Real-Time Water-Quality in Kansas

Turbidity and Suspended Sediment Workshop
Reno, Nevada
April 30 – May 2, 2002

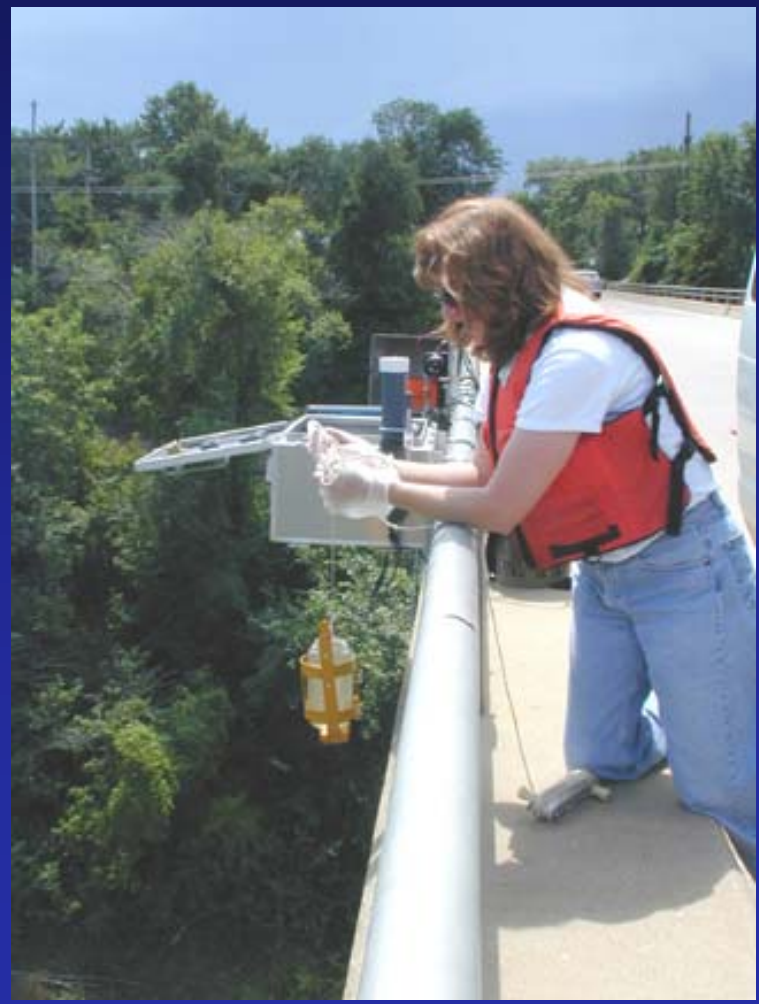
By Patrick Rasmussen, Victoria Christensen, and Andrew Ziegler

Water-quality data is obtained with almost the same processes used more than 50 years ago….

USGS
science for a changing world

Limitations of Conventional Water-Quality Monitoring

- **Daily and annual load estimates based on Q**
- **Seasonal, diurnal, and event driven WQ changes are missed**
- **Sample collection is timely**
- **Costs of manual sampling**



USGS
science for a changing world

Approach

1. **Upgrade selected USGS stream gages**
2. **Collect periodic manual samples**
3. **Develop regression equations**
4. **Estimate concentrations and loads**

