Missouri CEAP Update

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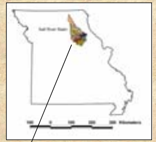
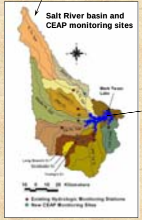
Site Description

- **Hydrology, Soils, Land Use**
  - The Salt River Basin in northeastern Missouri is the source of water to the Mark Twain Lake, a 7,530-ha Army Corps of Engineers reservoir.
  - The 6,522-km^2 Salt River system has ten watersheds at the 11-digit scale.
  - Soils were formed in loess overlying glacial till, with argillic horizons containing 40-60% smectitic clays.
  - Topography within the watershed is flat to gently rolling, with most areas having 0-3% slopes.
  - Land use is predominantly agricultural. Row crops are mainly soybeans, corn, wheat, and sorghum. Forages include tall fescue. Livestock includes beef cattle, with swine increasing in some watersheds.
  - Precipitation averages about 1000 mm per year. Stream flow in Goodwater Creek accounts for about 30% of precipitation. Runoff accounts for 85-90% of total stream flow.



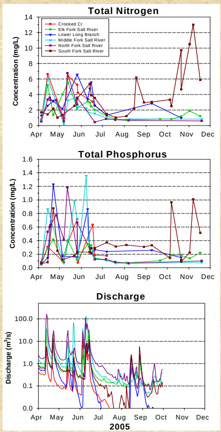


Salt River basin and CEAP monitoring sites

Mark Twain Lake and Clarence Cannon Dam

Basin Scale Monitoring

- **Monitoring Scheme and Rationale**
  - 13 monitoring sites were established in spring 2005 to monitor water quality for all major watersheds of Mark Twain Lake.
  - Water quality monitoring at Goodwater Creek has been conducted since 1991 and will continue during CEAP.
  - Contaminant loads can be assessed for individual watersheds.
  - The monitoring scheme allows contaminant mass balances to be estimated for Mark Twain Lake.
  - Water quality monitoring data and knowledge of contaminant residence times and dissipation within the lake will aid basin-scale modeling efforts.
  - At basin and watershed scales, grab samples will be collected twice a month, and all runoff events will be sampled by automatic samplers.
  - Contaminant monitoring will include commonly used corn and soybean herbicides, dissolved and total N and P, and suspended sediment.
- **2005 Results**
  - Total N and P concentrations and daily discharge for selected sites are shown in Fig. 2.
  - Overall, 2005 was quite dry with runoff events that were modest in magnitude and low or no flow conditions for much of the summer and early fall.
  - Total N concentrations were generally in the range of 1 to 10 ppm from April-June, with peak concentrations coinciding with runoff events.
  - Total N dropped to <3 ppm at all sites after mid-June, except the South Fork Salt River which had significantly higher concentrations from August through December than the other sites.
  - Total P concentrations showed a very similar pattern to that of total N, with highest concentrations coinciding with runoff events.

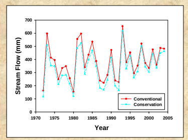


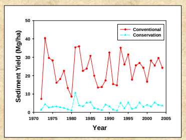
SWAT Model Evaluations for Goodwater Creek Watershed

Assumptions:
For the purposes of this test, we assumed two scenarios. The first was a fully mechanical (pre-herbicide use) *conventional tillage* system corresponding to typical use in the mid 1960s. The second was a more nearly current practice of *conservation tillage* to retain residue in the soil surface. Both scenarios were assumed to have operated for the 1972-2004 period, so that the differences between the simulations would illustrate the sensitivity of the SWAT model to gross differences in management practices.

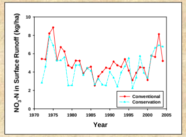
To avoid confounding interpretation caused by differences in timing of fertilizer and rainfall, applications of fertilizer for each crop were simulated on the same dates across management. This does not represent actual practice, but simulations to determine the effect of timing alone are the objective of future research.

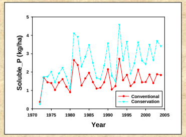
All crops were assigned according to the known proportions from the 1993 Farm Services Administration commodity program data. The remaining cropland was split among corn, wheat, soybean, and grain sorghum to approximate the county distribution.

