

# The Impacts of Drought on Groundwater and Water Quality

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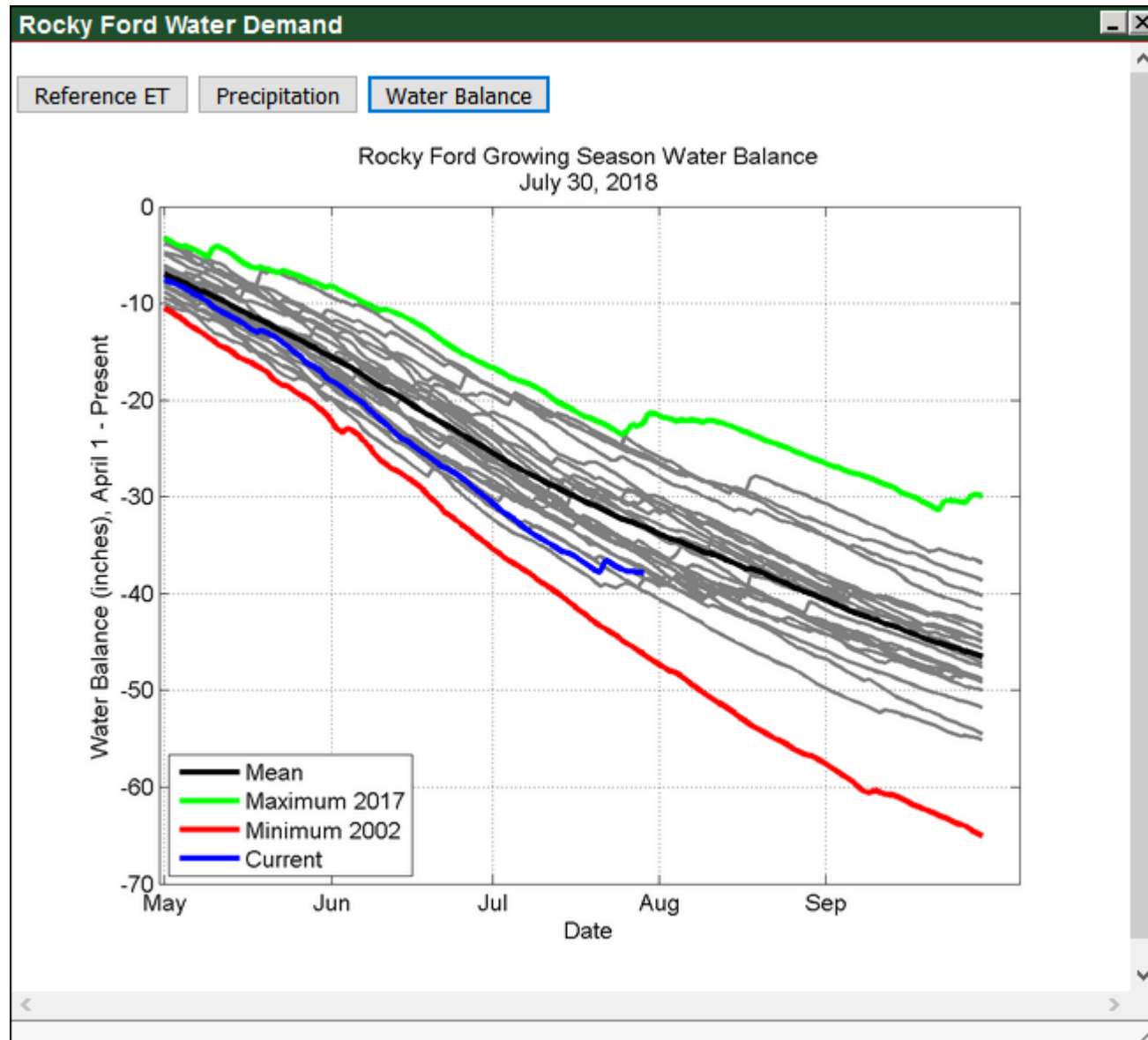




# General Hydrology



# General Hydrology



- Water fluxes
  - Negative Water Balance
- Topography/subsurface geology
  - Sub-irrigation
- Ecology
  - Drought hardened



