USGS Sediment Data-Collection Techniques Training: Selected Data Results

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Introduction

Sediment Data-Collection Techniques (SW1091) training has been offered regularly through the USGS National Training Center to personnel from the USGS and its federal and state partners since at least the 1970's. The current 5-day field-oriented training class is set in Castle Rock, Washington and offers an in-depth look at the rivers and sediment draining the slopes of Mt. St. Helens. On the bridge spanning the Cowlitz River (at USGS streamgage 14243000), instructors provide hands-on training with a diverse suite of samplers and instruments, demonstrating approved methods for obtaining reliable riverine suspended-sediment, bedload, and bed-material data. The student-collected samples obtained during the first day of the course are submitted to the USGS Cascades Volcano Observatory (CVO) sediment laboratory and the results are presented and discussed before the class adjourns. These data are useful for demonstrating the mechanics of fluvial-sediment transport, evaluating various samplers and sampling techniques, and providing insights toward avoiding data-collection and processing errors. In addition to sample collection, students learn about sediment surrogates (including optical and acoustic technologies) and complete computations of sediment load. The combination of field exercises and classroom instruction provide a broad perspective of the value of measuring and analyzing sediment transport in rivers and the importance of quality sediment data.

A data report summarizing 8 years of site conditions and sample results from the Sediment Data-Collection Techniques training course is in progress. The poster presents suspended-sediment sample sets from training held March 24-28, 2014, which provides a good example of the data collection and analysis lessons students receive in this class.

Data Collection

On March 24, student attendees of the training course (under the direction of experienced instructors) collected two cross-sectional samples using the equal-discharge-increment (EDI) method and equal-width-increment (EWI) methods (Edwards and Glysson, 1999) with two different Federal Interagency Sedimentation Project (FISP) approved samplers. A complete EDI or EWI sample consists of two cross-sectional passes (typically labelled A and B sets), the results of which are then averaged to produce a single "event" result. At distinct locations in the cross-section, three additional types of FISP-approved samplers and one non-isokinetic sampler were used to collect single-vertical samples from the water column. Numerous samples were collected at each location with a specific sampler, all of which are averaged to present a single result for each. On the left bank of the river just downstream of the bridge, an automatic pumping sampler was programmed to collect samples every 15 minutes for the duration of the sampling period. All these samples are also averaged to present a single result for the sampler. Detailed field notes were recorded for each sample, including sampling time and any special observations. Table 1 provides details of the sampling methods and sampler features.

Table 1. Sample method and sampler information

Method name	Sampler name	Sampler container	Sampler intake	Integrating
EDI	DH-95	Rigid bottle	Isokinetic	Depth
EWI	DH-76	Rigid bottle	Isokinetic	Depth
Single vertical	D-74	Rigid bottle	Isokinetic	Depth
Single vertical	D-96	Collapsible bag	Isokinetic	Depth
Single vertical	DH-2	Collapsible bag	Isokinetic	Depth
Single vertical	Weighted bottle	Rigid bottle	Non-isokinetic	Depth
Single vertical	P-61	Rigid bottle	Isokinetic	Point
Point	Automatic pump	Rigid bottle	Non-isokinetic	Non-integrating

During the time of the sample collection (1:00 to 5:00 pm), streamflow at the station averaged 14,000 cubic feet per second (cfs) and turbidity measured near the pump sampler intake averaged 26 Formazin Nephelometric Unit (FNU).

Data Results and Analysis

The training attendees collected approximately 135 separate bottles during the sample collection activities which were labeled, logged into the lab sample submission portal using the SEDiment-sample LOGIN application (SedLOGIN), and delivered to the CVO Sediment Laboratory the evening of March 24, 2014. Within 2 days, the lab had provided the suspended-sediment concentration (SSC) and percent fine sediment (less than 63 microns) results for each sample. The results are summarized in Figure 1.

