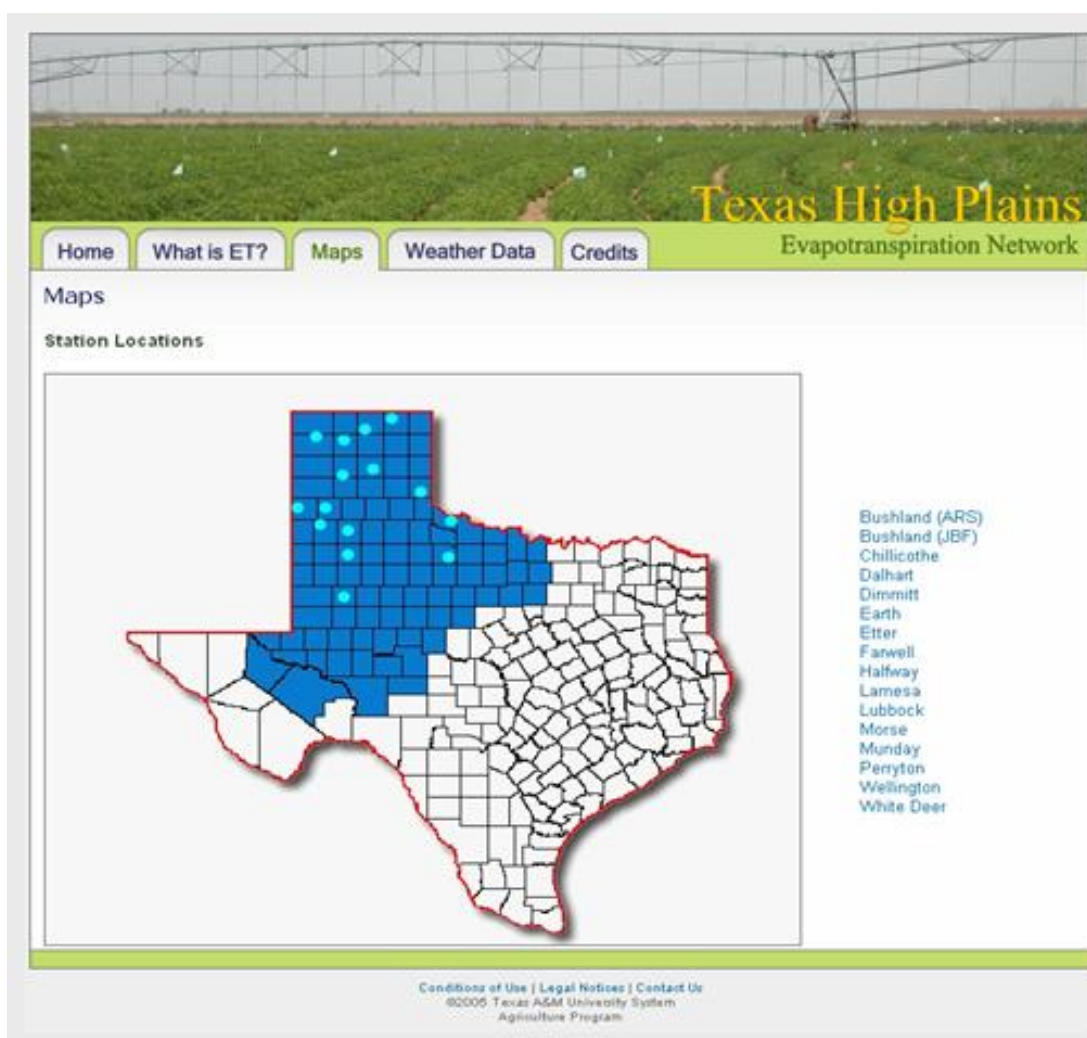


Figure 3. TXHPET network Maps web page.

## Station Information

When the user selects a site from the map or from the list, general information about the station location is provided. For each station, the previous day's data are summarized. The user can also go directly to the daily fax, cumulative daily data file, soil temperature file, or hourly printout data delivery formats for that day.

The screenshot shows the 'Station Information' page for the Bushland (ARS) station. The page features a navigation bar with tabs for Home, What is ET?, Maps, Weather Data, and Credits. The main content area is titled 'Weather Station' and includes a sub-section for 'Station Information' with links for Daily Fax, Daily Weather, Soil Temperatures, Grass, and Print C. The station details are as follows:

<b>Station Name</b>	Bushland (ARS)	<b>Longitude</b>	102'
<b>County</b>	Potter	<b>Latitude</b>	35'
<b>Nearest Town</b>	Bushland	<b>Elevation</b>	3894 ft

Below the station information is a 'Yesterday's Data Summary' section with the following data:

<b>Maximum Air Temp</b>	55 °F at 03:27:00 PM	<b>Reference ET</b>	N/A
<b>Minimum Air Temp</b>	33 °F at 11:24:00 PM	<b>Precipitation</b>	0.000 in
<b>Soil Temperatures at 2"</b>	53 °F	<b>Average Relative Humidity</b>	40 %
<b>Soil Temperatures at 6 "</b>	55 °F	<b>Average Wind Speed</b>	11 mph

The page also includes a 'Station Pictures' section at the bottom.

Figure 4. Station information page in Maps section of TXHPET network

## Hourly Printout

The **hourly data** printout summarizes the previous day's data in one-hour increments. This format provides detailed information, including solar radiation (irradiance), soil temperatures at 2 inch and 6 inch depths, air temperature, dew point temperature, relative humidity, average vapor pressure and vapor pressure deficit, wind speed and direction (and standard deviation of wind direction), precipitation, barometric pressure and reference crop ET. Daily cumulative or mean values (as appropriate for each parameter) are summarized at the bottom of the printout.

```

Station:BUSHLAND (ARS),TX   Long 102 deg 5 min  Lat 35 deg 11 min
Date:11/13/05  Year/DOY:2005317  Elev: 1187 m  Bar. Corr: 13.4
Sunrise 721  Sunset 1744  Daylight time = 10 hours 23 minutes

```

Time CST	Rs W/m <sup>2</sup>	Ts2 C	Ts6 C	Tair C	TDew C	RH %	AVP kPa	VPD kPa	WSpd m/s	Wdir deg	SDd deg	PREC mm	BP kPa	ETo mm
100	0.0	11.7	14.2	6.3	-2.5	54	0.51	0.45	3.1	1	35	0.00	88.5	0.02
200	0.0	11.4	13.9	8.8	-3.0	44	0.49	0.64	8.9	26	8	0.00	88.7	0.06
300	0.0	11.4	13.6	7.9	-5.2	39	0.42	0.65	8.4	20	8	0.00	88.8	0.06
400	0.0	11.2	13.3	6.1	-5.2	44	0.42	0.52	7.8	17	8	0.00	88.9	0.05
500	0.0	10.8	13.1	4.7	-4.9	50	0.43	0.43	6.9	16	7	0.00	88.9	0.04
600	0.0	10.4	12.9	3.5	-4.4	56	0.44	0.34	7.0	11	8	0.00	89.0	0.03
700	0.0	9.9	12.6	2.6	-3.6	63	0.47	0.27	6.7	9	8	0.00	89.2	0.02
800	25.9	9.5	12.4	2.3	-3.5	66	0.47	0.25	6.3	7	7	0.00	89.1	0.02
900	191.9	9.2	12.1	3.7	-4.1	57	0.45	0.34	7.0	15	9	0.00	89.4	0.11
1000	372.8	9.3	11.8	5.8	-4.8	47	0.43	0.50	7.6	26	11	0.00	89.2	0.20
1100	516.4	10.1	11.7	7.8	-5.9	37	0.39	0.67	6.2	44	14	0.00	89.5	0.28
1200	607.4	11.3	11.7	9.5	-6.9	31	0.36	0.83	5.8	49	14	0.00	89.5	0.35
1300	638.5	12.7	11.9	10.9	-8.1	25	0.33	0.98	5.4	53	15	0.00	89.2	0.39
1400	609.0	14.0	12.2	11.9	-9.1	22	0.31	1.08	5.1	60	15	0.00	89.3	0.39
1500	517.7	15.0	12.7	12.3	-8.8	22	0.31	1.12	4.3	79	20	0.00	89.2	0.35
1600	374.4	15.5	13.2	12.6	-9.0	21	0.31	1.15	3.7	99	26	0.00	89.0	0.27
1700	197.6	15.5	13.6	12.6	-9.2	21	0.30	1.15	3.9	120	15	0.00	89.1	0.19
1800	31.5	14.6	13.8	10.0	-9.6	24	0.29	0.94	1.8	133	9	0.00	89.1	0.04
1900	0.0	13.3	13.8	5.9	-9.8	31	0.29	0.64	0.9	146	6	0.00	88.9	0.00
2000	0.0	12.1	13.6	3.6	-9.9	37	0.29	0.50	1.4	167	9	0.00	88.8	0.01
2100	0.0	11.1	13.3	2.6	-9.8	39	0.29	0.45	1.6	176	7	0.00	89.1	0.01
2200	0.0	10.2	13.0	2.0	-9.6	42	0.29	0.41	2.0	186	9	0.00	89.1	0.01
2300	0.0	9.6	12.6	2.1	-9.0	44	0.31	0.40	3.2	179	8	0.00	88.7	0.02
2400	0.0	9.0	12.2	0.9	-8.3	50	0.33	0.33	2.7	179	7	0.00	88.8	0.02
Sum	14.7 MJ											0.00		2.95
Avg		11.6	12.9	6.5	-6.8	40	0.37	0.63	4.9	62	69		88.8	
Max	644.0	15.7	14.4	12.9	-1.6	66	0.54	1.19	12.3				88.8	
Time	1220	1557	0	1545	54	727	54	1605	140				888	
Min		8.7	11.6	0.4	-10.6	20	0.27	0.24					88.8	
Time		2359	1054	2340	1932	1606	1932	709					888	

Figure 5. TXHPET network hourly data file format.

## Daily Weather

The [Daily Weather](#) link accesses a file that includes daily data for the current calendar year (as of the previous day). Daily items presented include maximum and minimum air temperature, relative humidity, and dew point temperature; average wind speed and solar radiation (irradiance); reference crop ET; rainfall; and heat units for selected key crops in the region.

