Water Resources Board Meeting
August 29, 2016
1:00 PM EDT
Training Room C
300 Sower Blvd
Frankfort, Kentucky 40601

1. Call Meeting to Order and Roll Call of Board Members

2. Introduction of Guests

3. Approve Minutes of July 27, 2016

4. Presentation by Bill Caldwell, KDOW – Water Use in Kentucky

5. Presentation by Pete Cinotto, Assistand Director KY-IN Science Center, USGS – Monitoring Kentucky's Water Resources

6. Presentation by Dr. Stuart Foster, State Climatologist, Kentucky Climate Center WKU – Monitoring Kentucky's Climate: The Kentucky Mesonet

7. Action Items and Reports
   a. Projects Workgroup Report

8. Open Discussion for Board Members

9. Public Comment Period

10. Next Meeting 1:00 PM – September 29, 2016

Water Resources Board Meeting
300 Sower Blvd, Frankfort, KY 40601
August 29, 2016
PUBLIC SIGN-IN SHEET

Name	Agency/Organization	Email Address	Phone number
Aaron Keatley	DEP	aaron.keatley@ky.gov	564-2150
Bruce Scott	EEC	Bruce.Scott@ky.gov	782-6760
Lowell Atchley	LRC	lowell.atchley@lrc.ky.gov	564-8100 x469
Pete Cinotto	USGS	pcinotto@usgs.gov	502 493 1930
Jeff Woods	USGS	jwoods@usgs.gov	317-600-2762
Annette DuPont-Ewing	KMUA	adeKmua@gmail.com	502 223-2063
Jim Kipp	KWRRI	KIPP@UKY.EDU	859-257-1832
Stuart Foster	Ky Climate Center	stuart.foster@wku.edu	270-745-5983
Gary Larimore	Ky Rural Water Assn	g.larimore@krwa.org	270-843-2291
Bill Caldwell	DOW	bill.caldwell@ky.gov	502-782-6906
Samantha Kaiser	DOW	Samantha.Kaiser@ky.gov	502-782-6995

Water Resources Board Meeting
300 Sower Blvd, Frankfort, KY 40601
August 29, 2016
PUBLIC SIGN-IN SHEET

Name	Agency/Organization	Email Address	Phone number
Steve Coleman	KFBF	soi11951@yahoo.com	502-330-5044
Earl Brack	Judge Executive	brackmyjudge@windstream.net	606-402-1533
John Dix	KRWA	JOHND@WARRENWATER.COM	270-495-3491
Nancy Cox	UK Ag	ncox@uky.edu	859-230-7759
BRENT BURCHETT	KY DEPT of Ag	brent.burchett@ky.gov	502-226-0517
Paulette. Akers	Ky DCA	Paulette.Akers@ky.gov	502-782-6300
Haley McCoy	EEC	haley.mccoy@ky.gov	502-229-5527

Water Resources Board Meeting
300 Sower Blvd, Frankfort, KY 40601
August 29, 2016
BOARD MEMBER SIGN-IN SHEET

Name	Agency/Organization	Email Address	Phone number
Kevin Jeffries	KACD	KevinjeFF@bellsouth.net	502-553-2938
Brent Burchett	KY Dept. of Ag	brent.burchett@ky.gov	502-782-4126
Nancy Cox	UK Ag	ncox@uky.edu	859-257-4772
Steve Coleman	KFBF	sor11951@yahoo.com	502-330-5044
Kevin Rogers	KY Chamber of Comm	kevin.rogers@AMWATER.COM	859-268-6324

Water Resources Board
Draft Meeting Minutes
August 29, 2016

Board Members in Attendance: Lowell Atchley (Proxy, LRC); Brent Burchett (Proxy, Dept. of Agriculture); Earl Bush (County Judge Executives); Steve Coleman (KY Farm Bureau); Dr. Nancy Cox (UK); Lloyd Cress, Jr. (KY League of Cities); John Dix (KRWA); Teresa Hill (Proxy, LRC); Kevin Jeffries (Soil and Water Conservation Districts); Kevin Rogers (KY Chamber of Commerce); Charles Snavely (EEC Secretary);

Board Members Absent: Tom McKee (LRC); Ryan Quarles (Commissioner Dept. of Agriculture)

Others in Attendance: Paulette Akers (Acting Director, DCA); Bill Caldwell (KDOW); Pete Cinotto (USGS); Annette Dupoint-Ewing (KMUA); Stuart Foster (KCC); Peter Goodmann (Director KDOW); Samantha Kaiser (KDOW); Aaron Keatley (Commissioner DEP); Jim Kipp (KWRRI); Gary Larimore (KRWA); Haley McCoy (EEC); Bruce Scott (Deputy Secretary EEC); Jeff Woods (USGS)

The meeting began at 1:05 p.m.

Call Meeting to Order and Roll Call of Board Members

EEC Secretary and Board Chair Charles Snavely called the meeting to order and led the roll call of Board members.

Introduction of Guests

Guests introduced themselves.

Approve Minutes of July 27, 2016

Changes were made to the spelling of Brent Burchett's name. The Board approved the July Meeting Minutes by consensus.

Draft Ground Rules

Mr. Peter Goodmann discussed the draft ground rules. The Board agreed that a proxy may attend a meeting in the absences of a Board member. The ground rules will be updated with this change.

Presentation by Bill Caldwell, KDOW – *Water Use in Kentucky*

Mr. Caldwell gave a Power Point presentation regarding water use in Kentucky. Thermoelectric power generation is the largest contributor to water usage nationally and in Kentucky. Irrigation is the second largest contributor nationally to water usage. From 1964 to 2012, Kentucky increased the total number of irrigated acres by about 59,000 acres. Though future irrigation is difficult to project, increases are likely to occur in Kentucky. Monitoring and data collection should include assessments of water availability and demand on surface water, aquifers, springs, and lakes.

Presentation by Pete Cinotto, Assistant Director KY-IN Science Center, USGS – *Monitoring Kentucky's Water Resources*

Mr. Cinotto gave a Power Point presentation regarding monitoring Kentucky's water resources. As climate changes and growing seasons get longer, there will be a corresponding increase in demand for water. Irrigation will likely be of greater importance and the ability to quantify and manage local water resources will be more critical. Adequate data for Kentucky's waterbudget equation is necessary to manage Kentucky's water resources in critical areas. A notable gap exists in USGS's data in Western KY and the Cumberland River Basins. Kentucky Geological Survey is making progress towards improved statewide groundwater monitoring and research, but significant data gaps still exist. Real-time continuous data is critical to determining causes and effects of water quality issues. The USGS is using "Super Gages" to estimate nitrite plus nitrate annual loads of waters coming in and going out of Kentucky, but not all sites on all major river basins are being monitored.

Presentation by Dr. Stuart Foster, State Climatologist, Kentucky Climate Center WKU – *Monitoring Kentucky's Climate: The Kentucky Mesonet*

Dr. Foster gave a Power Point presentation regarding the use of the Mesonet system to monitor Kentucky's weather and climate. The most recent drought in Kentucky began in early 2012. Comparing historical drought data shows that every drought is different in terms of onset, duration, intensity, and geographical extent. Kentucky's climatological records have evolved from manual data collection to the Mesonet systems and the state's diverse terrain creates distinct local vulnerabilities to weather and climate. This makes site selection for the Mesonet system important because, quality data requires quality sites. WKU currently has about sixty-six Mesonet sites in Kentucky. One hundred sites would be adequate to decrease data gaps. Dr. Foster stressed the importance of partnering with local officials which is beneficial for site selection and maintenance.

Action Items and Reports

Mr. Steve Coleman distributed the Projects Subcommittee – Initial Concepts outline and briefly discussed it with the group. The next steps will be prioritizing listed items and add any additional items to the list.

Open Discussion for Board Members

The Board indicated interest in a presentation on funding sources, and to discuss the differences between State Cost Share Funds (SCS) and State Revolving Funds (SRF). Due to the increase in poultry farms, leveraging USDA dollars might be of interest to the Board. A member from the Army Corps of Engineers will be invited to a future meeting. The Board indicated interest in discussing Kentucky's Red Tape Reduction Initiative at the next meeting.

Public Comment Period

No public comments were made.

Next Meeting 1:00 PM - September 29, 2016

The meeting adjourned at 4:20 p.m.

Water Resources Board
Meeting Minutes
August 29, 2016

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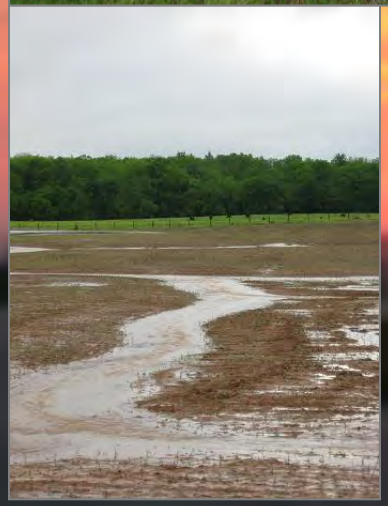
Monitoring Kentucky's Climate: The Kentucky Mesonet at WKU

Stuart A. Foster
State Climatologist for Kentucky
Kentucky Climate Center
Western Kentucky University

Kentucky Water Resources Board
Frankfort, Kentucky
August 29, 2016

Kentucky's Weather and Climate Extremes

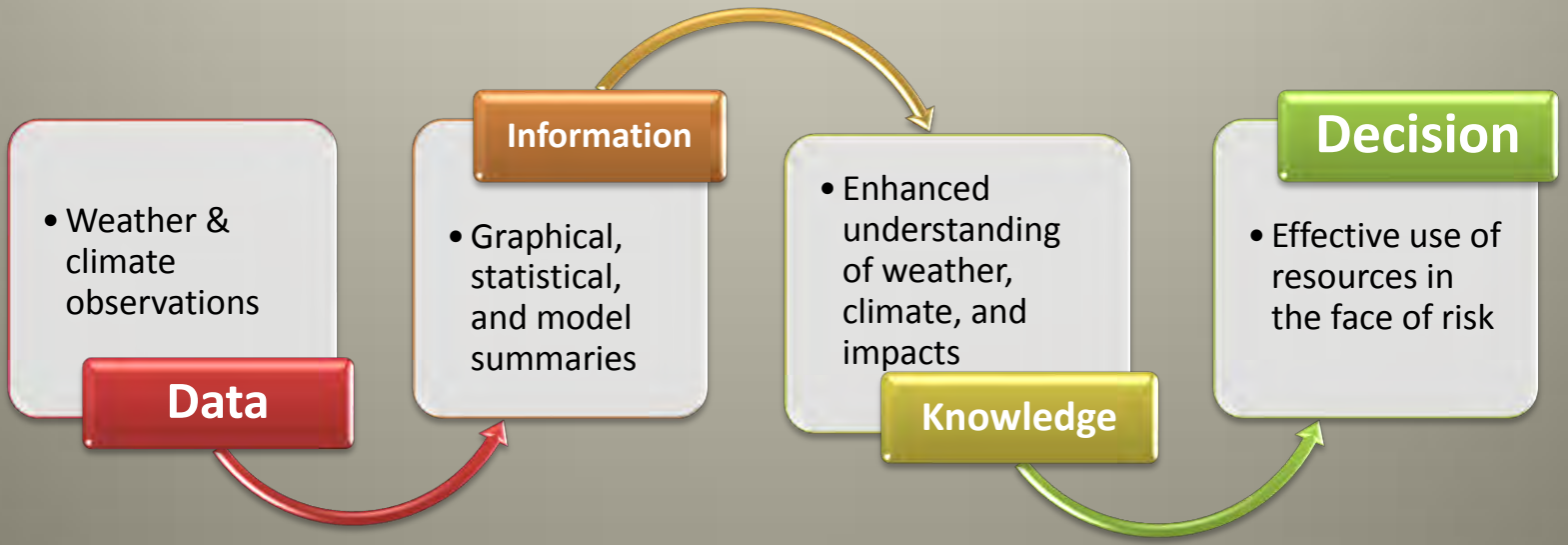
Warren County, May 2010



Todd County, October 2010

Kentucky Climate Center

- History
  - Established at Western Kentucky University in 1978
  - Recognized by the AASC as the State Climate Office for Kentucky in 2002
  - National Weather Service funding awarded to build the Kentucky Mesonet in 2006



Climate Services Partnerships

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

NATIONAL WEATHER SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

National Drought Mitigation Center

USDA

MRCC

AASC
AMERICAN ASSOCIATION OF STATE CLIMATOLOGISTS

KENTUCKY CLIMATE CENTER

A Matter of Perspective

Geostationary Earth Observing Platforms

http://www.photolib.noaa.gov/htmls/spac0256.htm

http://www.ruralimagecoop.org/tag/front-porch-sitting/

Remote sensing often provides a bird's-eye view, while people see the world from their front porch.

Talking Points

- Perspectives on Drought
- Kentucky Mesonet at WKU
- Strategic Initiatives
- Questions and Discussion

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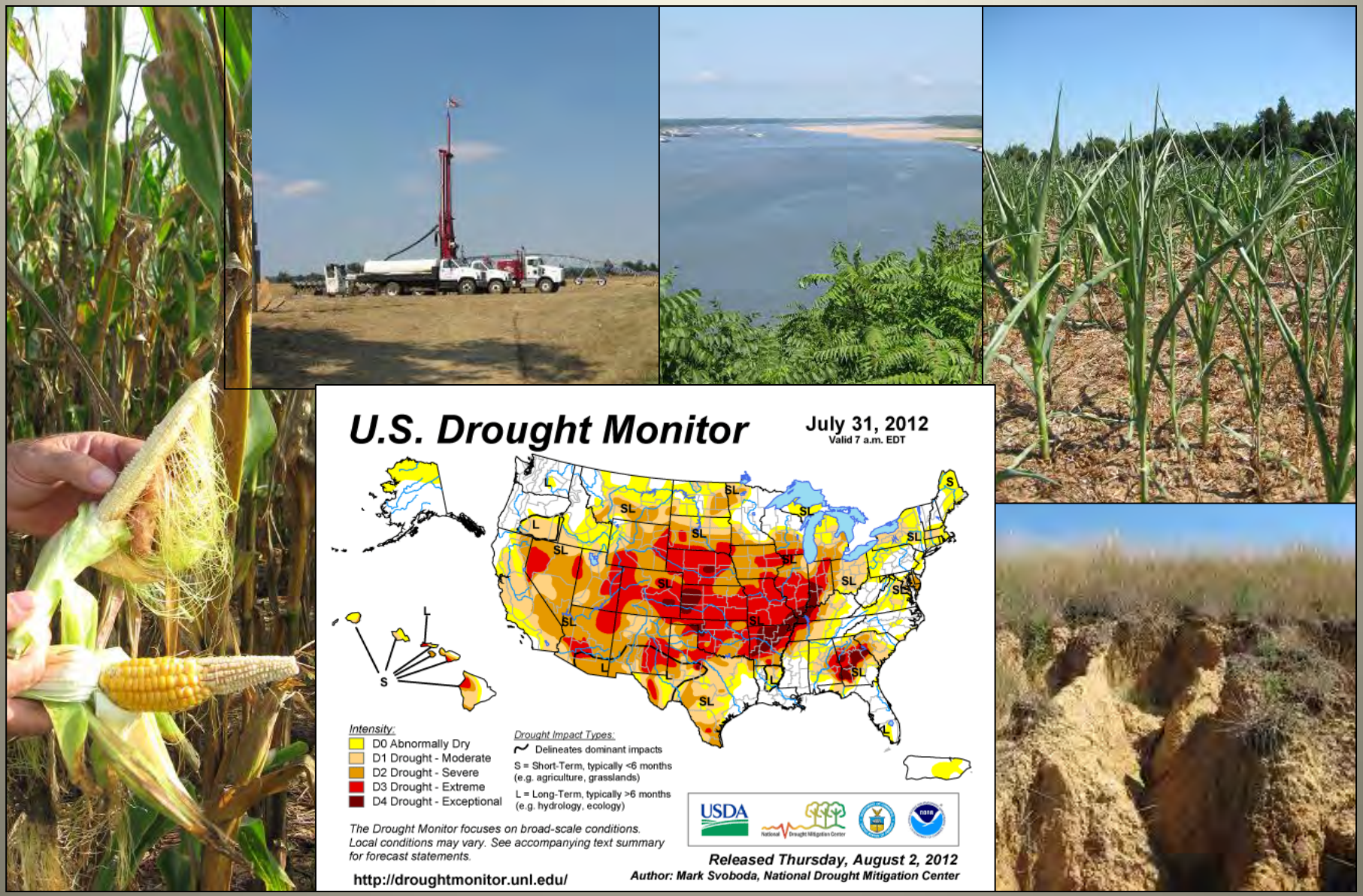
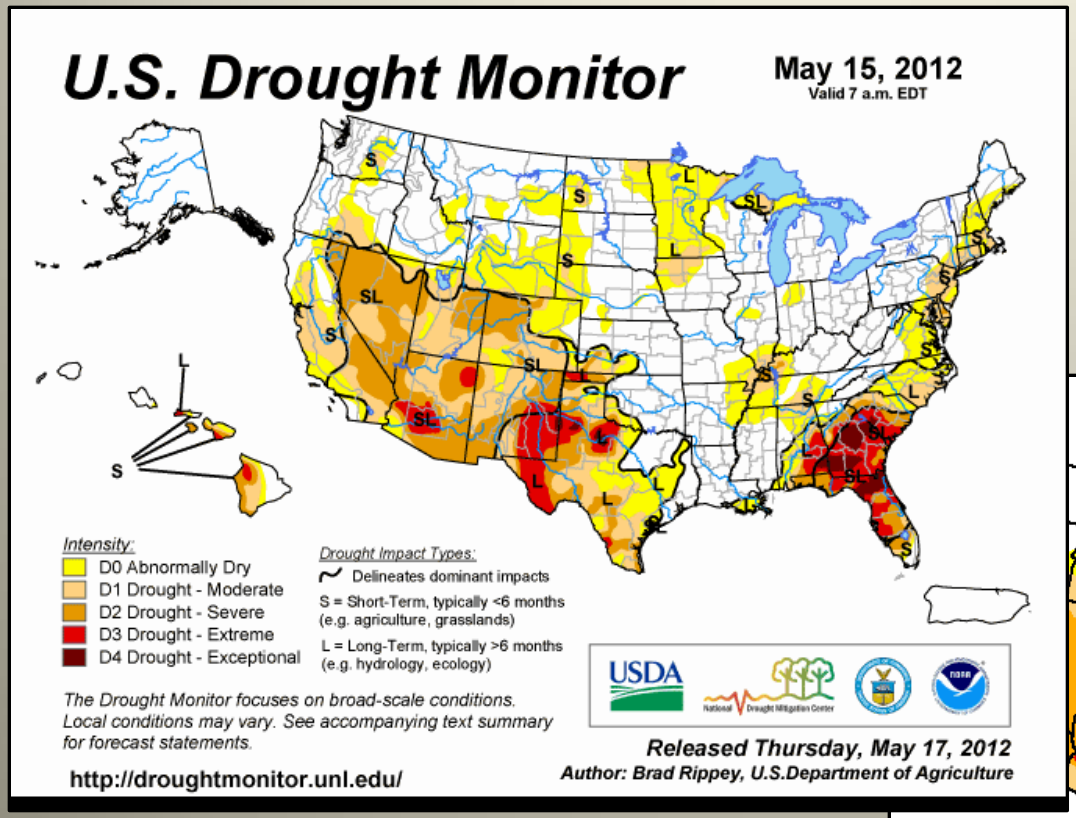
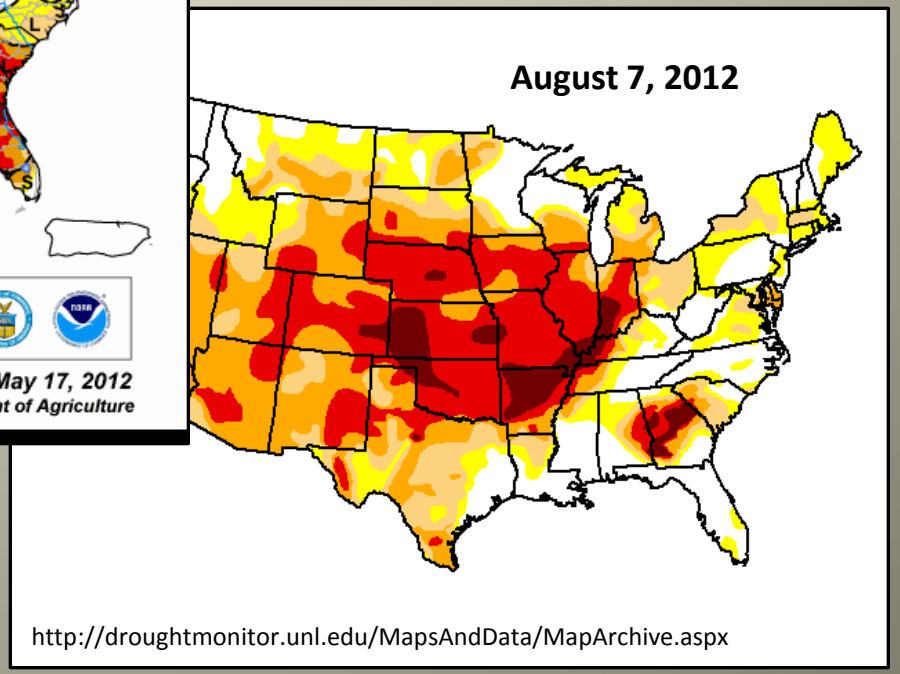
Flash Drought!



KENTUCKY CLIMATE CENTER

Continental Evolution of 2012 Drought

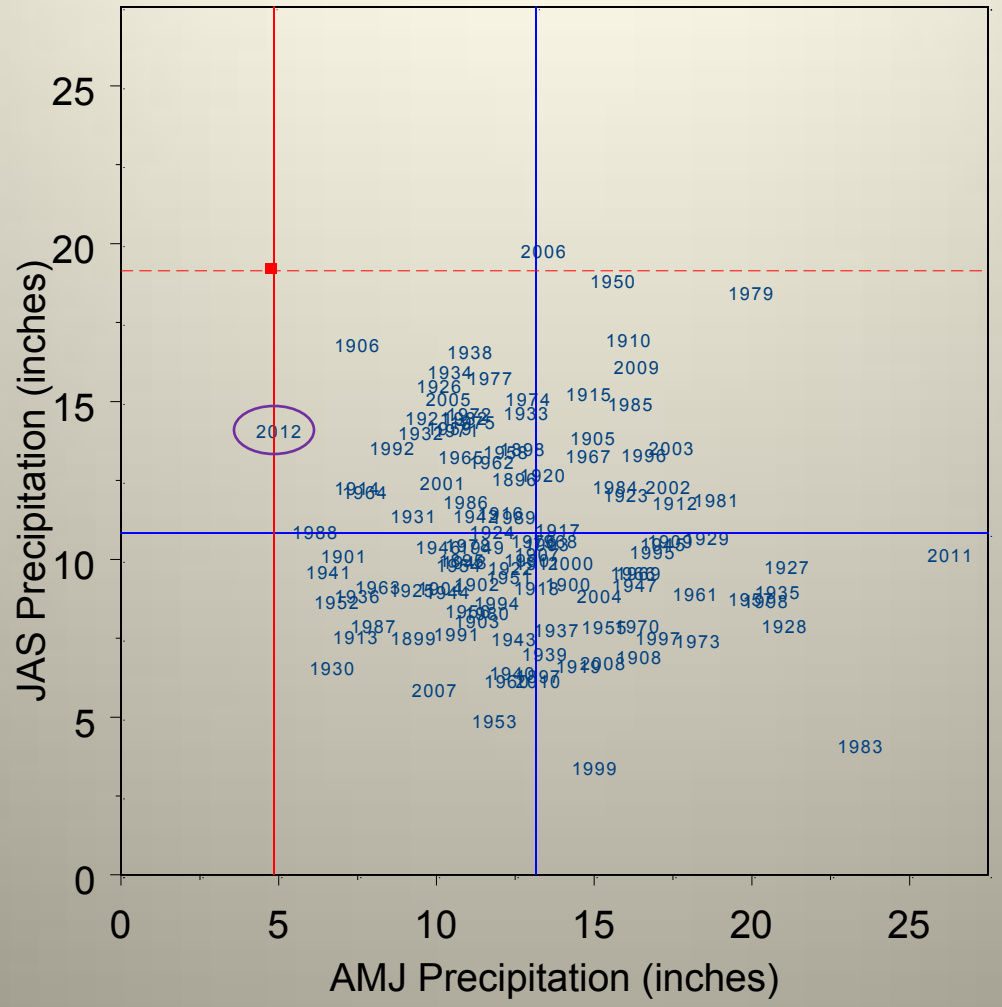




KENTUCKY CLIMATE CENTER

AMJ and JAS Precipitation, 1895-2011

Western Climate Division, Kentucky



Notes

Vertical blue line represents average[1] AMJ precipitation.

Horizontal blue line represents average[1] JAS precipitation.

Vertical red line represents actual 2012 AMJ precipitation.

Dashed red line represents precipitation for JAS of 2012 required to bring the combined AMJ and JAS total to the average[1].