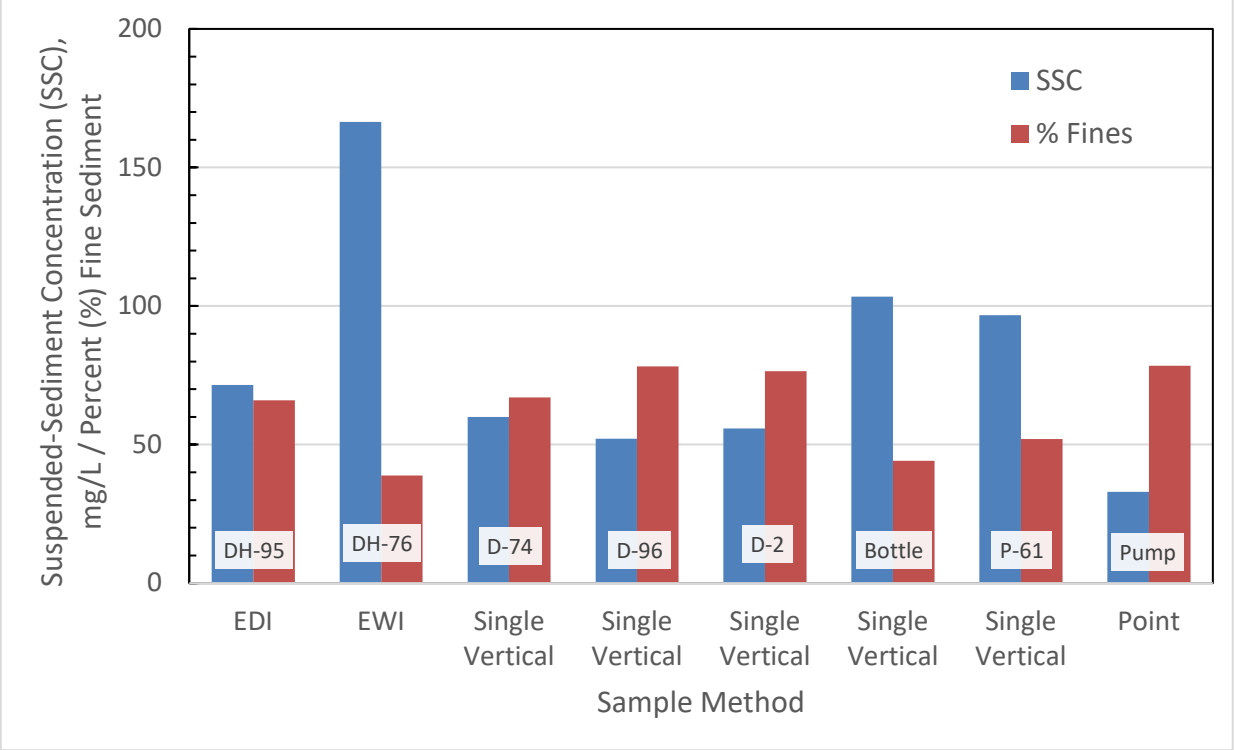

Figure 1. Suspended-sediment laboratory results by sampling method and sampler

The SSC of the compiled results range from 32 to 166 milligrams per liter (mg/L) and the percent fine sediment values range from 39 to 78 percent. Much of the variation is likely explained by sampling method. Most rivers have non-uniform velocity profiles, resulting in varying sediment concentrations in the cross-section. Unless the river is extremely well-mixed, the SSC of a single vertical sample is likely to differ from the mean obtained by an EDI or EWI sample. Non-isokinetic samplers are also understood to often produce biased SSC and percent fines results. The intakes of both the weighted bottle and pump samplers can either over- or under-sample suspended sediment. Whether biased by method or sampler, these SSC results can often be adjusted using correction factors for use in further analysis.

The two cross-sectional methods (EDI and EWI) should produce similar SSC and percent fines results, but the EWI sample collected appears to have higher sand content (lower percent fines) and much higher total SSC than the EDI sample. Examination of the individual sample results, rather than the averaged "event" results, reveals a likely problem with one of the EWI samples (Figure 2).