Date	Max T	Min T	Max RH	Min RH	Max Dew	Min Dew	Wind	SR	ET0	Rain	Heat Units				
	F	F	%	%	F	F	mil/hr	Langl.	Inches	Inches	Cotton	Corn	Sorghum	Peanuts	Wheat
01/01/05	064.3	040.9	097.6	043.6	049.8	035.3	11.54	009.1	0.088	00.00	00.0	00.0	00.0	00.0	20.6
01/02/05	045.4	035.6	097.3	071.8	039.4	032.6	05.31	003.8	0.032	00.12	00.0	00.0	00.0	00.0	08.5
01/03/05	059.0	035.7	098.4	051.5	048.0	035.1	04.82	007.9	0.046	00.02	00.0	00.0	00.0	00.0	15.3
01/04/05	044.6	028.0	098.5	093.0	044.1	027.6	11.95	003.7	0.006	00.23	00.0	00.0	00.0	00.0	06.3
01/05/05	028.1	014.8	098.7	085.9	027.8	012.6	07.97	004.5	0.023	00.00	00.0	00.0	00.0	00.0	00.0
01/06/05	046.8	016.1	097.7	051.1	036.3	011.9	10.20	007.1	0.054	00.00	00.0	00.0	00.0	00.0	07.4
01/07/05	041.4	028.6	095.0	041.9	031.5	019.1	09.73	011.1	0.051	00.00	00.0	00.0	00.0	00.0	04.7
01/08/05	062.1	028.6	090.0	042.0	043.8	023.0	11.63	010.3	0.108	00.00	00.0	00.0	00.0	00.0	15.1
01/09/05	066.5	037.9	083.3	029.9	042.7	030.8	10.40	007.8	0.122	00.00	00.0	00.0	00.0	00.0	20.2
01/10/05	069.5	041.8	080.5	030.6	046.6	034.5	08.47	006.7	0.118	00.00	00.0	00.0	00.0	00.0	23.7
01/11/05	064.2	028.7	098.7	036.2	042.9	028.2	10.27	006.1	0.096	00.00	00.0	00.0	00.0	00.0	16.1
01/12/05	051.8	030.5	098.0	025.1	037.1	014.9	16.72	008.2	0.095	00.00	00.0	00.0	00.0	00.0	09.9
01/13/05	049.2	022.5	091.2	031.1	030.4	018.4	08.28	011.5	0.067	00.00	00.0	00.0	00.0	00.0	08.6
01/14/05	050.5	026.8	095.8	041.8	033.1	023.3	11.70	006.9	0.078	00.00	00.0	00.0	00.0	00.0	09.3
01/15/05	027.4	015.3	098.2	089.5	026.5	013.7	05.16	003.5	0.015	00.00	00.0	00.0	00.0	00.0	00.0
01/16/05	025.0	020.3	097.1	091.2	023.2	019.0	06.25	002.8	0.013	00.00	00.0	00.0	00.0	00.0	00.0
01/17/05	033.2	019.3	096.8	079.2	028.3	017.4	08.01	005.4	0.026	00.00	00.0	00.0	00.0	00.0	00.6
01/18/05	056.0	021.8	094.7	040.3	035.0	020.1	11.11	011.3	0.091	00.00	00.0	00.0	00.0	00.0	12.0
01/19/05	064.4	029.4	089.0	032.4	039.0	026.2	04.79	011.4	0.082	00.00	00.0	00.0	00.0	00.0	16.2
01/20/05	071.6	030.3	089.2	020.9	039.4	026.7	04.34	011.4	0.096	00.00	00.0	00.0	00.0	00.0	19.8
01/21/05	069.8	034.4	080.2	022.6	041.9	028.3	05.95	007.4	0.107	00.00	00.0	00.0	00.0	00.0	20.1
01/22/05	045.1	026.0	085.7	038.6	032.6	017.5	10.48	011.1	0.064	00.00	00.0	00.0	00.0	00.0	06.6
01/23/05	061.7	021.6	077.9	025.2	028.4	014.9	10.93	012.2	0.135	00.00	00.0	00.0	00.0	00.0	14.8
01/24/05	069.7	029.6	075.9	028.6	038.9	020.6	07.45	012.0	0.127	00.00	00.0	00.0	00.0	00.0	18.9
01/25/05	071.2	035.0	092.3	019.5	038.1	022.9	08.78	012.4	0.148	00.00	00.0	00.0	00.0	00.0	21.1
01/26/05	058.2	034.4	089.6	039.6	042.9	026.7	06.66	008.8	0.082	00.00	00.0	00.0	00.0	00.0	14.3
01/27/05	053.3	043.3	100.0	086.8	050.9	042.9	09.85	002.2	0.017	00.05	00.0	00.0	00.0	00.0	16.3
01/28/05	043.7	030.3	100.0	091.9	045.0	029.7	09.13	004.0	0.002	00.02	00.0	00.0	00.0	00.0	05.8
01/29/05	052.5	026.0	098.4	059.1	043.9	025.1	03.29	010.3	0.047	00.00	00.0	00.0	00.0	00.0	10.2
01/30/05	034.6	030.4	099.1	096.4	034.3	030.1	07.72	003.2	0.015	00.01	00.0	00.0	00.0	00.0	01.3
01/31/05	032.8	027.6	098.9	087.2	031.4	027.0	07.68	002.5	0.013	00.00	00.0	00.0	00.0	00.0	00.4
02/01/05	033.1	030.2	095.4	084.0	030.5	028.1	04.99	001.9	0.016	00.01	00.0	00.0	00.0	00.0	00.5
02/02/05	046.7	027.4	093.3	044.1	036.1	024.5	07.00	012.8	0.061	00.01	00.0	00.0	00.0	00.0	07.4
02/03/05	055.0	026.6	088.6	025.0	033.5	018.5	03.87	013.7	0.074	00.00	00.0	00.0	00.0	00.0	11.5
02/04/05	056.2	024.2	084.7	026.9	033.9	019.4	08.34	013.8	0.100	00.00	00.0	00.0	00.0	00.0	12.1
02/05/05	051.2	030.8	096.5	043.9	037.2	027.2	11.99	006.1	0.073	00.03	00.0	00.0	00.0	00.0	09.6

Figure 6. TXHPET network cumulative daily weather data output format.



## Soil Temperatures

The [Soil Temperatures](#) link accesses a file of daily soil temperature data (at 2 inch and 6 inch depths) for the current calendar year (as of the previous day). Maximum, minimum, and average (mean) daily soil temperatures are presented in °F and °C.

```

Bushland (ARS), TX Soil Temperatures   Date: 11/14/2005   Time: 9:40:040 am
Date      Max T @ 2"   Min T @ 2"   Avg @ 2"   Max T @ 6"   Min T @ 6"   Avg @ 6"
          F      C      F      C      F      C      F      C      F      C      F      C
01/01/05  041.0  005.0  026.9  -02.9  034.0  001.1  031.0  -00.5  026.4  -03.1  028.5  -02.0
01/02/05  108.4  042.4  023.5  -04.7  031.3  -00.4  041.8  005.4  022.1  -05.5  027.8  -02.4
01/03/05  068.2  020.1  028.8  -01.8  038.1  003.4  032.1  000.0  021.0  -06.1  025.7  -03.5
01/04/05  065.5  018.6  012.1  -11.1  037.4  003.0  029.7  -01.3  017.8  -07.9  022.1  -05.5
01/05/05  012.8  -10.7  006.6  -14.1  009.9  -12.3  018.5  -07.5  011.8  -11.2  014.8  -09.5
01/06/05  040.7  004.8  005.2  -14.9  014.6  -09.7  018.6  -07.4  009.3  -12.6  013.3  -10.4
01/07/05  020.4  -06.4  007.5  -13.6  011.7  -11.3  013.6  -10.2  009.4  -12.6  011.5  -11.4
01/08/05  028.0  -02.2  009.8  -12.3  017.5  -08.1  020.6  -06.3  012.5  -10.9  016.4  -08.7
01/09/05  032.8  000.4  016.9  -08.4  023.8  -04.6  024.8  -04.0  018.3  -07.6  021.1  -06.0
01/10/05  034.9  001.6  021.6  -05.8  025.9  -03.4  026.5  -03.0  021.8  -05.6  023.8  -04.6
01/11/05  035.0  001.7  019.4  -07.0  025.4  -03.7  025.2  -03.8  020.7  -06.3  023.2  -04.9
01/12/05  052.8  011.5  018.7  -07.4  025.5  -03.6  025.1  -03.8  020.3  -06.5  023.2  -04.9
01/13/05  025.9  -03.4  017.4  -08.1  019.8  -06.8  022.8  -05.1  018.1  -07.7  020.7  -06.3
01/14/05  022.5  -05.3  014.0  -10.0  016.9  -08.4  020.1  -06.6  016.6  -08.5  018.3  -07.6
01/15/05  018.3  -07.6  013.3  -10.4  014.7  -09.6  019.0  -07.2  016.0  -08.9  017.1  -08.3
01/16/05  014.5  -09.7  011.2  -11.6  013.3  -10.4  016.8  -08.5  015.3  -09.3  015.9  -08.9
01/17/05  015.2  -09.3  009.4  -12.6  012.4  -10.9  015.8  -09.0  014.6  -09.7  015.1  -09.4
01/18/05  018.5  -07.5  010.3  -12.1  013.7  -10.2  015.4  -09.2  013.5  -10.3  014.4  -09.8
01/19/05  028.4  -02.0  013.8  -10.1  018.1  -07.7  018.3  -07.6  011.9  -11.2  014.9  -09.5
01/20/05  036.4  002.4  014.3  -09.8  022.5  -05.3  023.9  -04.5  015.9  -08.9  019.3  -07.1
01/21/05  032.1  000.0  016.2  -08.8  023.2  -04.9  024.3  -04.3  018.7  -07.4  021.6  -05.8
01/22/05  030.0  -01.1  015.9  -09.0  021.4  -05.9  023.6  -04.7  020.5  -06.4  022.1  -05.5
01/23/05  028.5  -01.9  013.1  -10.5  018.3  -07.6  021.5  -05.8  016.6  -08.6  019.3  -07.0
01/24/05  036.3  002.4  014.7  -09.6  023.1  -04.9  024.8  -04.0  017.3  -08.2  020.7  -06.3
01/25/05  037.2  002.9  019.5  -06.9  026.2  -03.2  027.1  -02.7  020.9  -06.2  023.7  -04.6
01/26/05  044.2  006.8  018.0  -07.8  025.3  -03.7  027.3  -02.6  021.7  -05.7  024.0  -04.4
01/27/05  M      M      M      M      M      M      M      M      M      M      M      M
01/28/05  036.8  002.6  023.1  -05.0  028.0  -02.2  022.1  -05.5  018.2  -07.7  020.5  -06.4
01/29/05  035.6  002.0  015.9  -08.9  023.1  -04.9  024.4  -04.2  017.6  -08.0  020.9  -06.2

```

Figure 7. TXHPET network daily soil temperature data output format.

