USE OF SUPPORTING DATA

for ET Estimates
SOURCES OF SUPPORT DATA

• Today, your main source of data may be the Internet and digital copies of publications from the library
• For me, the main source has been reprints and miscellaneous publications that I collected over a half century in my work because I was not stationed near a university library
• I subscribed to several engineering and agronomy journals and Irrigation Science
• A common practice before the Internet was to request a reprint of articles of interest from the authors, or request a copies from the USDA National Agricultural Library
• Many publications were mailed to me by authors that knew of my work and interests
• I retired first from ARS-USDA in 1987 and from CSU in 1993
• I was involved in several water-related projects from 1989 to 2011
• Three projects in which supporting data were very helpful in supporting my ET estimates or in verifying ET calculations will be described briefly
• These are:
  – ET estimates for the Nebraska vs. Wyoming lawsuit
  – Estimating ET and evaporation from Hoover Dam to Mexico
  – Estimating ET, irrigation efficiency and return flow from the Imperial Irrigation District (IID) in California
NEBRASKA vs. WYOMING

- Nebraska filed the suit in 1986
- Wyoming filed counter claims in 1987
- The case was settled out of court in 2001 the day before trial was to begin
- In brief, Nebraska claimed that Wyoming was consuming more water from the North Platte River than it was entitled to under the North Platte Decree as apportioned in 1945
- The apparent main basis for the suit was that crop yields in Wyoming had increased substantially, therefore the assumption was that more water was being consumed
- The 1945 Decree, supplemented in 1953, was modified in 2001 with later revisions of some Exhibits
Background

• Numerous publications in the early 1960s indicated that crop yields could be increased substantially by adding a deficient nutrient like zinc, phosphorus or nitrogen with little or only a slight increase in water consumed

• Much of the irrigated land along the North Platte River in Wyoming was irrigated hay

• There were some other crops like corn and grain crops
Examples of Supporting Data

• First, agricultural statistics indicated that the use of nitrogen fertilizer in Wyoming began increasing in the 1980s—a five-fold increase
• A study of hybrid corn yields using hybrids released from the late 1950s to the 1990s showed that corn yields increased depending on the year the hybrid was released
• Increasing corn yields in Wyoming paralleled the increase in hybrids based on the year the hybrid was released
• These and other data that I used, I believe, played a significant role in refuting the claims that water consumption must have increased as yields increased
• ET was estimated using traditional methods with some short term Bowen ratio & eddy covariance measurements
ESTIMATING WATER CONSUMPTION—
HOOVER DAM to MEXICO

• The USBR is required by law to account for consumption of water from the Colorado River from Hoover Dam to Mexico
• ET and evaporation estimates were needed
• Originally, the USBR planned to use a water balance model based on ET estimates made with the Blaney-Criddle equation
• A visit to all the weather stations from Hoover Dam to Mexico indicated many stations were poorly sited, next to bldgs, & other obstructions
Approach I Used to Estimate ET

• Daily weather data from CIMIS and AZMET
• Crop coefficients were mainly from FAO 56 for about 40 cropping & vegetation groups
• Crop and phreatophyte ET estimates verified using reported crop and phreatophyte data
• Free water evaporation estimates for each of the four reaches between dams were made using the Penman-Monteith equation
• The resulting system is known as the Lower Colorado River Accounting System (LCRAS)
Supporting Data Used

• Reported measured crop ET and salt cedar ET data from the literature & unpublished reports
• Measured ET from phreatophytes (salt cedar) based on Bowen ratio measurements
• Reported phreatophyte green-up & decline dates
• Surface water temperatures based on limnology studies on reservoirs
• Water temperature data from below dams and at the pumping station to the Arizona were used to support estimated surface water temperatures and for calculating horizontal energy advection
Results

• Initially, daily crop coefficients for each crop and vegetation group was provided to the USBR
• Later, I think the USBR developed monthly coefficients from the daily coefficients
• Estimates of total ET for each of the four reaches were compared with measured depletions and diversion to the All American Canal (Imperial Irrigation District)
• To my knowledge, the LCRAS system is still being used
ASSESSMENT of WATER USE by the IMPERIAL IRRIGATION DISTRICT (IID)

• An assessment first began in 1993 when the USBR organized a team of five to study use of water diverted from the Colorado River
• The study was supported by IID and the Metropolitan Water District (MWD)
• The team prepared a draft report of phase I and presented it to the IID in January 1994
• IID reneged on proceeding with phase II
Assessment Continued

• I was asked by the USBR to do an independent assessment of water use by the IID
• My first report was completed in 1995
• It was updated by Jensen and Ivan Walter in 1997 using a FORTRAN program to facilitate calculations
• Daily CIMIS and AZMET weather data were used
• ET estimates were verified as done with LCRAS
• Supporting data were published ET data and ET data in unpublished reports
Summary of Results

- Colorado River diversions and delivery to IID had increased about 400,000 ac-ft per year from 1987 to 1997 to 3.1 million ac-ft
- Tailwater and estimated leach water increased
- Net inflow to the Salton Sea increased about 20% from 1987 to 1990 & from 1994 to 2001
- The level of the Salton Sea increased reflecting the effects of the higher flows
- Why the increased diversions? My opinion
Current Status

• In 2003, an historic 75-year Quantitative Settlement Agreement (QSA) was signed by the parties involved.
• The QSA included the transfer a large share of Colorado River water to urban use from water diverted to IID which would reduce the flow to the Salton Sea.
• The QSA specified 80,000 ac-ft/yr to go to San Diego.
• In 2009, a lower court invalidated the QSA because it required California to write a blank check to offset environmental projects such as restoring the Salton Sea.
• On December 7, 2011 the State appeals court upheld part of the QSA reversing the lower court’s ruling.
Summary

• These brief examples illustrate that various data can support ET estimates or verify the ET estimates that were made
• My ET estimates, I believe, have impacted decisions that were made
• Conclusion—make the best of information available to you (example)