[1] *Average is defined as the arithmetic mean of the climate division values for 1895 through 2011.*

KENTUCKY CLIMATE CENTER

Dimensions of the 2012 Drought

Mayfield, Graves County
July 27, 2012

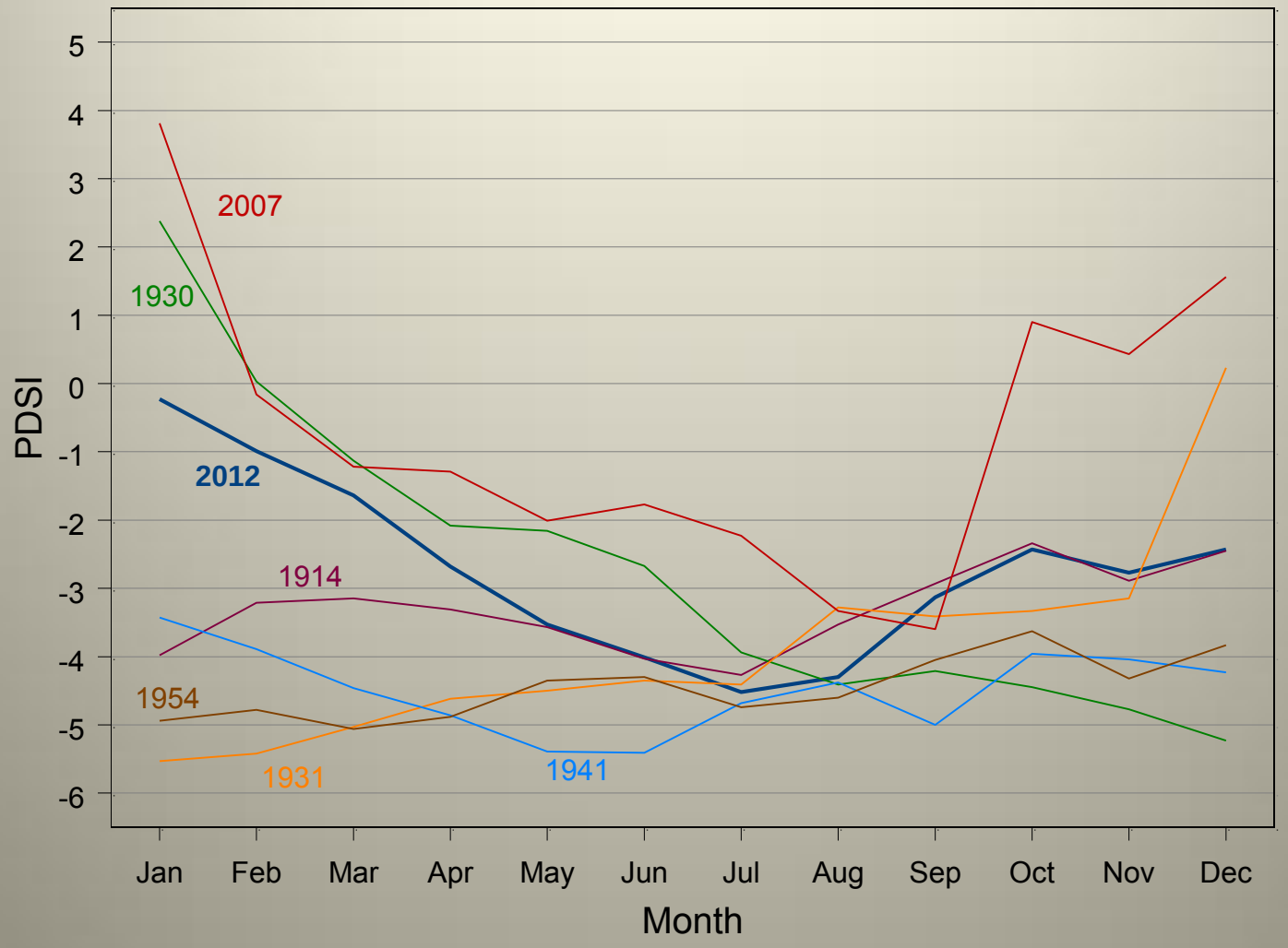
Graves County

- 3.22” – Precipitation on March 8th
- 4.40” – Precipitation for the entire spring season
- 99.4° - Average high temperature from June 28th through July 8th

KENTUCKY CLIMATE CENTER

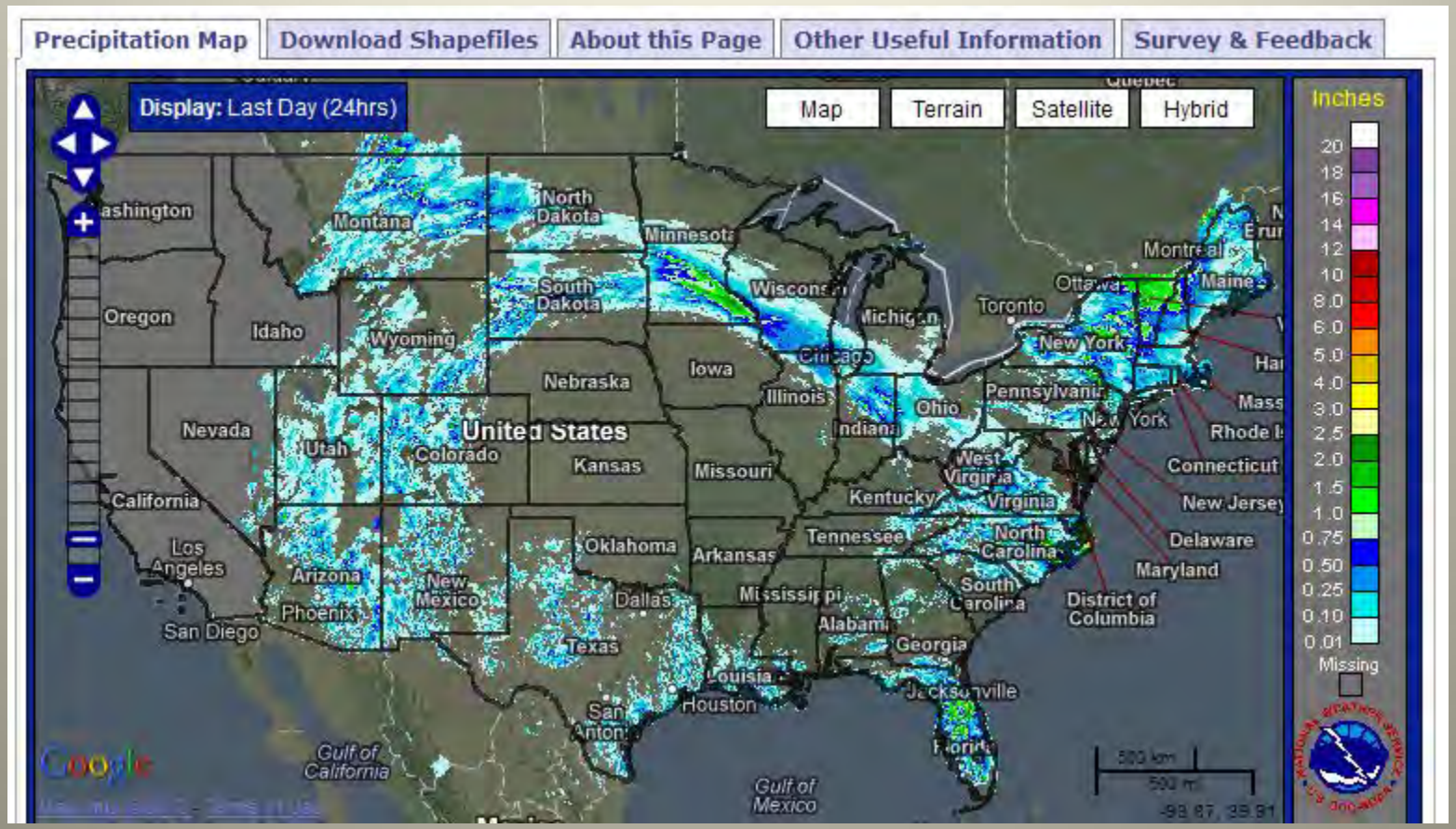
Historical Context for the Drought of 2012

Kentucky's Western Climate Division



KENTUCKY CLIMATE CENTER

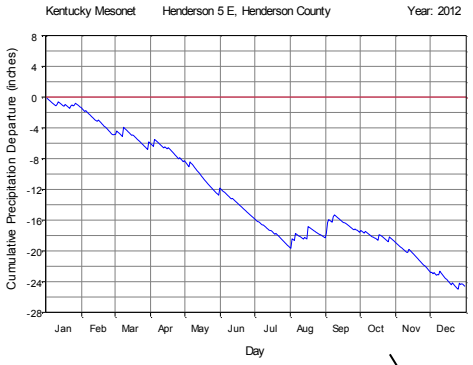
Synoptic Precipitation Pattern in Late July

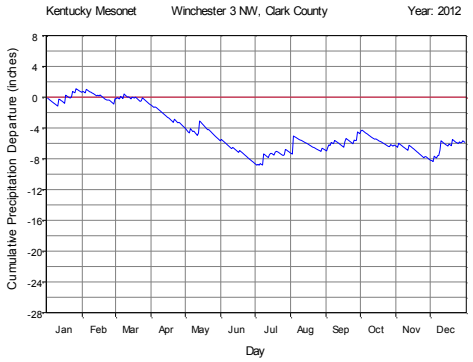


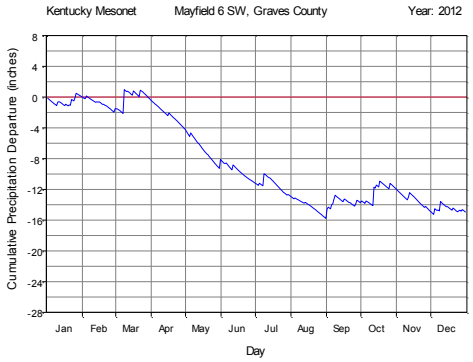
July 24, 2012

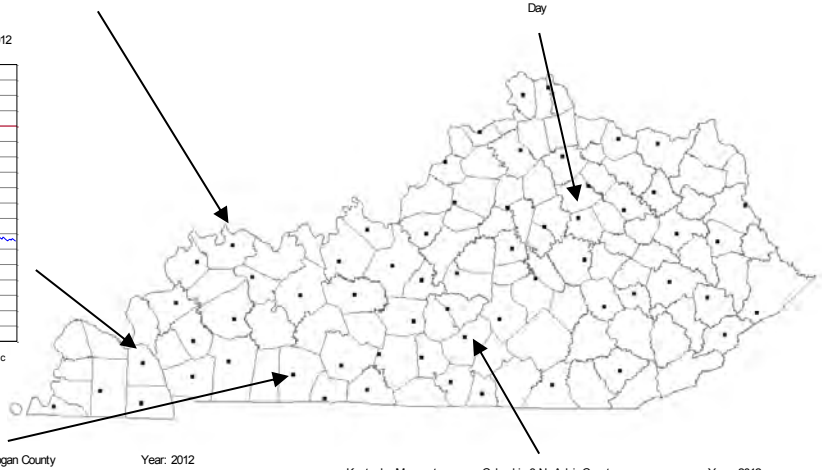
KENTUCKY CLIMATE CENTER

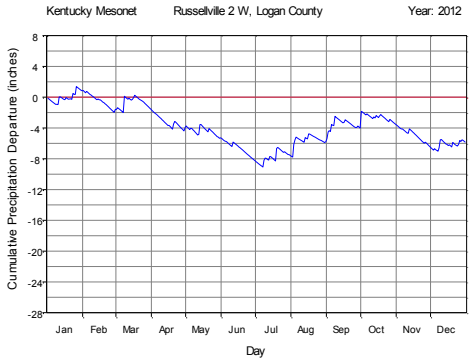
Evolution of the 2012 Drought in Kentucky

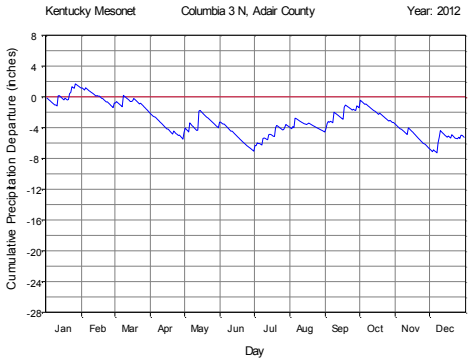










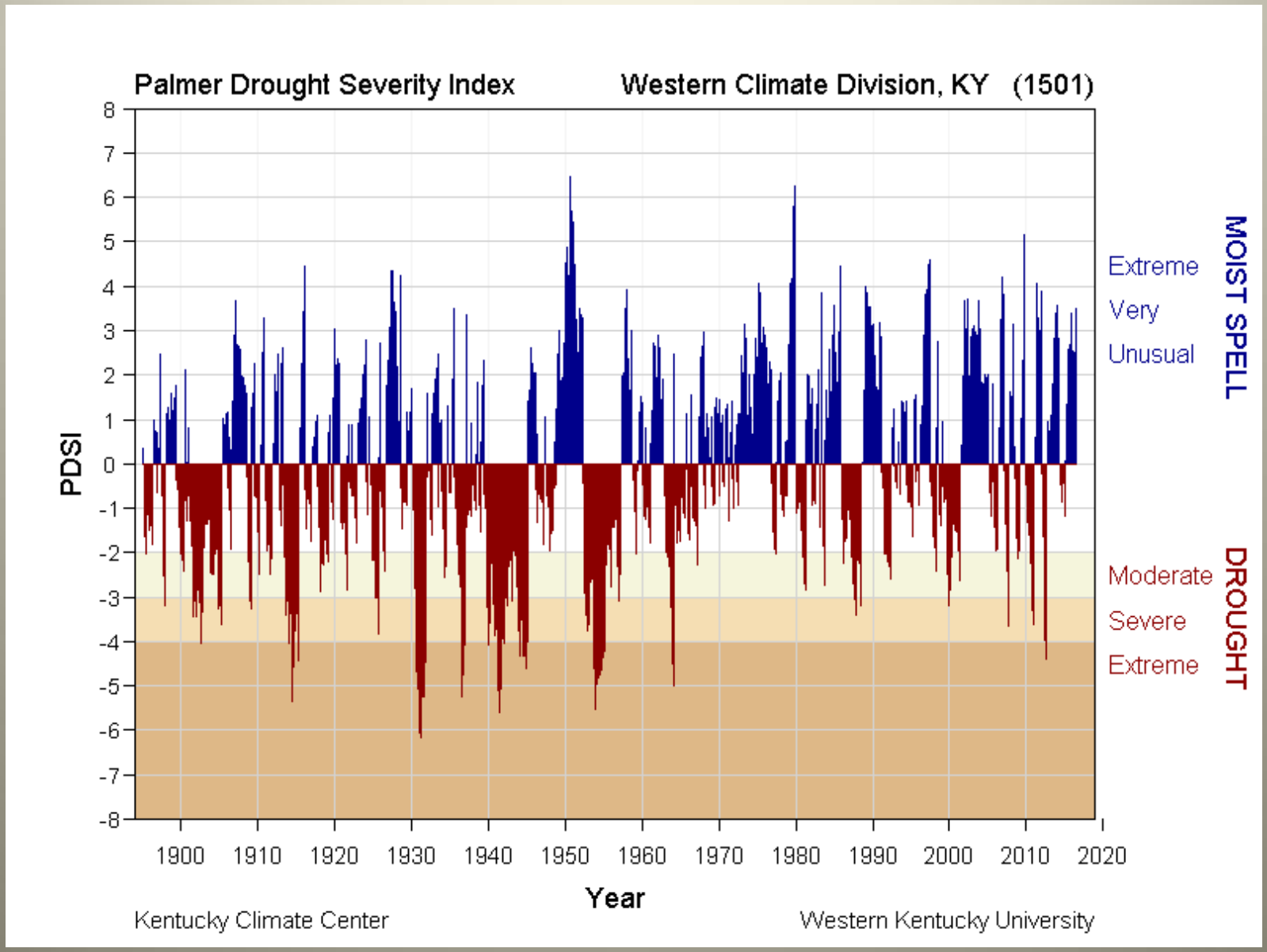


Dimensions of Drought in Space and Time

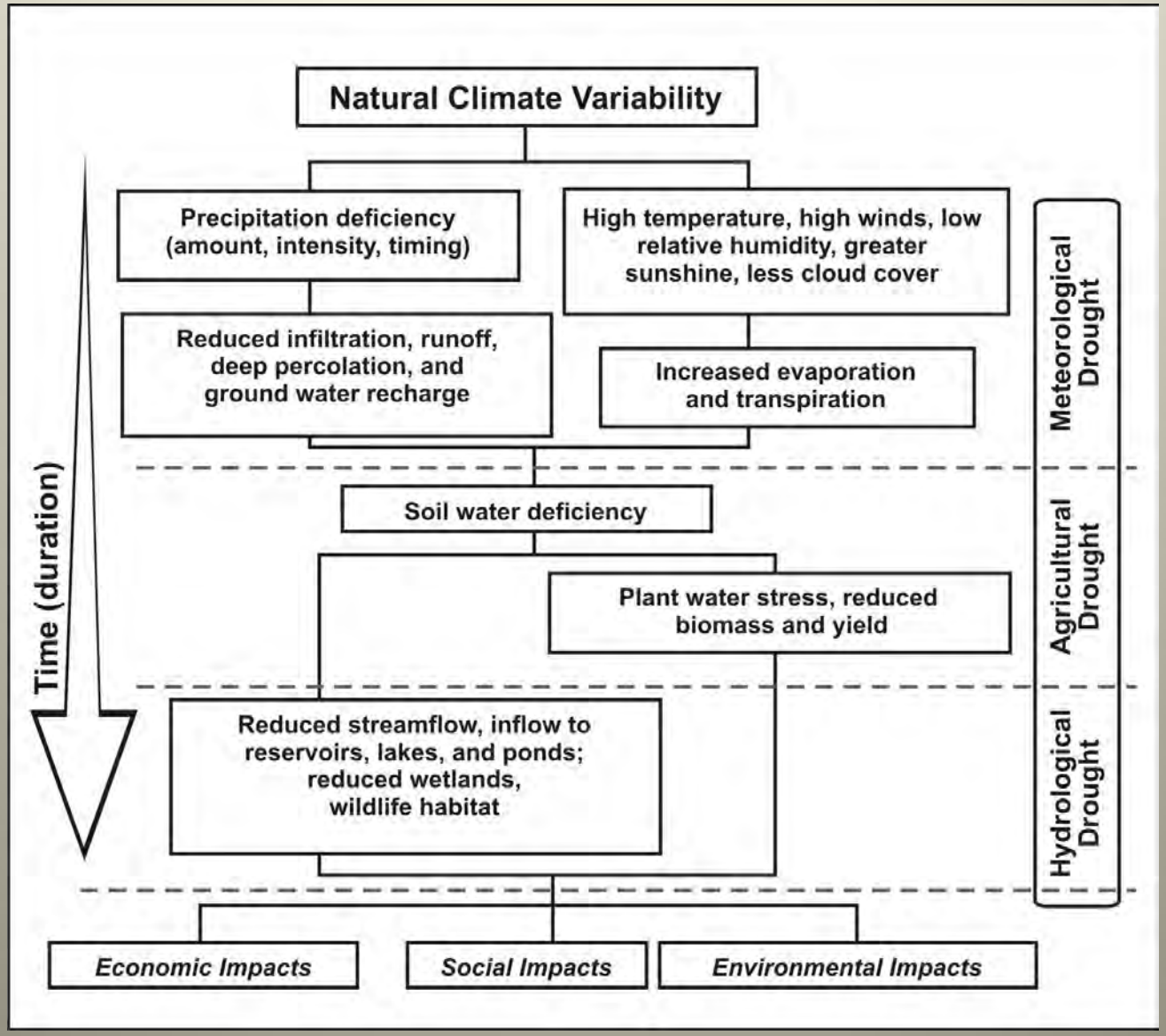
- Onset
- Duration
- Peak Intensity
- Extent

KENTUCKY CLIMATE CENTER

Palmer Drought Severity Index



Types of Drought



Sequence of drought occurrence and impacts for commonly accepted drought types. All droughts originate from a deficiency of precipitation or meteorological drought but other types of drought and impacts cascade from this deficiency. (Source: National Drought Mitigation Center, University of Nebraska-Lincoln, U.S.A.) http://drought.unl.edu/DroughtBasics/TypesofDrought.aspx

Kentucky's Climatological Record

- 1825 – U.S. Army
- 1861 – Smithsonian Institute
- 1874 – U.S. Army Signal Corps
- 1891 – U.S. Department of Agriculture
- 1940 – U.S. Department of Commerce
- 2007 – Kentucky Climate Center

Newport Barracks, July 1825

NWS COOP - Manual

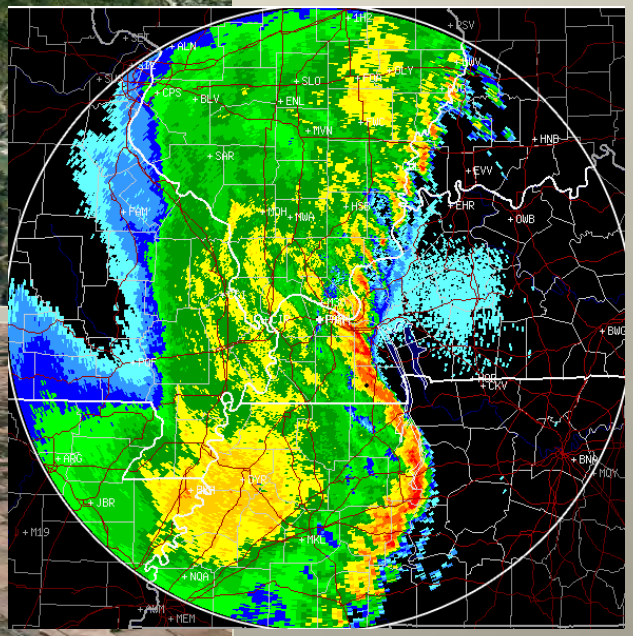
NWS COOP - Automated

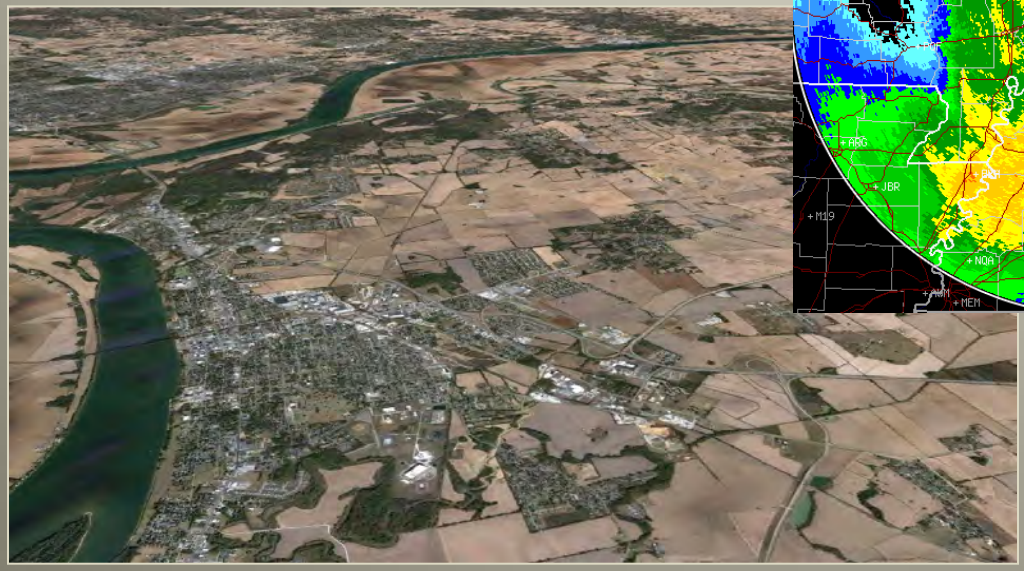
Kentucky Mesonet

KENTUCKY CLIMATE CENTER

KENTUCKY CLIMATE CENTER

Kentucky's diverse terrain creates distinct local vulnerabilities to weather and climate





Across the Commonwealth

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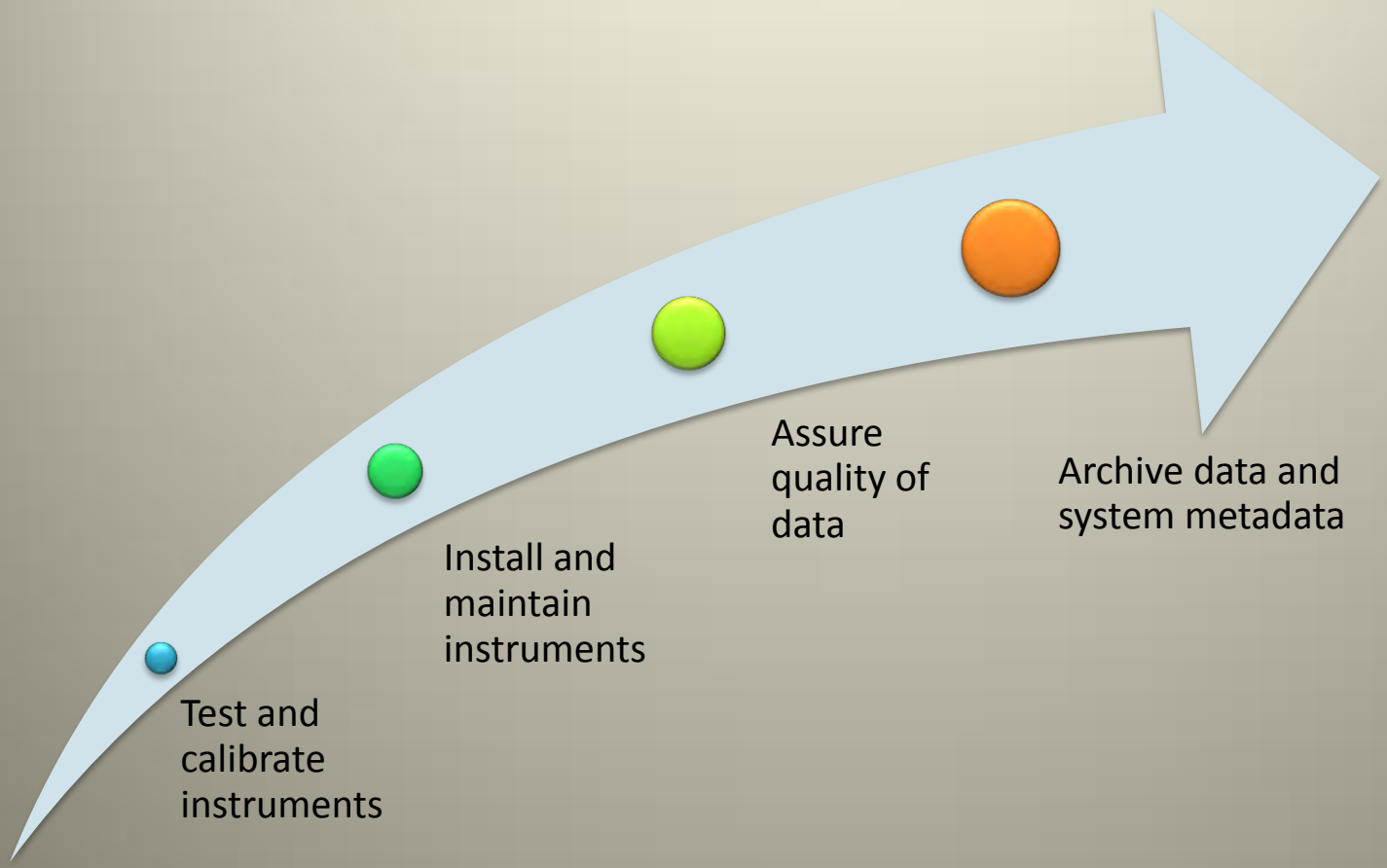
KENTUCKY CLIMATE CENTER

Vertically Integrated System



Site Surveys and Selection

- Candidate sites are surveyed and scored
- Sites are selected with input from NWS and local stakeholders