## Daily Fax

The **Daily Fax** output format delivers data in the form with which most of our North Plains ET Network and South Plains ET Network users are familiar. This format is very useful for irrigation scheduling operations. At the top of the page are daily values of reference crop ET, air and soil temperatures, precipitation and growing degree days (heat units) for the 3 days prior to the current date. The page summarizes daily water demand – on a daily, 3-day, 7-day, and seasonal basis - for some key crops in the region. Water use estimates and accumulated growing degree days are presented for several planting dates for each crop. Water demand for common lawn grasses are presented at the bottom of the page.

```

North Plains ET Network   Weather Station, Dimmitt, TX

      Temperatures (F)
Date   ETo  ---Air---  Soil Min  Prec.  Growing Degrees Days (F)
      in.  Max  Min  2in. 6in.  in.  Crn  Srg  Pnt  Cot  Soy  Wht
06/13/05 .32  92  47  67  75  0.00  18  21  18  10  21  31
06/14/05 .24  83  54  69  76  0.00  18  18  14   8  22  34
06/15/05 .30  93  54  69  76  0.00  20  23  19  13  24  34
10-day avg min soil temp 70  75  Wind 8.3 mph from 181 deg.

CORN      Short Season Var. Water Use      Long Season Var. Water Use
Seed Acc Growth Day 3day 7day Seas. Growth Day 3day 7day Seas.
Date GDD Stage -----in/d----- in. Stage -----in/d----- in.
04/01 1068 10-leaf .35 .33 .32  9.5 10-leaf .35 .33 .32  9.5
04/15  926  8-leaf .30 .29 .26  7.0  8-leaf .30 .29 .26  7.0
05/01  758  6-leaf .26 .24 .23  4.9  6-leaf .26 .24 .23  4.9
05/15  599  4-leaf .21 .20 .17  3.1  4-leaf .21 .20 .17  3.1

SORGHUM   Short Season Var. Water Use      Long Season Var. Water Use
Seed Acc Growth Day 3day 7day Seas. Growth Day 3day 7day Seas.
Date GDD Stage -----in/d----- in. Stage -----in/d----- in.
05/01  801  5-leaf .21 .20 .20  5.1  4-leaf .18 .17 .17  4.9
05/15  639  4-leaf .18 .17 .16  3.5  4-leaf .18 .17 .16  3.5
06/01  328  Emerged .12 .11 .12  1.7  Emerged .12 .11 .12  1.7
06/15   23  Seeded .12 .09 .09  0.1  Seeded .12 .10 .09  0.1

COTTON    North Plains Area Water Use      South Plains Area Water Use
Seed Acc Growth Day 3day 7day Seas. Growth Day 3day 7day Seas.
Date GDD Stage -----in/d----- in. Stage -----in/d----- in.
05/01  349  Emerged .15 .14 .14  3.4  Emerged .15 .14 .14  3.4
05/15  316  Emerged .15 .14 .14  2.8  Emerged .15 .14 .14  2.8
06/01  174  Emerged .15 .14 .11  1.1  Emerged .15 .14 .11  1.1
06/15   13  Seeded .04 .08 .10  0.0  Seeded .04 .08 .10  0.0

WHEAT                                Water Use
Seed Acc Growth Day 3day 7day Seas.
Date GDD Stage -----in/d----- in.
08/15 6406 Phy Mat .06 .11 .14 28.7
09/10 5502 H Dough .15 .14 .16 25.3
10/01 4803 H Dough .15 .14 .16 24.0
10/15 4464 H Dough .15 .14 .16 23.1

Fescue/Bluegrass lawn water use 0.30 inch
Bermuda grass lawn water use 0.22 inch
Buffalo grass lawn water use 0.15 inch

```

Figure 8. TXHPET network fax file data format.

## Weather Data

The most important function of the TXHPET network is to provide convenient and reliable access to meteorological data. This service to our clientele is the driving force behind all of these new developments.

One of the most significant new developments in the TXHPET network information delivery is the searchable database that includes data for all weather stations in the combined North Plains and South Plains ET Networks. Users can choose to access daily or hourly data. They can access data from one or multiple weather stations, over any time in the period of record.

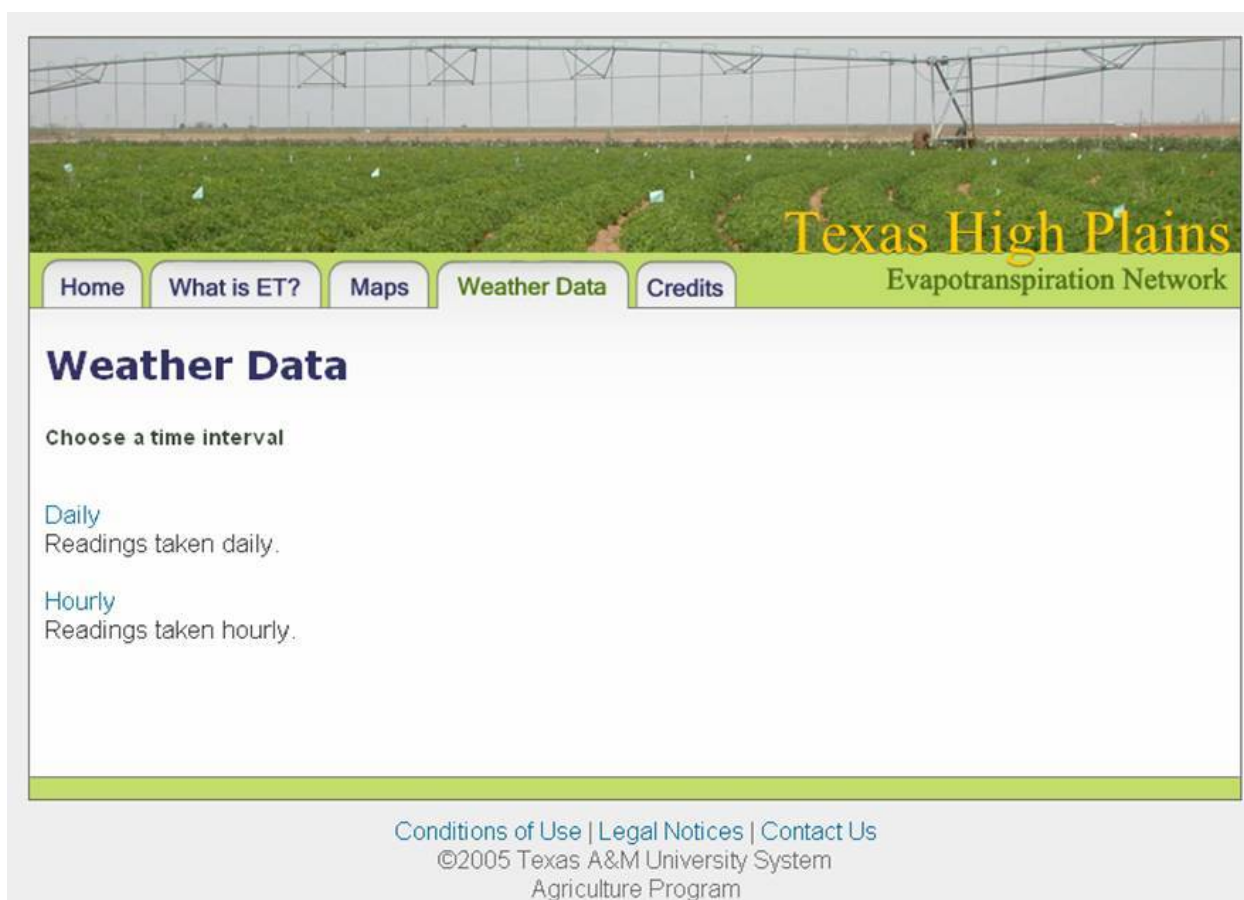


Figure 8. TXHPET network weather data section web page.

## Select a Location

A pull-down menu is used to select one or more meteorological stations from the list. After each location selection, the user must click the “Add” button to add the selection to the query. Single or multiple stations can be selected for each query.

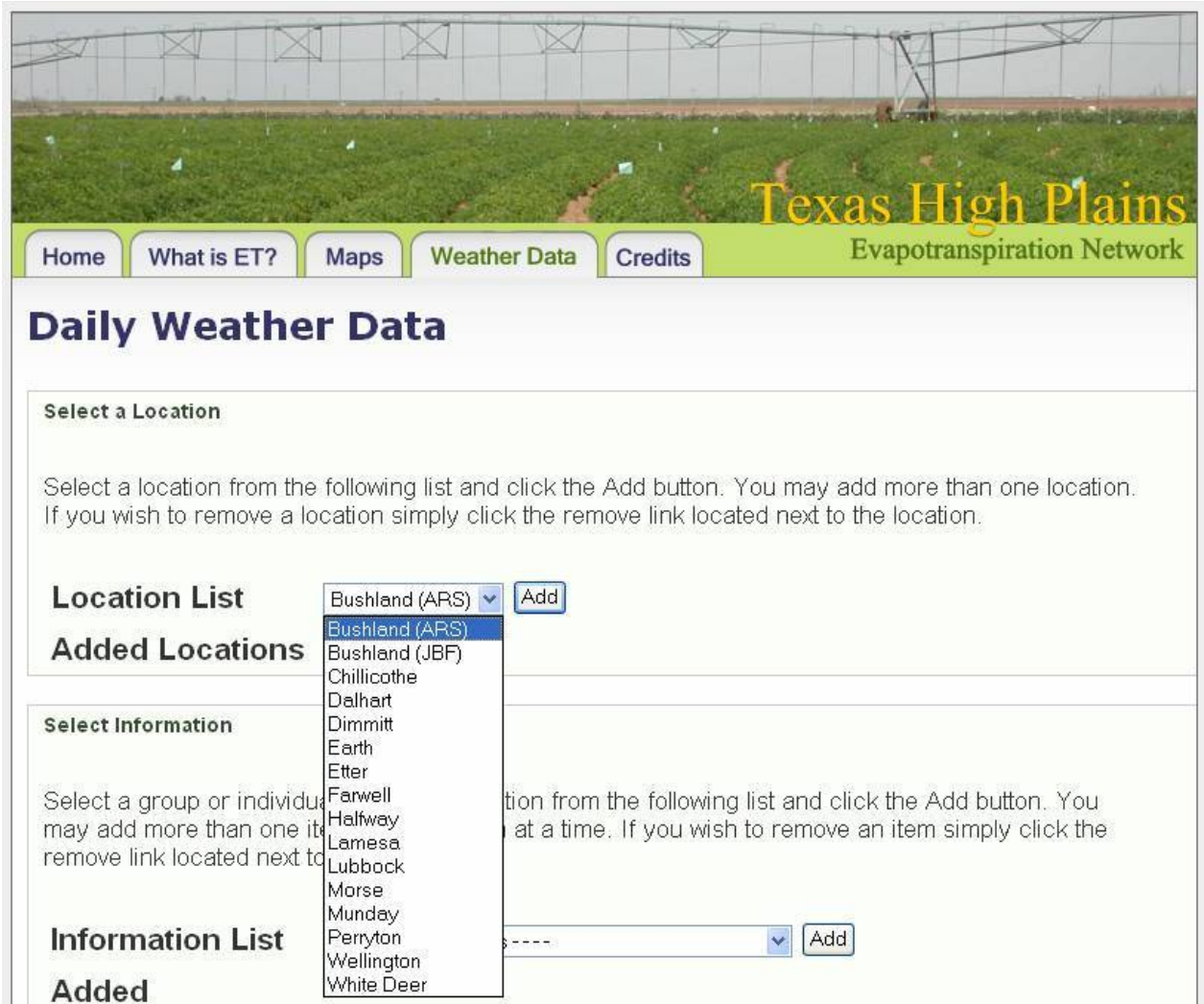


Figure 9. TXHPET network weather station selection pull-down menu.