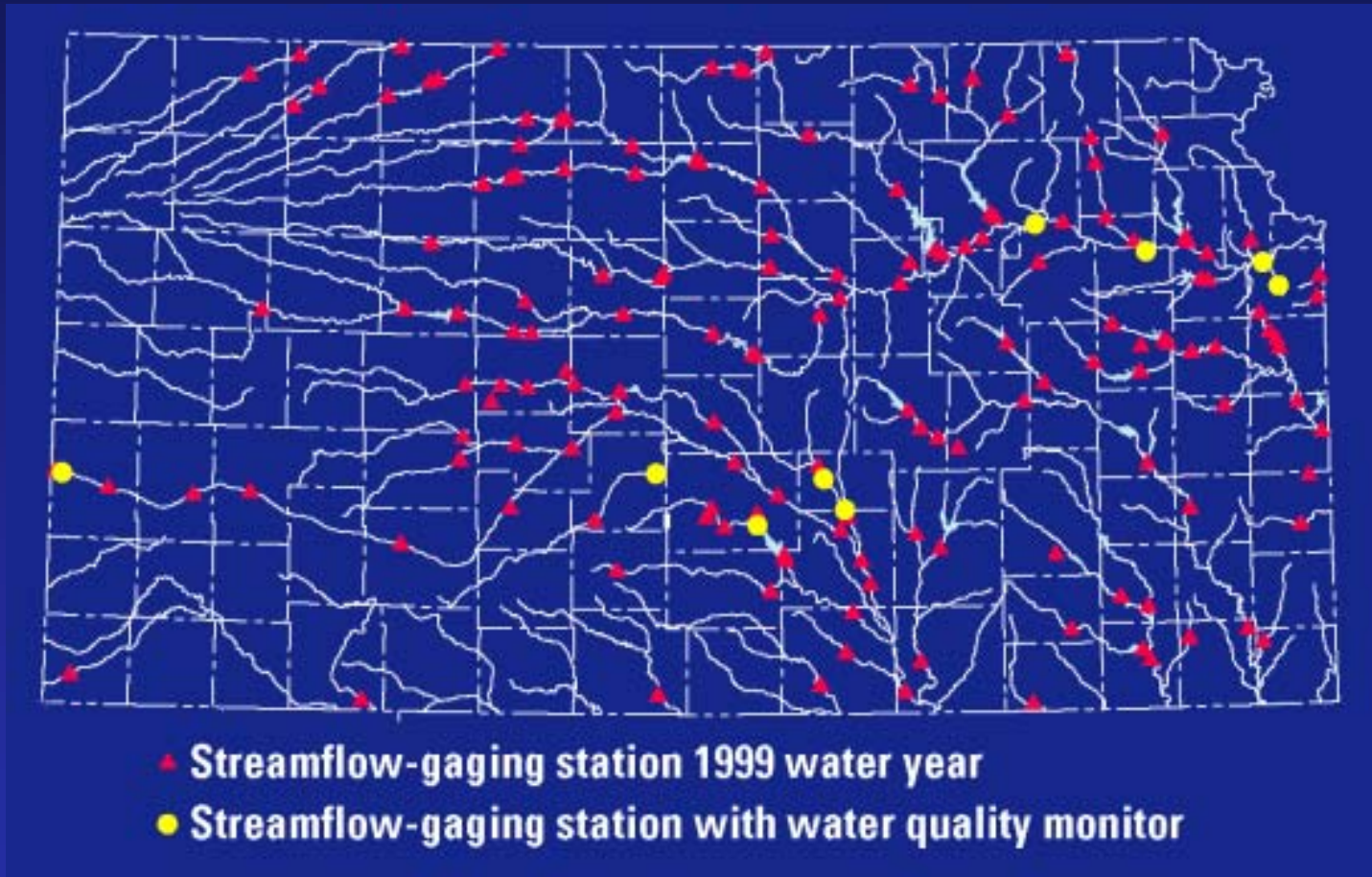
USGS
science for a changing world

Overview of Surrogate Studies in Kansas

- **Quivira National Wildlife Refuge**
- **New Lake Olathe**
- **Equus Beds Ground-Water Recharge Project**
- **Kansas River Real-Time Alert Network**

USGS
science for a changing world

Current Streamflow-Gaging Locations in Kansas



USGS
science for a changing world

Real-time, Continuous Water-Quality Monitoring

- **pH**
- **Water Temperature**
- **Dissolved Oxygen**
- **Specific Conductance**
- **Turbidity**
- **ORP**
- **Total Chlorophyll**

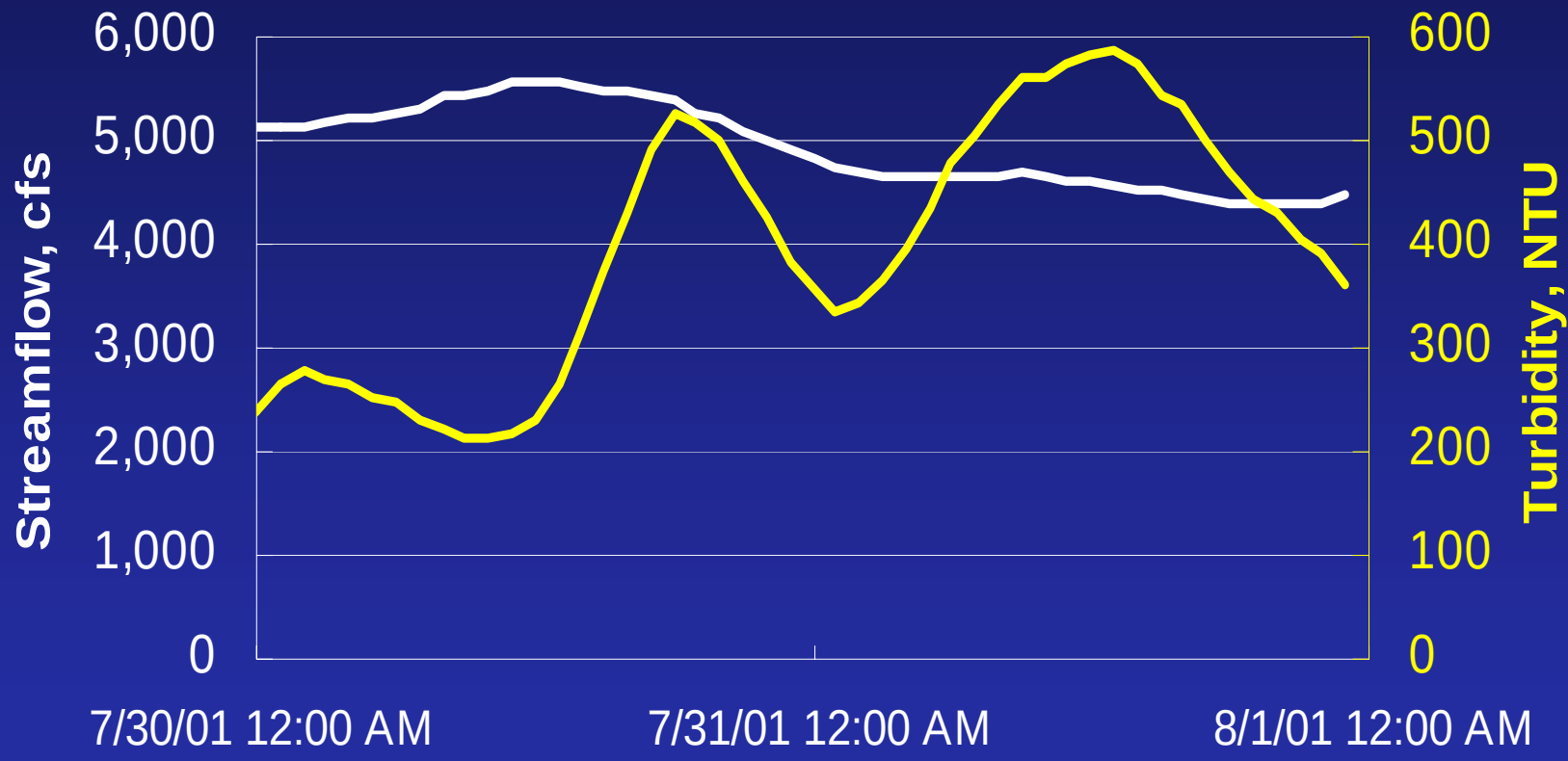
USGS
science for a changing world

Kansas River Alert Network

- Kansas Dept of Health and Environment (KDHE)
- Optimize sample collection frequency
- Fecal Coliform vs. E. Coli
- Monitor TMDLs
- Alert downstream water suppliers