Survey Scores	
Temperature	40
Precipitation	30
Wind	12
Soil	15
Total	97

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Station Installation and Maintenance

- Technicians install stations and instrumentation
- Technicians make spring, summer, and winter maintenance passes
- Technicians respond to “trouble tickets” when QA processes indicate problems

Design Criteria Emphasize Quality and Reliability

Temperature

Precipitation

Sensor Package

- Air temperature
- Precipitation
- Solar radiation
- Relative humidity
- Wind speed & direction
- Soil moisture & temperature*

** selected sites*

Package enables ET calculations

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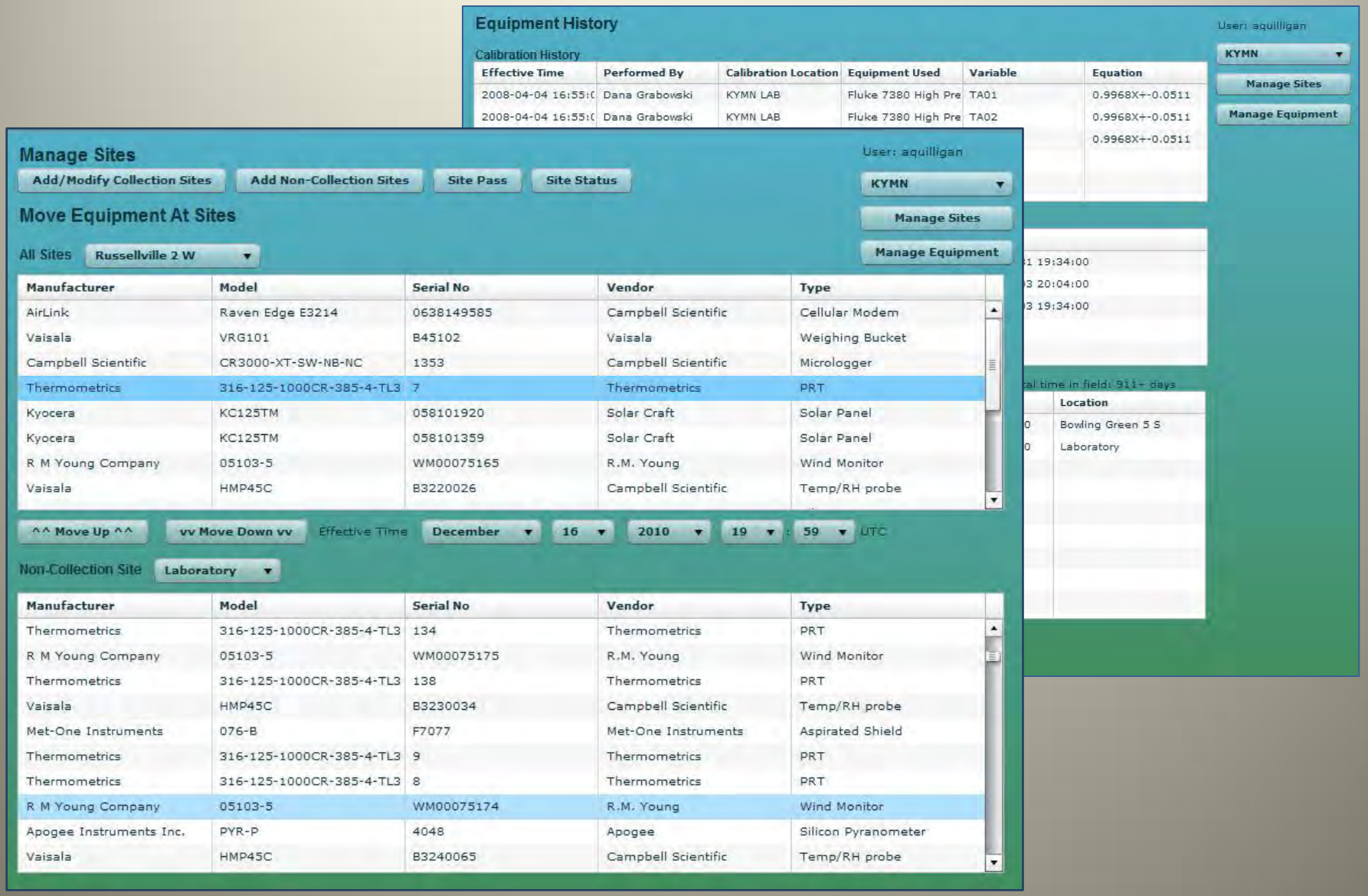
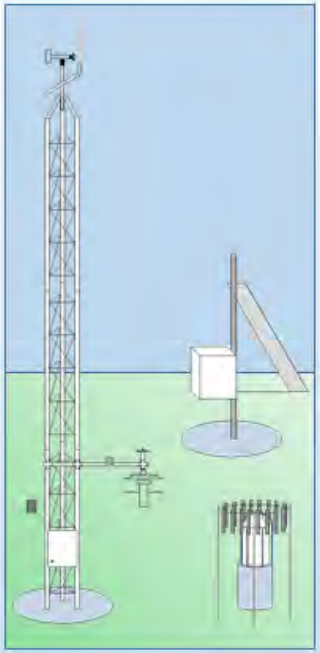
Metadata Database



KENTUCKY MESONET | WKU

MESONET DATA FLOW



Datalogger

Cellular Modem

AT&T Cell Tower

AT&T Custom APN

Product Generation

Mesonet Staff

VPN

Ingest / Quality Assurance

Server Rack

Web Server

Public Safety Users

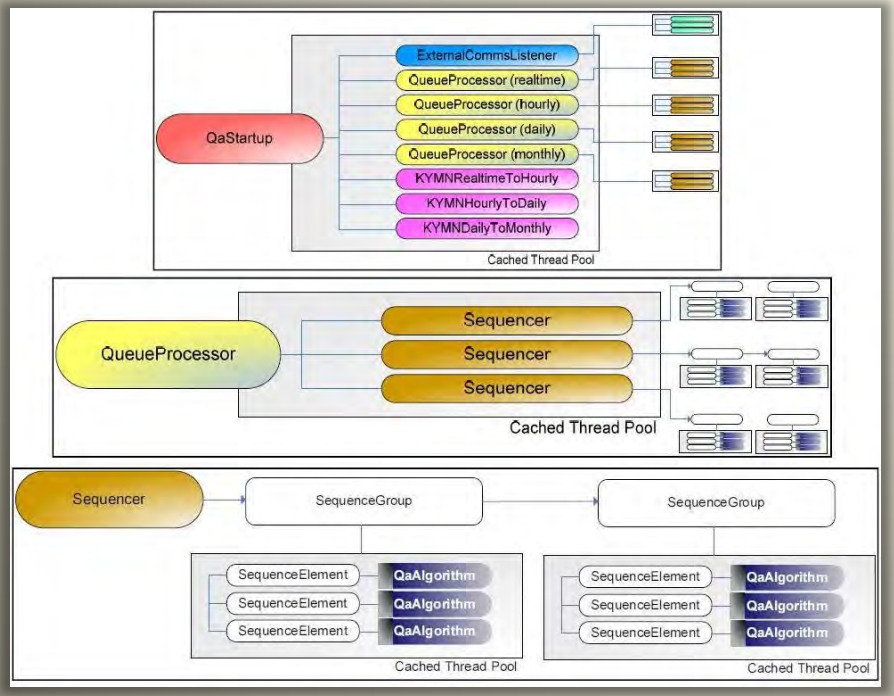
Private / Media Users
&
Consortium Users

Internet

Public Users

KENTUCKY CLIMATE CENTER

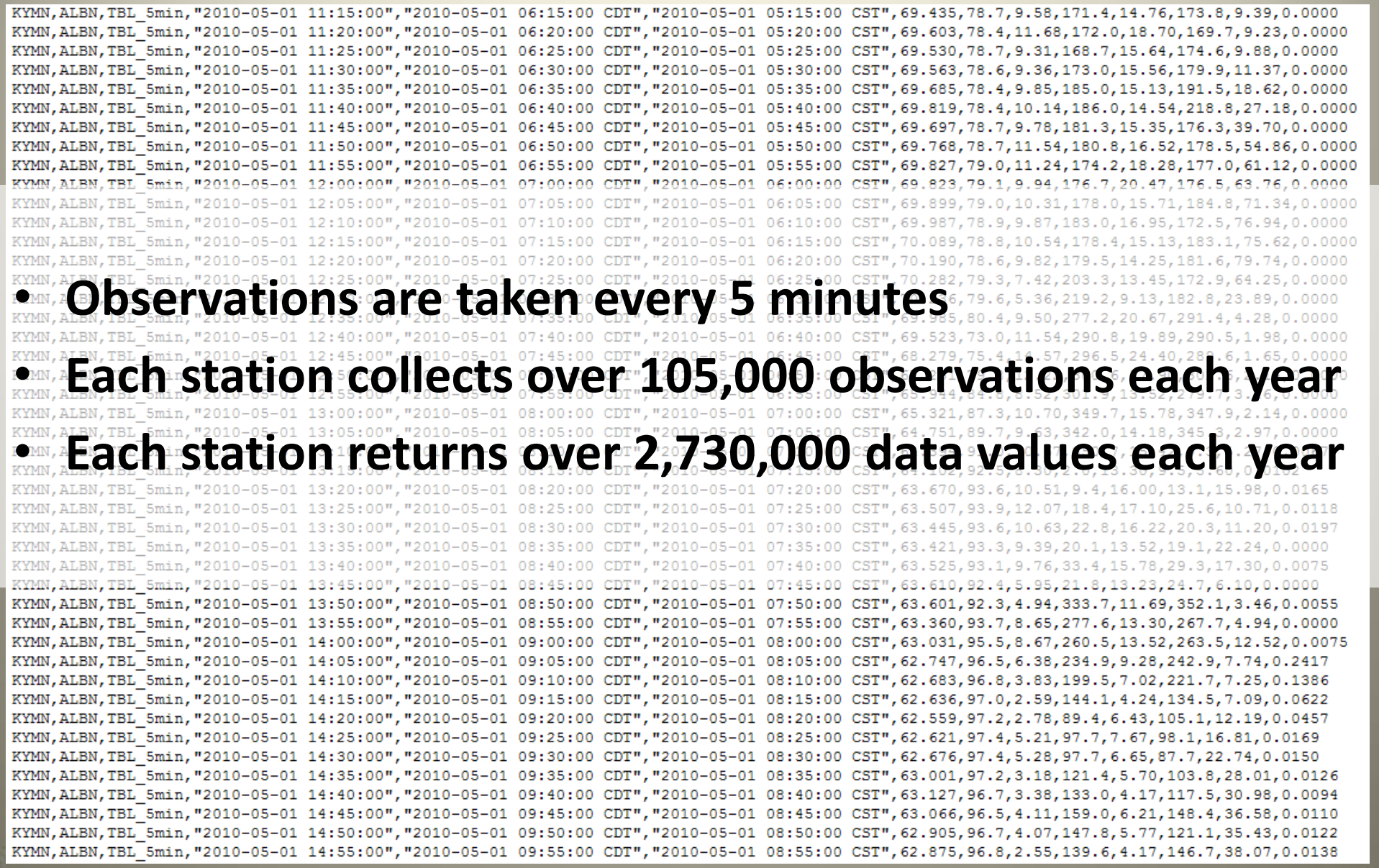
Quality Assurance Procedures



- Automated QA runs on five-minute data as they are collected from remote sites
- Manual QA is implemented on a daily basis to provide expert assessment of system performance

KENTUCKY CLIMATE CENTER

Meteorological Database

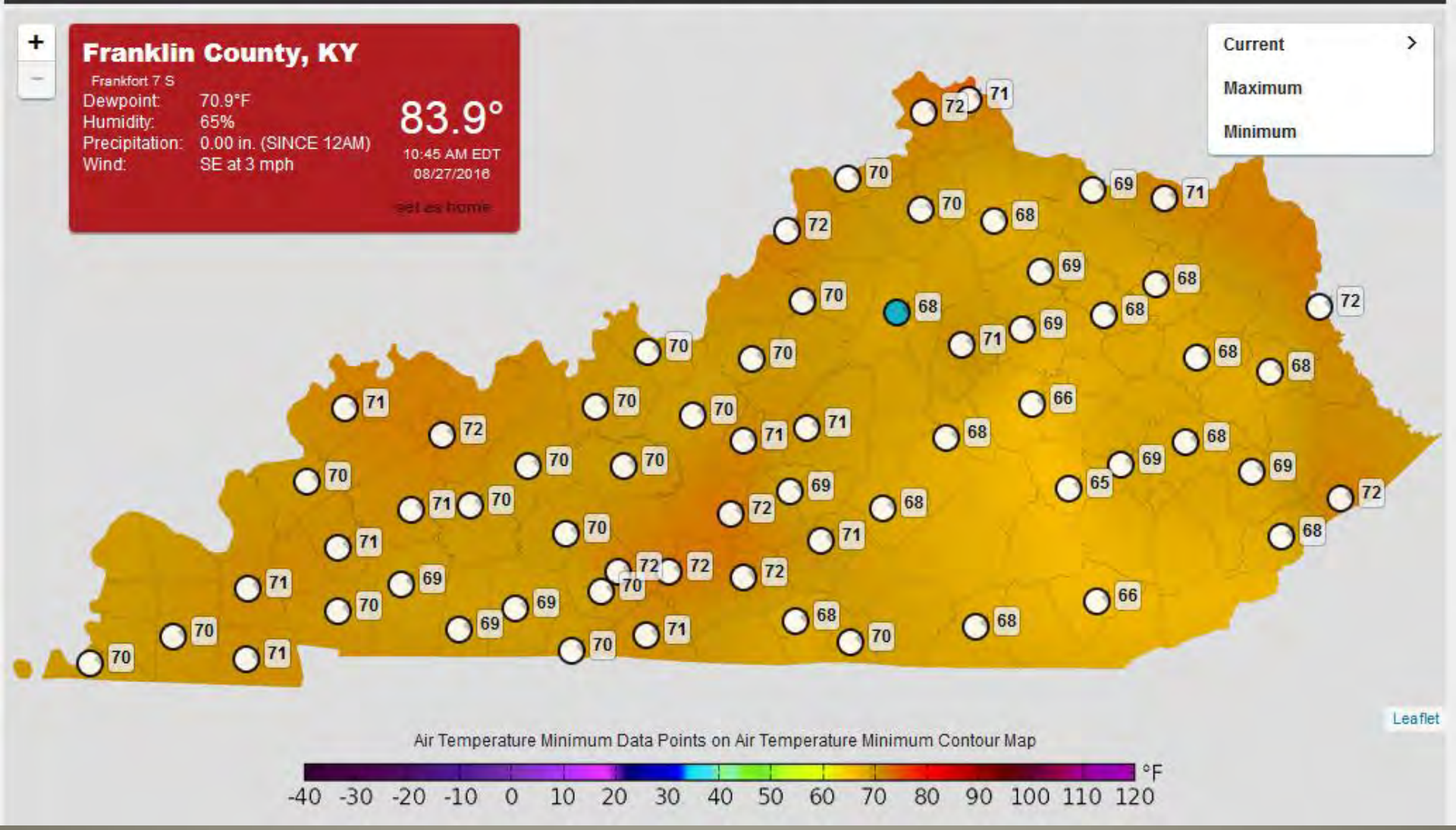


- **Observations are taken every 5 minutes**
- **Each station collects over 105,000 observations each year**
- **Each station returns over 2,730,000 data values each year**

KENTUCKY MESONET | WKU

The Commonwealth's Official Source for Weather and Climate Data

Home | About | Live Data | Summary Data | Event Tracking | Outreach



KENTUCKY MESONET | WKU

The Commonwealth's Official Source for Weather and Climate Data

Home | About | Live Data | Summary Data | Event Tracking | Outreach

SITE

Franklin County (LSML)

TEMPERATURE GRAPHS

WIND GRAPHS

MOISTURE GRAPHS

PRECIPITATION GRAPHS

✔ PRECIPITATION AND ACCUMULATED PRECIPITATION

ACCUMULATED PRECIPITATION AND TEMPERATURE

PRECIPITATION AND TEMPERATURE

PRECIPITATION, ACCUMULATED PRECIPITATION, AND TEMPERATURE

SOLAR RADIATION GRAPHS

TIME INTERVAL

6 HOURS

12 HOURS

24 HOURS

48 HOURS

72 HOURS

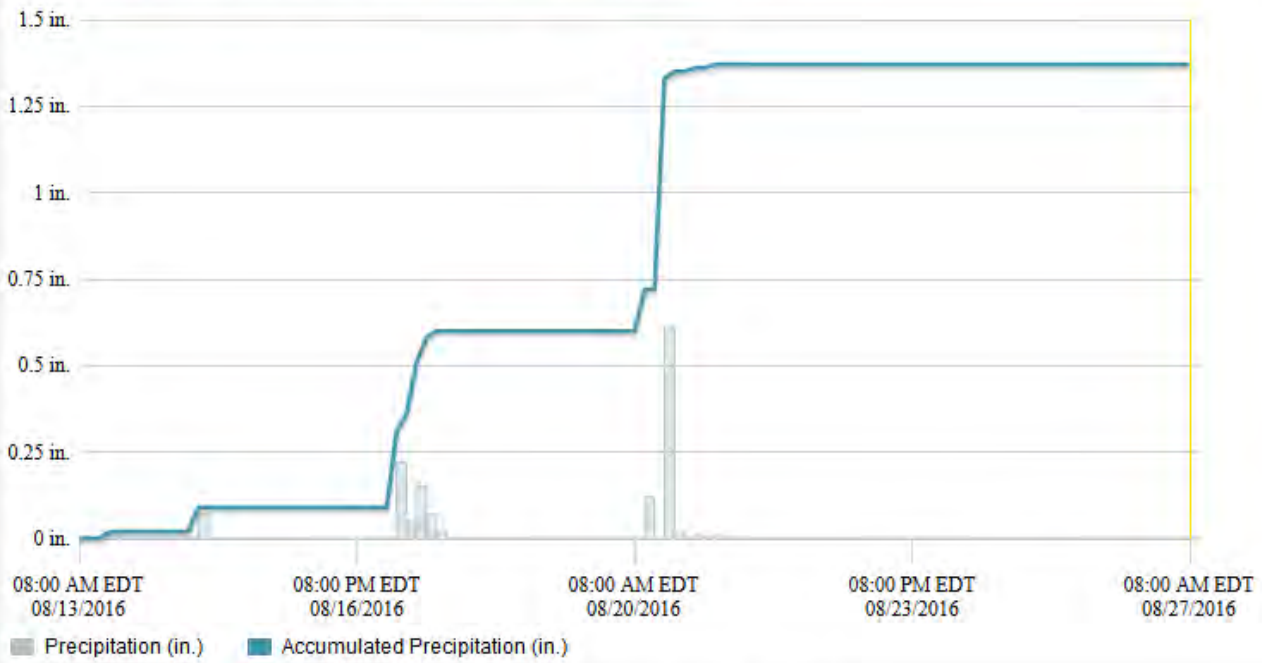
5 DAYS

7 DAYS

✔ 2 WEEKS

1 MONTH

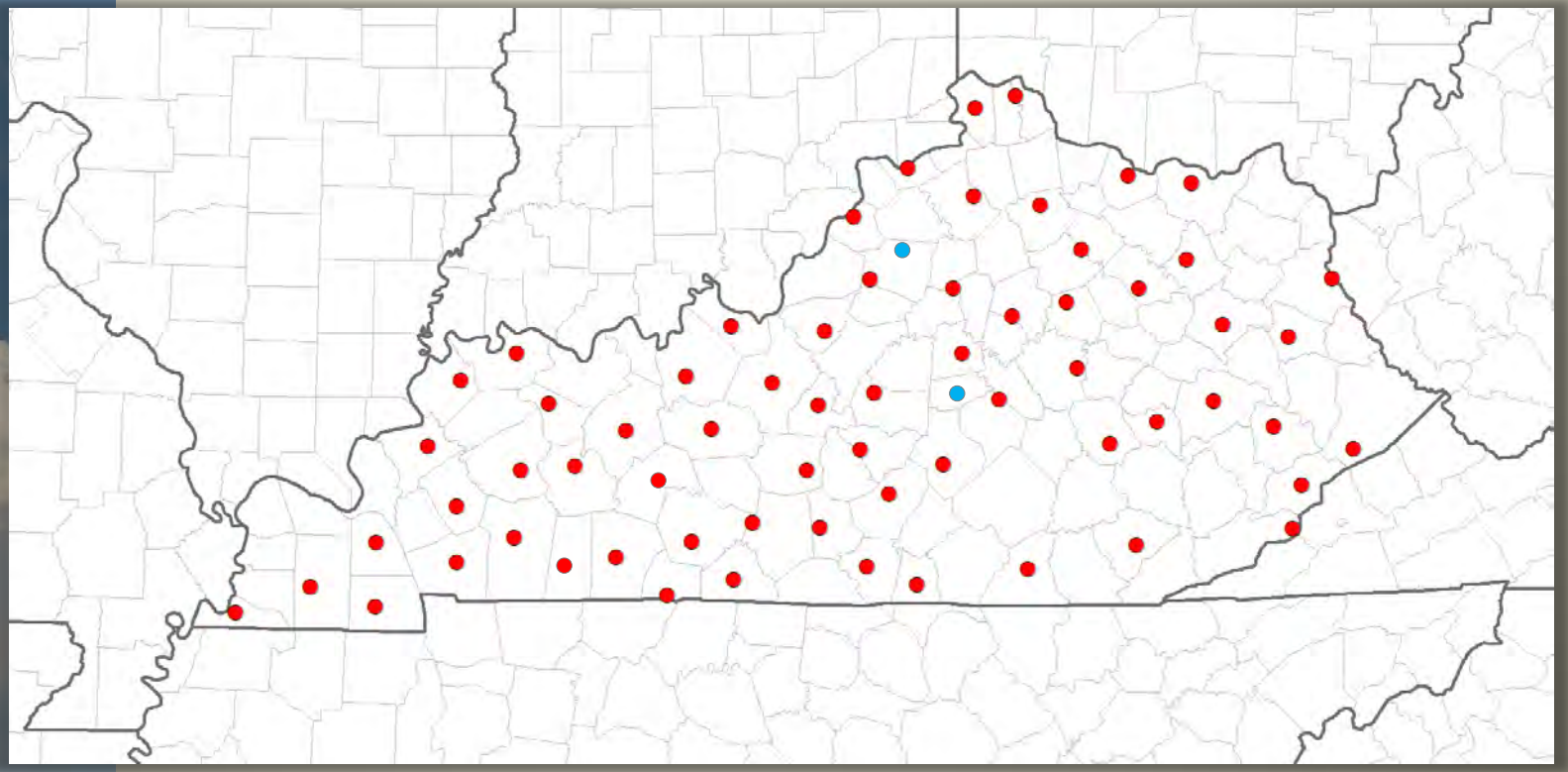
LSML Precipitation and Accumulated Precipitation (14 Day)



Station	Franklin County, KY
Time	08/27/2016, 08:00 AM EDT
Air Temperature	69.6 ° F
Relative Humidity	100 %
Precipitation	0.00 in.
Wind Speed	0 mph
Wind Direction	57 ° (NE)
Wind Speed Max Gust	1 mph
Solar Radiation	97 W/m^2
Dewpoint	69.6 ° F

KENTUCKY CLIMATE CENTER

Kentucky Mesonet Coverage Map

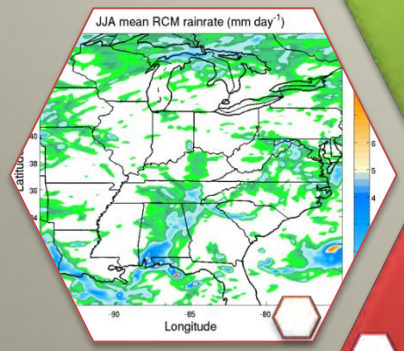


Operational station

Planned station

Kentucky Climate Center Strategic Initiatives

Kentucky Mesonet at WKU



Forecasts & Outlooks

Climate Modeling

Kentucky Mesonet

Strategic Initiatives

Kentucky Mesonet at WKU

- Add 10-12 stations to fill coverage gaps and custom stations to meet local demand
- Enhanced instrumentation package
  - Soil probes (where not currently deployed)
  - Multi-level temperature and wind
  - Add barometric pressure sensors
- Add 3 atmospheric flux monitoring stations

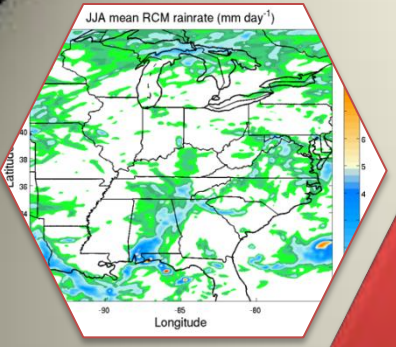
Targeted completion by FY19

Forecasts & Outlooks

Strategic Initiatives

Forecasting & Outlooks

- Develop an operational unit to provide customized weather forecasts and climate outlooks
  - Hire staff meteorologist and student interns
  - Utilize existing NWS forecast model output and develop option to generate forecasts incorporating mesonet data
  - Provide client-focused forecast and outlook products. For agriculture, these would include
    - forecasts relating to stress on crops and livestock
    - outlooks for growing degree days
    - forecasts for irrigation scheduling



Climate Modeling

Strategic Initiatives

Climate Modeling

- Conduct meso-scale simulations to model impacts of land use/land cover change on atmospheric conditions
- Provide high-resolution, downscaled climate model projections for Kentucky based on model runs reported in the most recent National Climate Assessment
  - Models can be run for various time horizons


Questions?

USGS
science for a changing world

Monitoring – Why is it important and what is needed?