Added items may be de-selected by using the “remove” link beside the station name. The user can add or remove stations from their data query as needed.

Next the user will select data or information items from another pull-down menu.

**Home** **What is ET?** **Maps** **Weather Data** **Credits** **Texas High Plains**  
Evapotranspiration Network

Daily Weather Data

**Select a Location**

Select a location from the following list and click the Add button. You may add more than one location. If you wish to remove a location simply click the remove link located next to the location.

Location List

Added Locations  
 Bushland (ARS) [remove](#)  
 Dalhart [remove](#)  
 Farwell [remove](#)

**Select Information**

Select a group or individual item of information from the following list and click the Add button. You may add more than one item of information at a time. If you wish to remove an item simply click the remove link located next to the item.

Information List

Added Information

**Time Range**

Figure 10. TXHPET network weather data web page.

## Select Information

The data / information pull down menu lets the user add items to the query. Please remember to click the “Add” button to complete each item selection. Single or multiple data items of interest can be included in each data query. The user should use judgment in the number of items added as too many will clutter a graph, if chosen. Added items may be de-selected by using the “remove” link.

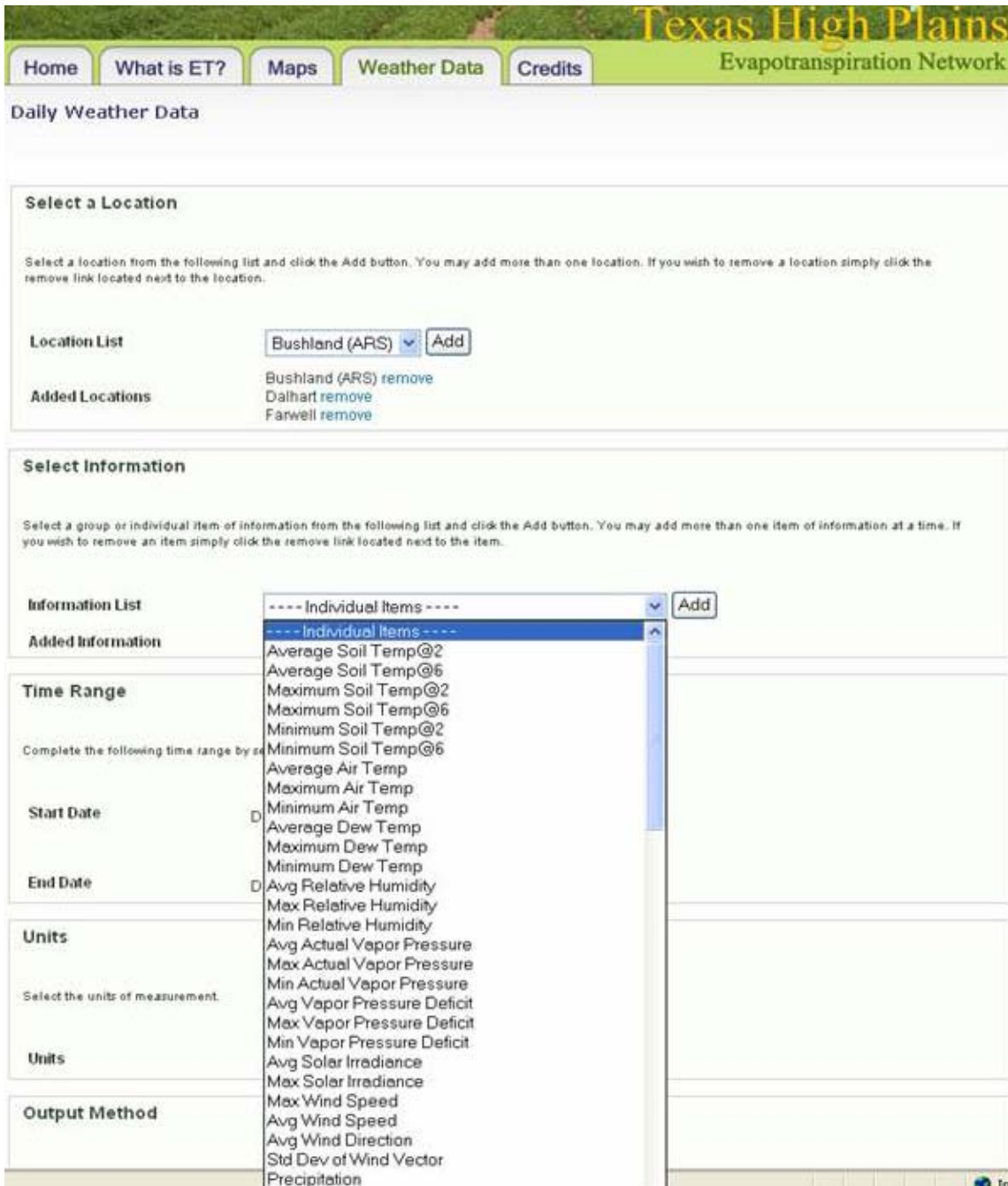


Figure 11. TXHPET network weather data parameter selection menu.

## Time Range

Most users are interested in data from a particular period of time (certain dates, an entire crop season, 2 years, etc.). The Time Range function is used to select the start and end dates for the period of interest.

Start and end dates are selected from a pull down menu. Data are available for the length of record for each station in the networks.

**Select Information**

Select a group or individual item of information from the following list and click the Add button. You may add more than one item of information at a time. If you wish to remove an item simply click the remove link located next to the item.

<b>Information List</b>	<input type="text" value="---- Individual Items ----"/>	<input type="button" value="Add"/>
<b>Added Information</b>	Average Air Temp <a href="#">remove</a> Reference ET Calculation <a href="#">remove</a>	

---

**Time Range**

Complete the following time range by setting a start date and an end date. Be sure to enter a valid year.

<b>Start Date</b>	Date	<input type="text" value="November"/>	<input type="text" value="14"/>	<input type="text" value="2004"/>
<b>End Date</b>	Date	<input type="text" value="March"/>	<input type="text" value="14"/>	<input type="text" value="2005"/>

November
January
February
March
April
May
June
July
August
September
October
November
December

---

**Units**

Select the units of measurement.

**Units**

Figure 12. TXHPET network date selection menu.

## Units and Output Format

TXHPET data are available in English or Metric (SI) units. The units pull down menu is used to make this selection. Below the Units selection area is the Output Method selection. By clicking on the corresponding circle, the user selects data table, text file, graph or advanced graph output formats. The “Submit” button initiates the database query. The “Reset” button clears all selections for a new query. After a query, the “Back” button in the browser returns to the query page, so the user can make changes to the query and re-submit. (Sometimes a page refresh may be required to update a data series or graph when using the “back” button operation to change data selections.)

**Time Range**

Complete the following time range by setting a start date and an end date. Be sure to enter a valid year.

**Start Date**      Date June 1 , 2005

**End Date**        Date September 15 , 2005

---

**Units**

Select the units of measurement.

**Units**            English  
English  
Metric

---

**Output Method**

Select an output method for your data.

**Output Method**     Data Table  
 Text File  
 Graph  
 Advanced Graph (next page for options)

Figure 13. TXHPET network units selection menu.

### Output Format Examples: Data Table

When the Data Table format is selected, data are presented in a spreadsheet format. If long data records are selected, information will be presented on multiple pages, with a pull down menu and page buttons for navigation between pages. Note that there is a toggle button at the bottom of the page that allows the user to view the data in graphical format directly from this page.

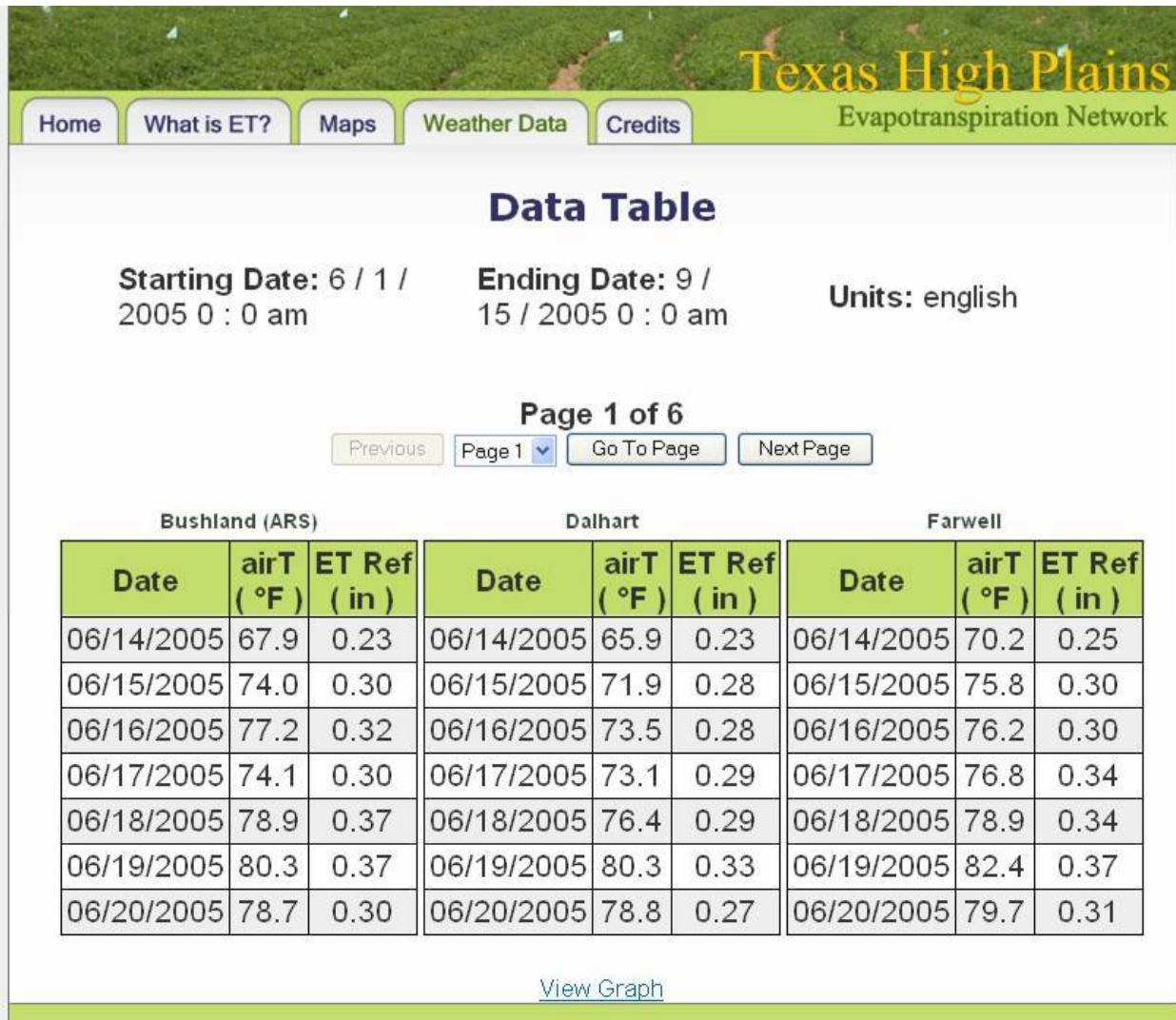


Figure 14. TXHPET network data table output format.