# General Hydrology

- Potential negative impacts of drought on the hydrologic cycle
  1. Reduction in transpiration (VS - L)
  1. Increased “relative” evaporation (S)
    1. Rising soil temperatures
  1. Springs and streams go dry (S,L)





# Livestock Watering Storage Tanks







11/30/2009



# Livestock Water Storage Tanks

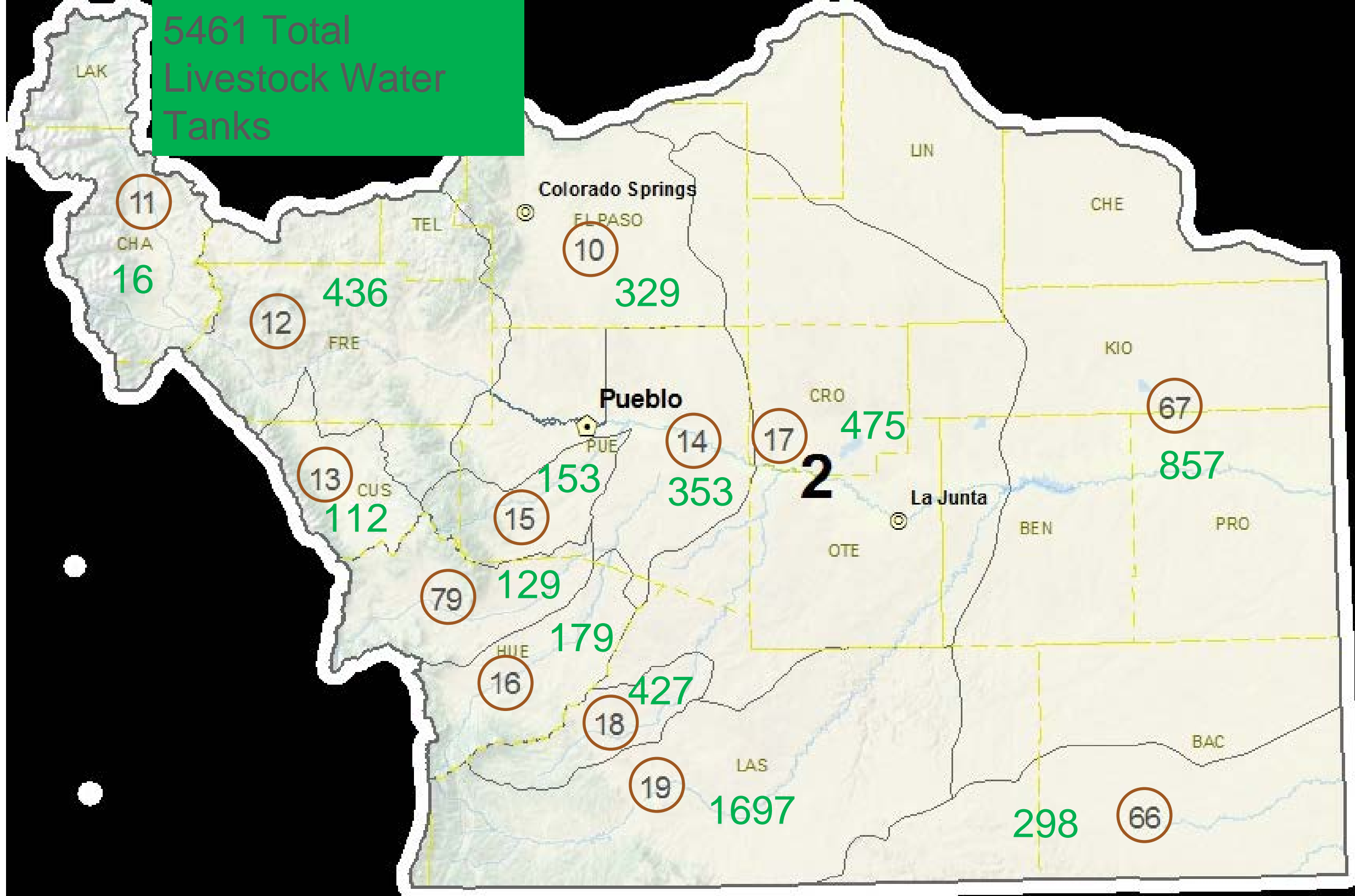
- **Colorado Revised Statutes 35-49**

- Constructed on normally dry (80% of the time) drainages as determined by the State Engineer
- Vertical height 15 feet or less; volume 10 acre-feet or less at emergency spillway level
- Given a chronological “priority” as against other LWST’s on same drainage

