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Instrument News . . .

AN AUTOMATIC BEDLOAD SEDIMENT SAMPLER

To narrow the "sediment gap" in watershed engineering studies...

TO sample coarse sediment flowing along the channel bottom, this sampler is attached to a streamflow measuring flume on the Walnut Gulch Experimental Watershed near Tombstone, Ariz.

A 1-in. wide by 12-in. high open metal slot intake traverses the downstream edge of this V-floor supercritical-depth flume (Figs. 1 and 2). The slot intake, powered by an electric motor and chain drive, moves at uniform speed along a track to collect the width-integrated sample. After the water-sediment mixture passes through the intake it is diverted onto a stack of six graded sieves (Fig. 3), the last and smallest of which has 0.064 mm openings. This graded sieve stack dewaters the sediment sample without overloading any individual sieve tray. After taking an integrated sample, the sieve stack is replaced. The sediment is cleaned from the sieves, recombined, and packaged for lab analysis.

The sampler's path starts at one side of the flume, goes to the center and returns automatically — thus sampling half the flow twice. On a flat-floored structure it can traverse the entire width of flow. It can be used on any drop structure where there's a free-falling sheet of water.

Bedload material within the range of 0.064 mm to 2.52 cm (1 in.) in diameter can now be sampled; however, this range can be extended to 4 in. by adding a 4-in. slot next to the 1-in. slot.

Although the slot intake, which protrudes 1 ft up into the flow, is of heavy gage steel, a spare is kept on hand.

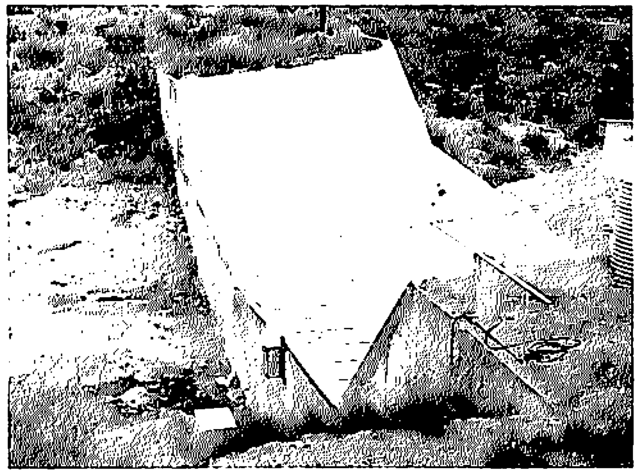

Fig. 1 The sediment sampler and track on the critical-depth flume. Brushes on either side of the sampler keep sediment from accumulating in the track

High velocities of course occur here at the downstream end of the flume; these are augmented by the effluent, which may include rocks of up to boulder size.

Clogging of the intake slot has not been a problem. The leading edges of the intake are swept back 30 deg, sharpened, and a slight amount of relief provided just inside the intake. The sampler can, however, be closely observed during the sampling operation because only the intake chute actually is in the water. The lower portion remains relatively dry under the nappe. Periodic checks during sampling indicate a constant water flow out the bottom of the sampler.