### Output Format Examples: Graphed Data

The Graphed Data format provides a convenient way to view the selected data. Graphs can have multiple axes to present multiple data units as needed. In this format axes are adjusted automatically to accommodate the data range values. A “View Data” link above the graph area allows the user to view data in data table format directly from this page. User defined axes limits, and other features are available in the Advanced Graphing format option.

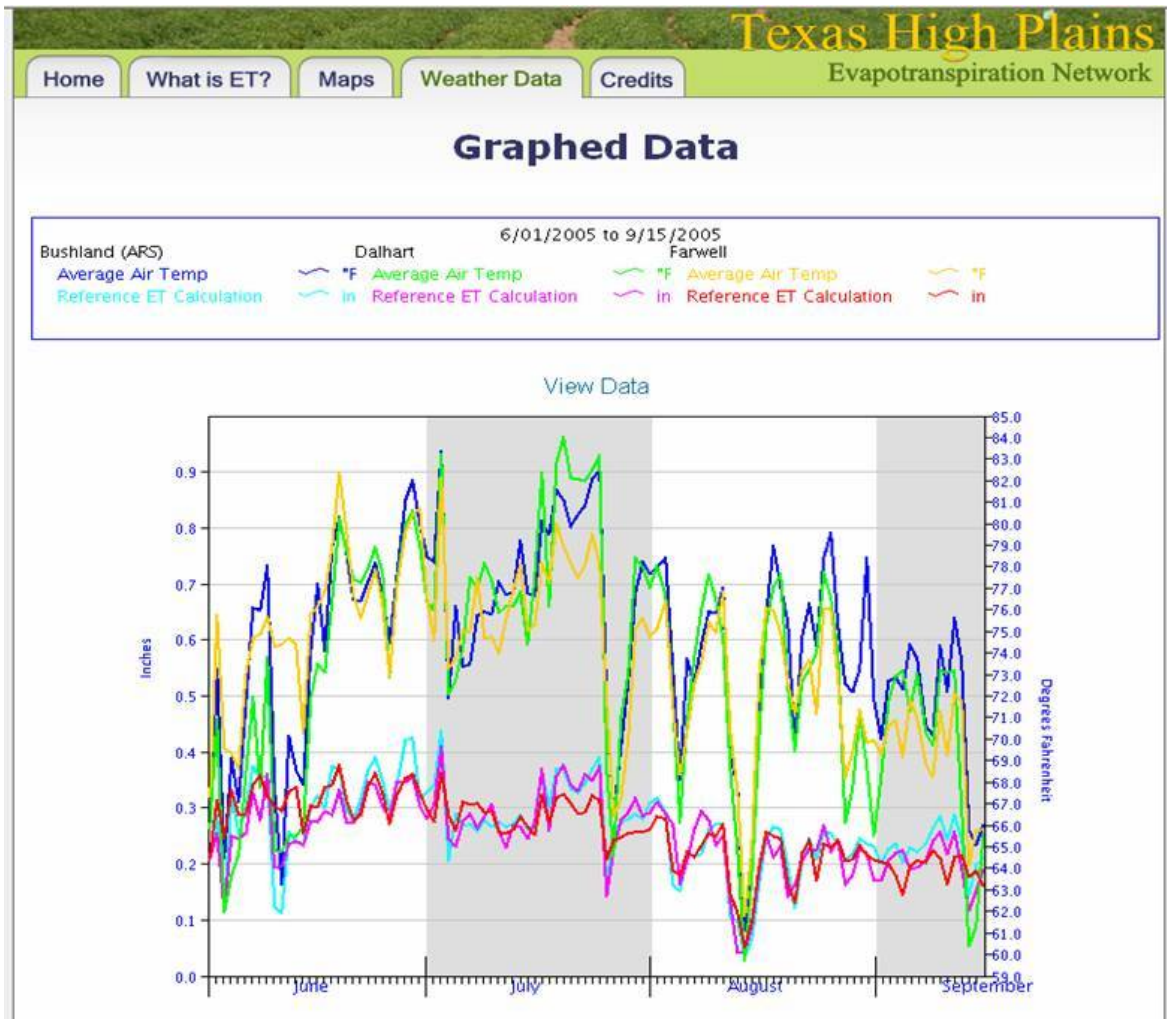


Figure 15. TXHPET network graphed data output format.

### Output Format Examples: Text File

The text file format is a convenient way for the user to access relatively long data records without page breaks. This format is particularly useful for importation into spreadsheets for further analysis or plotting. The file can be downloaded, copied and pasted and saved in a variety of formats for further user-directed analysis and presentation.

Bushland (ARS) Dalhart Farwell	airT ET Ref	6 / 1 / 2005 0 : 0 am	9 / 15 / 2005 0 : 0 am	english
--------------------------------------	----------------	-----------------------	------------------------	---------

[Click Here to Download](#)

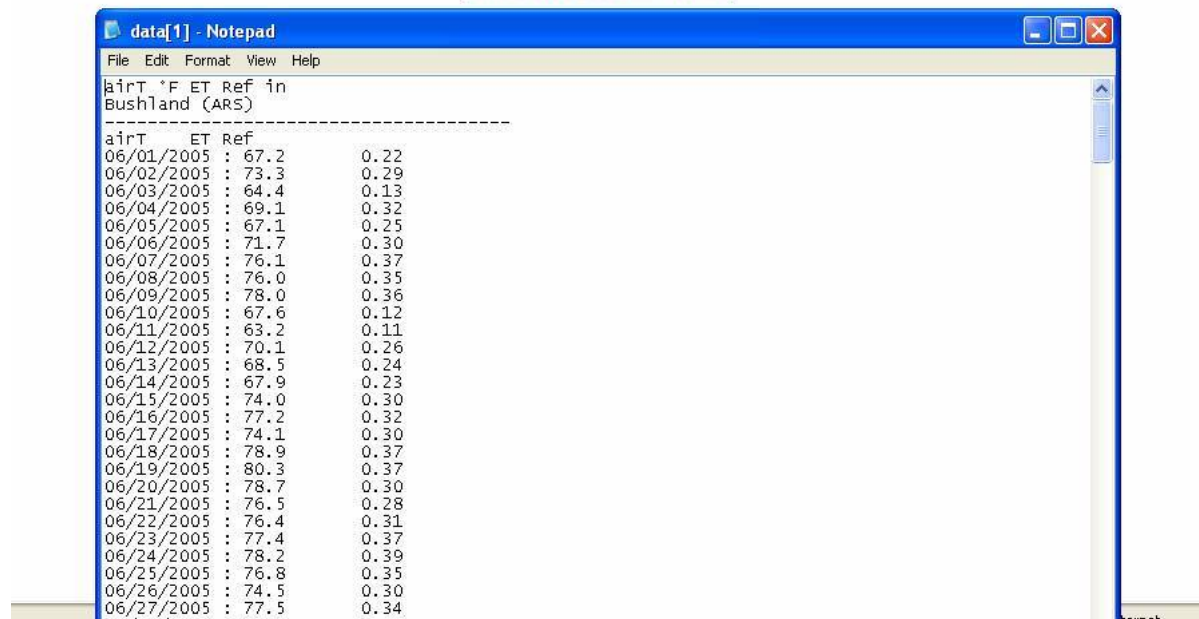


Figure 16. TXHPET network text file output format.

## Output Format Examples: Advanced Graphing

Advanced Graphing options enable the user to modify line weights and colors, manipulate axes, and set graphed data ranges. Line properties, axis limits, etc. are selected for each data item and for each location/station separately. Default properties will be used for items not otherwise specified by the user. Clicking the “Submit” button initiates the query and generates the respective graph of the data selected.

Select the output manner of each sensor

Select a station(s) from the following list. You may only select one station at a time.

Bushland (ARS)

Sensor	Type	Plot Color	Thickness	Upper Limit	Lower Limit	Use Separat Axis
airT	Line	Blue	2			<input type="checkbox"/> Yes
ET Ref	Line	Cyan	2			<input type="checkbox"/> Yes

Dalhart

Sensor	Type	Plot Color	Thickness	Upper Limit	Lower Limit	Use Separat Axis
airT	Line	Cyan	2			<input type="checkbox"/> Yes
ET Ref	Line	Green	2			<input type="checkbox"/> Yes

Farwell

Sensor	Type	Plot Color	Thickness	Upper Limit	Lower Limit	Use Separat Axis
airT	Line	Magenta	2			<input type="checkbox"/> Yes
ET Ref	Line	Orange	2			<input type="checkbox"/> Yes

Submit Previous Page

Figure 17. TXHPET network advanced graphics section.



## Hourly Weather Data

Like the daily data query, the hourly data query selection includes pull down menus for locations and data items. After each station location and after each data item selection, click the “Add” button to complete the selection. Added items can be de-selected by clicking the “remove” link beside those items.

**Hourly Weather Data**

**Select a Location**

Select a location from the following list and click the Add button. You may add more than one location. If you wish to remove a location simply click the remove link located next to the location.

**Location List**      Bushland (ARS) ▾    Add

**Added Locations**

---

**Select Information**

Select a group or individual item of information from the following list and click the Add button. You may add more than one item of information at a time. If you wish to remove an item simply click the remove link located next to the item.

**Information List**      ---- Individual Items ---- ▾    Add

**Added Information**

**Figure 18. TXHPET network hourly weather data section.**

## Time Range, Units, and Output Format Selection

The time range selection for an hourly data query is more specific, allowing for the hourly time step. Use the pull down menu to select start and end dates and times. Recall that time stamped data of 01:00am represents data from 24:00am to 01:00am.