**35-49-109. Priority determined - how.** The state engineer's certificate of approval of a livestock water tank on each normally dry stream and its tributaries shall be chronologically numbered in the order of approval and in concert with any erosion control dams approved pursuant to section 37-87-122, C.R.S. Priority of right as between such tanks located on or within the watershed of each such dry stream shall be determined by such numbers seriatim, number one being first in such right.



5461 Total  
Livestock Water  
Tanks





# Website Information

- Existing permits
  - <https://data.colorado.gov/Water/DWR-Livestock-Water-Tank-and-Erosion-Control-Dams/r2rp-ecjb/data>
- LWST Applications
  - [http://water.state.co.us/DWRIPub/Documents/ds\\_livestock.PDF](http://water.state.co.us/DWRIPub/Documents/ds_livestock.PDF)



# Where do I look to find my permit?

The screenshot shows the Colorado Information Marketplace website. The main heading is "Where do I look to find my permit?". The website interface includes a search bar, navigation links (Home, Data Catalog, Help, Video Tutorials, Feedback, Status Blog), and a "Sign In" button. Below the navigation is a "Save As..." and "Revert" section. The main content area displays a data table titled "Based on DWR Livestock Water Tank and Erosion Control Dams". The table has the following columns: Receipt, Application Type, Title, Title No, Applicant Name, Application Date, Completion Date, DIV, WD, County, PM, and Township. The table contains 24 rows of data, each representing a different permit application.

Receipt	Application Type	Title	Title No	Applicant Name	Application Date	Completion Date	DIV	WD	County	PM	Township
1	LIVESTOCK WATER TANK	KLETT	1-1941	KLETT, R H	07/23/1941		2	67	BENT	S	25 S
2	LIVESTOCK WATER TANK	KLETT	2-1941	KLETT, R H	07/23/1941		2	67	BENT	S	26 S
3	LIVESTOCK WATER TANK	KLETT	3-1941	KLETT, R H	07/23/1941		2	67	BENT	S	25 S
4	LIVESTOCK WATER TANK	KLETT	4-1941	KLETT, R H	07/23/1941		2	67	BENT	S	26 S
5	LIVESTOCK WATER TANK	MANIFOR	1941	MANIFOR, HENRY	07/28/1941		2	17	BENT	S	24 S
6	LIVESTOCK WATER TANK	STOUT	2-41	STOUT, JOHN W	08/01/1941	08/20/1941	2	67	BENT	S	27 S
7	LIVESTOCK WATER TANK	SNIFF BROS	2-1941	SNIFF BROS	08/07/1941	09/02/1941	2	67	BENT	S	25 S
8	LIVESTOCK WATER TANK	SNIFF BROS	3-1941	SNIFF BROS	08/07/1941	10/07/1941	2	67	BENT	S	26 S
9	LIVESTOCK WATER TANK	SNIFF BROS	4-1941	SNIFF BROS	08/07/1941	09/29/1941	2	67	BENT	S	26 S
10	LIVESTOCK WATER TANK	SNIFF BROS	5-1941	SNIFF BROS	08/07/1941		2	67	BENT	S	24 S
11	LIVESTOCK WATER TANK	HASSER	1941	HASSER, OSCAR	09/04/1941		2	67	BENT	S	25 S
12	LIVESTOCK WATER TANK	HALL	1941	HALL, ELVIN	09/24/1941		2	67	BENT	S	27 S
13	LIVESTOCK WATER TANK	MCENDREE	1941	MCENDREE, I F	10/15/1941		2	67	BENT	S	27 S
14	LIVESTOCK WATER TANK	TROSTEL	1-41	TROSTEL BROS	10/15/1941	06/21/1940	2	67	BENT	S	24 S
15	LIVESTOCK WATER TANK	TROSTEL	2-41	TROSTEL BROS	10/15/1941	10/11/1941	2	67	BENT	S	27 S
16	LIVESTOCK WATER TANK	TROSTEL	3-41	TROSTEL BROS	10/15/1941	10/30/1940	2	67	BENT	S	26 S
17	LIVESTOCK WATER TANK	GALL		GALL, H F	10/22/1941		2	67	BENT	S	27 S
18	LIVESTOCK WATER TANK	SNIFF	1	SNIFF BROTHERS	10/10/1941		2	67	BENT	S	24 S
19	LIVESTOCK WATER TANK	DEAHL		DEAHL BROS	05/22/1942		2	17	BENT	S	26 S
20	LIVESTOCK WATER TANK	SMITH		SMITH, FLOYD C	09/12/1941		2	17	BENT	S	24 S
21	LIVESTOCK WATER TANK	AULT	1	MCENDREE BROS	10/15/1941		2	67	BENT	S	27 S
22	LIVESTOCK WATER TANK	SORENSEN	1	SORENSEN, HAROLD	11/28/1941		2	67	BENT	S	24 S
23	LIVESTOCK WATER TANK	POINTON	1	POINTON, JAMES	02/06/1942		2	67	BENT	S	22 S
24	LIVESTOCK WATER TANK	POINTON	2	POINTON, JAMES	07/06/1942		2	67	BENT	S	21 S

