UTILIZING INSTRUMENTATION TO MEASURE ACOUSTIC REFLECTANCE AS A SURROGATE FOR SUSPENDED-SEDIMENT CONCENTRATIONS ALONG A PIEDMONT RIVER IN ROCKDALE COUNTY, GEORGIA

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Abstract. Erosion and sedimentation is a prevalent water-quality issue in many Piedmont streams in Georgia (Landers and others, 2002). Typically, concentrations of suspended sediment are determined by collecting water samples and making physical measurements of sediment mass per unit volume in a laboratory setting. Particle-size distributions of individual samples also are typically performed in a laboratory. The U.S. Geological Survey is conducting an ongoing research project in Rockdale County, Georgia, and is using state-of-the-art instrumentation in an attempt to develop surrogate in situ, real-time measurements of particle-size and suspended-sediment concentrations in streamwater. The ultimate goal is to use in situ, real-time particle-size- and suspended-sediment concentration measurements for computing continuous sediment loads.

Instrumentation installed in the Yellow River near Milstead, Georgia, includes the Sequoia LISST™-100 (Laser In-Situ Scattering and Transmissiometery) size distribution sensor (Fig. 1) and the SonTek® Argonaut-Shallow Water (SW) velocity meter[1] (Fig. 2). The LISST™-100 is designed to report real-time in situ measurements of particle-size distribution (Gartner and others, 2001). The Argonaut-SW is a bottom-mounted, acoustic Doppler meter that is designed to report water velocity utilizing two vertically oriented beams and water-surface elevation using a third beam.

The instrumented site is characterized by gradually-sloping, nonvegetated granite bedrock that controls flow of the river from baseflow to flood conditions. The gradual slope of the granite bedrock presented design and installation obstacles to locating the instruments at the proper depth and outside of an area of recirculating backflow. Site installation was designed to protect the instrumentation from potentially-damaging flow-transported debris, premature wear, and vandalism, and to allow removal of the sensor for periodic maintenance during low to high baseflow conditions (Wagner and others, 2000). To meet these requirements, a polyvinyl chloride (PVC) pipe "deployment" tube was assembled and attached with steel wedge anchors bolted into the granite bedrock.

Figure 1. Sequoia LISST™-100 before deployment at study site.

The deployment tube was raised approximately 10 centimeters off the streambed to ensure that the LISST™-100 would only measure entrained particles in the primary flow and not be skewed by larger sediments transported within the variable flow zone resulting from the bedrock channel. The LISST™-100 sensing tip was exposed approximately 10 centimeters beyond the end of the deployment tube such that the sensor would not be fouled by the collection of fine sediment within the interior of the deployment tube. To prevent excessive strain on the LISST™-100 data cable, a light-gauge wire tether was connected to the instrument casing and anchored to the bedrock streambed. The degree of exposure of the sensor from the deployment tube end could be adjusted by changing the length of the wire tether.

The Argonaut-SW was designed to use Doppler technology to measure stream velocity. The instrument functions by measuring the Doppler shift in reflected acoustic energy from entrained sediment particles within the water column. In order to use the Argonaut-SW to produce a surrogate for sediment concentrations, data compiled from the reflectivity function within the velocity computation are compared to actual sediment concentrations (Gray and others, 2003) measured from traditionally collected samples. In theory, a larger measured reflectance will correspond to a greater sediment concentration.

[1] Any use of trade, product, or firm names in this publication is for descriptive purposes only and does not imply endorsement by the U.S. Government.

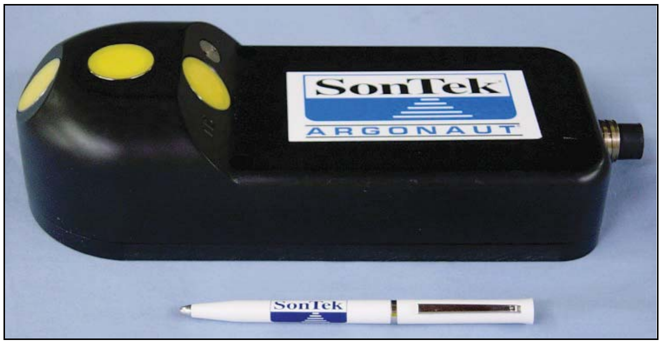

Figure 2. SonTek® Argonaut–Shallow Water velocity meter; pen for scale.

The SonTek® Argonaut-SW was mounted on the upstream side of the LISST-100 deployment tube on a polyethylene board to prevent turbulence from interfering with the velocities of the particles being measured. Data cables initially were run from each instrument to the data collection platform for real-time data transmissions. Electrical interference with existing instrumentation, difficulties in effectively grounding all equipment, and lack of space within the gage house increased field maintenance trips to the site. Internal logging of the data to the in situ instruments resolved these problems. Data collection for this project is ongoing, and analysis and results are still preliminary. Future plans call for public posting of data on the Internet once data collection has been reviewed and reached a satisfactory level of accuracy.

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