Units and output formats are selected the same as for the daily data query. Use the pull down menu to select English or Metric units. Click on the circle beside the desired output format to select the output method. Click on the “Submit” button to initiate the query.

**Time Range**

Complete the following time range by setting a start date and an end date. Be sure to enter a valid year.

**Start Date**      Date June 1 , 2005

                          Time 1 : 00 a.m.

**End Date**         Date June 15 , 2005

                          Time 1 : 00 a.m.

**Units**

Select the units of measurement.

**Units**             English

**Output Method**

Select an output method for your data.

**Output Method**     Data Table

Text File

Graph

Advanced Graph (next page for options)

**Figure 19. TXHPET network hourly time range selection section**

## Hourly Data Query Example: Selecting Stations, Data Items, and Time Range

For this example, air temperature and 2 inch soil temperature will be accessed for the same weather stations (Bushland, Farwell, and Dalhart) as those used in the daily example. The period of interest is October 14 thorough November 15, 2005.

<p><b>Select a Location</b></p> <p>Select a location from the following list and click the Add button. You may add more than one location. If you wish to remove a location simply click the remove link located next to the location.</p>	
<p><b>Location List</b></p>	<p>Bushland (ARS) <input type="button" value="Add"/></p>
<p><b>Added Locations</b></p>	<p>Bushland (ARS) <a href="#">remove</a>            Farwell <a href="#">remove</a>            Dalhart <a href="#">remove</a></p>
<p><b>Select Information</b></p> <p>Select a group or individual item of information from the following list and click the Add button. You may add more than one item of information at a time. If you wish to remove an item simply click the remove link located next to the item.</p>	
<p><b>Information List</b></p>	<p>---- Individual Items ---- <input type="button" value="Add"/></p>
<p><b>Added Information</b></p>	<p>Air Temperature <a href="#">remove</a>            2" Soil Temperature <a href="#">remove</a></p>
<p><b>Time Range</b></p> <p>Complete the following time range by setting a start date and an end date. Be sure to enter a valid year.</p>	
<p><b>Start Date</b></p>	<p>Date <input type="text" value="October"/> <input type="text" value="14"/>, <input type="text" value="2005"/>            Time <input type="text" value="1"/> : <input type="text" value="00"/> <input type="text" value="a.m."/></p>
<p><b>End Date</b></p>	<p>Date <input type="text" value="November"/> <input type="text" value="15"/>, <input type="text" value="2005"/>            Time <input type="text" value="1"/> : <input type="text" value="00"/> <input type="text" value="a.m."/></p>

Figure 20. TXHPET network hourly data selection section.

### Hourly Data Query Example: Data Table Format

The Data Table format provides date and time along with the data items selected for the locations of interest. Above the table are some page navigation buttons. This presentation format enables the user to view the data for multiple locations in a side-by-side manner.

The View Graph link below the table conveniently switches to a graphical data presentation format.

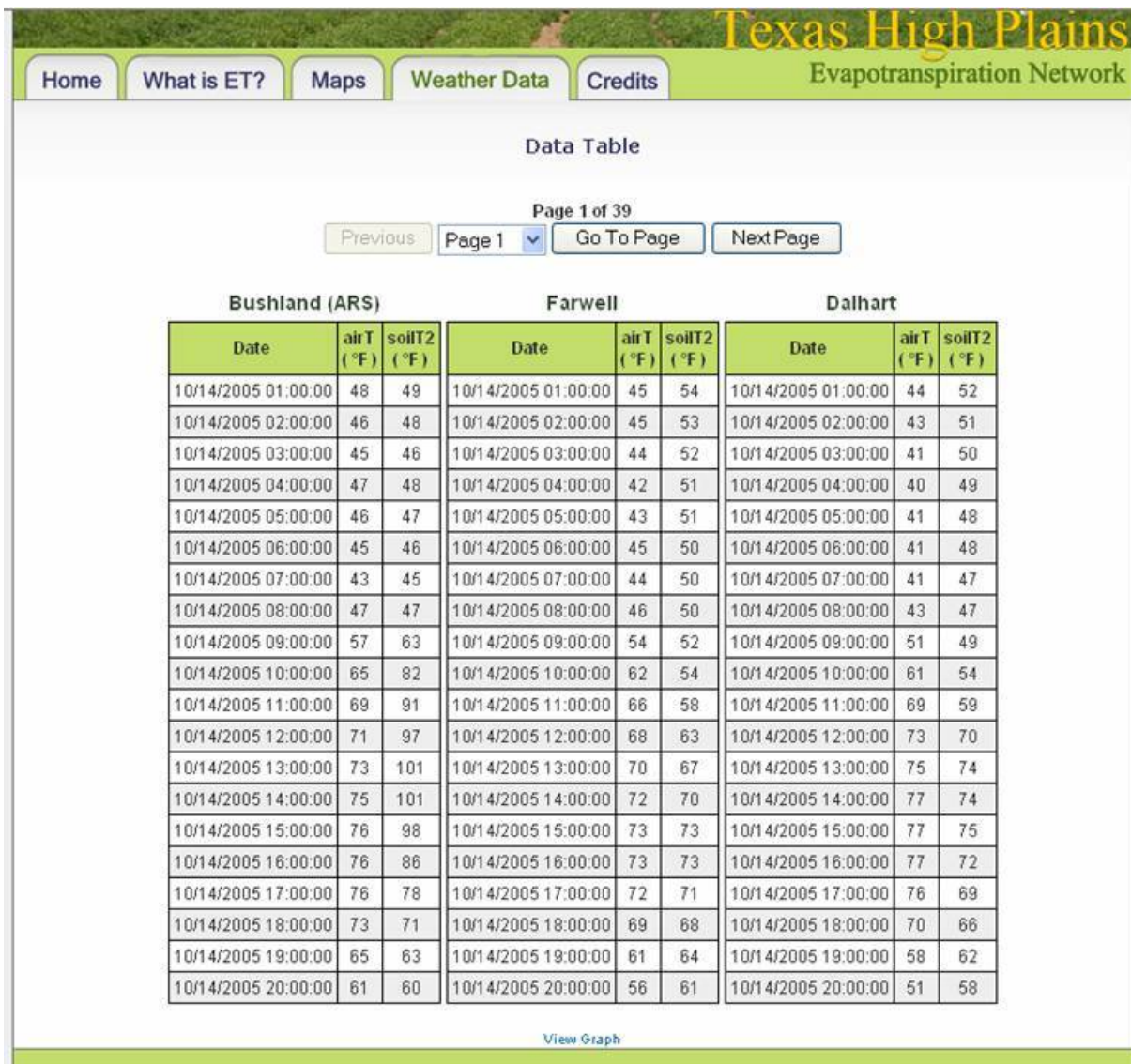


Figure 21. TXHPET network hourly data table format.

### Hourly Data Query Example: Graphed Data Format

The Graphed Data format provides a convenient way to view the selected data. Graphs can have multiple axes to present multiple data units as needed. In this format axes are adjusted automatically to accommodate the data range values. Note that with hourly data intervals, long data records can result in a crowded graph. Selection of shorter time ranges (fewer days) or using a daily data interval can improve readability of the graph if necessary. A “View Data” link above the graph area allows the user to view data in data table (spreadsheet) format directly from this page. User defined axes limits, and other features are available in the Advanced Graphing format option. Use of this option is the same as for the Daily Data query.

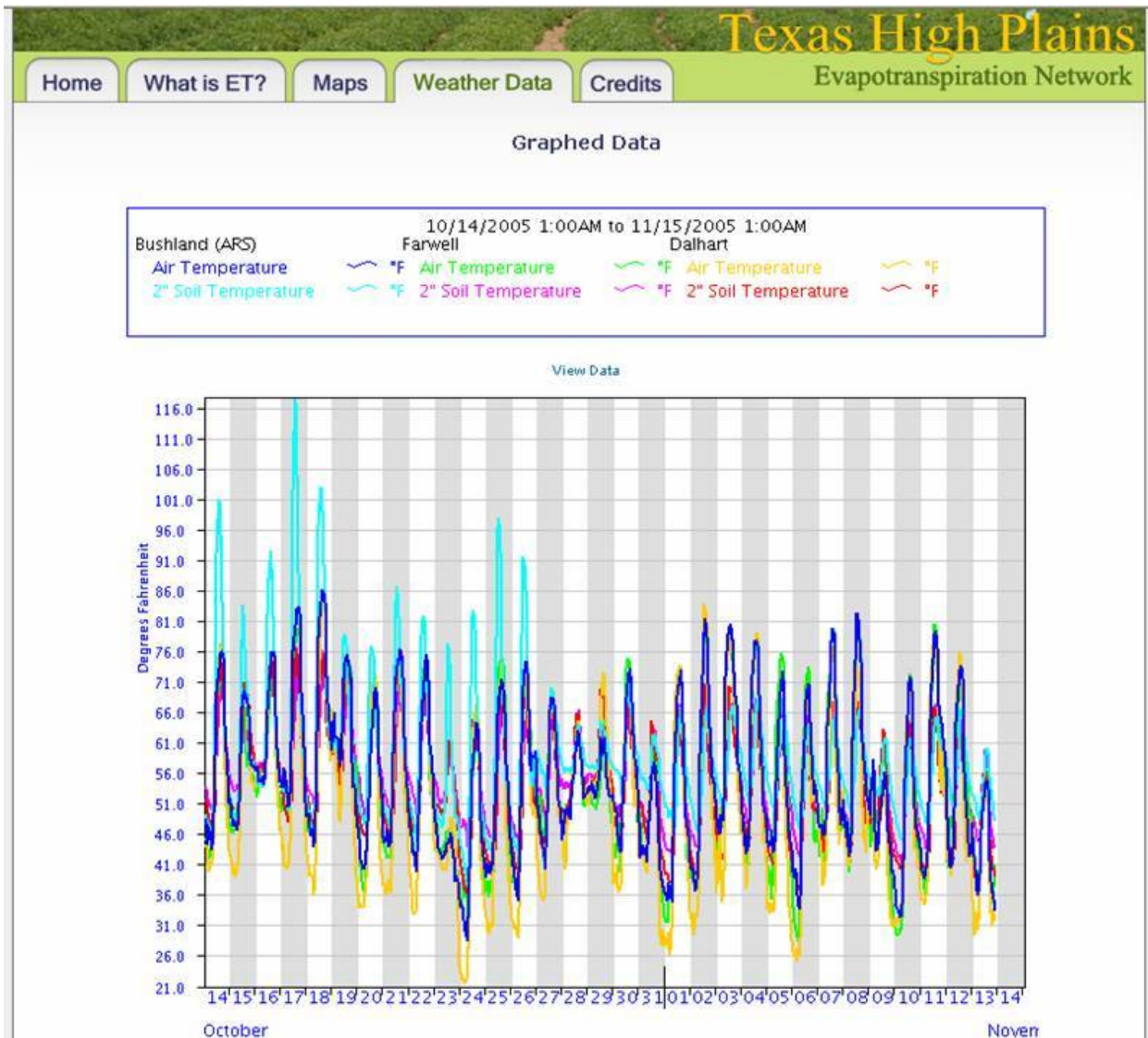


Figure 22. TXHPET network hourly data graph output format.