Kentucky Water Resources Board

August 29, 2016

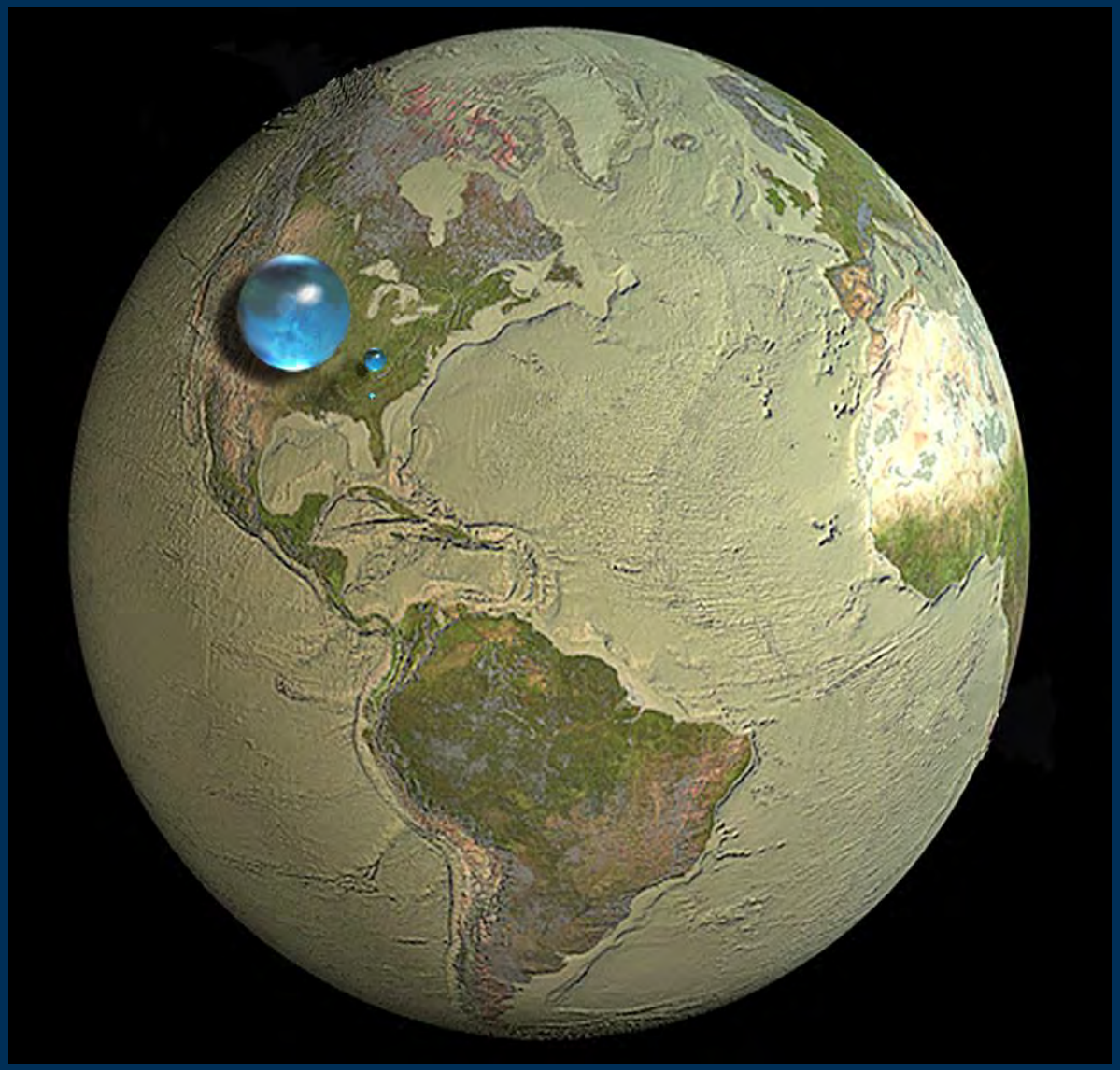
U.S. Department of the Interior
U.S. Geological Survey

Water – what are we working with?

All water on earth – volume = ~332,500,000 cubic miles (mi^3)

All liquid fresh water (over KY) - ~170 mi across or ~2,551,100 mi^3

All water in lakes and rivers (over GA) - ~ 35 mi across or ~22,339 mi^3



USGS

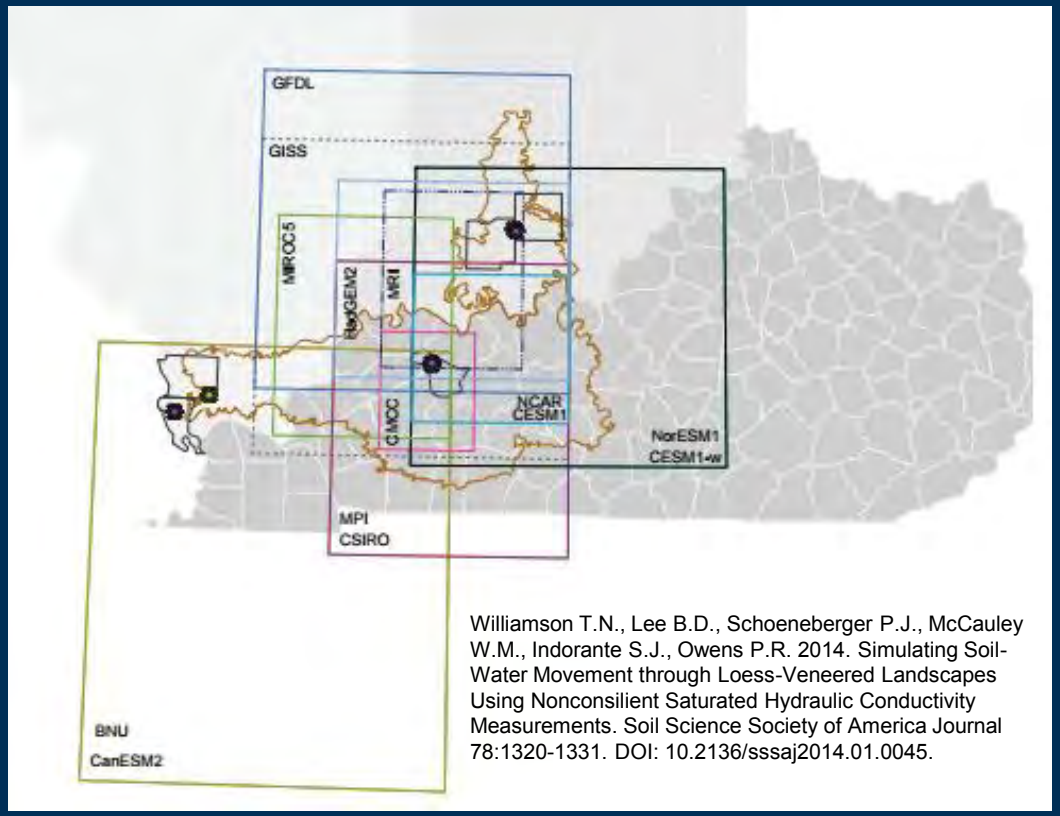
We've heard about water-use, so lets look down the road…

USGS

Lets first look at some KY information

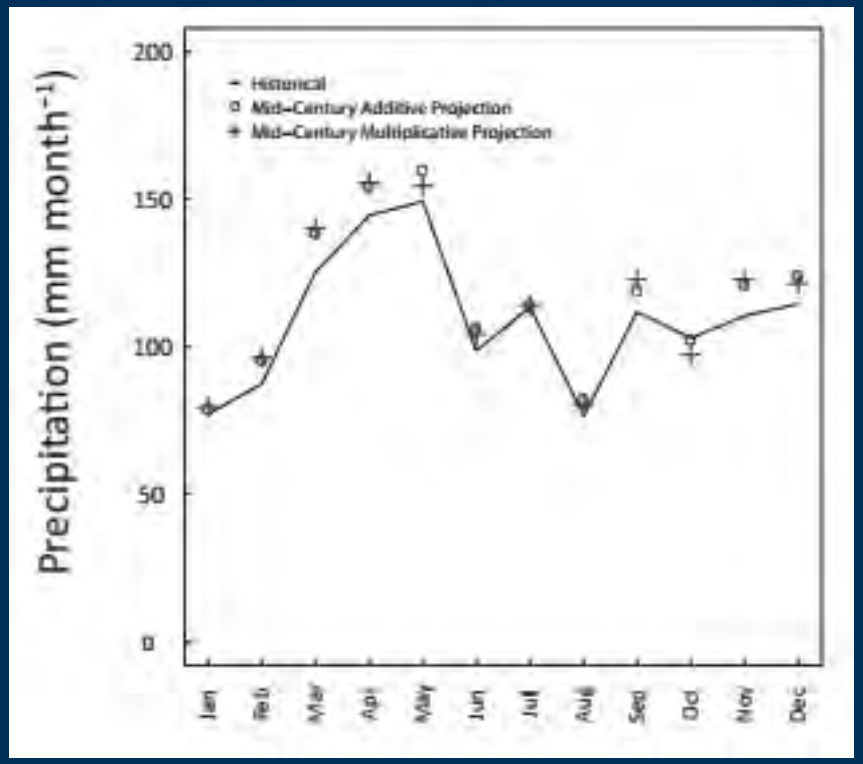
Projected Climate Changes at the Shawnee Hills Sites and Incorporation with Simulation of Soil-Water Storage

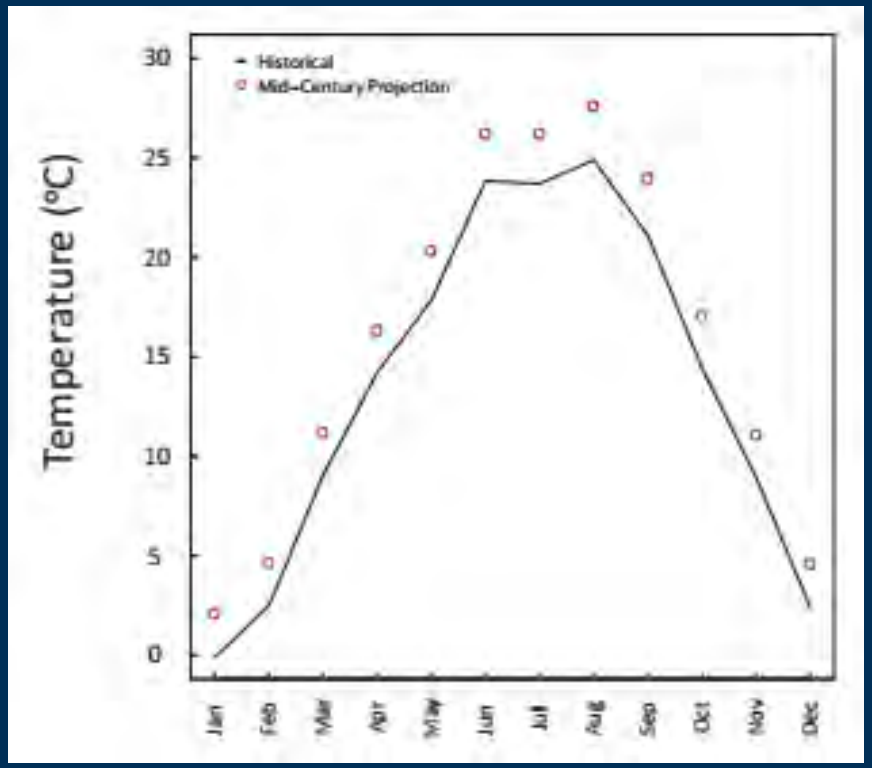
Work conducted in by USGS, UK, NRCS, and Purdue using the **WATER** application developed by USGS and KDOW.



Williamson T.N., Lee B.D., Schoeneberger P.J., McCauley W.M., Indorante S.J., Owens P.R. 2014. Simulating Soil-Water Movement through Loess-Veneered Landscapes Using Nonconsilient Saturated Hydraulic Conductivity Measurements. Soil Science Society of America Journal 78:1320-1331. DOI: 10.2136/sssaj2014.01.0045.

What does the data show?





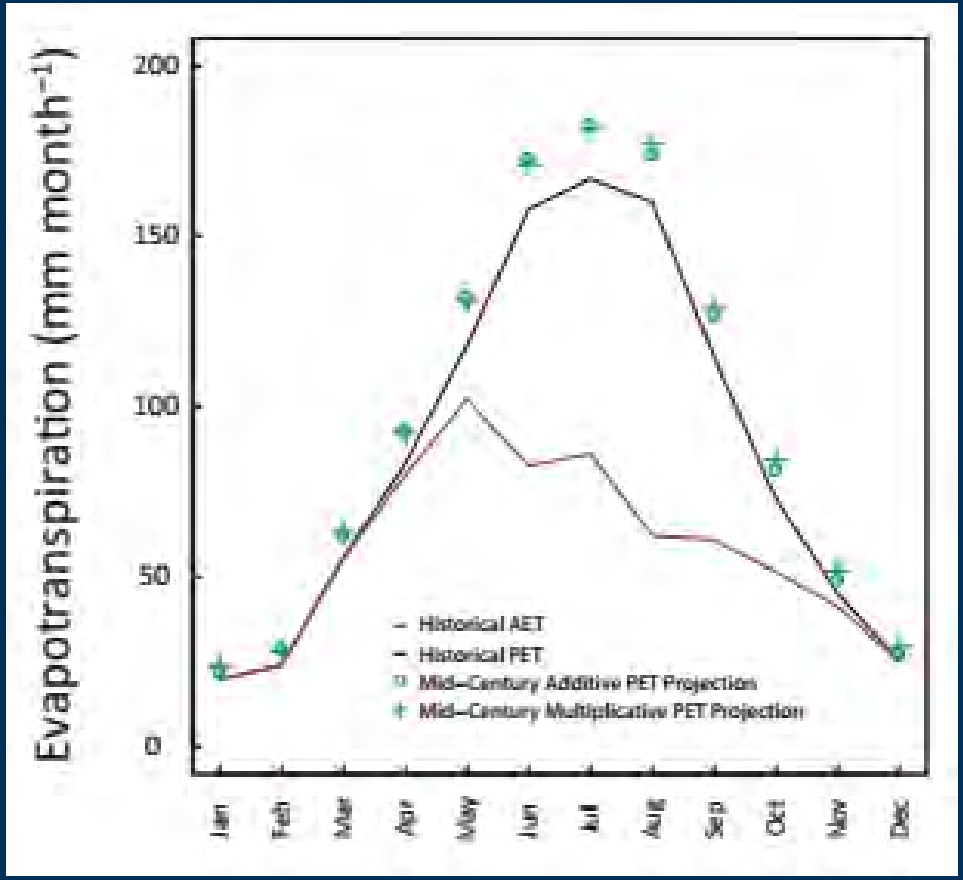
A longer growing season and more rain - but precipitation will likely occur largely in the winter.

USGS

What does that mean to KY (especially agriculture)?

Increased demand (potential evapotranspiration) in times when the system is historically water limited (actual evapotranspiration).

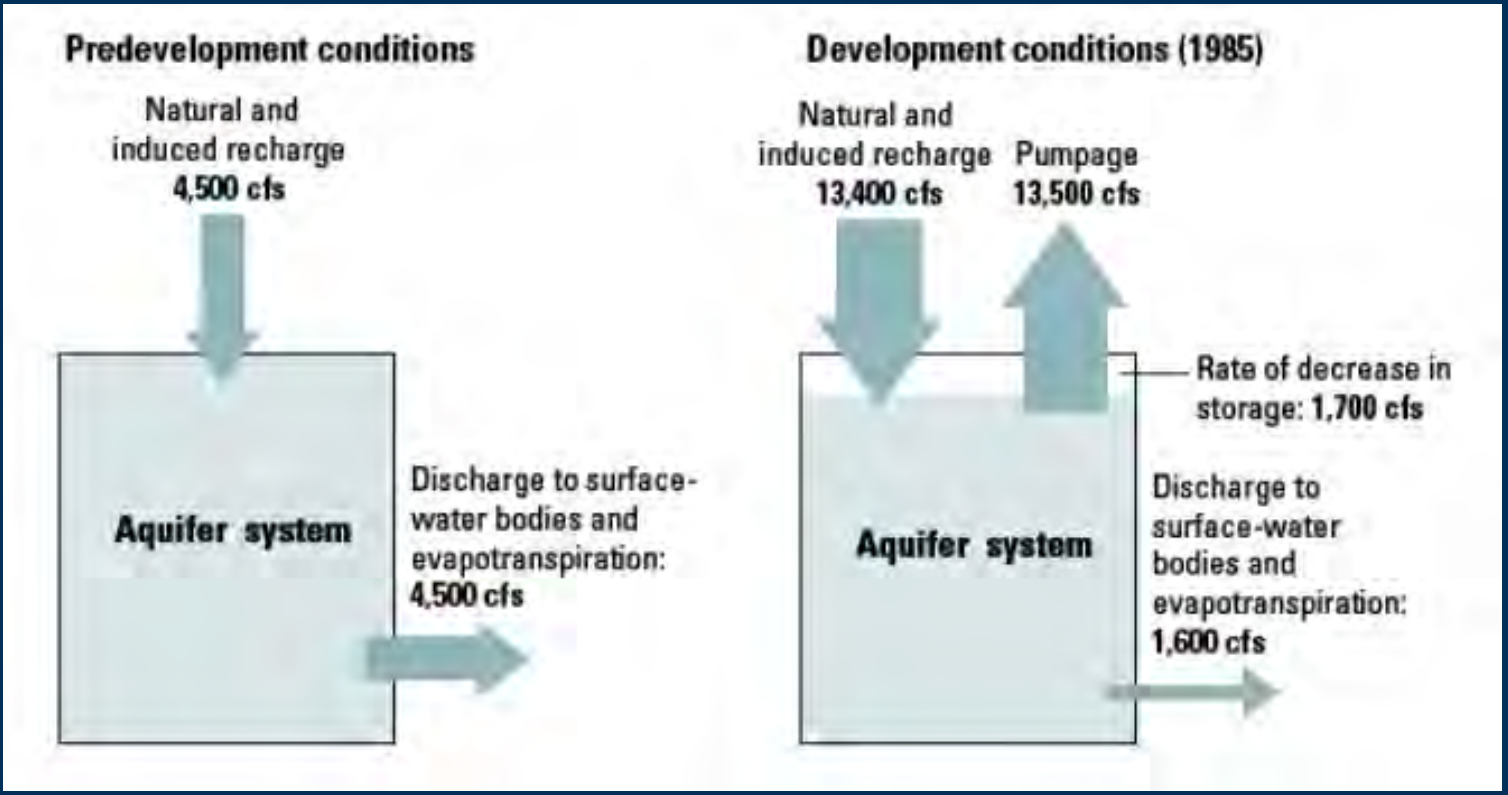
This would indicate that irrigation will likely be of greater importance and the ability to quantify / manage local water resources will be more critical.



USGS

As we develop our water resources...

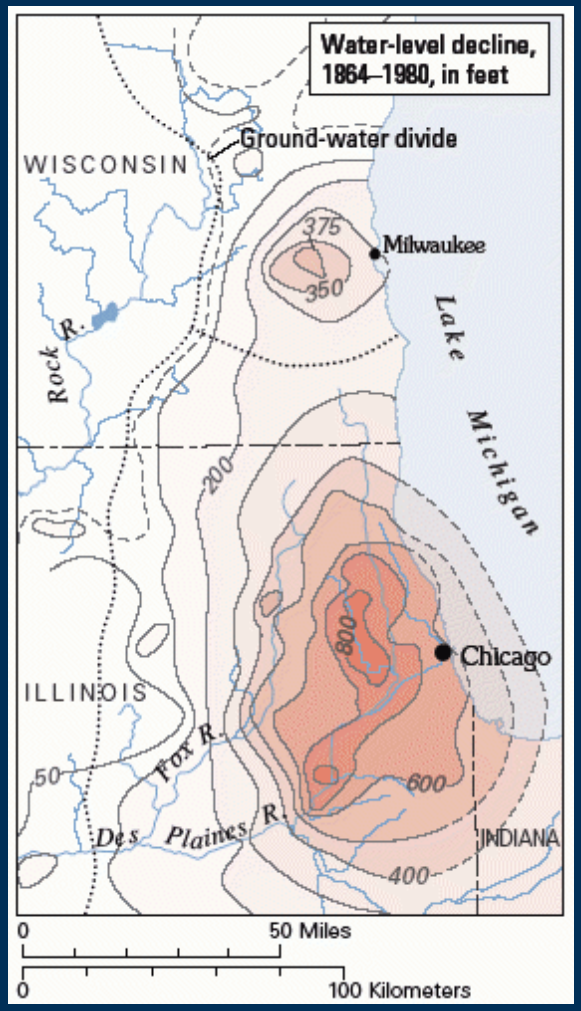
Plot shows groundwater budgets before and after development of the Gulf Coastal Plain aquifer system. The withdrawals from the aquifers have been balanced by increases in recharge to the aquifer system and decreases in storage and discharge from the aquifer system – note that one parameter alters the others.



USGS

Figure modified from Williamson and Grubb, 2001

Water management is a concern in the Western U.S., but other parts of the Nation are experiencing issues as well…



Groundwater has been the sole source of drinking water for about 8.2 million people in the Great Lakes watershed since ~1864. This long-term pumping has lowered groundwater levels by as much as 900' in the sandstone aquifer underlying the Chicago area. Concern over how such pumping affected surface water in the Great Lakes region led to the reduction of groundwater withdrawals in much of the area. Water levels are recovering in some areas, however, declines continue in others (Grannemann and others, 2000 and Alley and others, 1999).

http://pubs.usgs.gov/fs/fs-103-03/JBartolinoFS(2.13.04).pdf

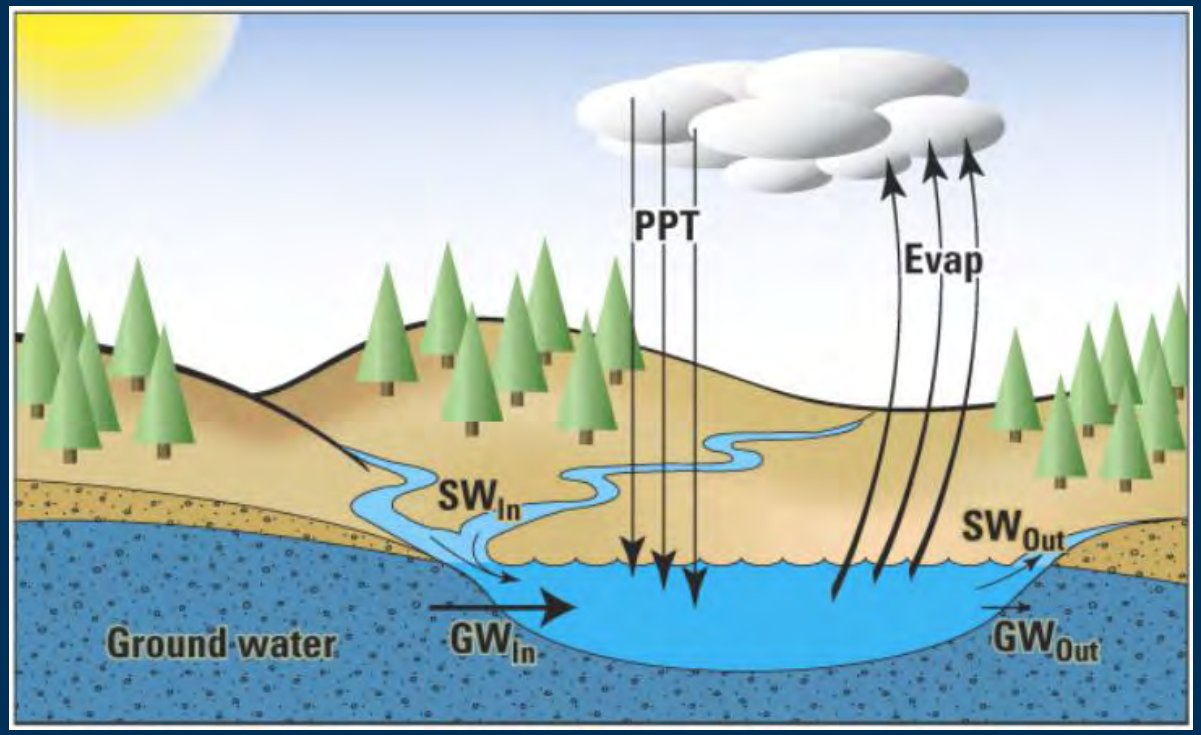
How do you keep ahead of water-use and water-quality issues?

Hydrologic monitoring networks.

USGS

We need adequate data to solve a basic water-budget equation in KY's critical areas so we can manage water resources.

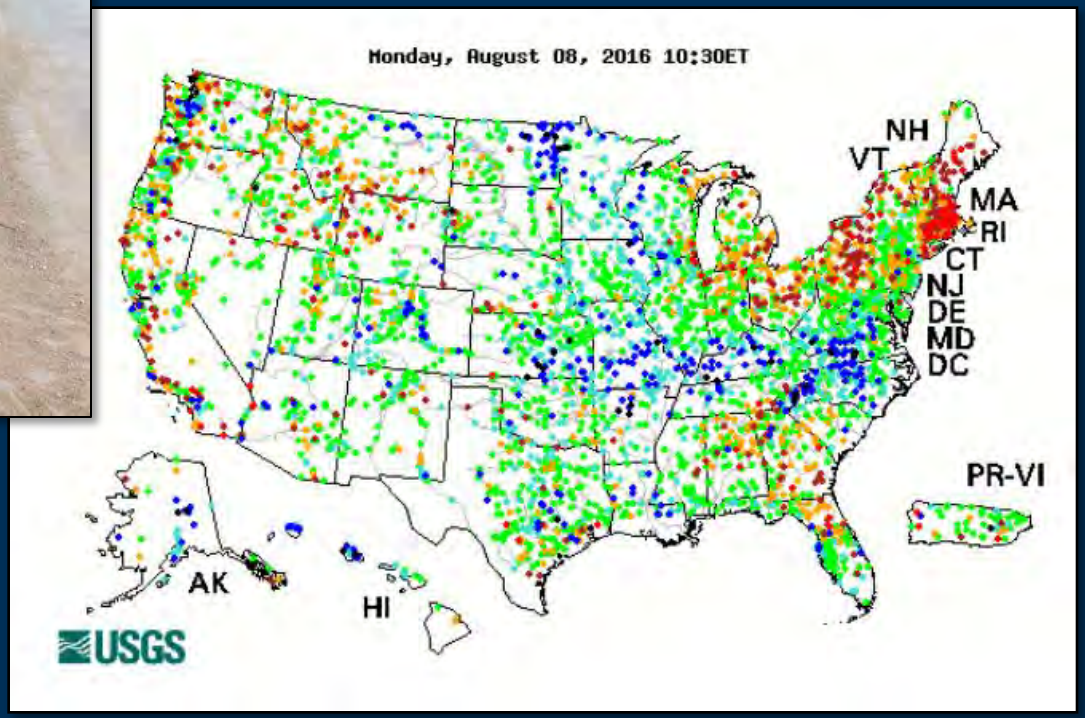
Precipitation = Evapotranspiration (ET) + Streamflow (Q) + ΔGroundwater (GW) + ΔSoil Moisture (SM) + ΔReservoir Storage (RSV) + ΔDiversions



USGS

Streamflow -
USGS Real-Time Streamgages

USGS operates approximately 15,000 sites nationally with real-time streamflow data. This national network allows local data to be quickly scaled-up to a regional or national context to assess conditions – but it may NOT be locally optimized for specific uses.