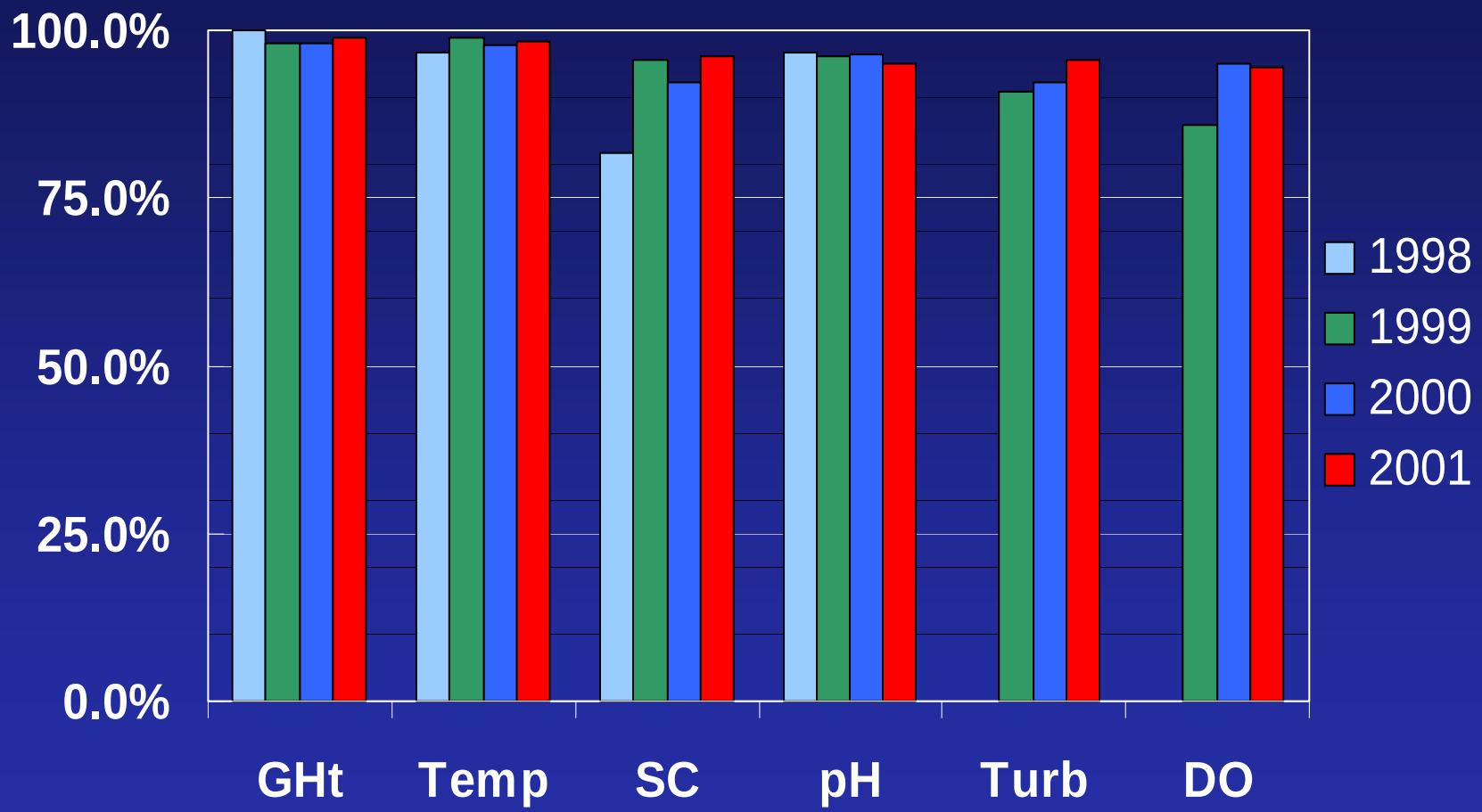
USGS
science for a changing world

Turbidity is NOT Correlated with Streamflow



USGS
science for a changing world

Data Completeness



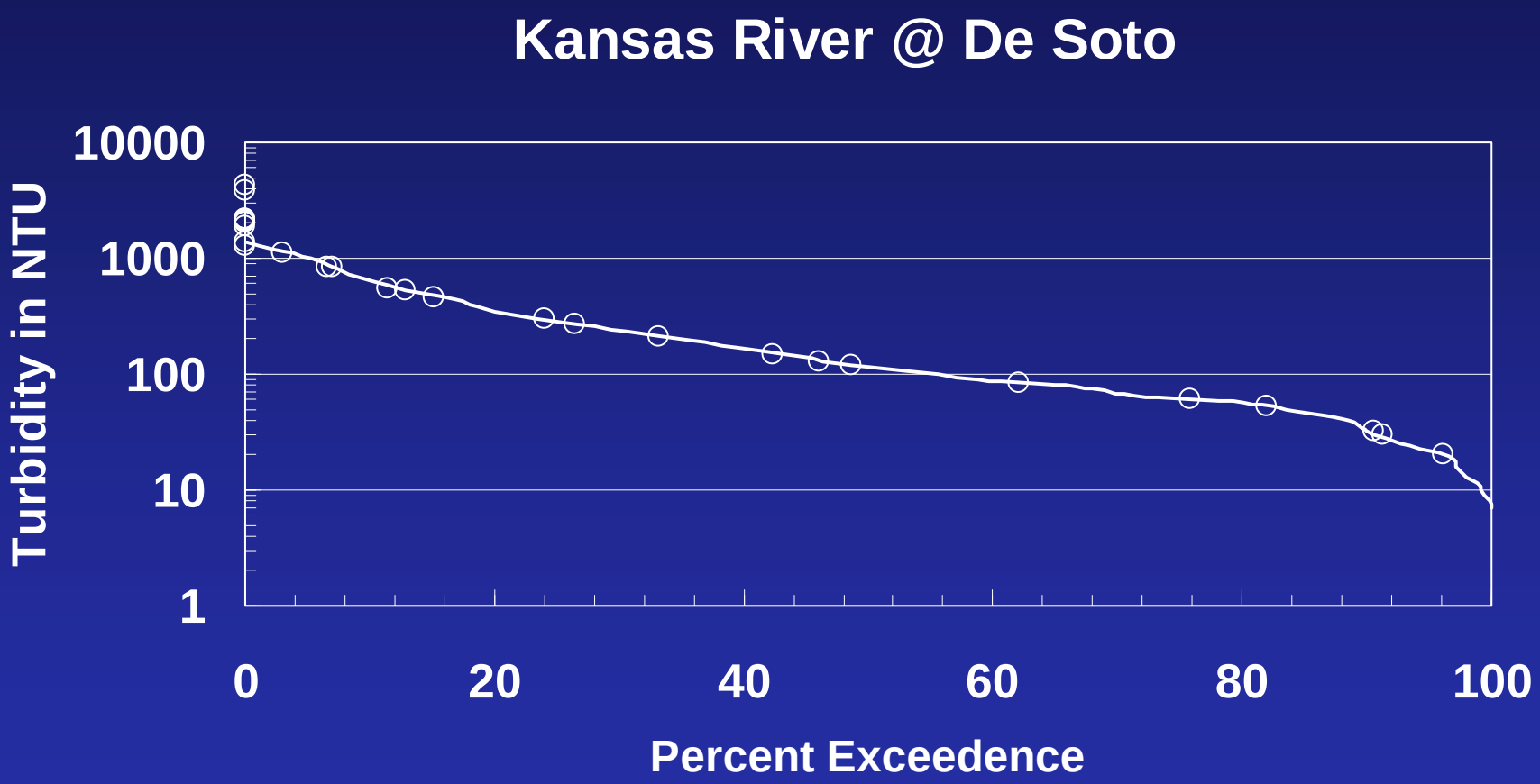
USGS
science for a changing world

Collection of Manual Samples

- **Collected during a range of hydrologic and water-quality conditions**
- **Analyzed for nutrients, bacteria, and other selected constituents**