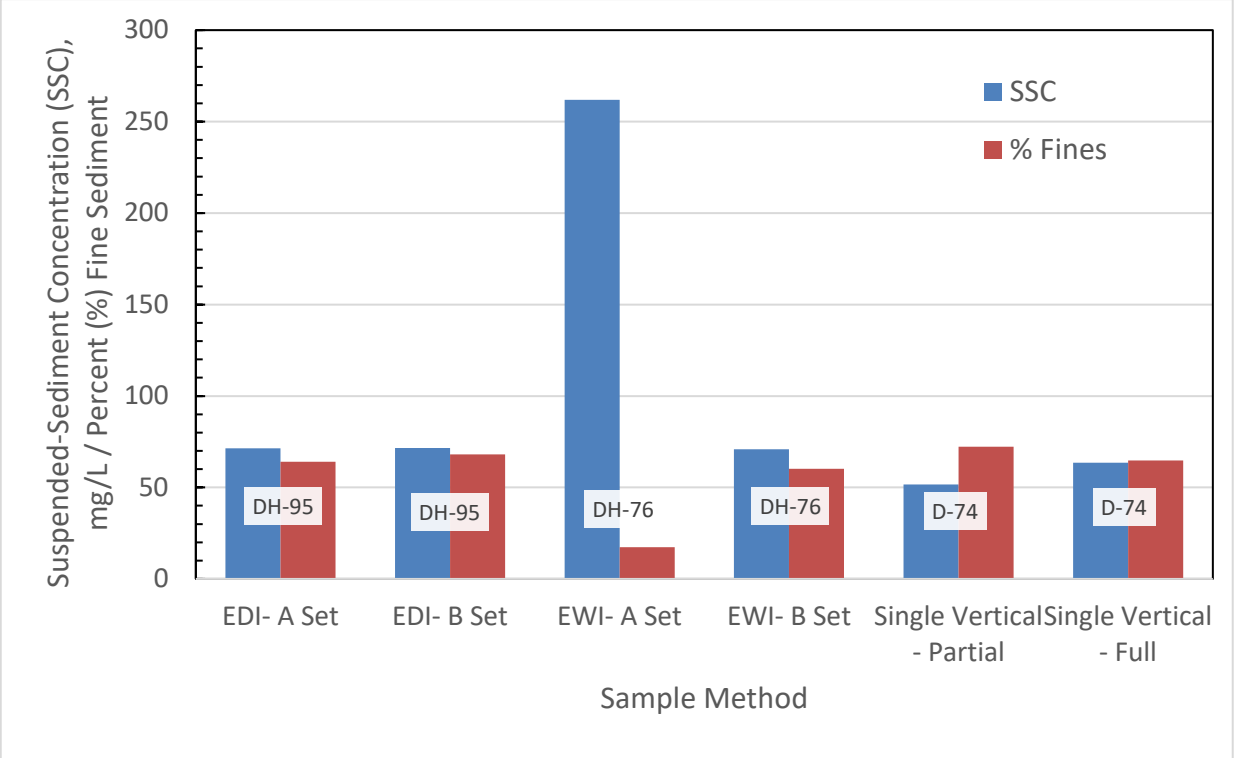

Figure 2. Individual suspended-sediment laboratory results by sampling method and sampler

The SSC results of the EWI samples were 262 mg/L (17 percent fines) and 71 mg/L (60 percent fines). Without the other sample results for comparison, it would be difficult to determine which of these results is more "correct," but the comparison indicates that set A was not representative of the sediment transport conditions at the time. The field notes collected at the time noted that the DH-76 sampler may have bumped the riverbed, stirring up coarse sediment that was drawn into the sampler. Inspection of the sample at the time of collection might have allowed the

opportunity to reject the questionable bottle and collect another one, but at least the field notes provide justification for removing the EWI A set from further analysis. The Sediment Data-Collection Techniques training class provides numerous real sampling scenarios such as this to the attendees, demonstrating the importance of careful sample collection and good field documentation.

References

Edwards, T.K. and Glysson, G.D., 1999, Field Methods for measurement of fluvial sediment: U.S. Geological Survey Techniques of Water-Resource Investigations, book 3, chap. C2, 89 p.