Federal Interagency Sedimentation Project (FISP)
Technical Committee Memorandum 2007.01

October 25, 2006

Subject: Collection and Use of Total Suspended Solids (TSS) Data

FISP Policy on Collection and Use of Total Suspended Solids Data:

1. The use of Total Suspended Solids data (TSS, USGS parameter code 00530) resulting from the analysis of water samples to determine the concentration of suspended material in water samples collected from open channel flow and calculations of fluxes based on these data is not appropriate.

2. When collection of samples to determine TSS is required, concurrent collection of samples for suspended-sediment concentration (SSC) analysis must be done. Concurrent SSC analysis can only be discontinued after it is conclusively documented in a publicly available report that the TSS data, on a site-by-site basis, can adequately represent SSC data over the whole range of flows that can be expected.

3. The SSC analytical method, ASTM D 3977, Standard Test Method for Determining Sediment Concentration in Water Samples (ASTM, 2006), is the accepted standard for determining concentrations of suspended material in surface water samples. It is recommended that this method be used by all U.S. Federal agencies' sediment laboratories, and by cooperating laboratories providing suspended-sediment data to the Federal government.

Background:

An important measure of water quality is the amount of material suspended in the water. The USGS and a few other Federal agencies have traditionally used measurements of suspended-sediment concentration as the most accurate way to measure the total amount of suspended material in a water sample collected from the flow in open channels. In order to collect representative samples from open channel flow for analysis of suspended-sediment concentration, an approved isokinetic sampler and cross sectional, depth-intergraded procedures must be used. For more information on these samplers see the Federal Interagency Sedimentation Project (http://fisp.wes.army.mil/) and for sample collection techniques, see Edwards and Glysson (1999). Another commonly used measurement of suspended material is the TSS analytical method. This method was originally developed for use on wastewater samples, but has been widely used as a measure of suspended material in stream samples because it is mandated or acceptable for regulatory purposes and is an inexpensive laboratory procedure. Using the TSS

analytical method to determine concentrations of suspended material in open channel-flow can result in unacceptably large errors and is fundamentally unreliable.

Summary of Recent Studies:

Studies on the accuracy of the SSC analytical method by ASTM (1999) and the USGS Branch of Quality Systems (Gordon and others, 2000) have shown that the SSC analysis represents an accurate measure of the concentration of the suspended sediment in a sample. Other measurements such as TSS and turbidity are often used as surrogates for suspended sediment and are often less expensive to collect and (or) analyze and some may be collected on a near-continuous basis. However, proper use of these surrogate measurements of suspended material requires that a relationship between SSC and the surrogate be defined and documented for each site at which the data are collected.

Differences between the TSS and SSC analyses were investigated using 3,235 paired TSS and SSC samples provided by eight USGS Water Science Centers (Gray and others, 2000), and with 14,466 data pairs from the USGS's National Water Information System (NWIS) data base (Glysson and others, 2000 and 2001). The findings of these studies can be summarized as follows:

1. The TSS analysis is normally performed on an aliquot of the original sample. The difficulty in withdrawing an aliquot from a sample that truly represents suspended material concentration leads to inherent variability in the measurement. By contrast, SSC analysis is performed on the entire sample, thus measuring the entire sediment mass. When a sample contains a substantial percentage of sand-size material, stirring, shaking, or otherwise agitating the sample before obtaining a subsample will rarely produce an aliquot representative of the suspended material and particle-size distribution of the original sample.

2. TSS methods and equipment differ among laboratories, whereas SSC methods and equipment used with ASTM Standard D-3977 are consistent, and have been quality assured by the USGS National Sediment Laboratory Quality Assurance Program (OSW Technical Memorandum 98.05; Gordon and others, 2000).

3. Results of the TSS analytical method tend to produce data that are negatively biased by 25 to 34 percent with respect to SCC analyses collected at the same time and can vary widely at different flows at a given site. The biased TSS data can result in errors in load computations of several orders of magnitude (Glysson and others, 2001).

Analysis of paired data for TSS and SSC (Glysson and others, 2000) indicates that in some cases, it might be possible to develop a relation between SSC and TSS at a given site. At least 30 paired sample points, evenly distributed over the range of concentrations and flows encountered at the site, would be needed to define such a relationship. There is no reliable, straightforward way to adjust TSS data to estimate suspended sediment without corresponding SSC data.

Because the TSS analytical method is widely used in the United States for the determination of suspended-material concentrations in water samples from open channel flow, and because the TSS analysis is specified in several States' water-quality criteria standards for sediment, it would be appropriate for Federal agencies to share this information with their cooperators. For questions or additional information, contact Doug Glysson (gglysson@usgs.gov) or John Gray (jrgray@usgs.gov) at the USGS Headquarters in Reston, VA or the Chief, FISP by phone at (601) 634-2759 or by mail at FISP, Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199

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(* References are on-line at URL
http://water.usgs.gov/osw/techniques/sedimentpubs.html)