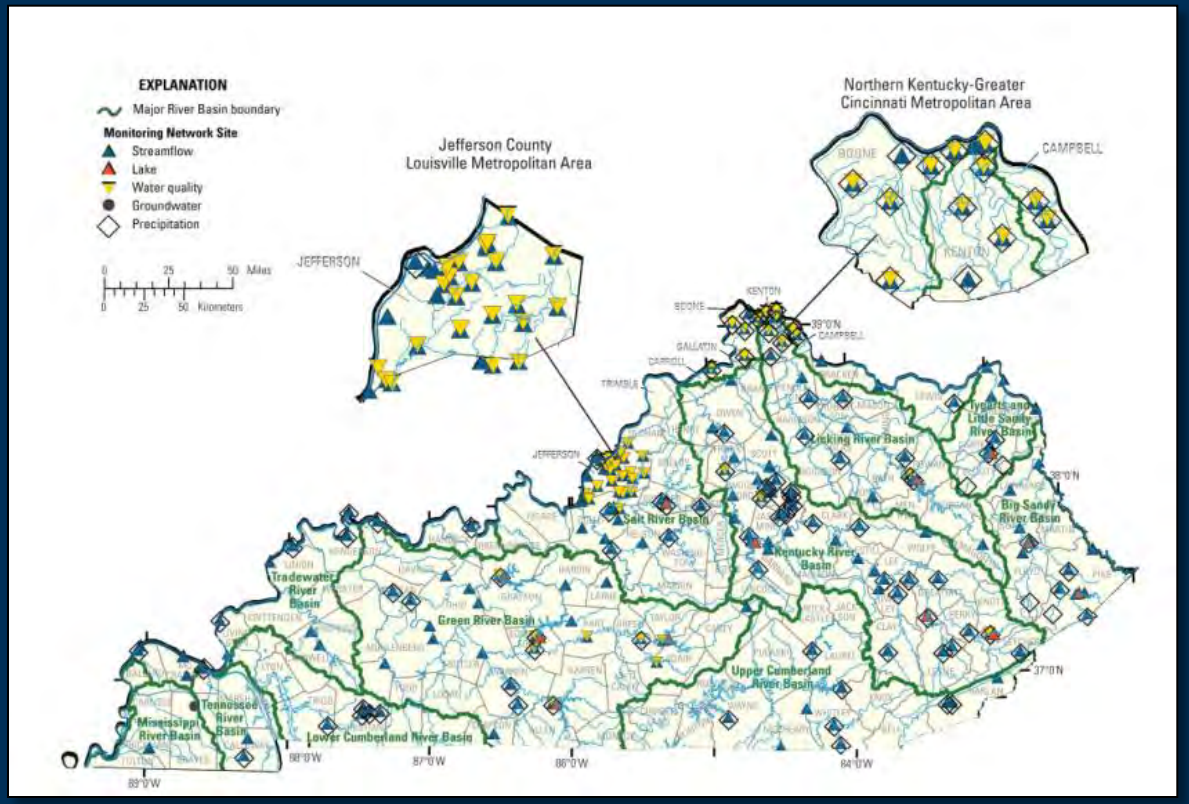
USGS

USGS IN-KY WSC has over 200 sites with real-time data in Kentucky

USGS continually assesses the statistical strength of the network; we already see a loss of statistical strength in rural areas as static funding is shifted to urban areas to address changing priorities.

Notably, gaps exist in the Western KY and the Cumberland River Basins.

Gages are also used to compute estimates of GROUNDWATER RECHARGE and other related water-budget parameters.



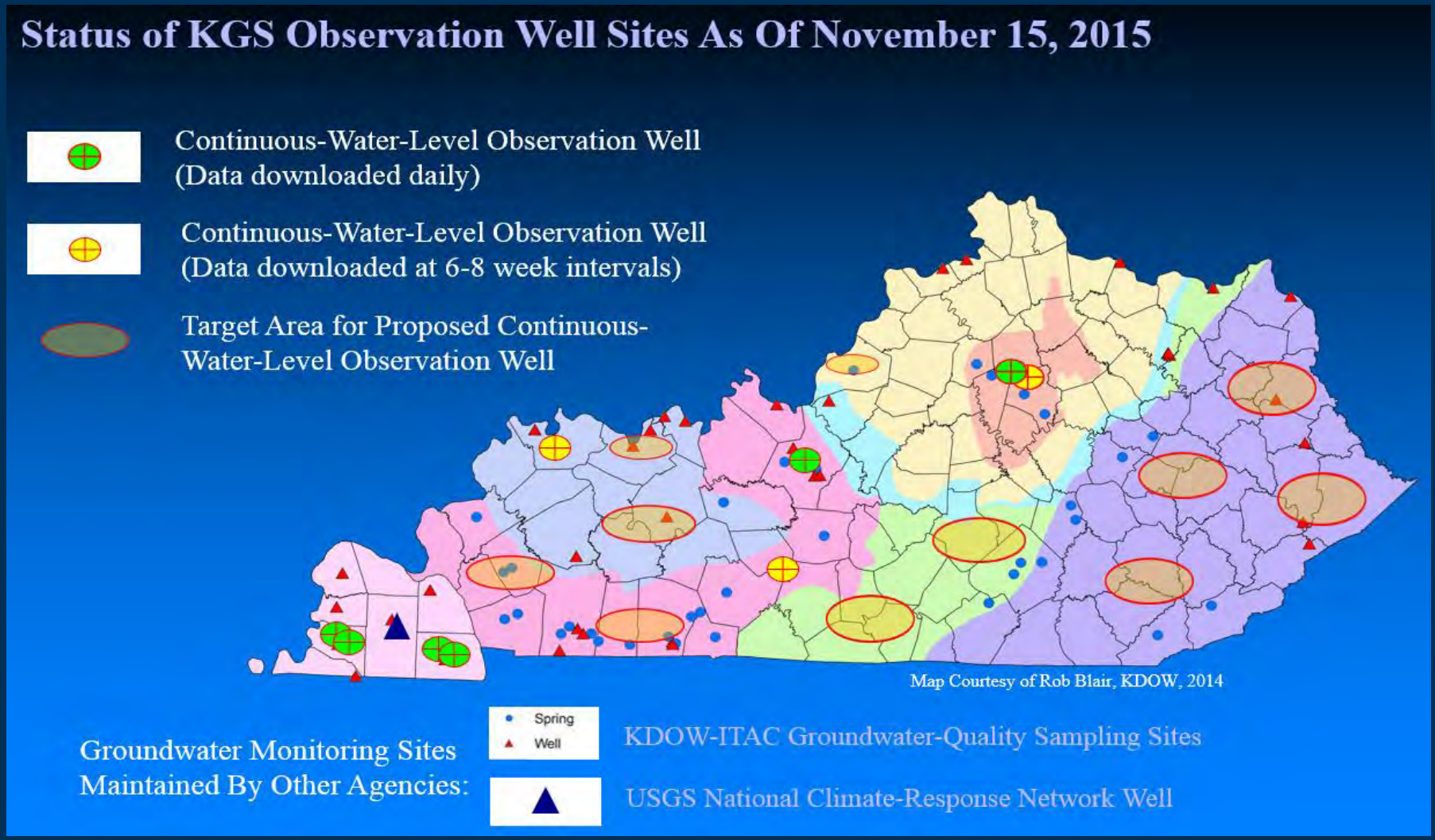
Groundwater -

KGS Making Progress Toward Improved Statewide Groundwater Monitoring and Research but there are significant gaps.

*Precipitation = ET + Streamflow + **ΔGW** + ΔSM + ΔRSV + ΔDiversions*

UK UNIVERSITY OF KENTUCKY Kentucky Geological Survey

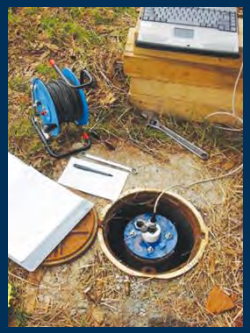
Re-Establishing a Groundwater-Level Observation Network

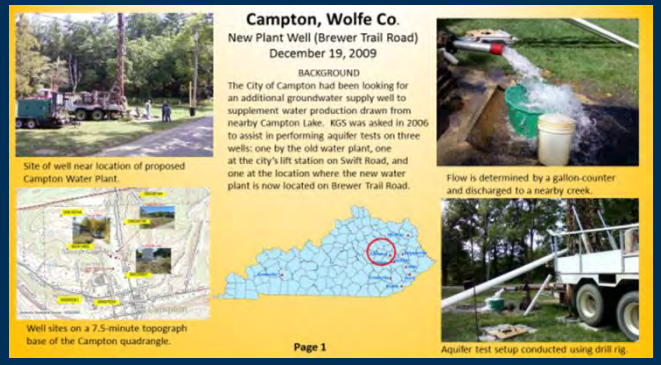


UK UNIVERSITY OF KENTUCKY
Kentucky Geological Survey

Summary: KGS Activities to Improve GW Monitoring

- ✓ Began re-establishing statewide network of long-term water-level observation sites.
- ✓ Conducting focused groundwater research to better characterize the aquifer system in the Jackson Purchase Area.
- ✓ Conducting aquifer tests to enable better assessment of groundwater availability.
- ✓ Creating new webpages needed to enhance public access to groundwater data.
- ✓ Conducting targeted sub-regional groundwater-quality assessments.





Mesonet –
Climate and soil-moisture data

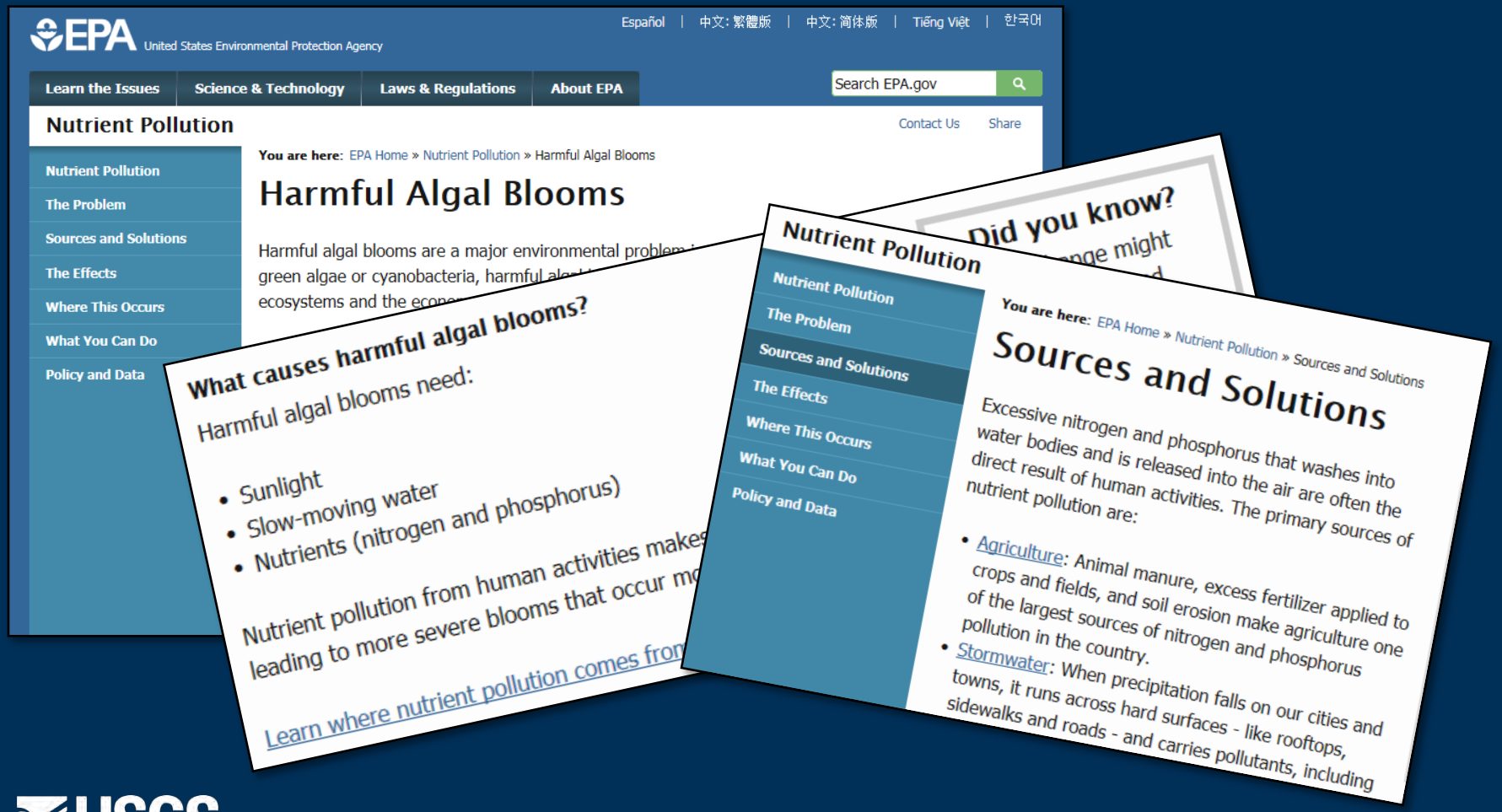
KENTUCKY CLIMATE CENTER

Precipitation = ET + Streamflow + ΔGW + ΔSM + ΔRSV + ΔDiversions

Water quality

There are many issues related to water quality.

Harmful Algal Blooms (HABs) is among the most recent but there is the Gulf Hypoxic Zone and many other issues.

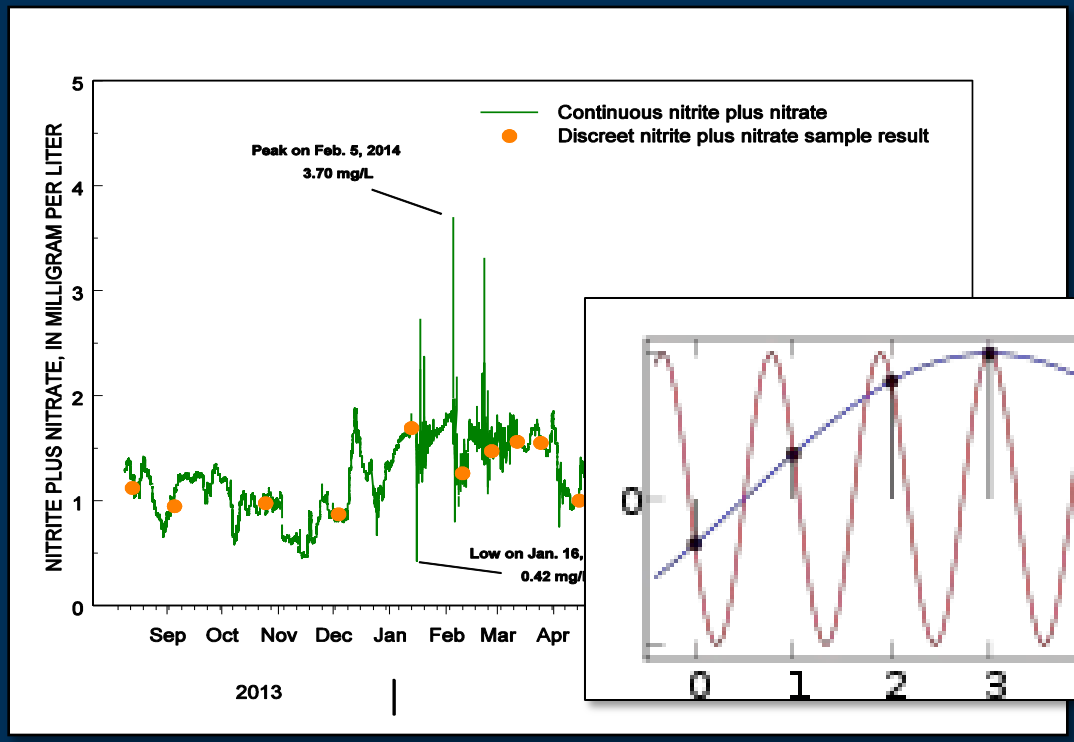


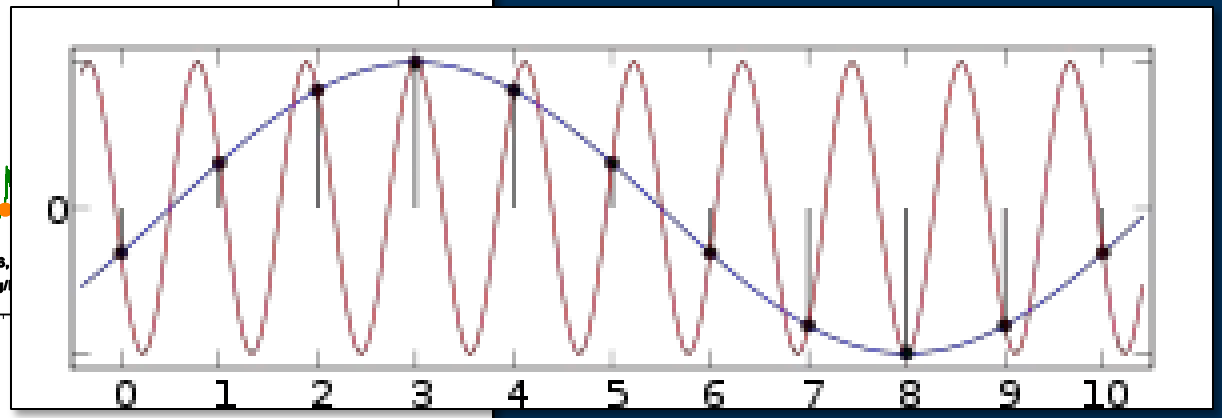
USGS

http://www.epa.gov/nutrientpollution/harmful-algal-blooms

With issues such as HABs and Gulf Hypoxia, we need defensible science to know (among other things):

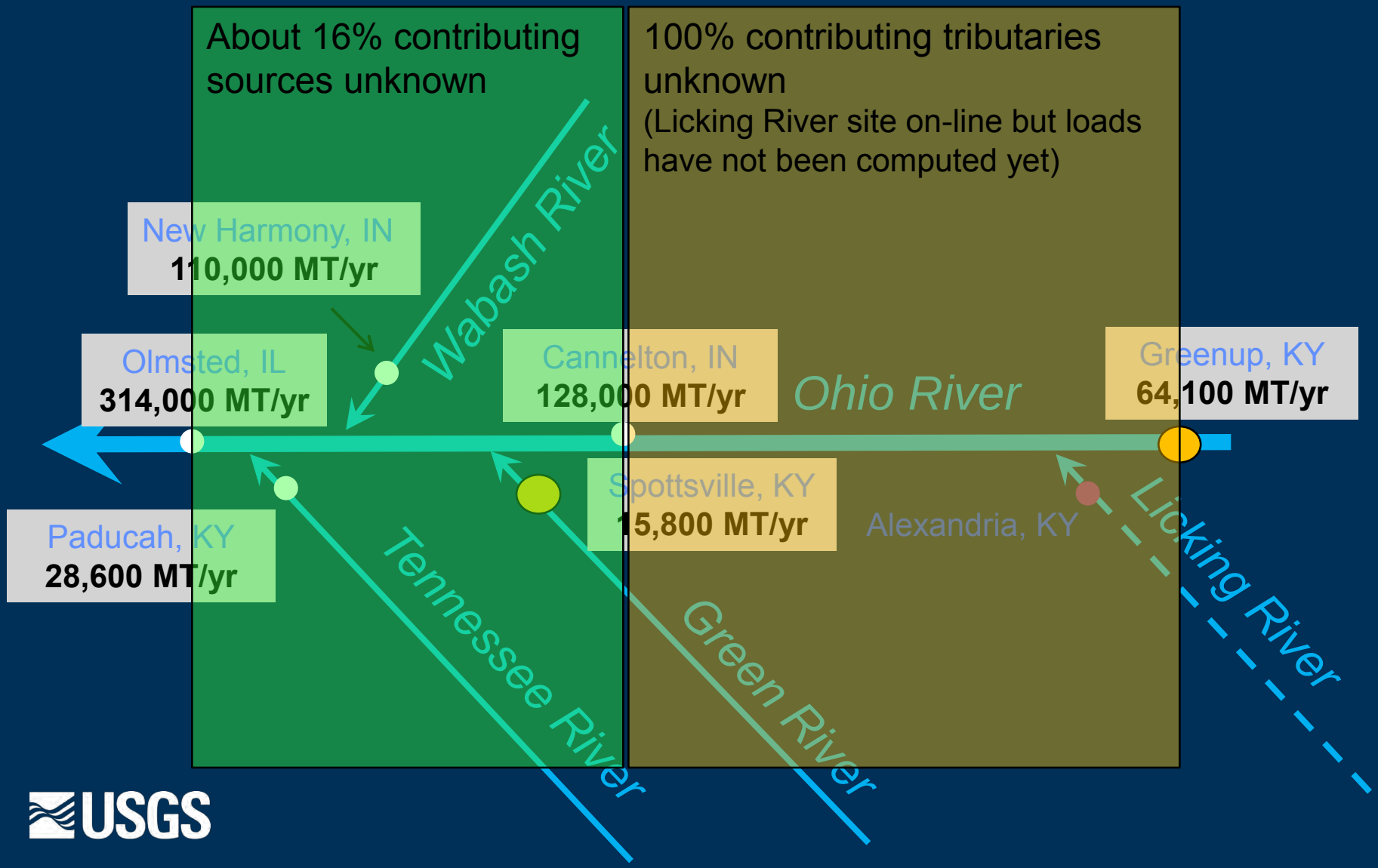
1) What are the causes / effects of water-quality issues? Here, real-time continuous data is critical to determining these.





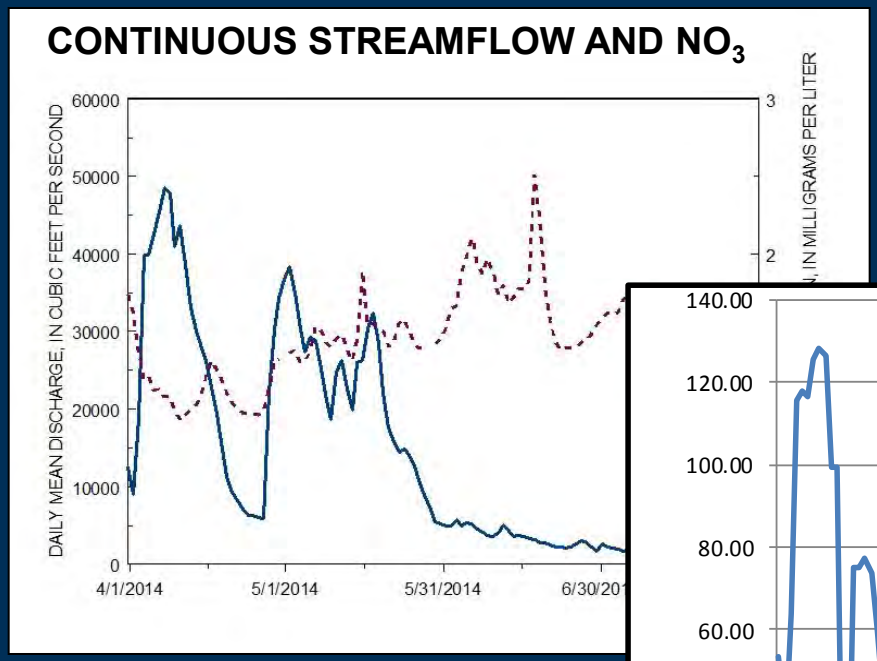
2) What's coming into Kentucky and what's going out?

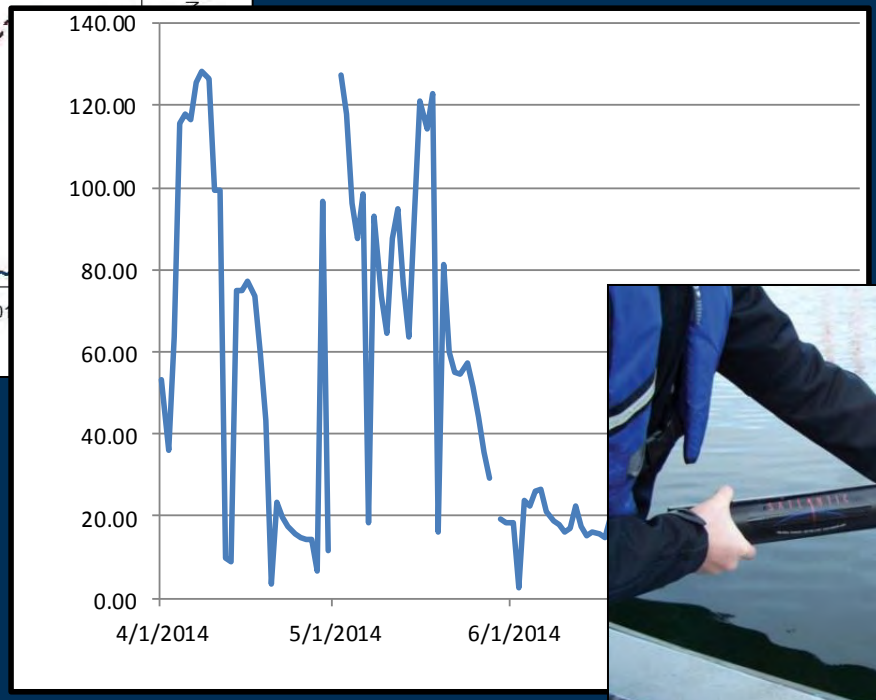
Estimates of nitrite plus nitrate ANNUAL loads



USGS

Real-time continuous nitrate data
Green River at Spottsville, KY



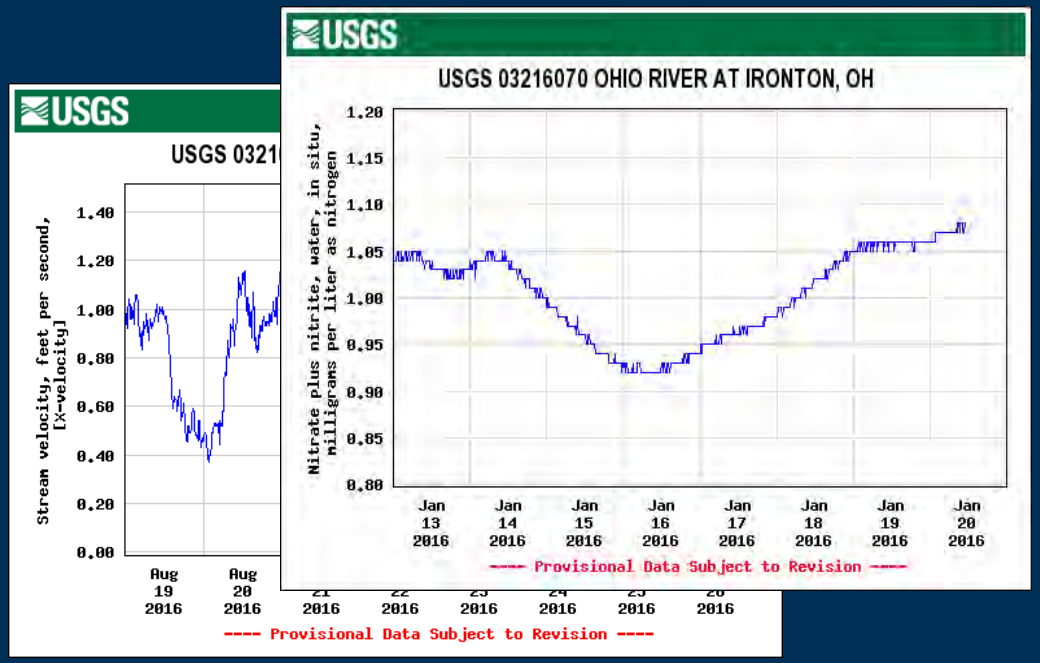


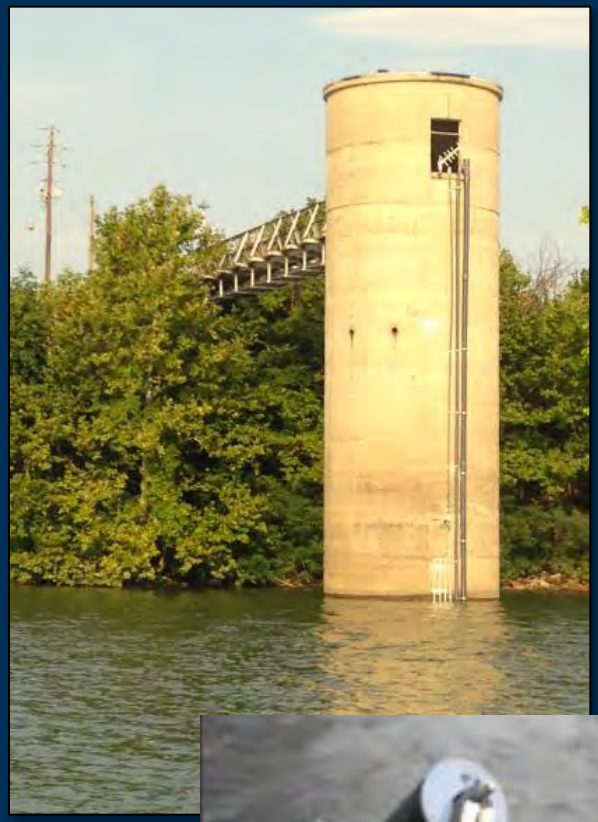
Daily Load = much greater information about what's happening in the basin

USGS

USGS “Super Gage” – what is it?