At the bottom of the page, there are navigation links: Home, Data Catalog, Colorado.gov, Terms of Use, Privacy Policy. The footer also includes the text: © 2017 State of Colorado Powered By Socrata.



# Drought and Water Quality

Drought can impact both surface, and subsurface water quality.





# Drought and Water Quality

- General Water Quality in the Wet Mountain Valley
  - Pure mountain water!
  - Major issues include: sedimentation, nutrients (N&P), salinity, selenium
- Can impact livestock watering, but also domestic wells
- Water Temperature – Affects on aquatic biology and water chemistry



# Drought and Water Quality

- Water Temperature – *Biological*
  - Increase aquatic vegetation production
    - Depends on starting temperature, is temp a limiting factor to growth?
    - Most pronounced in still water (i.e. ponds)
  - Stress in aquatic life, including fish
    - Most aquatic invertebrates can better tolerate heat
    - Fish species have different tolerances
      - Is the warming gradual, or sudden?



# Drought and Water Quality

- Water Temperature – *Chemical*
  - Warm water can speed up chemical reactions
    - Impacts to groundwater quality
  - Warm water holds less oxygen
  - Lower stream flows can create stagnation and higher chemical concentrations
    - Selenium, salts, arsenic

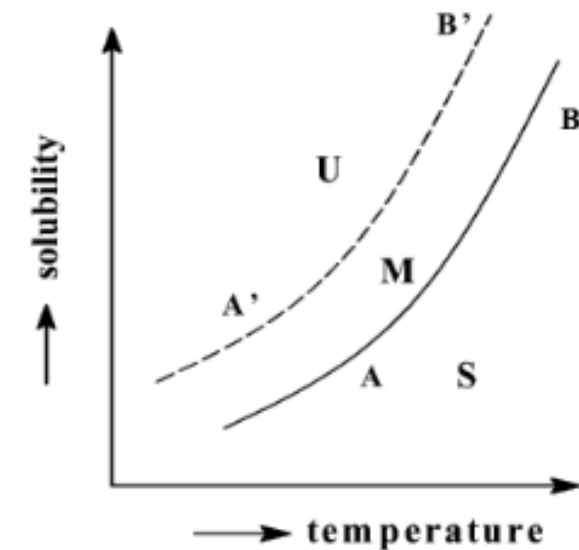
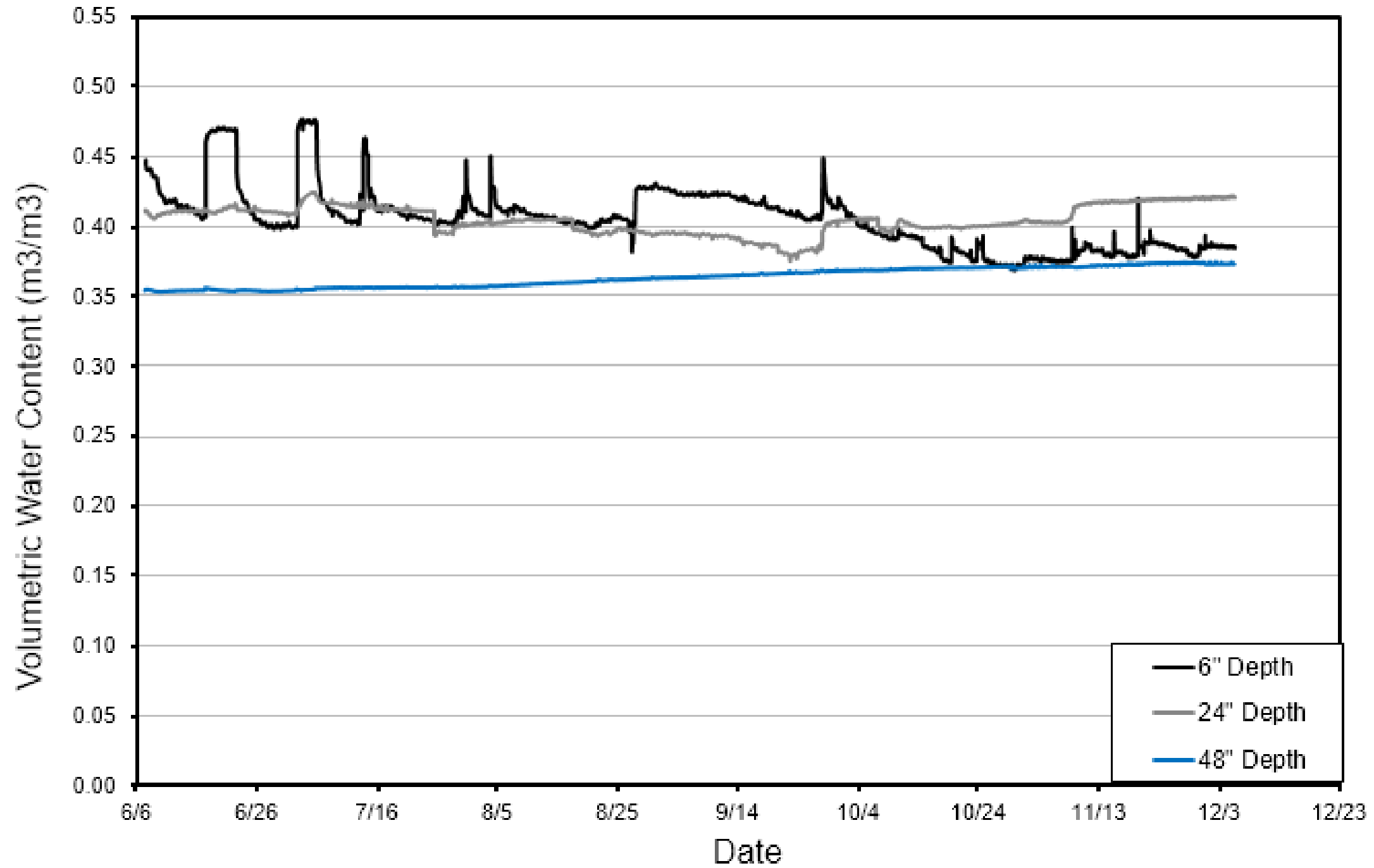


Fig. 6 A typical solubility curve showing the temperature-concentration relation. S, stable region; M, metastable supersaturation region; U, unstable supersaturation region of the solution.





# Soil Moisture Content: *Site C*



# Summary

1. Drought can have short or long-term effects, and these effects vary greatly within the landscape
1. Livestock Water Storage Tanks can be protected under a “priority” system
1. Drought can significantly affect water temperatures and water quality



# Thank you



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# Drought and Water Quality

- General Water Quality in the Lower Arkansas River Valley
  - Water quality in the river gets progressively worse as you get closer to Kansas
  - Major issues include: uranium, selenium, manganese, a variety of salts
- Can impact livestock watering, but also domestic wells
- Water Temperature – Affects on aquatic biology and water chemistry