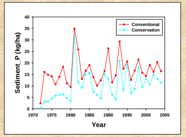




Runoff and Sediment:
These results are generally expected from the suite of input parameters varied. Most original conservation tillage measured were designed to reduce erosion, and sediment loss reflects that intent. Residue is generally considered to reduce runoff, which is consistent with Curve Number input parameter choices, but this will need to be checked carefully against measurements, as the effect of conservation tillage on runoff from claypan soils is ambiguous.







Water Quality Parameters:
The effect of conservation tillage practices on water quality are not as unequivocal as the effect on runoff and sediment in these simulations. The reduction of nitrate in surface runoff is somewhat expected, given that much of the N for corn and grain sorghum was knifed to a 20-cm depth. This appears to offset the remainder of the N for these crops and all of it for remaining cropland being on the surface, whereas all of the N for conventional practice was mixed into the soil soon after application. The increase in soluble P for conservation practice reflects it all being broadcast and remaining on the surface. The somewhat more nearly equal fluxes of sediment-borne P suggests that the surface placement of P in the conservation practice increased the amount bound to the soil lost as sediment.

Conclusions:
Annual results shown here suggest several steps our modeling effort must undertake. First, daily and perhaps event-based results should be examined closely to ascertain the causes of quite different relationships between water quality results from conventional and conservation practice in certain years. For instance, studying 1981 would appear to be educational. Second, it appears that some trends emerge from the period of study, and the cause for this within the model structure and results must be determined. In particular, the initial decade appears to be substantially different from the final one. While the weather in the 1970's and 1990's was generally different, attention must be given to rainfall distribution, frequency, and intensity differences to judge whether these may cause the trends. These examinations will be concurrent with the model calibration and validation process.

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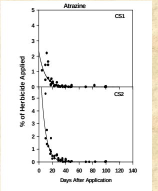
Assessment of Conservation Practices

- **Effect of Cropping Systems on Surface Water Quality**
  - From 1997-2002, a plot-scale study was conducted on the effects of crop rotation, tillage, and placement of herbicides and nutrients on surface water quality.
  - Cropping System 1 (CS1) was a conventionally-tilled production system with herbicide incorporation; Cropping System 2 (CS2) was a no-till production system with herbicides not incorporated.
  - Results showed an exponential decrease in herbicide loss as a function of time.
  - Herbicide incorporation decreased herbicide loss.
  - From this data, a generalized equation was developed to predict herbicide concentration in runoff (Eqn. 1). This equation can also be used to predict loss as a function of time.



Percent of atrazine applied transported in runoff as a function of days after application.

Flume and autosampler during a runoff event.

$$[C] = a * \left(\frac{R}{Q}\right) * e^{-(k*t)} \qquad [1]$$

Where:
[C] = Computed atrazine concentration (μg L^{-1});
R = Herbicide application rates (μg ha^{-1})
Q = Runoff measured for the events (L ha^{-1})
t = Time after herbicide application, days

Watershed-Scale Evaluation of Soil and Water Conservation Practices in the Goodwater Creek Watershed

The Goal

Goal: How do land forms, soils, climate, economic constraints, human factors, and agricultural practices interact to improve water quality?

The effect of climate, crops, and management practices is imperfectly known at the field and watershed level. What is known is embodied in watershed models such as the Soil and Water Assessment Tool.

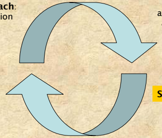
The Process

Survey

Assess factors impacting grower decisions related to cropping and best management practices.

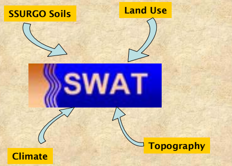
Data Analysis
Detect trends in flow and water quality and correlate them with land use changes and adoption of management practices.

Education and outreach: Field days, demonstration sites.



Economic Analyses
Assess the farm-scale economic impact of implementing best management practices

Modeling and GIS



- Analyze the impact of land use and management practices on water quality at the watershed level.
- Identify critical locations for BMPs

Steering Committee

Develop a watershed management plan

The Outputs

Increased knowledge
A watershed model
Educational materials
A watershed plan