USGS
science for a changing world

Turbidity Duration Curve



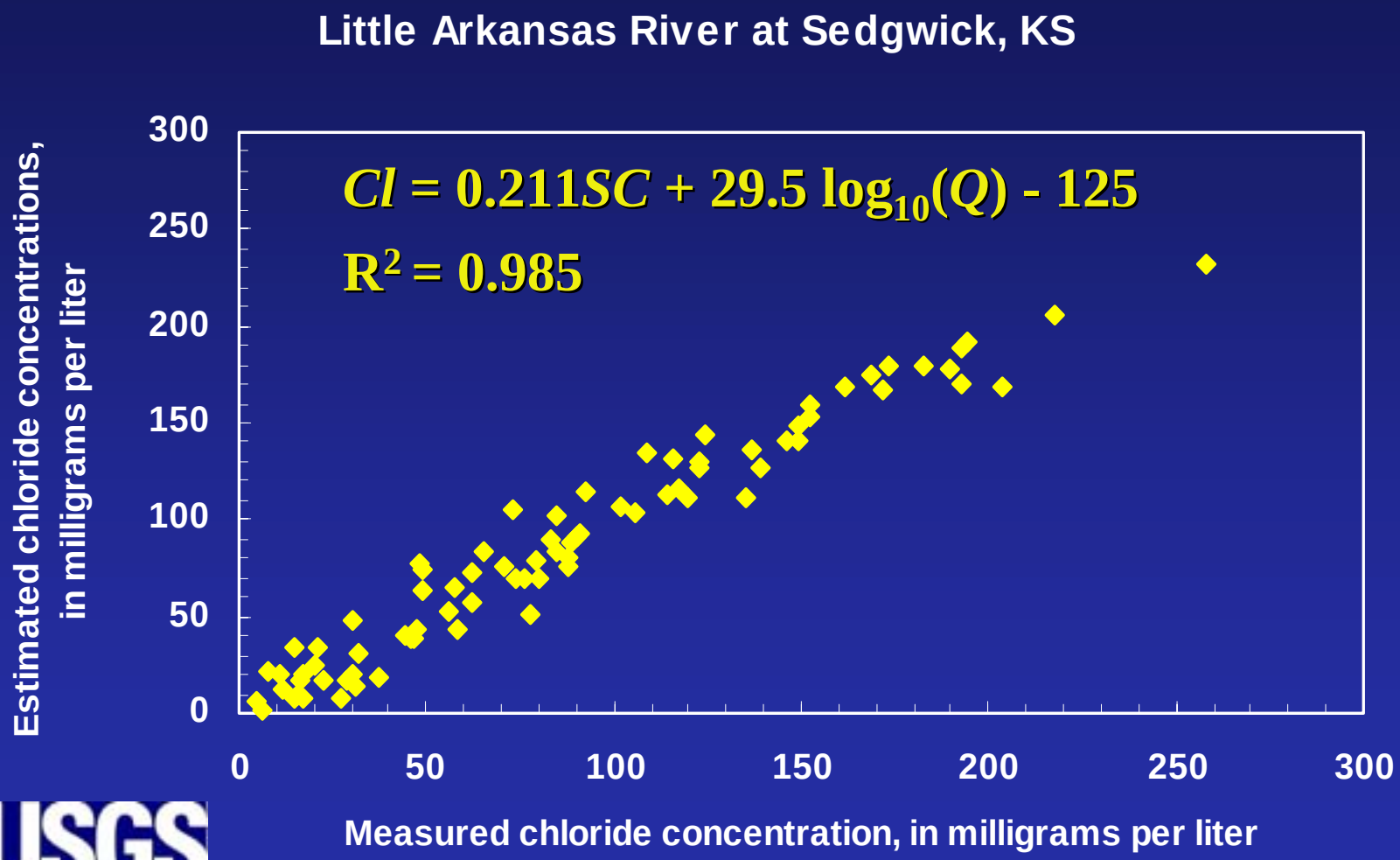
USGS
science for a changing world

Surrogate used to Predict

Stage	Discharge
Specific Conductance	Chloride, alkalinity, dissolved solids, sulfate, triazine
Turbidity	Total suspended solids, suspended sediment, fecal coliform, *E. coli*, total nitrogen, total phosphorus
Fluorescence	Chlorophyll-a, Taste and odor