Ohio River at Ironton, OH





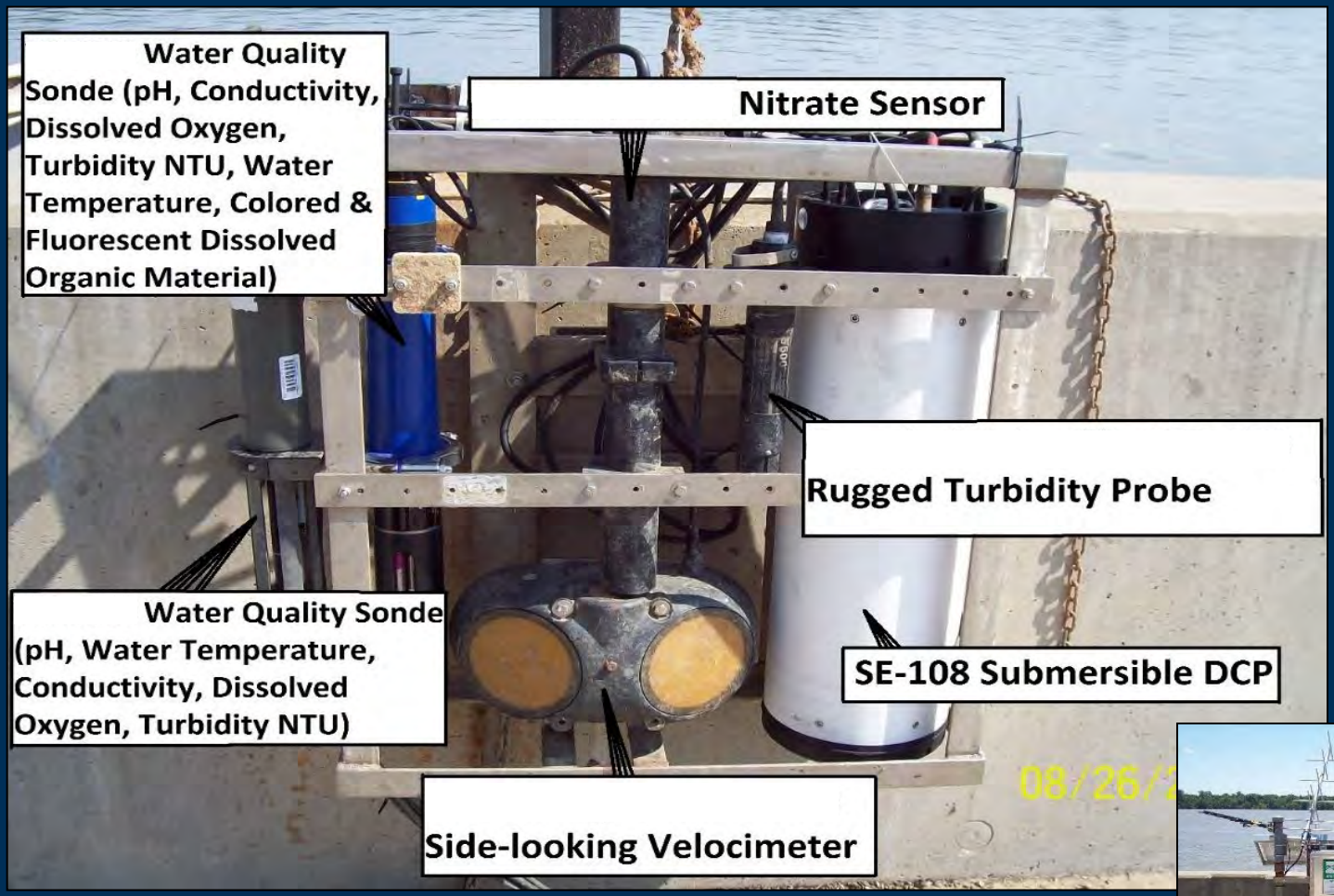
USGS Super Gages

- Extensive equipment and real-time telemetry
- Continuous “real-world” data
- Data ties models to reality and improves accuracy
- QA/QC = defensible data

USGS

USGS Super Gage

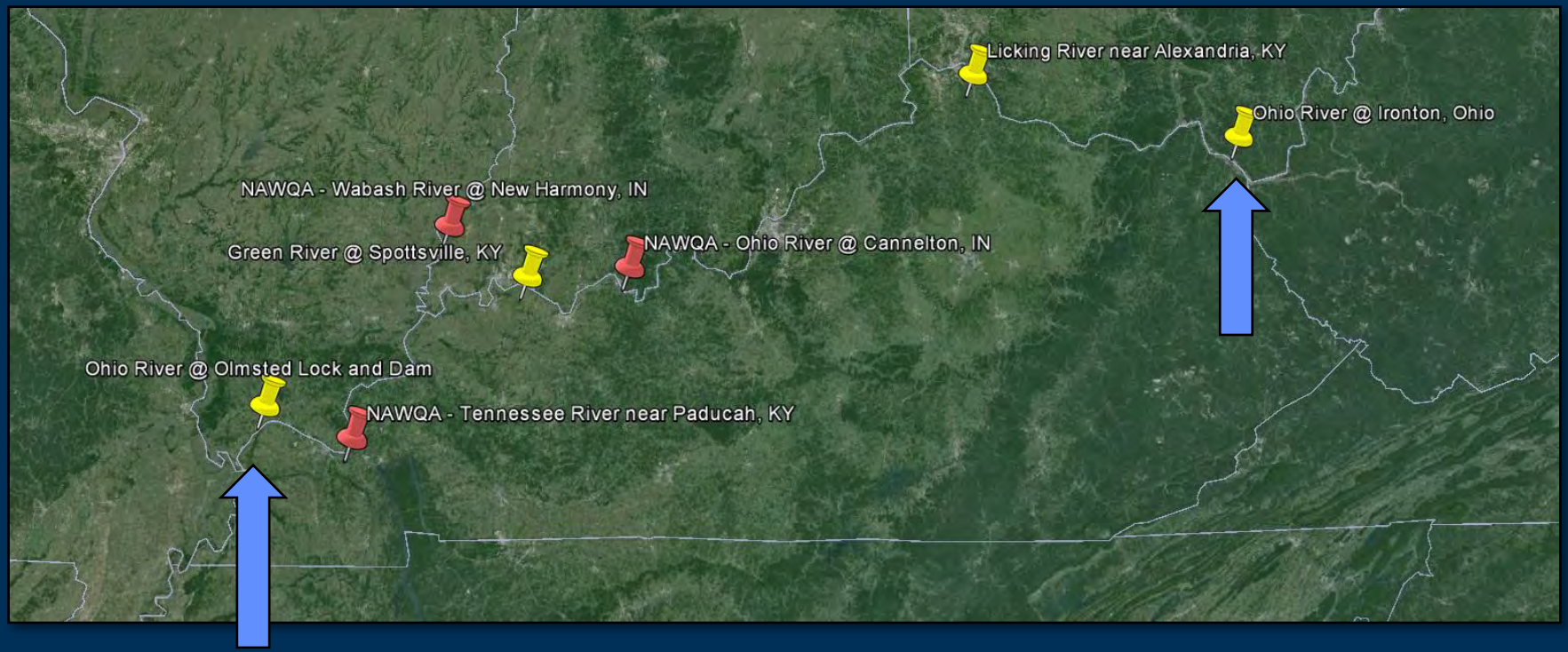
Ohio River at Olmsted Lock and Dam



USGS

Current USGS Super Gage Locations

Incoming



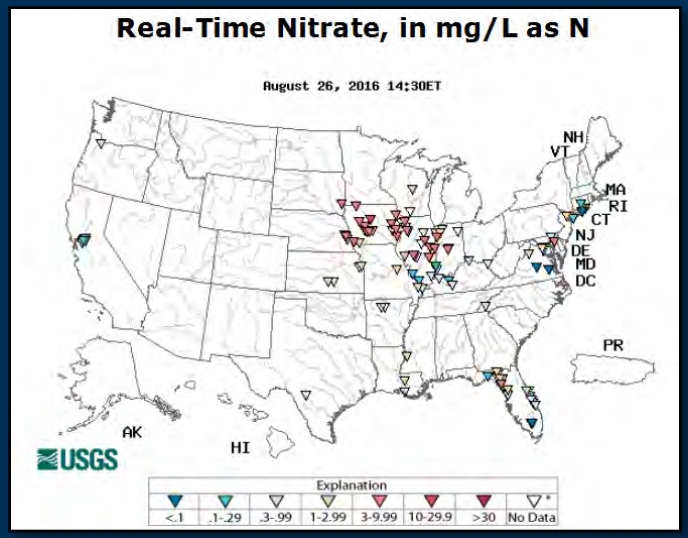
Outgoing

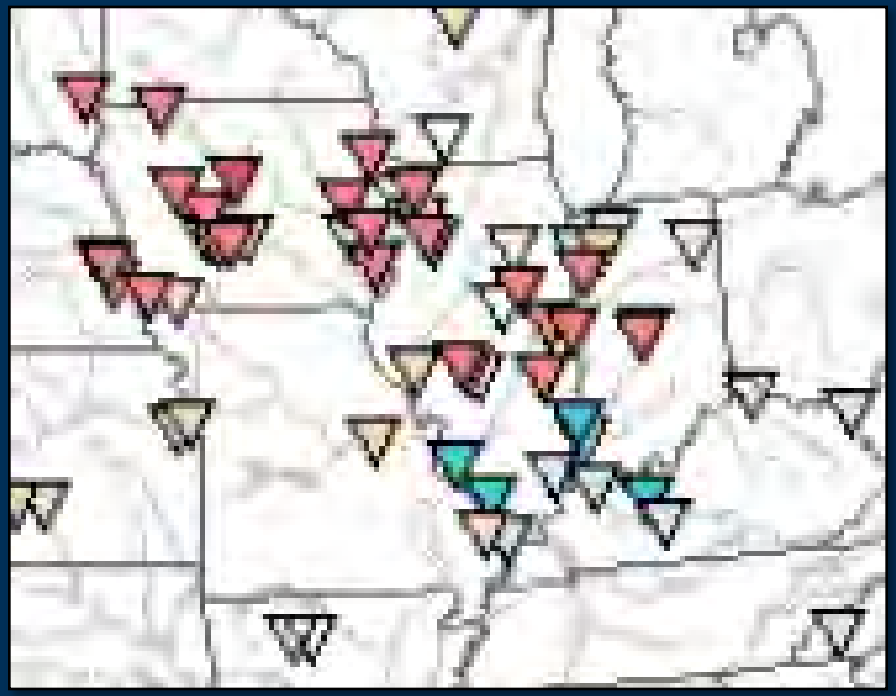
USGS

Yellow – Real-time USGS Super Gage

Red – USGS long-term NAWQA sampling sites

National Perspective – with real-time monitoring (8/26/2016)





Explanation							
<.1	.1-.29	.3-.99	1-2.99	3-9.99	10-29.9	>30	No Data

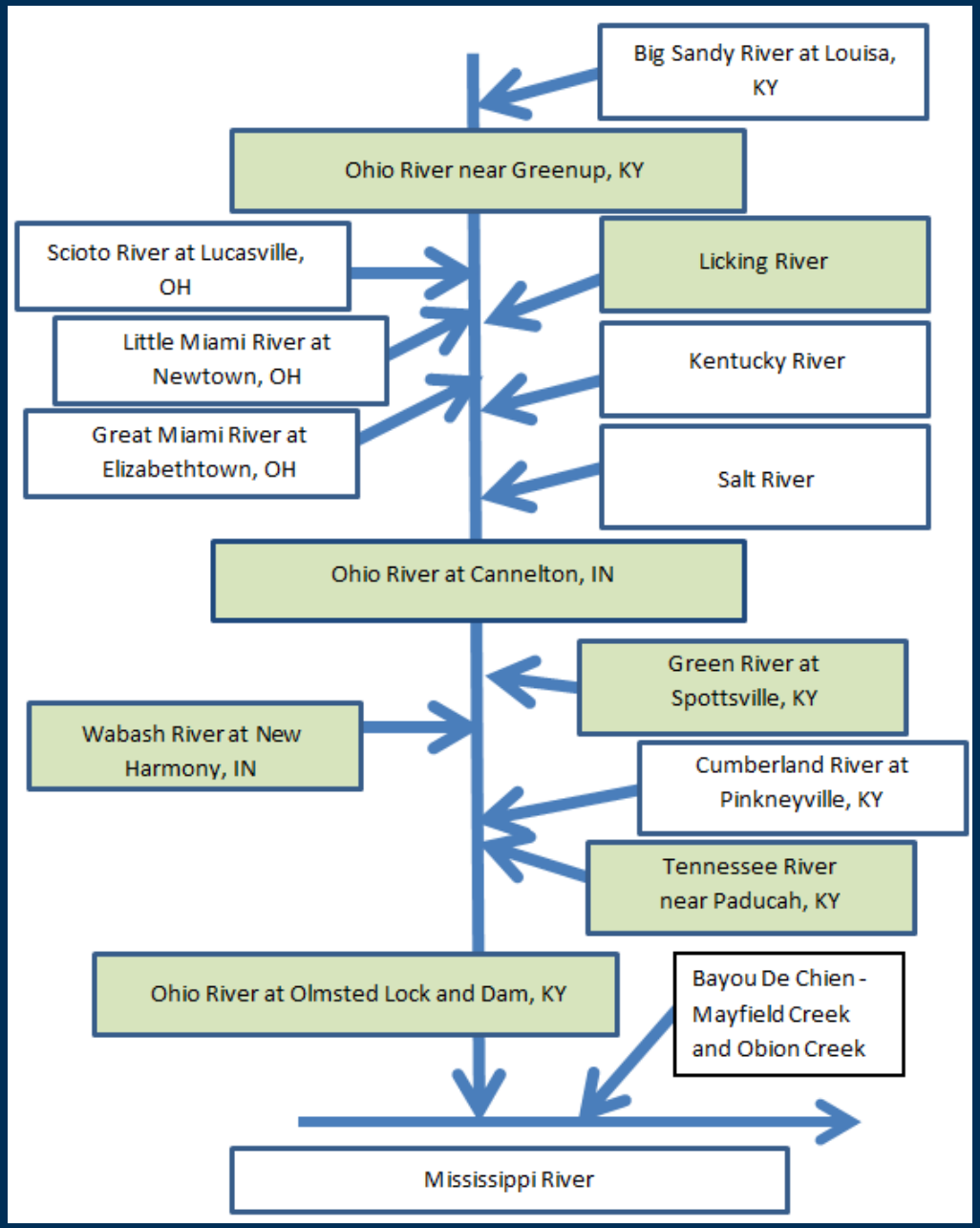
USGS

http://waterwatch.usgs.gov/wqwatch/

Future needs

* Sites on all major river basins

* Sustainable funding



USGS

Questions?

Contact information:

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Louisville, KY 40299-1906

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502-493-1909 - fax

https://profile.usgs.gov/pcinotto

Water Use in Kentucky

Water Resources Board

August 29, 2016

Department for Environmental Protection
Energy and Environment Cabinet

To Protect and Enhance Kentucky's Environment

Kentucky UNBRIDLED SPIRIT™

KENTUCKY FARM BUREAU

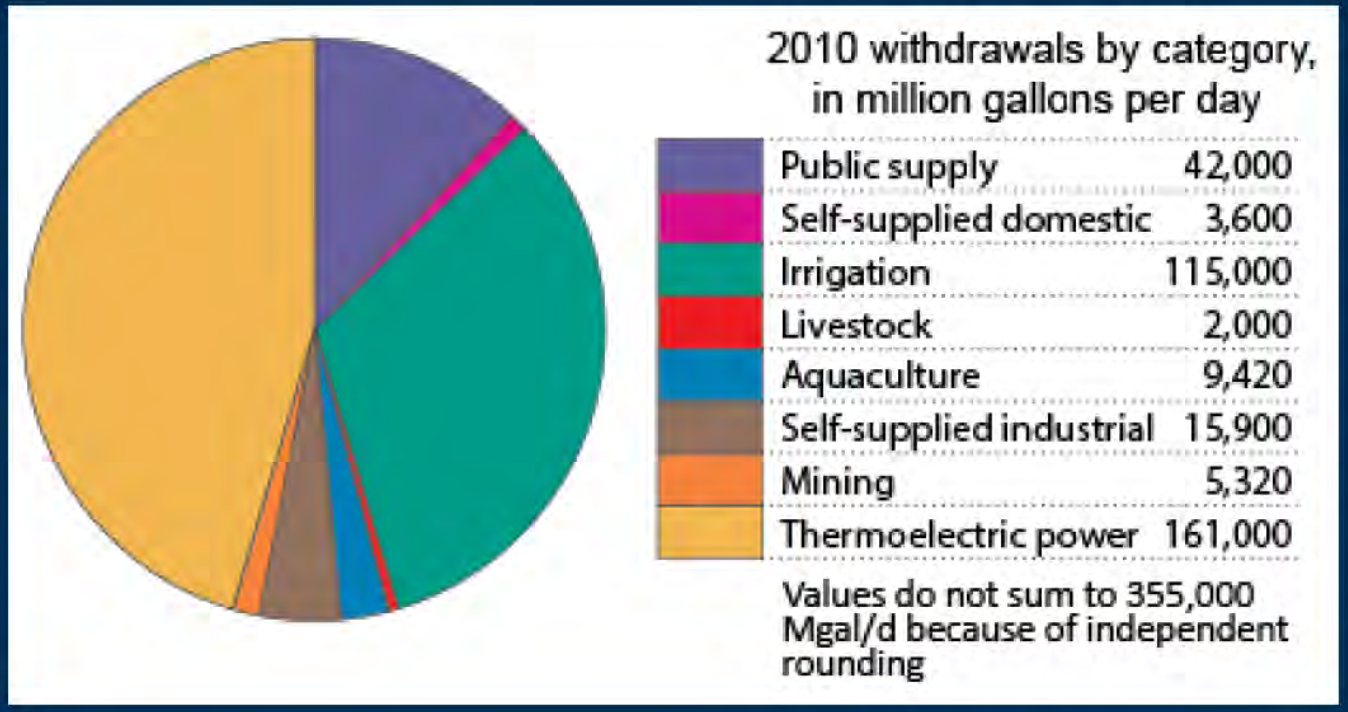
WATERMANAGEMENT
WORKING GROUP

https://www.kyfb.com/federation/water/resources/

Kentucky
UNBRIDLED SPIRIT

Where / How is water used?

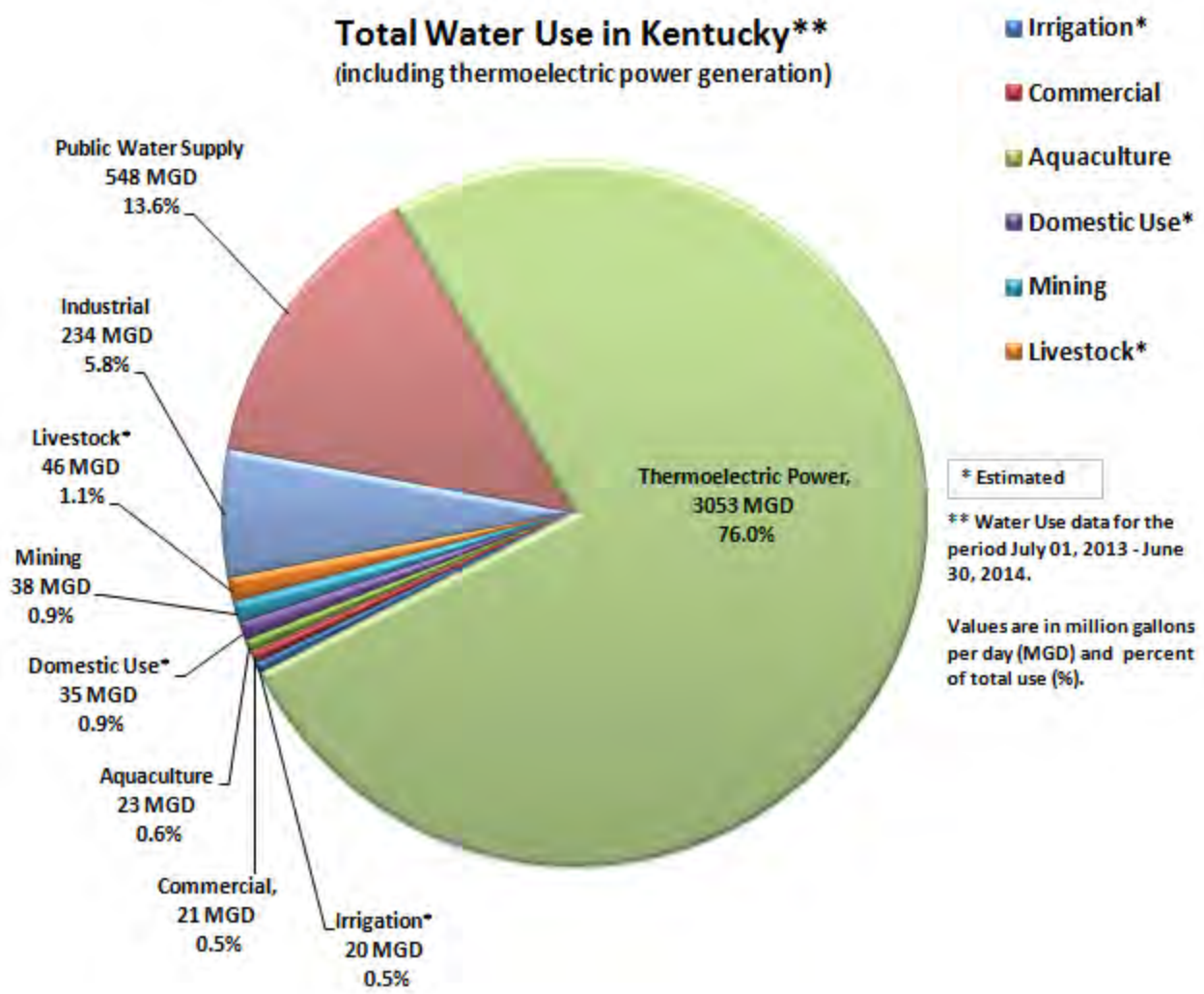
National withdrawals by category



USGS

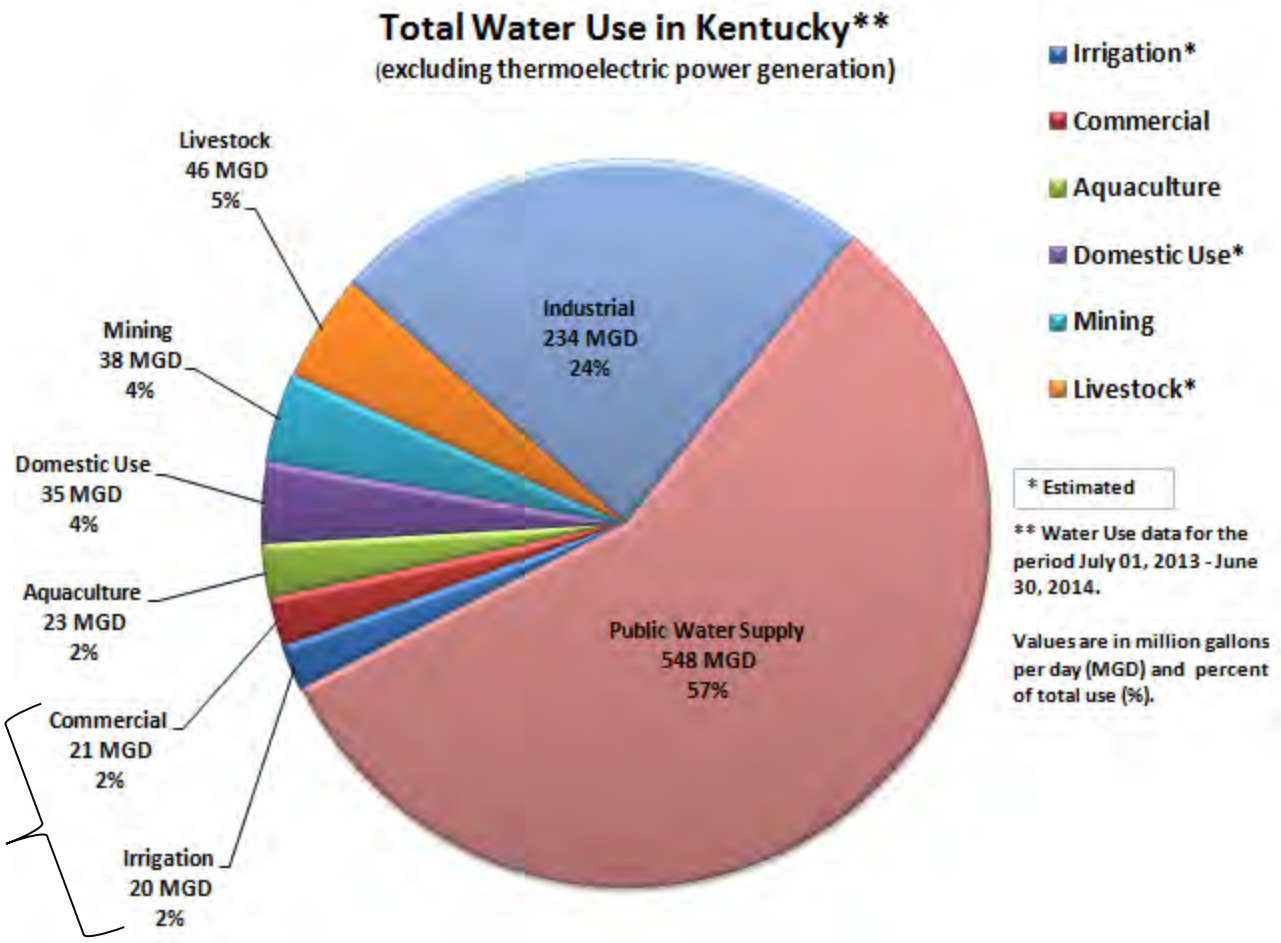
Kentucky UNBRIDLED SPIRIT

Total Water Use in Kentucky**



Kentucky
UNBRIDLED SPIRIT

Total Water Use in Kentucky**
(excluding thermoelectric power generation)