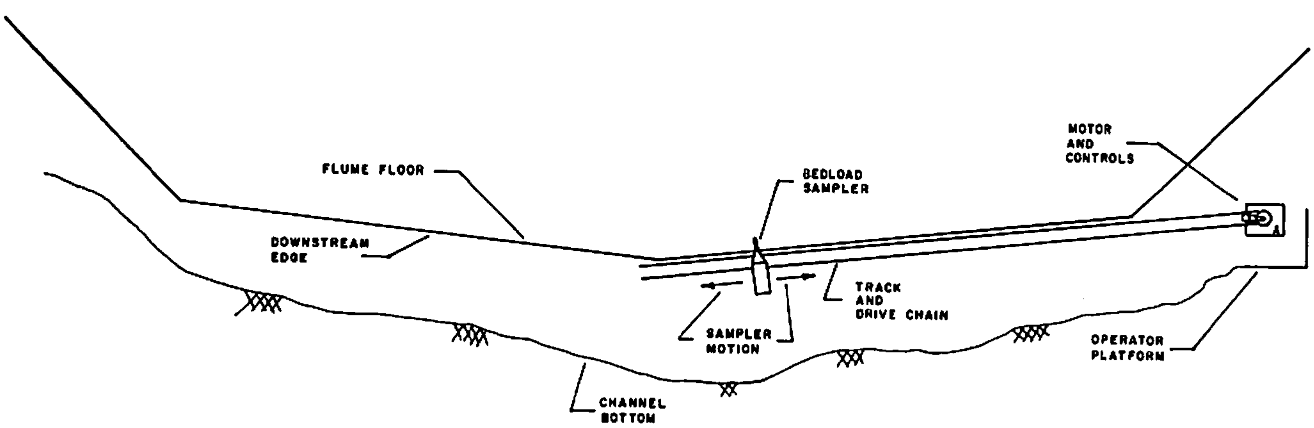

Fig. 2 The sampler mechanism is installed on the downstream edge of the flume

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Because streamflow at the sampling site is ephemeral, this sampler operates only a few times a year. During the last runoff season the largest of the three flows sampled was 3 ft deep at peak and averaged 10 fps at the sampling point. The sampler is designed to handle flow velocities to 30 fps.

Sampling frequency and traverse speed are easily regulated. The limiting factor in sampling frequency is the speed at which the sieve stack can be replaced; this has been accomplished in less than 4 min. When flow rates vary greatly, sampling frequency must be high to provide a complete water-sediment discharge relationship (Fig. 4). The variable drive system allows the operator to change traverse speeds at any time during sampling. Generally a 1 fps traverse speed created little turbulence.

Several data analyses were performed to compare water-sediment discharge relationships and determine sampling method reliability. Surprisingly, particle size diminished — and their numbers greatly increased — during the flow recession, with the peak bed discharge after the hydrograph peak. These sediment peaks on the recession of the runoff hydrograph may represent successive build-up and decay of dunes on the streambed.

Fig. 5 shows log probability curves plotted to indicate if the samples analyzed were truly unaltered and had representative grain size distribution. • •

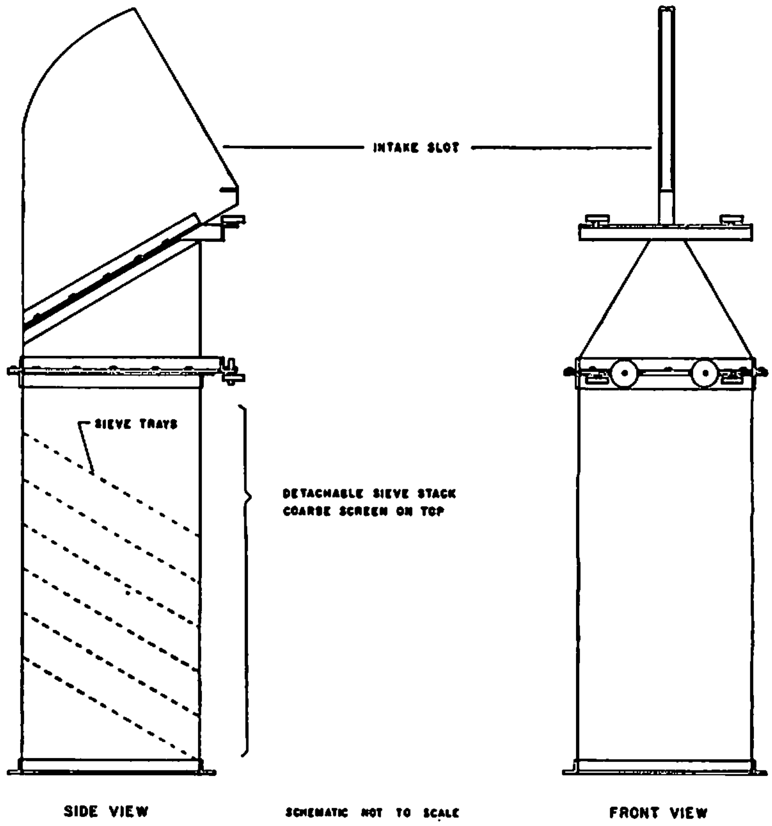

Fig. 3 Side view of the intake slot. Note the detachable sieve stack — the coarse screen is the top one

This is a contribution from the Southwest Watershed Research Center, SWCRD, ARS, USDA, and was prepared in cooperation with the University of Arizona Agricultural Experiment Station at Tucson, Ariz.

