

# The Colorado State University LYSIMETER PROJECT

## MEASURING CROP WATER USE TO COMPLY WITH THE ARKANSAS RIVER COMPACT

The CSU Lysimeter Project, established in 2006 and expanded in 2009, is based at the Arkansas Valley Research Center in Rocky Ford, Colorado. The project uses two lysimeters and a network of weather stations to precisely measure the amount of water used to cultivate crops in Colorado's agriculturally important Arkansas River Valley. CSU researchers use data gathered with these instruments to improve scientific calculations and analysis of the amount of water used in regional crop production. This research-based information is critical to Colorado's ability to comply with the Arkansas River Compact, which directs the states of Colorado and Kansas in use of – and returns to – the Arkansas River.

### Background

- The mathematical equation used as the standard to calculate crop consumptive water use, known as crop evapotranspiration, or Etc, was changed to the more accurate Penman-Monteith equation as a result of litigation between Kansas and Colorado over the Arkansas River Compact.
- The Penman-Monteith equation has not been tested in the Arkansas River basin, and requires a new set of crop coefficients to estimate ETC for crops grown in the basin. The CSU Lysimeter Project helps provide and test this information.
- Calculated ETC values are used in the Hydrological-Institutional Model (H-I Model) that is used to calculate the effects of well pumping and replacement water on usable stateline flows in the Arkansas River.

### Project objectives

- Validate the American Society of Civil Engineers (ASCE) Penman-Monteith equation for calculating reference evapotranspiration (ET<sub>r</sub>) in the basin for use in Arkansas River Compact compliance.
- More accurately represent consumptive water use of major irrigated crops in the basin, by defining the crop coefficients (K<sub>c</sub>) used to convert ET<sub>r</sub> to equivalent crop ET (ET<sub>c</sub>) values.



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## How the lysimeters work

The CSU project at Rocky Ford maintains two lysimeters: The larger instrument is used for measuring crop Etc; a second, smaller lysimeter is used as a control and measures alfalfa as a reference.



A steel box containing undisturbed soil is set on a very sensitive underground weighing scale that continuously records the mass of the box.



The weighing scale detects all additions and subtractions of water in the lysimeter box. Crop  $ET_c$  is the main subtraction of water from the lysimeter, and is recorded continuously. Any irrigation, rainfall, or drainage is also detected by the weighing scale.

The lysimeter is managed the same way as the surrounding field with the goal of having crop growth in the lysimeter that is very similar to the surrounding field.



## Project Benefits

- More accurate calculations of replacement water required for depletions from well pumping.
- ASCE Penman-Monteith equation validated for Arkansas Valley conditions.
- Better  $ET_r$  and  $K_c$  values for use in the H-I Model, allowing for compliance with the Arkansas River Compact.
- Accurate mapping of  $ET_c$  across the entire basin.
- Better crop coefficients for ET-based irrigation scheduling.
- Better  $ET_c$  calculations for future administration of water rights.