Continuous Surrogate Measurement of Bedload Sediment Transport Using Hydrophone Installations on the San Joaquin River

Summary of Data Collection Efforts

Hydrophone monitoring stations were installed at 10 sites (Figure 1) starting in December 2014 to record acoustic data related to sediment-generated noise during flow events. At each site, two hydrophones were installed in the channel, near the edge of the bank. The hydrophones were mounted to rebar which was driven 1-2 feet into the bed of the river. A waterproof case containing batteries and recording equipment was secured to the bank. Two pressure transducers were installed at each site; one in the vicinity of the hydrophones and one approximately 2-3 channel-widths upstream. The pressure transducers record absolute pressure which is used to determine water elevation. Each pair of pressure transducers at a site are used to calculate water surface slope just upstream of the hydrophones. Measurements of particle-size distribution of the surface bed-sediment in the vicinity of each hydrophone were conducted in March, 2014.

Table 1 Hydrophone installation sites during December 2013-June2014, River Mile location, channel location, installation period, median particle size (D50), and eighty-fourth percentile particle size (D84)

Site	River Mile	Channel Location	Installation Time Period	D50 (mm)	D84 (mm)
Cottonwood Creek (Tributary)	267.4	river left	12/2/13-4/12/14	2	299
Lost Lake	264.6	river right	12/4/13-present	27	92
Riffle 40, left bank	261.5	river left	12/5/13-present	80	113
Riffle 40, right bank	261.5	river right, at island	12/5/13-present	76	115
Little Dry Creek (Tributary)	260.6	river left	12/4/13-4/12/14	23	90
Riffle 38	260.8	river right	12/5/13-present	57	91
Owl Hollow	258.6	river left	12/3/13-present	64	103
Hwy 41 Crossing, left bank	254.5	river left	2/4/13-present	46	77
Hwy 41 Crossing, right bank	254.5	river right	2/4/13-present	53	89
Hwy 145 Crossing	234.6	river right	12/3/13-present	26	43

Between December and mid-May, no flow-producing storms occurred and environmental flow releases were canceled due to the state-wide drought. After April the likelihood of a large flow-producing storm occurring in the region drops significantly; therefore, instruments were removed from the two tributary sites. The remaining instruments were all in the main-stem San Joaquin River and were left in place during exchange-contractors flow releases from Friant Dam. Due to the drought conditions, physical bedload-sediment samples were not collected this year by the USGS. Physical measurements of bedload-sediment are important to ground-truth and potentially calibrate the acoustic data from sediment-generated noise.

Preliminary Results

Very little sediment-generated noise was detected at most sites due to the large sediment particles and the low discharge from Friant Dam (relative to the discharge expected to generate sediment movement of large particles). Measurements of particle-size distribution in the vicinity of the hydrophones show that

the sediment at the Hwy 145 site has a finer overall distribution (D50=26mm, D84=43, Table 1), but is still within the expected detectable range of hydrophones (>20mm). Sediment movement was detected at the Hwy 145 site although it was not verified by physical bedload sediment measurements. The preliminary acoustic data is currently being processed.

Using hydrophones as a surrogate sediment monitoring technique is a relatively new technology with very few previous field studies. Despite low river discharge during WY 2014 and the absence of physical bedload-sediment sample to use for calibration, field testing the 10 hydrophone monitoring stations provided valuable information on types of environmental conditions which can affect data quality. The dataset collected thus far will also be useful to test different signal analysis techniques. We will continue to work on improving the hardware, deployment techniques, and signal analysis method.

Figure 1. Map of hydrophone monitoring stations on the San Joaquin River and its tributaries