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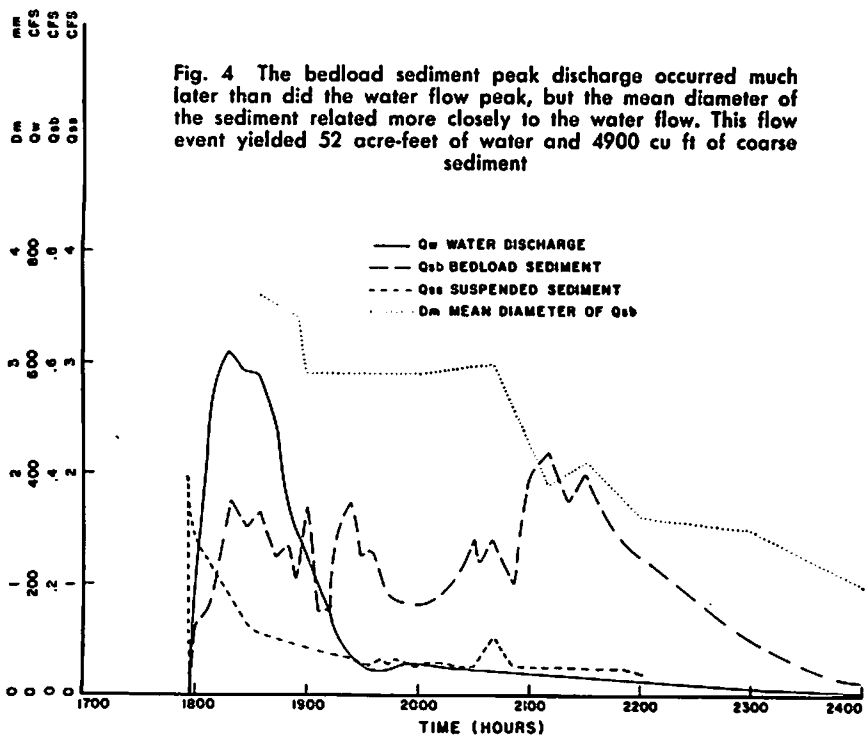

Fig. 4 The bedload sediment peak discharge occurred much later than did the water flow peak, but the mean diameter of the sediment related more closely to the water flow. This flow event yielded 52 acre-feet of water and 4900 cu ft of coarse sediment

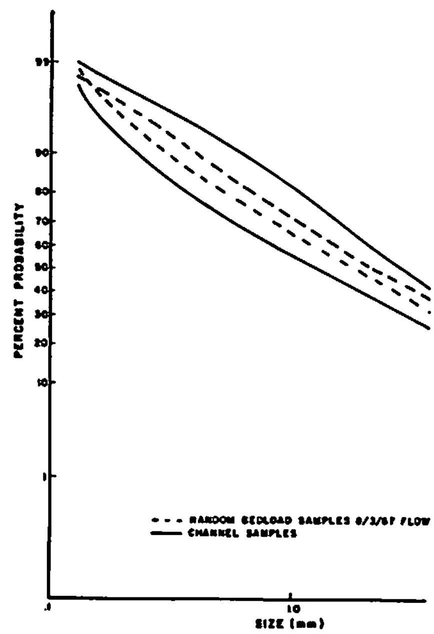

Fig. 5 (above) The broken lines represent samples collected by the sampler during the flow; the solid lines represent material taken from the same channel between flows