EVALUATION OF TECHNIQUES TO ESTIMATE SUSPENDED-SEDIMENT CONCENTRATIONS IN THE KANSAS RIVER

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Abstract: Continuous streamflow data are traditionally the surrogate used by hydrologists to estimate suspended-sediment concentration (SSC) and load in surface water because of its widespread availability. The U.S. Geological Survey in Kansas currently uses in-situ nephelometric (90-degree scatter) turbidity sensors to estimate SSC with less uncertainty than that associated with streamflow-based SSC estimation. Although in-situ nephelometric turbidity sensors have decreased the uncertainty associated with estimates of SSC, these sensors are prone to environmental fouling and have a maximum range of approximately 2,000 milligrams per liter. During 2004 and 2005, estimates of SSC using acoustic Doppler return signal strength, nephelometric turbidity, and optical backscatter were evaluated using data from a Yellow Springs Instruments model 6136 turbidity sensor currently deployed in the Kansas River at DeSoto, Kansas. These comparisons were done to find an SSC-estimator with increased range and minimal uncertainty.

The Sontek Argonaut 1.5 megahertz (Yellow Springs Instruments, Yellow Springs, Ohio) is a single-frequency acoustic Doppler instrument typically used to estimate streamflow velocity. However, recent studies by the U.S. Geological Survey have shown that acoustic signal strength can estimate SSC. The Sontek Argonaut was deployed from April to September 2004. Signal strength from the instrument did not correlate with YSI (Yellow Springs Instruments, Yellow Springs, Ohio) turbidity data. Signal strength truncated at a YSI-estimated SSC of 500 milligrams per liter, indicating the upper limit of the instrument's effectiveness. Limited SSC range and inability to measure small particle sizes preclude the Sontek Argonaut 1.5 megahertz from being an effective SSC estimator when small particle sizes and large sediment concentrations frequently occur.

The Forest Technology Systems (FTS) DTS-12 (Forest Technology Systems, Bellingham, Washington) is a nephelometric turbidity sensor with a manufacturer-determined range from 0 to 2,000 formazin nephelometric units. The DTS-12 was deployed from July 28 to October 1, 2004. The DTS-12 reported periods of inaccurate, spiking data values resulting in deletion of 31 percent of the total data reported during this period. Spiking data values were caused by a broken drive shaft that resulted in the wiper parking on or near the sensor optics. Although this monitor had wiper-parking problems, unaffected data correlated well with data reported by the YSI model 6136 turbidity sensor. The maximum value recorded by the FTS DTS-12 during the period of study did not exceed the 2,000 formazin nephelometric unit maximum, although YSI-estimated suspended-sediment concentrations reached 1,600 milligrams per liter.

The Hach optiquant TS-Line sensor (Hach, Loveland, Colorado) is a wiped optical backscatter sensor used to monitor sludge in wastewater-treatment operations, with a manufacturer-determined range of 0 to 50,000 milligrams per liter of suspended solids. The sensor was deployed in November 2004 and has been used continuously since February 2005. Data collection using the TS-Line sensor will continue through December 2005. The TS-Line sensor has only been tested thus far with a small range of estimated SSC (20-400 milligrams per liter), but results correlated well with YSI turbidity data.

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