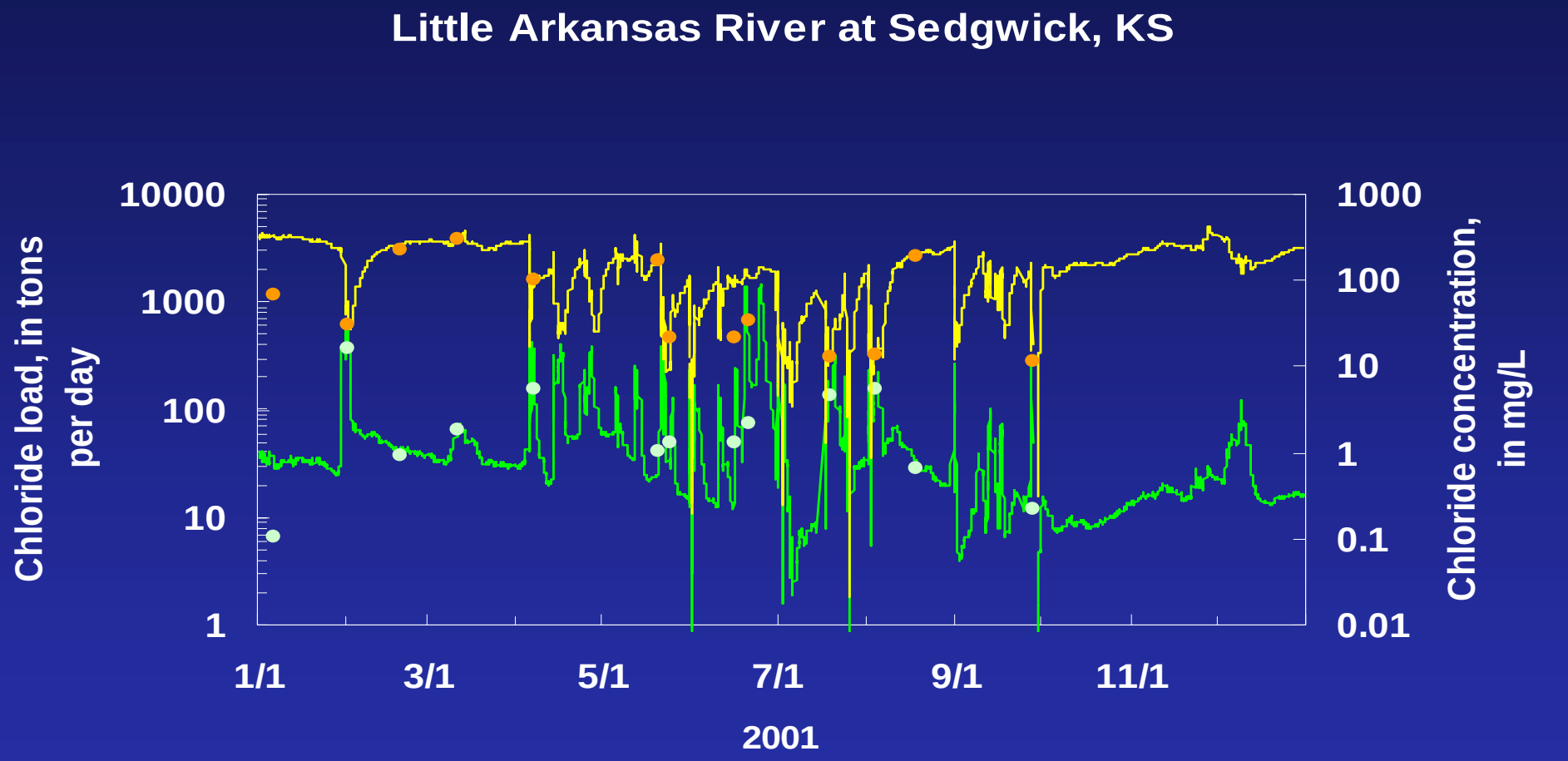
USGS
science for a changing world

Estimated vs. Measured Chloride Concentrations



USGS
science for a changing world

