Supplemental Material I: Bias Testing

Merging suspended sediment samples from two studies extended the temporal range of analysis, but both sample sets (USGS and those collected for this study) included samples from two locations (S1 and S2), and the proportional contribution of these two sites to the total data set was not stable over time (Fig. 2). Selecting only USGS samples with particle size data could also bias analyses because of potential differences between samples with and without particle size data (Table SI.1).

Bias concerns were first addressed by constructing C_{SS}-Q rating curves (see section 4) for subgroups defined by sampling site (S1 or S2), or whether USGS particle size distribution analysis was performed. These subgroup rating curves were then tested for significant differences in the C_{SS}-Q relationship using ANCOVA methods (see section 6.1 and Supplemental Material II). The rating curves subgroups for the particle size distribution categories utilized total C_{SS} data (C_{SSf} + C_{SSs}); all others were based on C_{SSf}. Assessment of differences between S1 and S2 suspended sediment behavior was based on data from water years when samples were collected from both sites, and was further broken down into two time periods: {1969,78,79,86} and 2008-2011 to avoid confounding with potential temporal trends. The particle size distribution subgroup comparisons were also performed on data from subsets defined by decade. In order to investigate the effect of omitting USGS samples without particle size data from this study, the rating curve for the entire USGS dataset was compared to the subgroup of samples with associated particle size data.

All bias investigations through rating curve comparisons produced no statistically significant differences for the entire period of record, except for one incidence of non-coincidence between samples with and without particle size data. The rating curves in this case were found to have offsets and slopes that were not significantly different, and the comparison of rating curves with particle size data to the entire USGS sample set showed that the rating curve was not significantly changed by the inclusion of samples without particle size data. Furthermore, only 30 of 317 suspended sediment samples collected by the USGS were not processed for particle size distribution analysis (see Table SI.1). Thus, selection of the suspended sediment sample set for those that have associated particle size data, and inclusion of samples from stations S1 and S2 were found to have no significant biasing effect on the analyses of suspended sediment behavior in the lower Salinas River.

Supplemental Material II: The ANCOVA Method of Rating Curve Comparison

For ANCOVA comparison between suspended sediment subgroups, multiple regression models were constructed from data subsets using the following general model for two group comparison as per Larsen (2003):

$$\mathrm{Log}(C_{SS}) = \beta_0 + \beta_1 \mathrm{Log}(Q_i) + \beta_2 Z + \beta_3 (\mathrm{Log}Q_i) Z + \varepsilon \qquad \text{(SII.1)}$$

where *Z* is a synthetic variable categorizing the data into any two subsets using a value of 1 or 0, β values are regression fitted coefficients and ε represents random variation not accounted for by the rest of the model. The model for the relationships between

Log(Q) and Log(C_{SS}) for the two groups can then be defined as:

G1 (Z = 1): $$\mathrm{Log}(C_{SS}) = (\beta_0 + \beta_2) + (\beta_1 + \beta_3)\mathrm{Log}(Qi) + \varepsilon \qquad \text{(SII.2)}$$

G2 (Z = 0): $$\mathrm{Log}(C_{SS}) = \beta_0 + \beta_1 \mathrm{Log}(Q_i) + \varepsilon \qquad \text{(SII.3)}$$

These models form the basis for testing the subgroup rating curves for coincidence, where both subgroups should be described by the same rating curve, parallelism, the condition where rating curve slopes are statistically the same, and offset equivalence, where rating curve intercepts are equal. Coincident subgroups display the exact same relationship between the dependent and independent variables, in this case log(C_{SS}) and log(Q). In testing for coincidence the null hypothesis is:

H_0: $$\beta_2 = \beta_3 = 0. \qquad \text{(SII.4)}$$

If the null hypothesis cannot be discarded, then both groups are considered coincident, and the relationship between log(C_{SS}) and log(Q) is described as Eq. 3 for the entire data set. If the null hypothesis is discarded, then further tests for parallelism and equivalence of offset (also known as equality of intercepts or elevation equivalence) are required to determine how the relationship between log(C_{SS}) and log(Q) significantly differ. The null hypothesis of parallelism, the condition in which the slopes of the two subgroup regression lines are equal, is:

$$H_0: \quad \beta_3 = 0. \tag{SII.5}$$

Similarly, difference in offset requires only that the intercepts of the two subsets are significantly different, with a null hypothesis of:

$$H_0: \quad \beta_2 = 0. \tag{SII.6}$$