## Hourly Data Query Example: Text File Format

The text file format is a convenient way for the user to access relatively long data records. The file can be downloaded, copied and pasted, and saved in a variety of formats for further user-directed analysis and presentation.

Bushland (ARS)	airT	10 / 14 / 2005 1 : 0 am	11 / 15 / 2005 1 : 0 am	english
Farwell	soilT2			
Dalhart				

[Click Here to Download](#)

```

data[1] - Notepad
File Edit Format View Help
airT `F soilT2 `F
Bushland (ARS)
-----
airT      soilT2
10/14/2005 01:00:00 : 48      49
10/14/2005 02:00:00 : 46      48
10/14/2005 03:00:00 : 45      46
10/14/2005 04:00:00 : 47      48
10/14/2005 05:00:00 : 46      47
10/14/2005 06:00:00 : 45      46
10/14/2005 07:00:00 : 43      45
10/14/2005 08:00:00 : 47      47
10/14/2005 09:00:00 : 57      63
10/14/2005 10:00:00 : 65      82
10/14/2005 11:00:00 : 69      91
10/14/2005 12:00:00 : 71      97
10/14/2005 13:00:00 : 73      101
10/14/2005 14:00:00 : 75      101
10/14/2005 15:00:00 : 76      98
10/14/2005 16:00:00 : 76      86
10/14/2005 17:00:00 : 76      78
10/14/2005 18:00:00 : 73      71
10/14/2005 19:00:00 : 65      63
10/14/2005 20:00:00 : 61      60
10/14/2005 21:00:00 : 57      57
10/14/2005 22:00:00 : 53      55
10/14/2005 23:00:00 : 51      53
10/15/2005 00:00:00 : 52      52

```

Figure 23. TXHPET network text output format.

## E-mail Listserv Capability

While current users can continue to receive TXHPET related \*.fx and \*.prt files through the current modes of faxing and or electronic web based downloading from the NPET and SPET network sites, a preferred new delivery option has been developed to replace faxing. This delivery mode is intended to reduce phone costs and the time required to disseminate the data files each day. A network listserv delivers fax and .prt files via e-mail each morning. On-line web based signup for the listserv e-mail service is available at <http://amarillo2.tamu.edu/listserv> For most users (irrigators, for instance) the \*.fax and \*.prt data formats will be of primary interest. Other formats available for e-mail distribution are intended primarily for research and model applications

Upon entering the listserv page, the user can create a new account or modify an existing one. The front page of the listserv site is shown below:

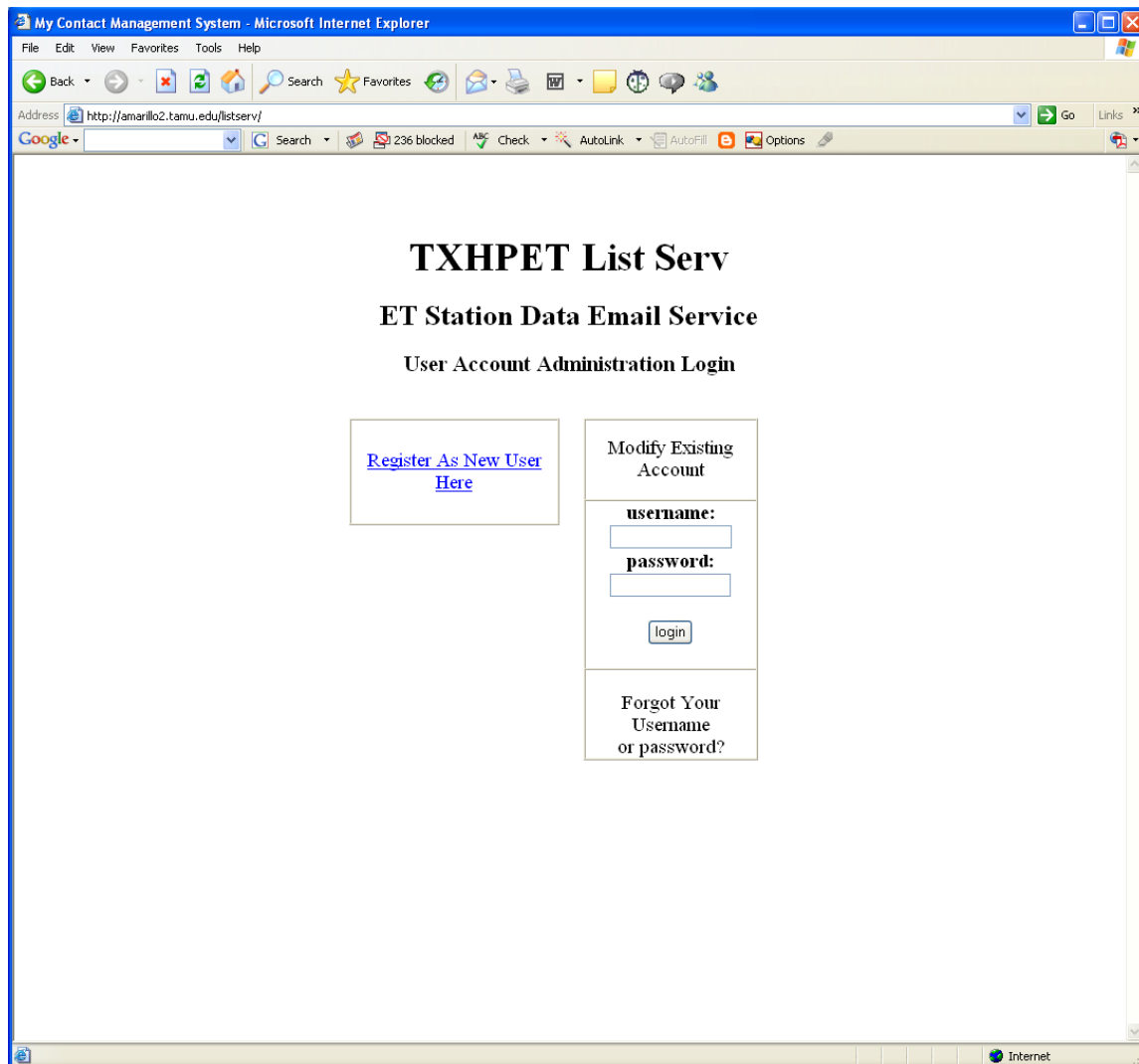


Figure 24. TXHPET network listserv front page.

The new user registration screen is shown below. The user should fill in all applicable blanks. Account data are used only to assess data applications and audiences and to provide a means of contacting users as needed for correction of data delivery problems.

**User Management System**

*Add a User*

<b><i>User Information</i></b>	<b><i>System Login Information</i></b>
First Name: <input type="text"/>	User Name: <input type="text"/>
Last Name: <input type="text"/>	Password: <input type="text"/>
Street: <input type="text"/>	
City: <input type="text"/>	<b><i>Business Information</i></b>
State: <input type="text"/>	Occupation: <input type="text"/>
Zip: <input type="text"/>	Business Name: <input type="text"/>
Home Phone: <input type="text"/>	Business Description: <input type="text"/>
Cell Phone: <input type="text"/>	Business Contact: <input type="text"/>
Email Address: <input type="text"/>	Business Phone: <input type="text"/>
	Business Fax: <input type="text"/>

Figure 25. TXHPET network listserv new user input section.



Following successful submission of user information, the station and file selection screen (illustrated below) will appear. Generally the fax file designated by the “fax” file extension and the hourly meteorological data files designated by the “prt” file extension are the files of interest to most users, including irrigated producers. Other files designated by the various extensions are again primarily for researchers and modelers associated with the TXHPET network. A user can select one or more stations and formats of interest. The selected files will be sent to the user’s e-mail address each morning.