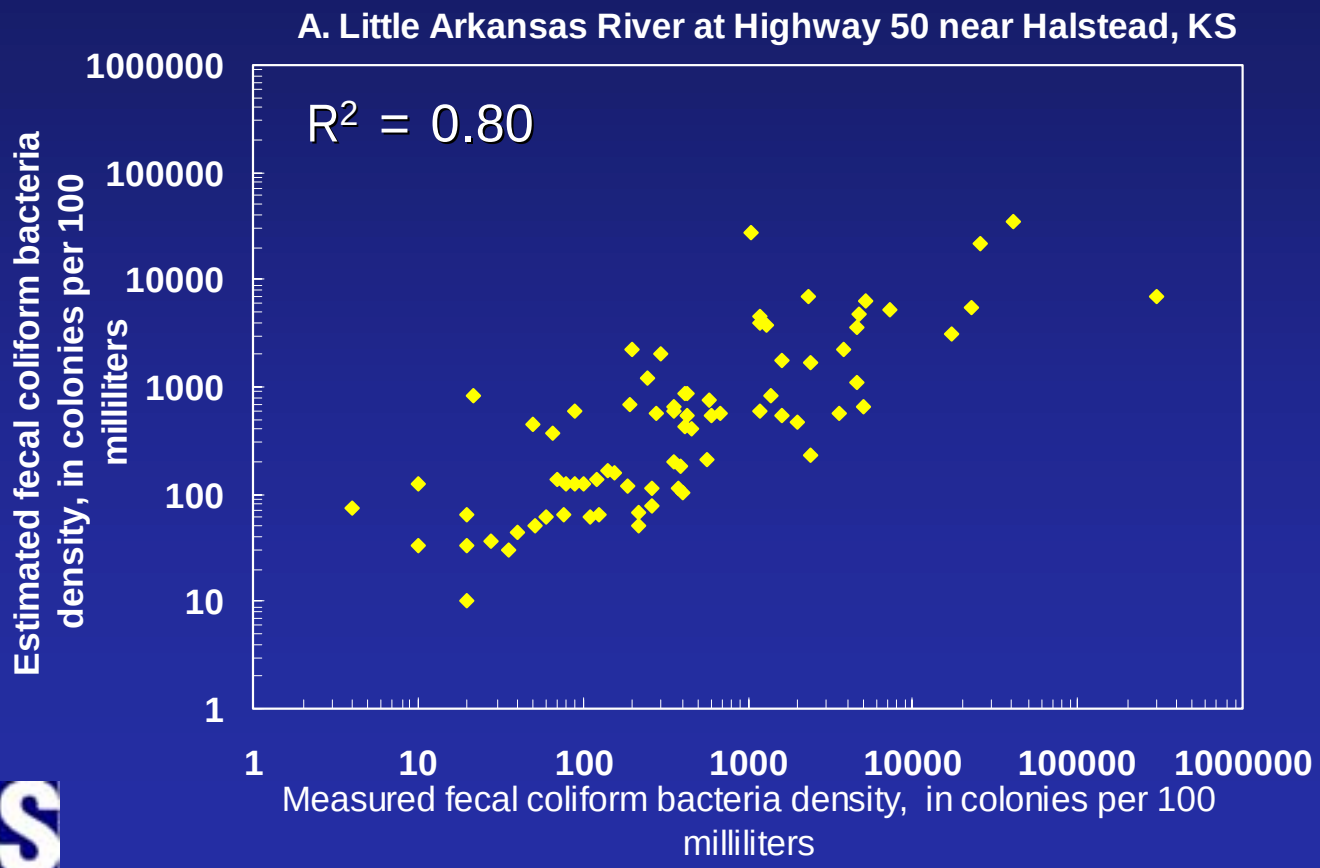
Real-Time Concentrations and Loads



USGS
science for a changing world

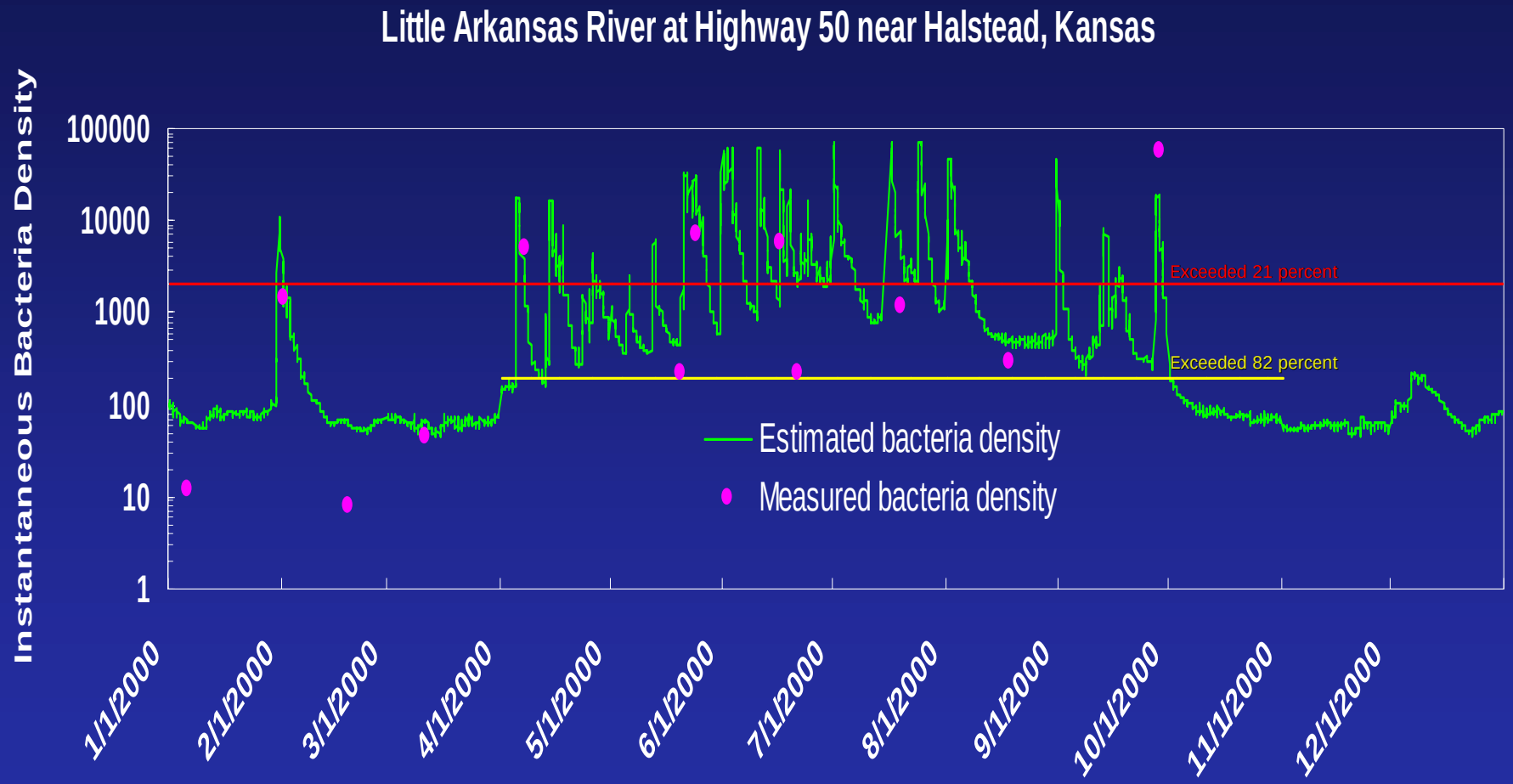
Estimated vs. Measured Bacteria Densities

