Safety, Monetary, and Environmental Considerations in Replacing Footbridges with Cableway Installations for Peak-Flow Monitoring of Sediment and Discharge in the Ouachita Mountains, Arkansas

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1.0 Summary

Cableway systems were selected by the Forest Service (FS) to replace footbridges used for high-flow water quality and quantity sampling in the Ouachita National Forest of Arkansas and Oklahoma. Cableway systems offer several advantages including lower costs and greater safety. Installation of the cableway system produced short-term increases in total suspended solids (TSS) during rising-limb flows, but maximum concentrations were within the range for natural events in the Ouachita Mountains.

2.0 Problem Statement

Discharge and water sampling is required during high streamflows to measure transport rates when they are at their highest values and when streams cannot be waded.

3.0 Footbridges

Footbridges have historically provided relatively low-cost sampling platforms. Foot-bridges have been used for high-flow monitoring by FS and Weyer-haeuser scientists since the mid-1990s at 11 sites with the Ouachita Mtns.

3.1 However, footbridges can be problematic. To minimize costs, bridge elevation is often reduced to the bare minimum, thus increasing the failure risk.

3.2 The tropical storm produced as Hurricane Gustav during 1-4 September 2008 destroyed or damaged three footbridges used by the FS for high-flow sampling.

NA660 Station before Gustav

SAOUT Station before Gustav

NA660 Station after Gustav

SAOUT Station after Gustav

4.0 Cableway Solution

Cableway systems were chosen by the FS to replace the destroyed and damaged footbridges. A cableway system consists of a heavy wire cable suspended between two support posts installed on opposite streambanks. A traveling block is attached to the cable and is used to deploy a current meter or sediment sampler across the stream using a winch system to control and measure both lateral and vertical position of the instruments.

Figure 2: Schematic of the cableway system with sounding reel and current meter in use. (1) near post with pulley drive housing, (2) sounding reel, (3) cableway cable, (4) sounding reel cable, (5) traveling block, (6) current meter, and (7) tailhold on far post. (J. VanDeWater)

From Paradiso (2000)

Completed cableway

5.0 Cableway Advantages

Decreased potential for structure or equipment loss or damage The only thing continuously exposed are the cables, and these can be suspended at a much higher elevation above the stream than footbridges.

Decreased potential for environmental impacts resulting from footbridge failure If the cableway were to fail, only the cable would fall into the stream; in contrast to a failed footbridge where most, if not all, of the bridge material would fall into and be transported by the stream.

Increased safety for personnel Cableway systems are operated from the bank, and do not require personnel to be in or above the channel during high flows.

Less expensive than footbridge Purchase and installation of a cableway system by the US Geological Survey was less than half the cost for a private-contractor installed footbridge.

6.0 Cableway Installation Impacts

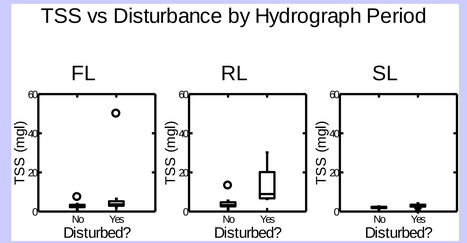
To assess the environmental impact of installing a cableway system, the FS monitored TSS concentrations during installation of one of the cableway systems.

6.1 Methods

Two-way treatment structure using a completely randomized design. Treatments = Disturbance Period (disturbed vs. not) and Hydrograph Period (Rising, Falling, Steady flow).

500-700 ml water samples collected every 1-3 hours via ISCO 3700 pump sampler.

Subset of samples (61) randomly selected by Hydrograph Period and analyzed for Total Suspended Solids concentration.



6.2 Results

Parametric ANOVA test indicates that construction disturbance caused TSS to …

- Increase during Rising limb periods (P = 0.004)
- Possibly increase during Falling limb (P = 0.123)
- Not change during steady flow (P = 0.812)

Nonparametric ANOVA results yield the same conclusions.

Maximum TSS concentrations during construction (30-50 mgl) are similar to the range of maximum values measured from undisturbed basins (51-144 ppm, Miller and others [1985]).