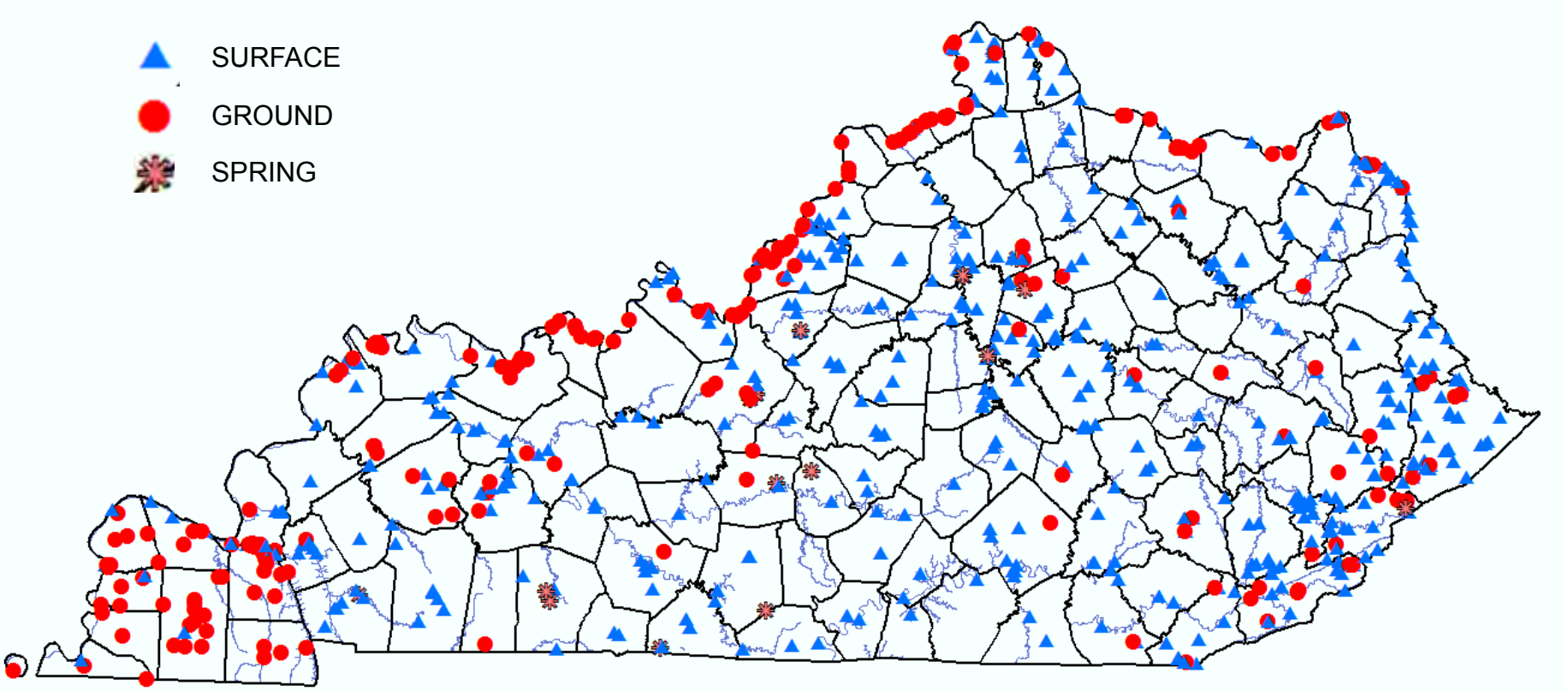


Irrigation "Seasonal" Water Withdrawal
(90 – 120 days)

105 MGD to 145 MGD

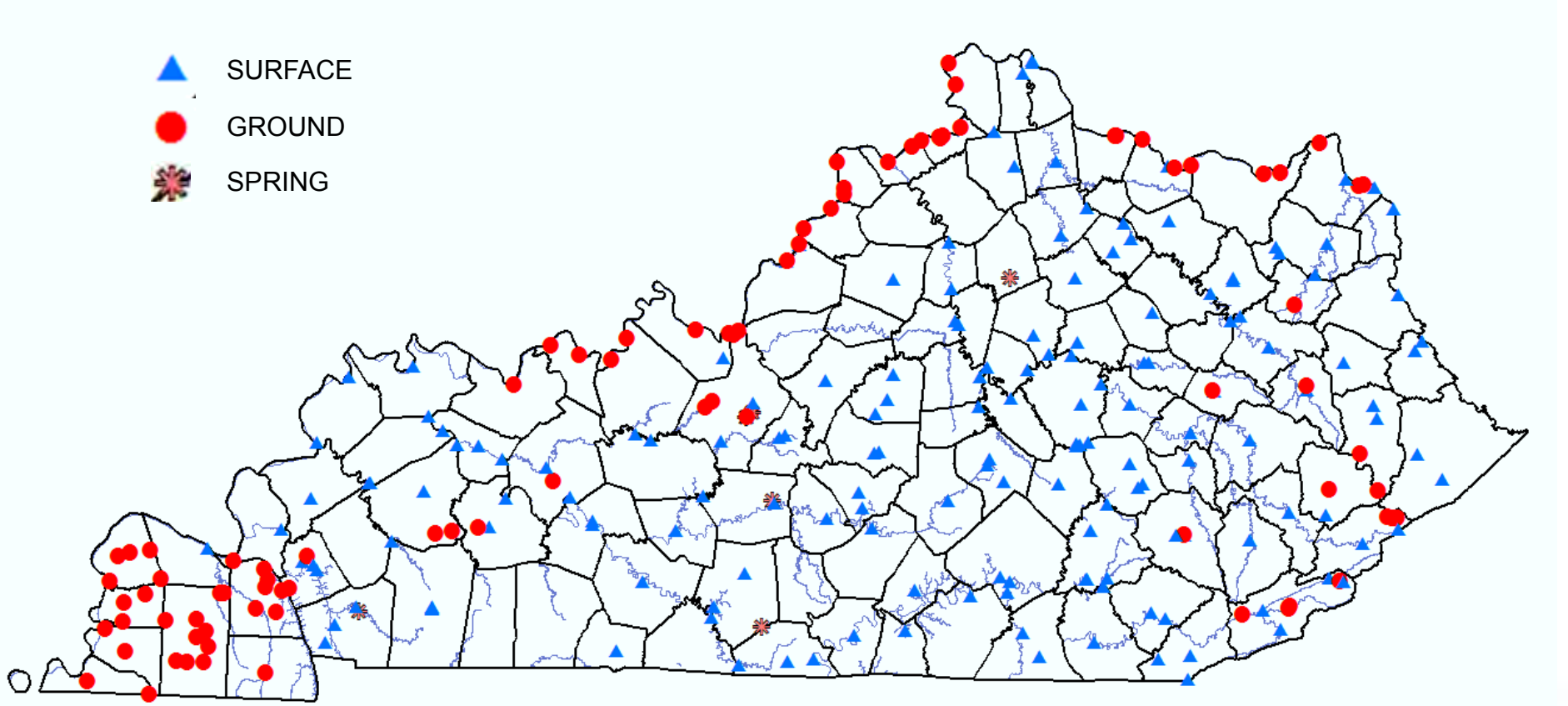
Kentucky
UNBRIDLED SPIRIT

Regulated water withdrawals



Kentucky
UNBRIDLED SPIRIT

Regulated water supply withdrawals



Kentucky
UNBRIDLED SPIRIT

Total Water Use in Kentucky, 2014
(excluding thermoelectric power generation)

Water Use Sector (Based on reporting from permitted water users)	Average Daily Withdrawal (MGD)				
	Rivers and Streams	Lakes and Ponds	Wells and Springs	USACE Reservoirs	Underground Mines
Public Water Supply	323.1	89.3	99.0	34.8	1.30
Industrial	146.2	4.5	79.5	3.6	0.00
Aquaculture	15.2	0.0	1.7	6.2	0.00
Mining	8.9	15.0	13.4	0.0	0.82
Commercial	5.2	2.5	10.3	0.3	0.04
Total	**499**	**112**	**204**	**45**	**2**

Kentucky UNBRIDLED SPIRIT

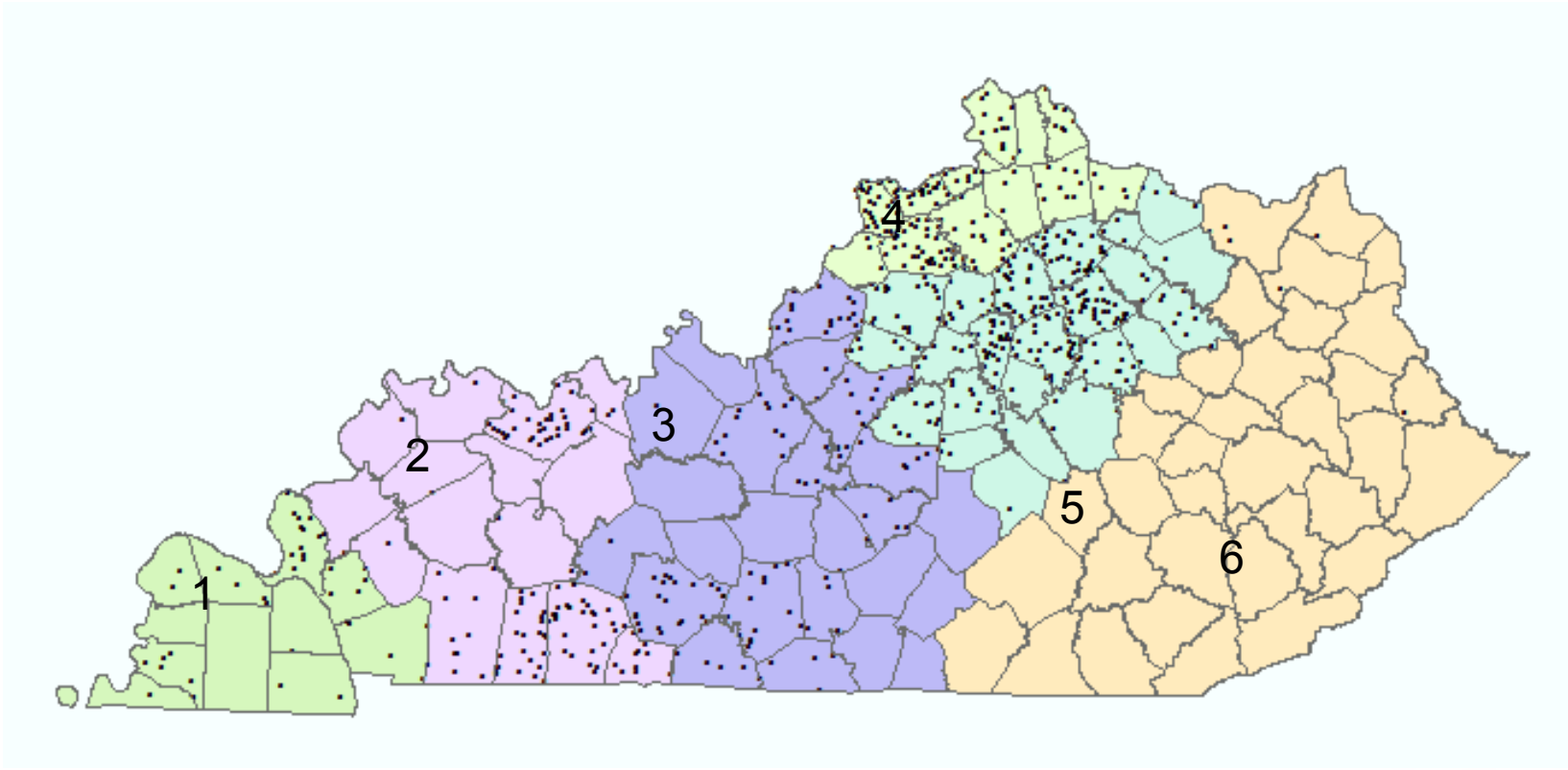
Agriculture: Irrigation

1964 Total Irrigated Acres

(across 6 agricultural districts)

Total Irrigated Acres = 14,500

Corn – 730 out of 981,000 (0.07%)
Tobacco – 10,230 out of 211,000 (4.8%)



One dot = 20 acres

Source: USDA Census of Agriculture

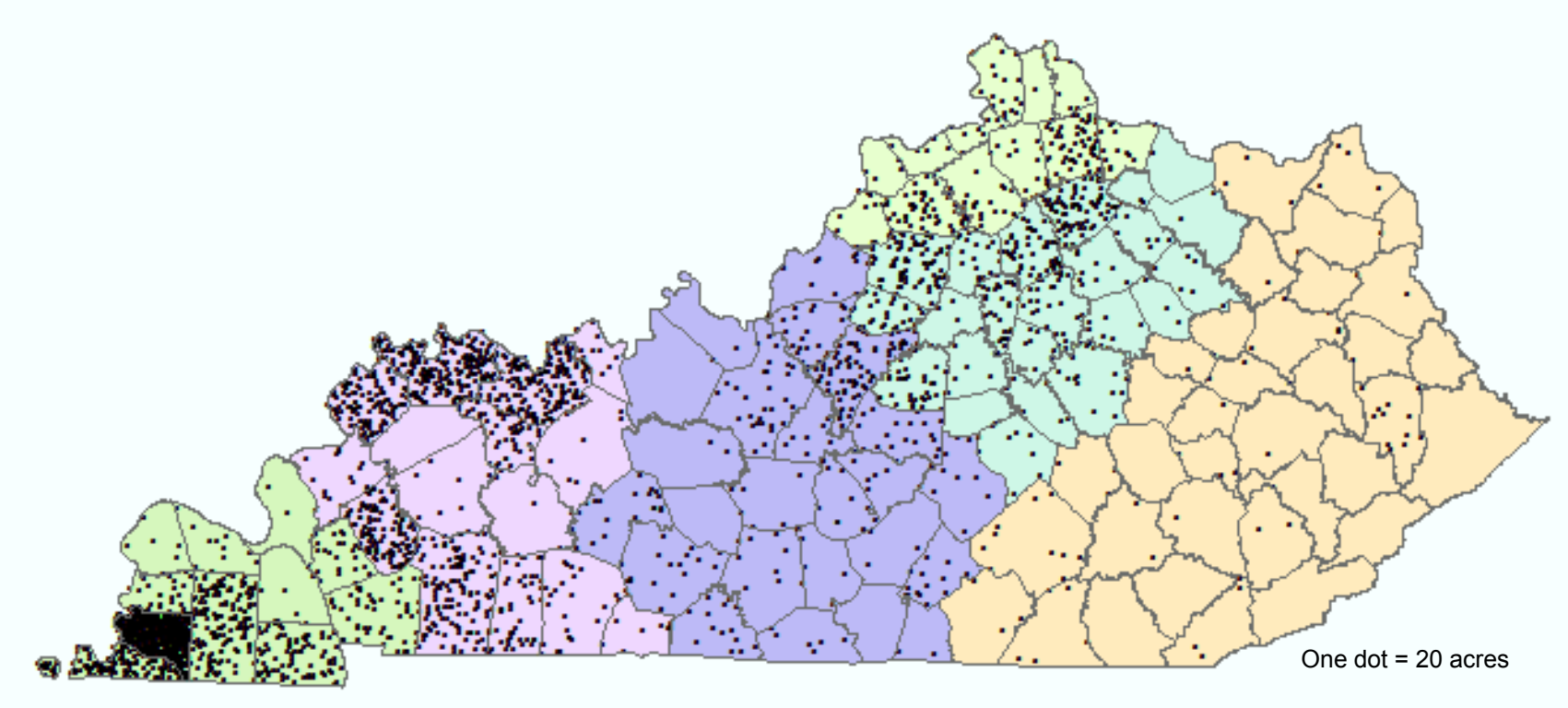
Kentucky UNBRIDLED SPIRIT

2007 Total Irrigated Acres

(across 6 agricultural districts)

Total Irrigated Acres = 58,700

Corn – 22,500 out of 1,310,000 (1.7% of Corn acreage)
Tobacco – 14,000 out of 87,000 (16.1% of Tobacco acreage)
Soybean – 10,000 out of 1,087,000 (0.92% of Soybean acreage)



Source: USDA Census of Agriculture

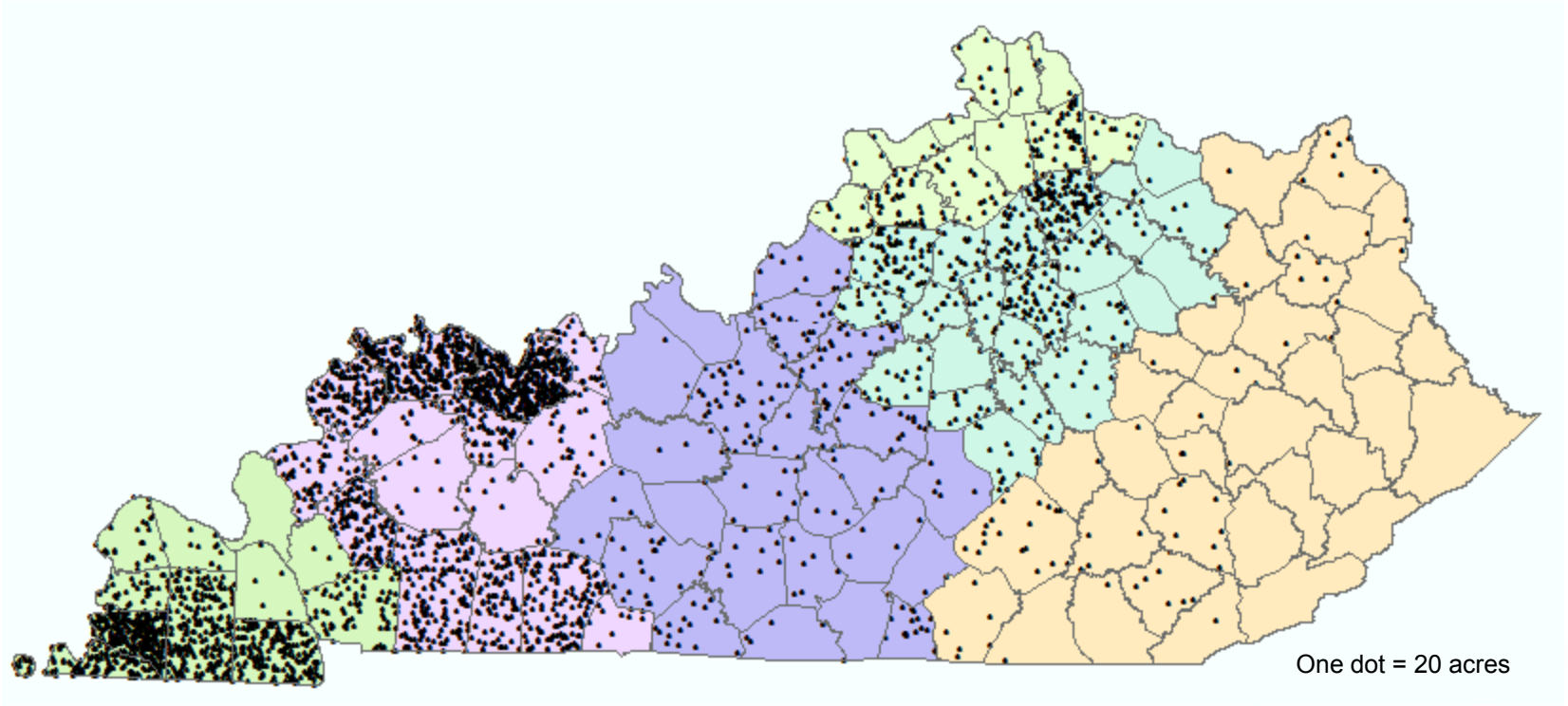
Kentucky UNBRIDLED SPIRIT

2012 Total Irrigated Acres

(across 6 agricultural districts)

Total Irrigated Acres = 73,573 (25 percent increase over 2007)

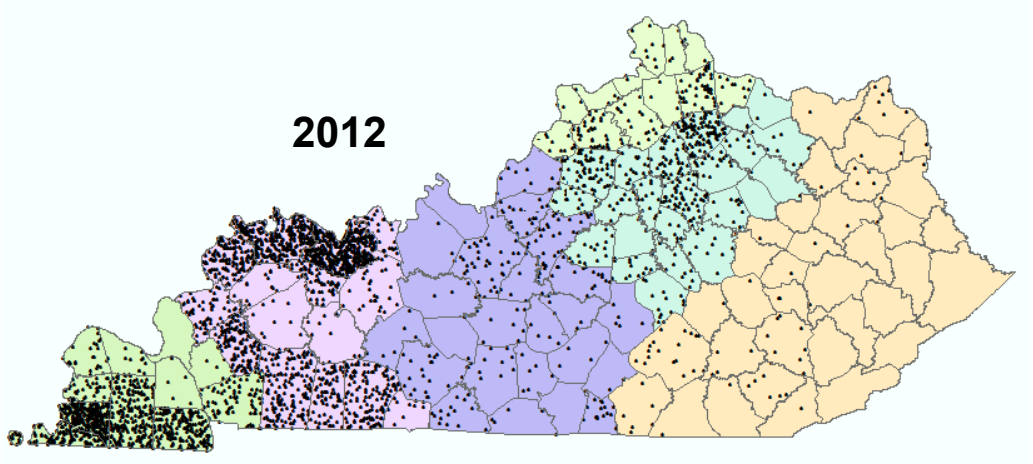
Corn – (2.1% of corn acreage) - increase of 41 percent over 2007
Tobacco – (14.5% of Tobacco acreage) – decrease of 9 percent from 2007
Soybean – (1.1% of Soybean acreage) – increase of 63 percent over 2007

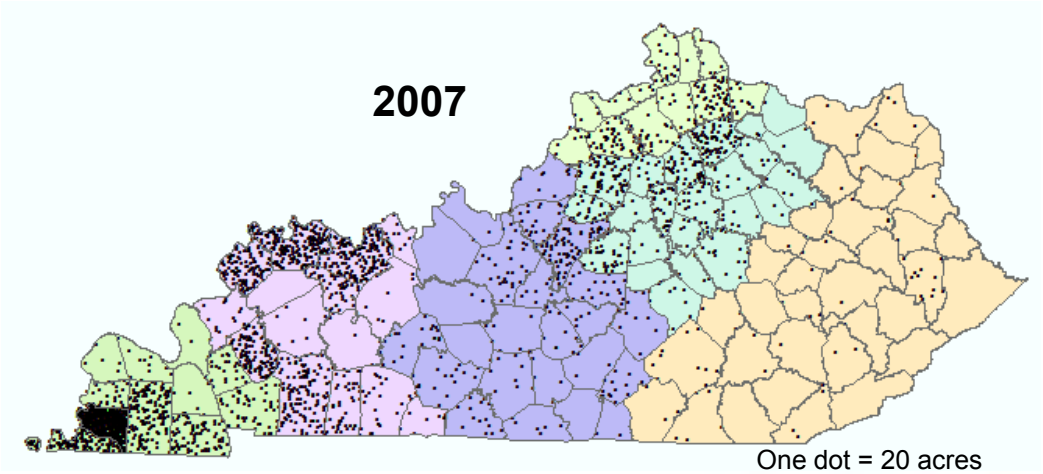


Source: USDA Census of Agriculture

Kentucky UNBRIDLED SPIRIT

Total Irrigated Acres
(across 6 agricultural districts)





	Acre-feet Applied	
Survey Year	Wells	Surface
1954	849	11297
1955	657	4988
1960	422	5654
1969	916	7247
1982	4012	17122
1998	9336	10395
2003	5253	4082
2008	9586	4958
2013	9043	10574