$$\log_{10}(FCB) = 0.960 \log_{10}(NTU) + 0.771$$



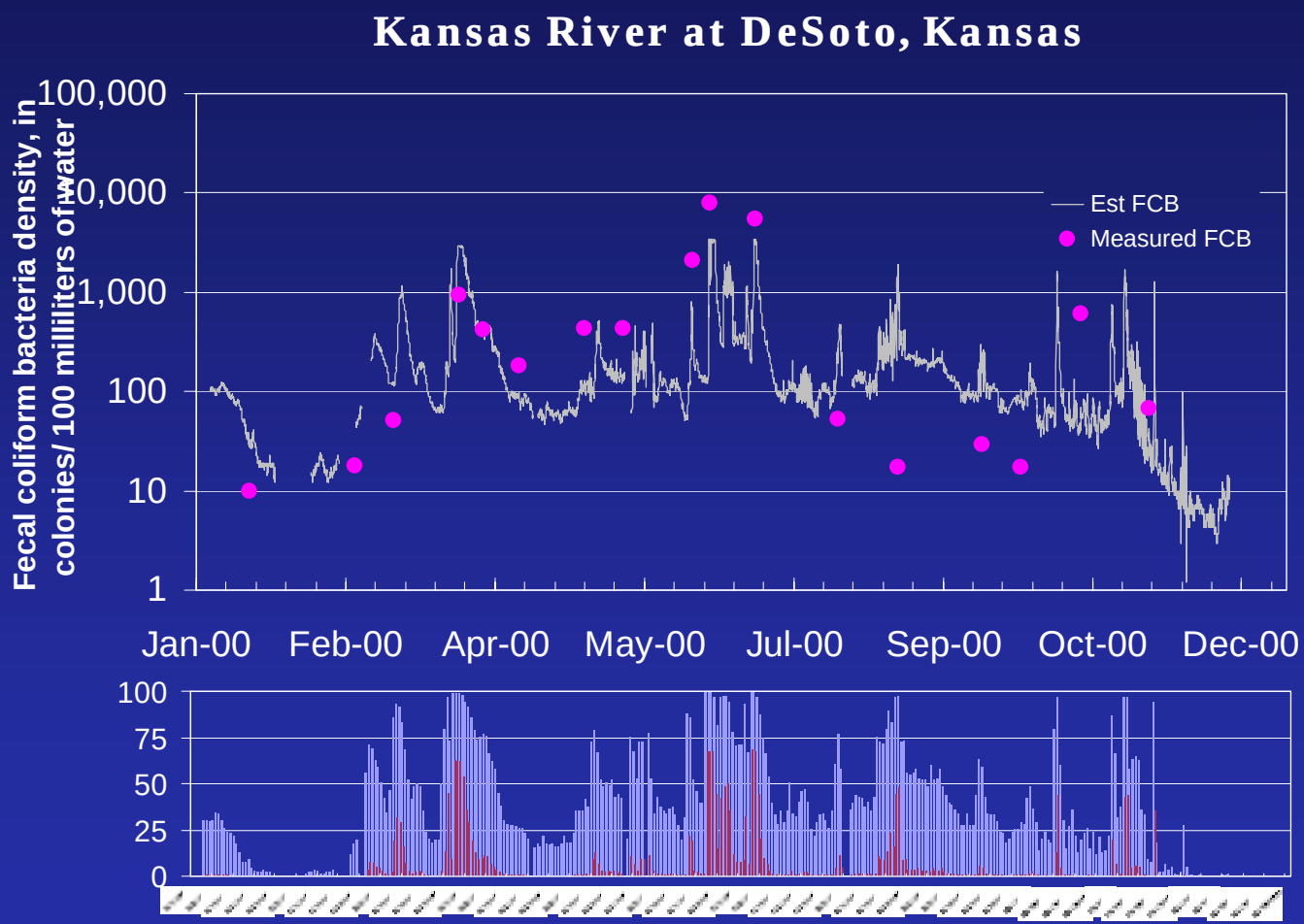
USGS science for a changing world

Fecal Coliform Densities



USGS
science for a changing world

Fecal Coliform Bacteria



Real-time concentrations on the web

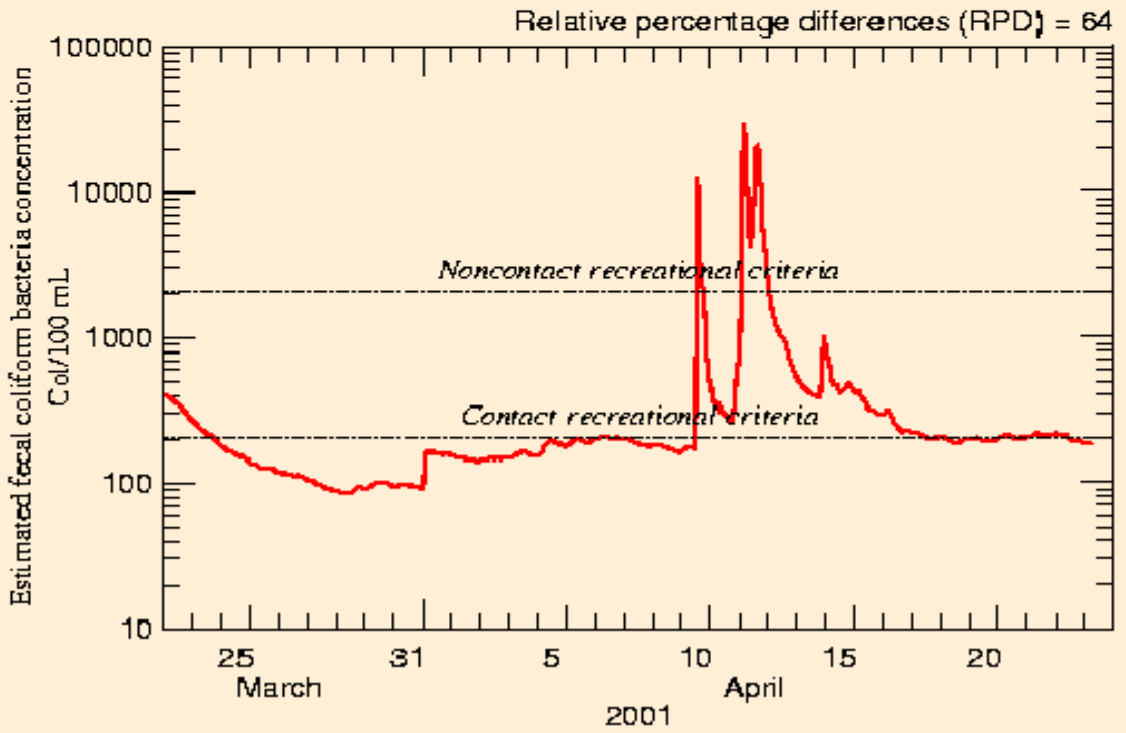
Real-time Water-Quality Concentration and Load Estimated by Regression Analysis

USGS station: 07143672 Little Arkansas River At Highway 50 near Halstead

Parameter: Real-time | Fecal coliform bacteria | Concentration

Output format: Time series plot only

< Go >



USGS science for a changing world

Sources of Uncertainty

- Missing explanatory information
- Sampling and sub sampling/splitting
- Laboratory analysis
- Sensor measurements
- Streamflow measurements
- Regression analysis

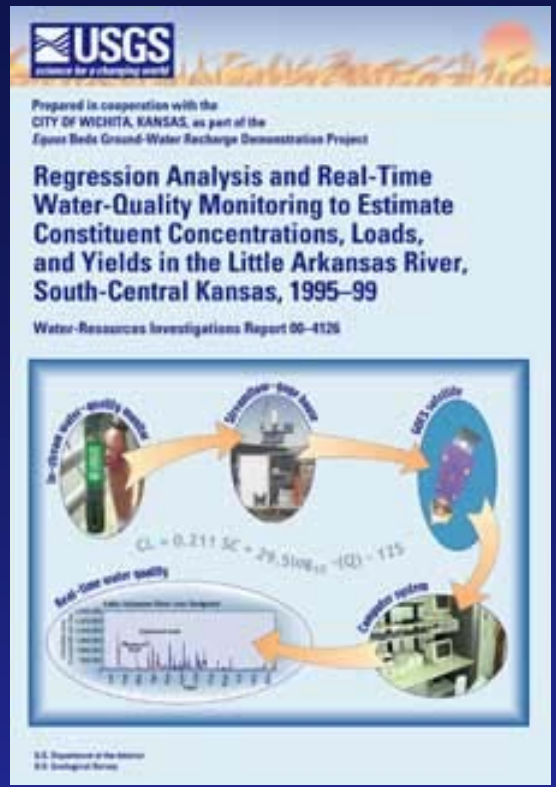
USGS
science for a changing world

Summary

- **Provides continuous concentration and load estimates**
- **Evaluates BMPs and TMDLs**
- **All water users have access to current water quality**
- **The only way to evaluate whole-body contact criteria in real-time**

USGS
science for a changing world

For more information on real-time water quality in Kansas:



http://ks.water.usgs.gov/Kansas/qw/

http://water.usgs.gov/ks/nwis/

USGS
science for a changing world

Benefits of Real Time Water Quality

- Continuously measure water quality in real time
- Warning of changes in water-quality conditions
- Defined uncertainty
- Identify source areas and evaluate trends for BMPs and TMDLs
- Optimize timing of sample collection
- Improve our understanding of the hydrology and water quality of streams

USGS
science for a changing world

USGS is uniquely positioned for RTQW

- Existing infrastructure of streamflow gages
- National workforce of field capable personnel capable of the heavy O&M
- Capabilities in statistical hydrology and water quality

USGS
science for a changing world

Future Needs for Real-time Water Quality

- Recognize that in-situ is how water quality can and needs to be done
- Reduce O&M costs/time
- Installations to deal with ice
- Enhance NWIS to handle RTQW relations
- Improve sensors to measure constituents of concern directly
- Improve analytical techniques for bacterial analysis
- Improve ways to estimate and communicate uncertainty
- Improve statistical techniques for estimating water quality

USGS
science for a changing world