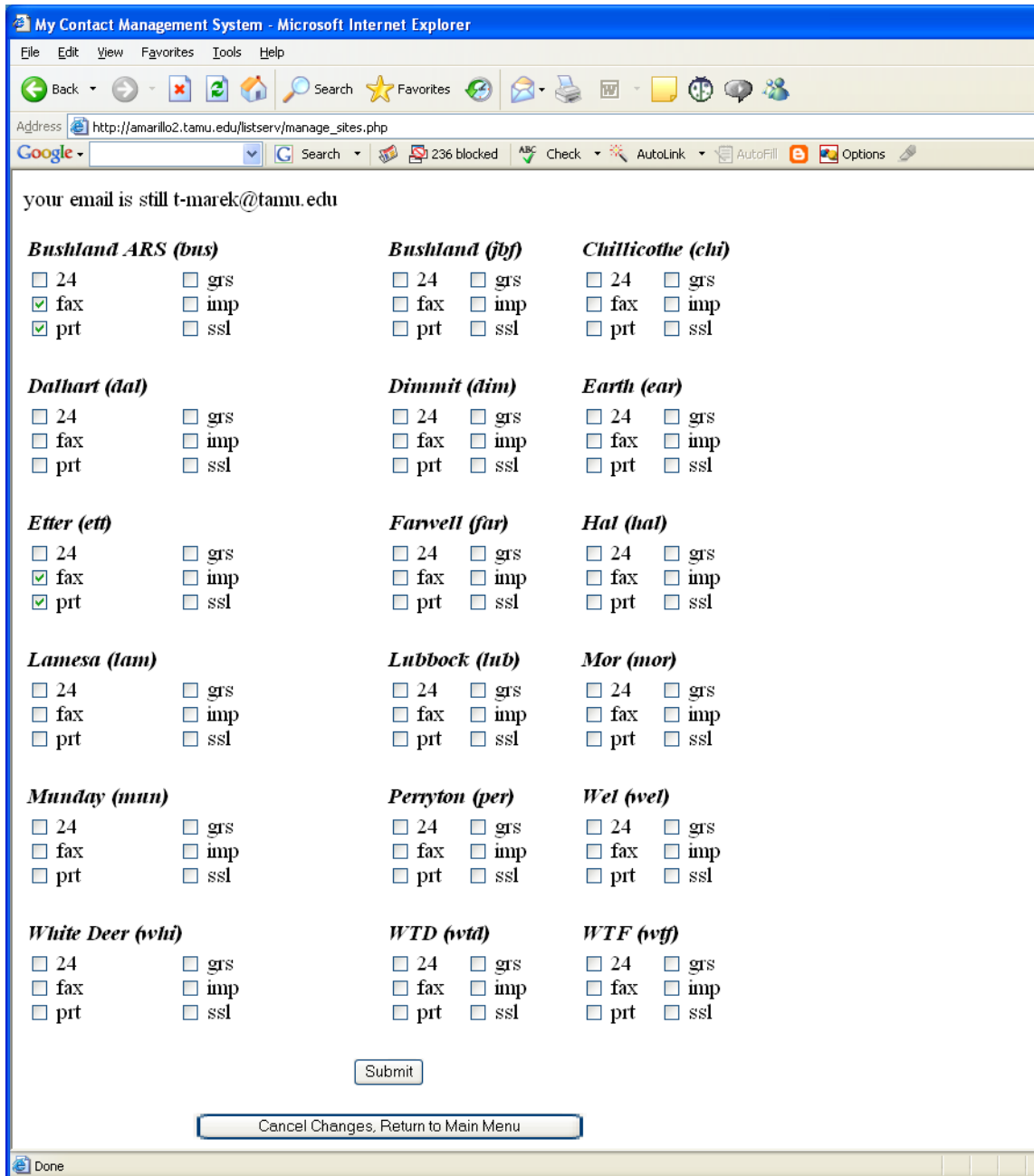
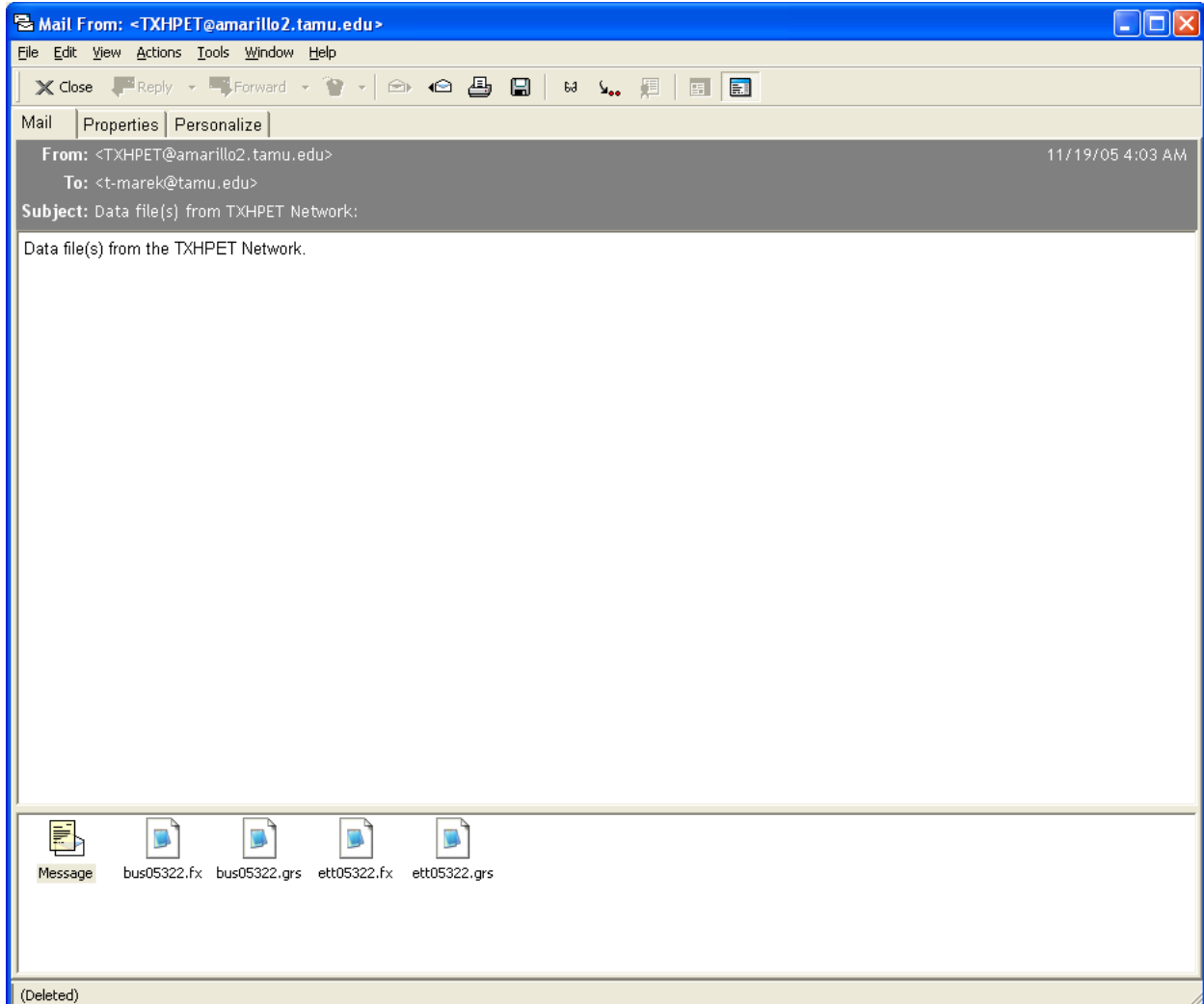


Figure 26. TXHPET network listserv station selection page.

E-mail receipt of the files can vary slightly but a typical example is shown below:



**Figure 27. Typical e-mail delivery of TXHPET network selected files.**

If you need further assistance in navigating the TXHPET website, please contact:

Texas Southern High Plains:

**Dr. Dana Porter**, P.E., South Plains ET Network manager, TCE/TAES – Lubbock  
[d-porter@tamu.edu](mailto:d-porter@tamu.edu)

Texas Panhandle and Northern Texas High Plains:

**Leon New**, P.E., Professor and Irrigation Specialist, TCE- Amarillo  
[l-new@tamu.edu](mailto:l-new@tamu.edu)

For technical assistance or for the reporting of web-based operational or content errors, please contact Dr. Dana Porter or Thomas Marek at [t-marek@tamu.edu](mailto:t-marek@tamu.edu).

## Credits

These developments would not have been possible without support of our sponsors. We greatly appreciate their financial and in-kind support.



Figure 28. TXHPET network partners section.

## **Acknowledgements**

Special thanks to the following talented and dedicated individuals whose contributions and expertise have turned ambitious ideas into matter-of-fact reality for the benefit of those using the data.

**Don Dusek**, TAES - Amarillo instrumentation, data acquisition, and meteorological data QA/QC “data master”.

**Craig Carpenter**, TAES - Lubbock computer programmer and database “guru extraordinaire”.

**Nicholas Greene**, TAES - Amarillo computer specialist and right-hand man programmer of the TXHPET listserv developer/manager.

**Andrew Huff**, TAES - Lubbock web page and graphics designer.

**Mike Blanton**, TAES - Lubbock systems analyst and patient supervisor who allowed us to access the talent of his band of smart, young computer “dudes”.

**Pat Porter**, PhD, TCE - Lubbock extension entomologist and information delivery visionary.

**Paul Sittler**, TAES/TCE- College Station, information technologist and computer expert.

Furthermore, acknowledgement is extended to the administrators of the partnering agencies who continue to support the efforts and mission of the TXHPET. These individuals are:

**Dr. John Sweeten**, TAES-Amarillo Resident Director

**Dr. Jaroy Moore**, TAES-Lubbock Resident Director

**Dr. R.N. Clark**, USDA-ARS Bushland, Laboratory Director, Research Leader, and Supervisory Agricultural Engineer

**Dr. Bob Robinson**, TCE- Amarillo/Lubbock, Regional Program Director, Agriculture and Natural Resources

**Dr. Don Topliff**, WTAMU, Professor and Head, Division of Agriculture

**Dr. James Clark**, WTAMU, Dean for the College of Agriculture, Nursing and Natural Sciences

**Special thanks are also extended to the following partnering organizations** that have contributed to the development of the North Plains and South Plains ET networks. Their support is greatly appreciated.

**Texas Corn Producers Board**

**Texas Wheat Producers Board**

**North Plains Water conservation District**

**Panhandle Groundwater Conservation District**

**High Plains Groundwater Conservation District #1**

The Texas High Plains Evapotranspiration Steering Committee includes:

**Thomas Marek**, P.E., North Plains ET network manager, TAES - Amarillo  
**Dr. Dana Porter**, P.E., South Plains ET network manager, TCE/TAES - Lubbock  
**Dr. Terry Howell**, P.E., Water Management Research Leader, USDA-ARS - Bushland  
**Leon New**, P.E., Professor and Irrigation Specialist, TCE- Amarillo  
**David Bordovsky**, Research Scientist, TAES – Chillicothe/Vernon  
**Dr. David Parker**, P.E., Associate Professor of Environmental Science and  
Engineering, WTAMU - Canyon

The TXHPET development committee is currently made up of selected TXHPET personnel, listed below. Please feel free to contact these individuals for special ET related requests and comments.

**Thomas Marek**, P.E., North Plains ET Network manager, TAES – Amarillo  
t-marek@tamu.edu  
**Dr. Dana Porter**, P.E., South Plains ET Network manager, TCE/TAES – Lubbock  
d-porter@tamu.edu  
Dr. Terry Howell, P.E., Water Management Research Unit Leader, USDA-ARS –  
Bushland  
Dr. Jerry Michels, Entomologist, TAES- Amarillo  
Dr. David Parker, WTAMU, Canyon

## APPENDIX

## Units

Item	English Unit	Metric (SI) Unit
Evapotranspiration (ET), Reference	Inch (in)	Millimeters (mm)
Evapotranspiration, Crop	Inch (in)	Millimeters (mm)
Growing Degree Days (Heat Units)	Degrees Fahrenheit (°F)	Degrees Celsius (°C)
Precipitation (rainfall)	Inch (in)	Millimeters (mm)
Pressure, barometric	Millibar (mbar)	Kilopascals (kPa)
Relative humidity	%	%
Solar Irradiance (solar radiation)	Langley (ly)	Megajoules per square meter (MJ/m <sup>2</sup> )
Temperature, air	Degrees Fahrenheit (°F)	Degrees Celsius (°C)
Temperature, dew point	Degrees Fahrenheit (°F)	Degrees Celsius (°C)
Temperature, soil temperature	Degrees Fahrenheit (°F)	Degrees Celsius (°C)
Vapor Pressure deficit	Millibar (mbar)	Kilopascals (kPa)
Vapor Pressure, actual	Millibar (mbar)	Kilopascals (kPa)
Wind Direction	Degree (°)	Degree (°)
Wind Direction, standard deviation	Degree (°)	Degree (°)
Wind Speed	Miles per hour (mph)	Meters per second (m/s)

---

Citation of this document can be made as follows:

Porter, D., T. Marek, T. Howell, and L. New. 2005. The Texas High Plains Evapotranspiration Network (TXHPET) User Manual. TAMU-TAES, Amarillo Agricultural Research and Extension Center, Amarillo, TX, Publication AREC 05-37. 37p.

DP/THM:THM