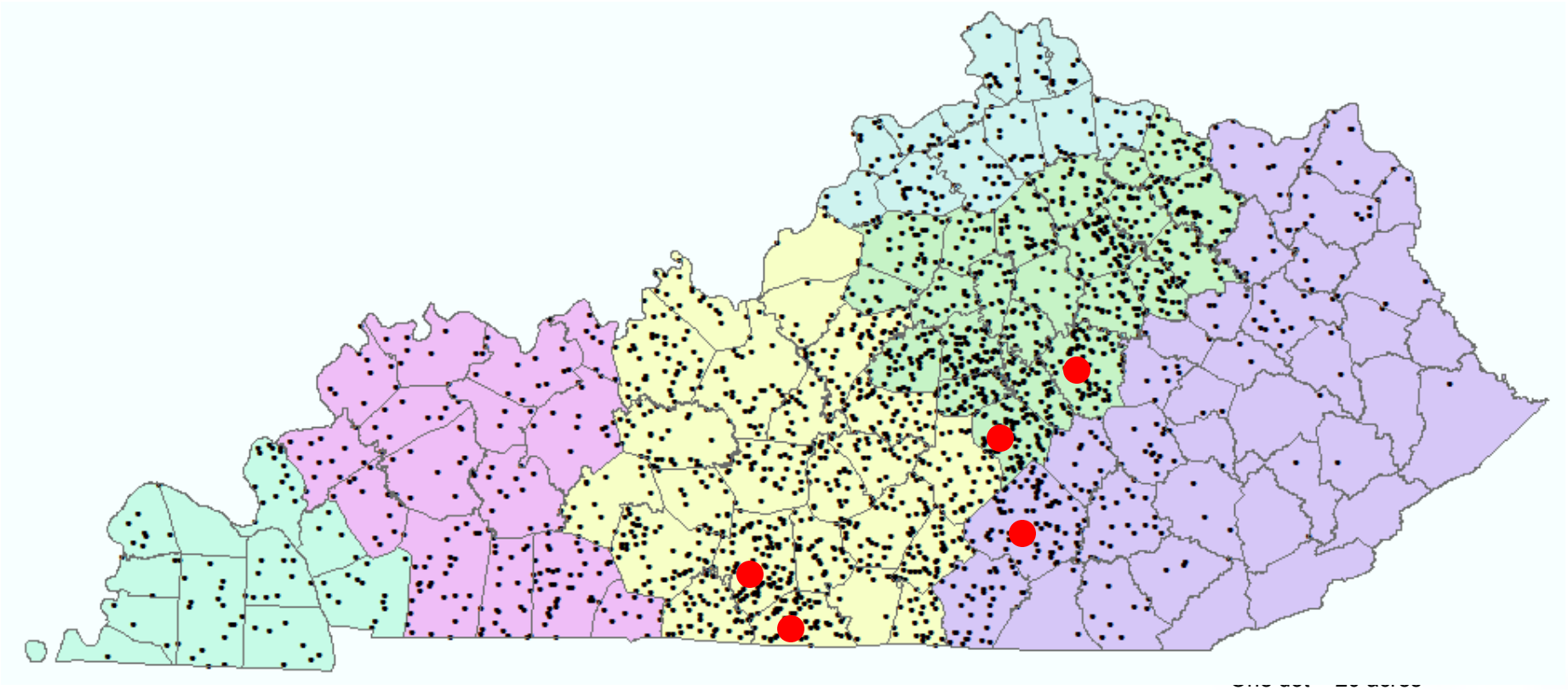
Source: USDA Census of Agriculture

Kentucky UNBRIDLED SPIRIT

Agriculture: Livestock: Cattle

2012 Cattle Populations per County

(across 6 agricultural districts)

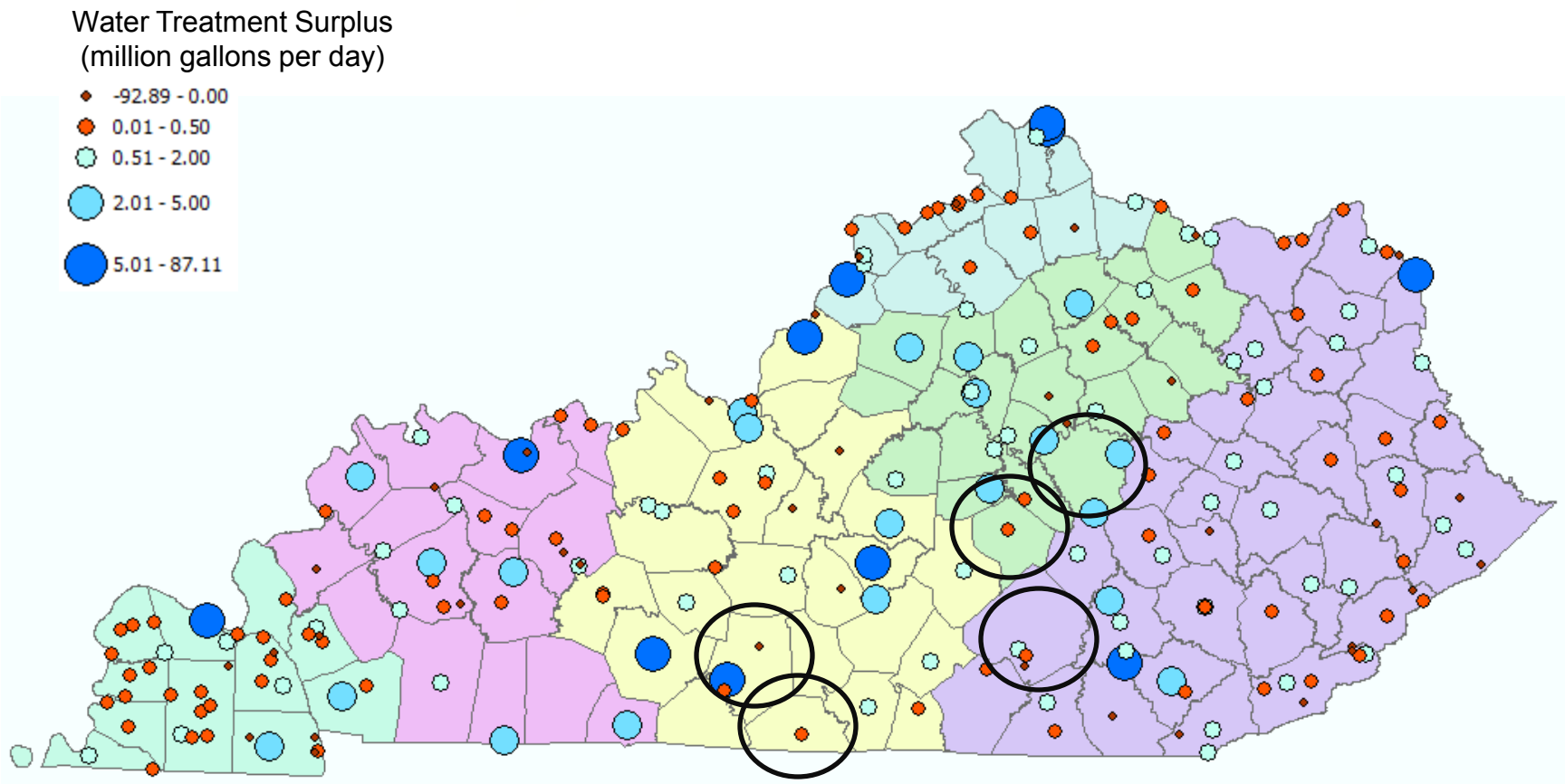


One dot = 5000 Cattle

Source: USDA Census of Agriculture

Kentucky UNBRIDLED SPIRIT

Surplus of Kentucky Water Treatment Plants



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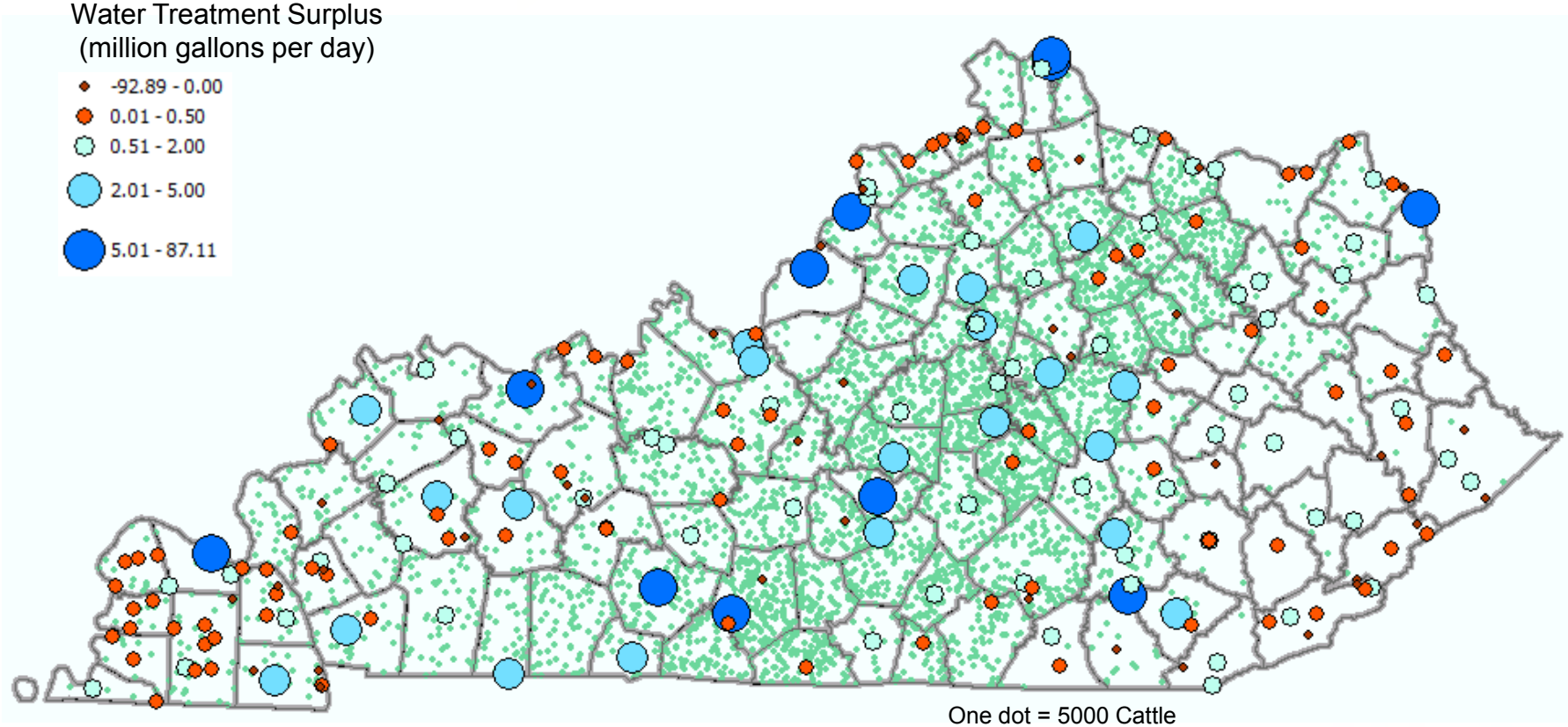
Water Surplus and Livestock Demand (Cattle)



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Difficult to project future increases in irrigation but a majority will likely occur in agricultural districts 1 and 2.

Potential for significant increase in agricultural uses of surface waters, not just wells.

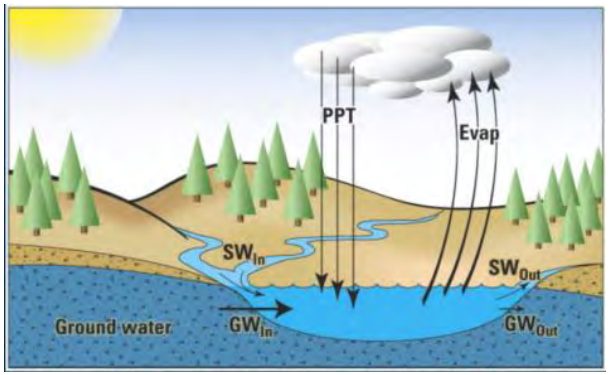
Important to project future-growth sectors' needs (rural population changes or new poultry and dairy operations for example)

Monitoring and data collection should include assessments of

- water availability and **demand** – surface water, aquifer, springs, lakes
- potential conflicts – users upstream and downstream, nearby domestic or public water supply wells, recreation.
- impacts to source water bodies – special use waters, impaired waters, regional availability

Kentucky UNBRIDLED SPIRIT

Water Resources Development
What do we need to know?



PUBLIC
AWARENESS,
EDUCATION
AND OUTREACH

FARM AND COMMUNITY
DECISION-SUPPORT SYSTEMS
AND TOOLS
-- DROUGHT EARLY WARNING
-- IRRIGATION MANAGEMENT
-- RURAL WATER RESILIENCY

VULNERABILITY
MITIGATION
PLANNING
ADDRESSING KNOWLEDGE GAPS

"why monitor if you don't fix the problem?"

WATER AVAILABILITY ⇄ WATER DEMANDS

MONITORING / RESEARCH / DATA COLLECTION

Kentucky
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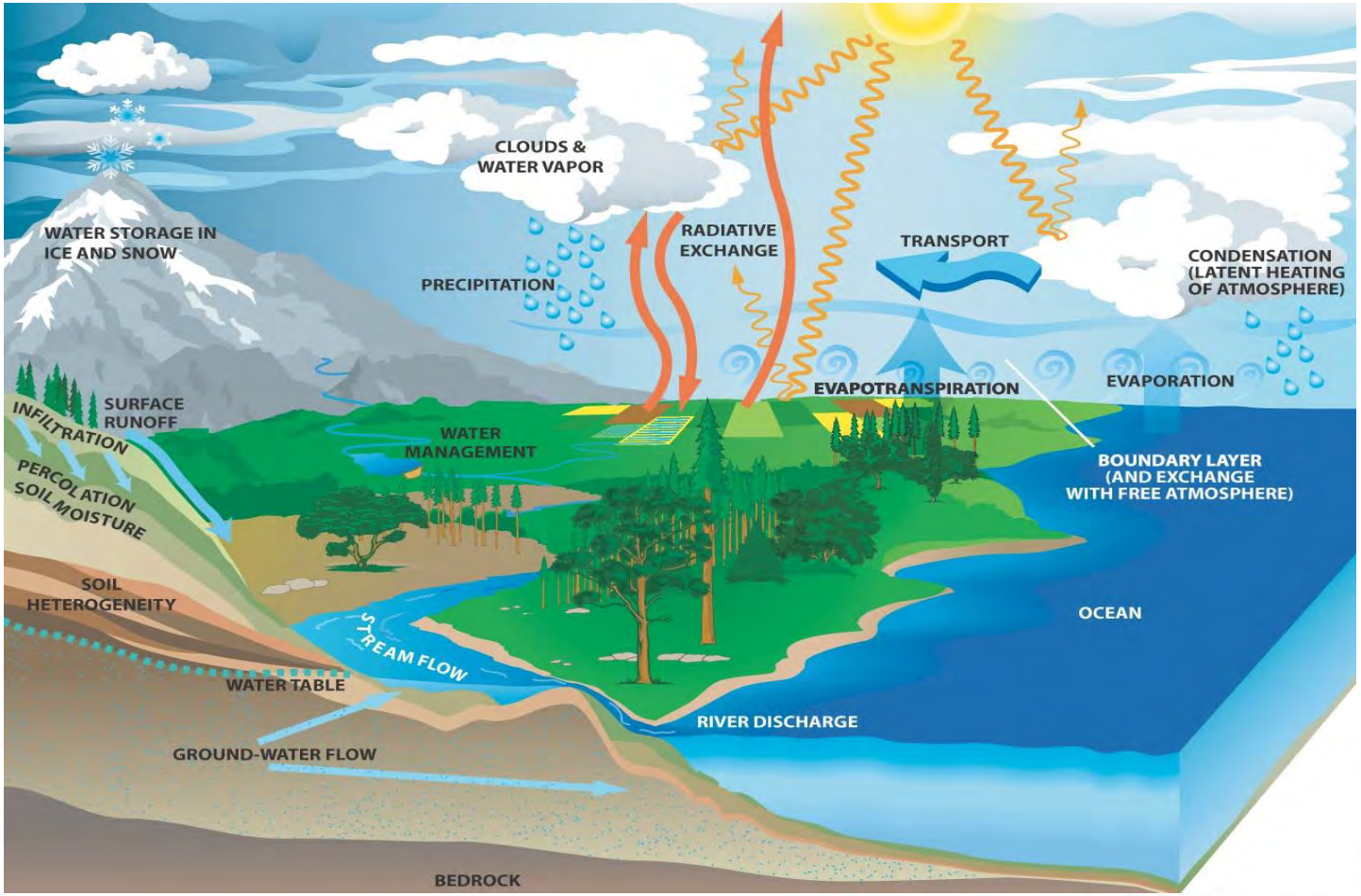
State Drought Plan: Mitigation

- **Expand / Maintain data networks and provide long-term funding**
- **Inventory and quantify the state's available water resources**
- Identify and project drought vulnerabilities
- Pursue opportunities to increase available raw water supplies
- Improve state and local drought response
- Become more efficient in the use of the state's water resources
- Public education, awareness and outreach

Water Resources Development
The next few meetings



Kentucky
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KENTUCKY MESONET | WKU

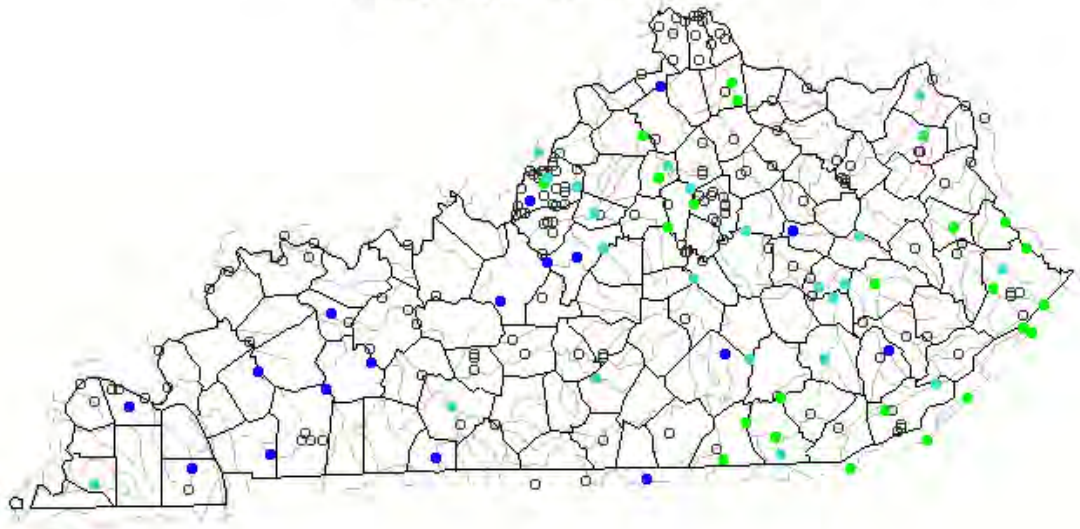
The Commonwealth's Official Source for Weather and Climate Data

Home | About | Live Data | Summary Data | Event Tracking | Outreach

Map of real-time streamflow compared to historical streamflow for the day of the year (Kentucky)

Kentucky or Water-Resources Regions

Monday, August 29, 2016 07:30ET



USGS

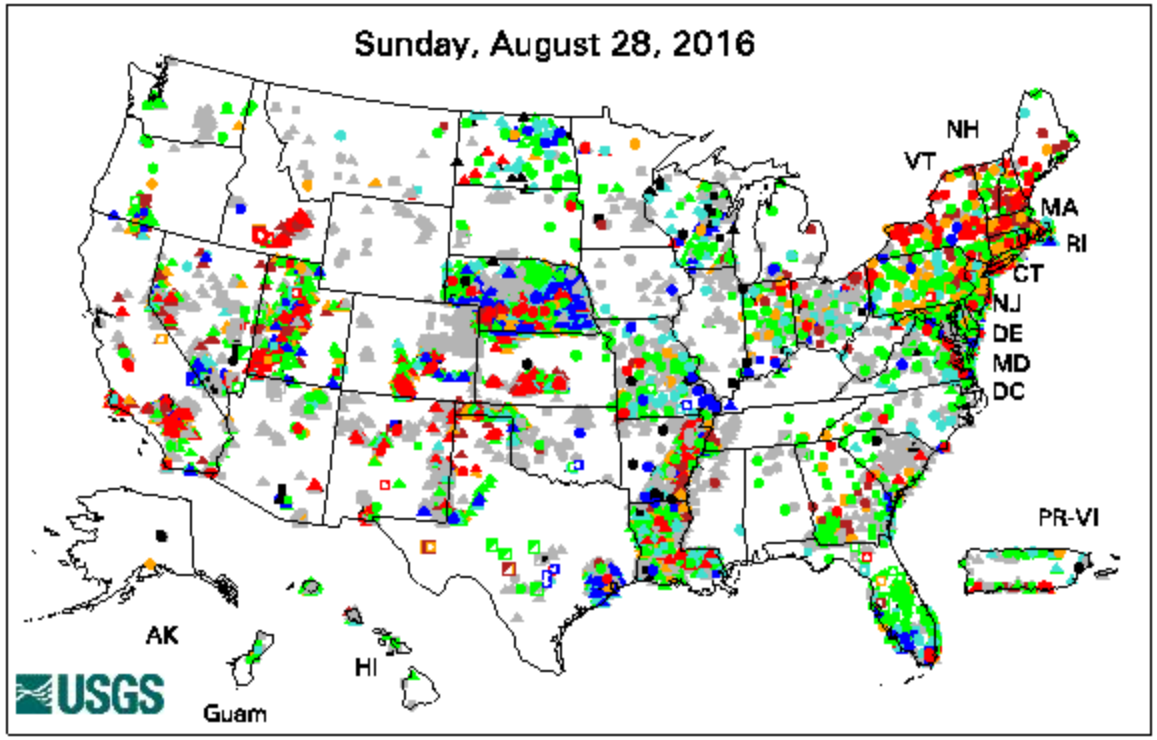
Choose a data retrieval option and select a location on the map

List of all stations **Single station** **Nearest stations** **Peak flow**

Explanation - Percentile classes							
Low	<10	10-24	25-75	76-90	>90	High	Not-ranked
	Much below normal	Below normal	Normal	Above normal	Much above normal		

Kentucky UNBRIDLED SPIRIT

Active Groundwater Level Network



Explanation - Percentile classes (symbol color based on most recent measurement)							
Low	<10 Much Below Normal	10-24 Below Normal	25-75 Normal	76-90 Above Normal	>90 Much Above Normal	High	Not Ranked

Wells	Springs
Real-Time	
Continuous	
Periodic Measurements	

Active Well Count

Real-Time: 1,586 Daily: 1,189 Periodic: 16,049

Map generated 8/28/2016 11:36:17 AM

Kentucky UNBRIDLED SPIRIT

KENTUCKY WATER RESOURCES BOARD
PROJECTS SUBCOMMITTEE - INITIAL CONCEPTS

1) MESONET (SOIL MOISTURE AND CLIMATE) – (3 Years) - WESTERN KENTUCKY UNIVERISTY - (**$824,000** - Matching Funds – TSA, WKU, and Local Gov. & Private)

   a. Acquisition and installation of soil moisture probes (50 new sites) **$275,000**

   b. Install 12 NEW basic MESONET Stations (EXCLUDING SOIL PROBES) with a cost estimate cost of $20,750 each, including equipment, material, and installation costs. **$249,000**

   c. Expand capacity of the MESONET SCIENTIFIC INSTRUMENT CALIBRATION FACILITY **$100,000**

   d. EXPAND THE SUITE OF INSTRUMENTATION AT 40 MESONET STATIONS **$200,000**

2) DATA MANAGEMENT AND INTEGRATION – US GEOLOGICAL SURVEY - (**$34,000** - Matching Funds – TSA & USGS)

   a. **$28,000** to design and implement a data integration and management portal centered on water-use and drought-related data. USGS will provide $12,000 CWP funding as match (total project cost is $40,000). Note also that there are nominal annual operation and maintenance cost associated with maintaining a dynamic web page and these are detailed below ($3,000 per year).

3) Funding for updating and adding agriculture concerns to Kentucky Drought Mitigation Plan. Development of NOAA Drought Early Warning System for Kentucky. –(**$25,000** - Matching Funds – TSA, NOAA, and State Gov.)

4) SURFACE WATER (STREAMFLOW) – (3 Years) - US GEOLOGICAL SURVEY - (**$468,500** - Matching Funds – TSA, USGS, and State Gov.)

   a. 5 Gages (installation, equipment, and operation costs) total within 22 counties with a cost estimated cost of $26,000 each one time cost and O&M $14,000 each annually. **$272,500**

   b. **$98,000** for construction of a new water-quality monitoring station on the Salt River at the confluence with the Ohio (this cost includes supporting sampling and laboratory analyses). The Salt River site has been identified as being of importance to KY Agriculture as it quantifies the nutrient loads from a large urban area and places the primary agricultural basins into context. USGS will provide $42,000 CWP funding as match (total project cost is $140,000 in year one).

   c. **$98,000** for construction of a new water-quality monitoring station on the Kentucky River at the confluence with the Ohio (this cost includes supporting sampling and laboratory analyses). The Kentucky River site has been identified as being of importance to KY Agriculture as it quantifies the nutrient loads from a large portion of the Commonwealth and also places the primary agricultural basins into context. USGS will provide $42,000 CWP funding as match (total project cost is $140,000 in year one).

5) GROUNDWATER – (3 Years) - KENTUCKY GEOLOGICAL SURVEY - (**$366,000** - Matching Funds – TSA, USGS, KGS, and State Gov.)

   a. Drill 10 NEW observation wells in critical areas **$118,000**

   b. Upgrade 15 existing wells with real-time satellite telemetry **$57,000**

   c. Operation and Maintenance (25 WELLS) **$177,000** – over 3 Years

   d. Equipment replacement contingency **$14,000**

6) Rural Water System Source Assessment, Diversification, and Planning – ($500,000 - Matching Funds – TSA, SRF, and Local Gov.) Understanding the capacity of rural and urban water supply systems and their vulnerability during low flow or drought conditions to meet demand.

   a. Community Low Flow Variability (Single versus multiple source water supply assessments)

   b. Water Use Inventory - Agriculture

   c. Community Drought Preparation Planning.

   d. Source Water Protection Program.

7) Demonstration on-farm water management BMPs – ($750,000 - Matching Funds – TSA, CIG, RCPP, SCS, SRF)

   a. Water trapping, harvesting, and alternative water storage BMPs.

   b. Retrofitting of tile drainage system to control water flow during dry periods

   c. Irrigation efficiency assistance, variable rate, drip and injection systems for irrigation systems, etc.

   d. Alternative water source development and efficiencies for animal agriculture water supply.

8) Infrastructure Improvements in P.L. 566 and State Owned Dams - ($200,000 - Matching Funds – TSA, SRF, and State Gov.)

   a. Providing access and pumping stations for use during drought declarations.

9) Support USDA program modifications to allow NRCS to provide technical assistance for the planning and development of new on-farm water supplies and irrigation systems.

10) Demonstration of Groundwater Recharge Facilities - (Matching Funds – TSA, CIG, RCPP, SCS)

TOTAL ESTIMATED COST FROM ALL SOURCES $3,167,500.00