

Rapid River

General Information

Rapid River is a tributary to the Little Salmon River near Riggins, Idaho. The study reach is a 1,200 ft length of stream about 2 miles upstream from the confluence with the Little Salmon River and just upstream of the fish hatchery. The site is on land administered by the Forest Service at an elevation of about 2,200 ft. The drainage area is 108 mi² and the geology of the watershed is predominantly sedimentary.

This site is associated with an existing Forest Service gaging station. Streamflow records and sediment transport measurements are available from water year 1986 to 1999. Additional measurements included a survey of the stream reach, pebble counts of the substrate surface, core samples of the substrate subsurface material and transport distance of painted rocks during the high snowmelt flows in 1995. Figure 1 shows a photograph of looking downstream from the gaging station. There is a cableway just upstream of the gaging station to facilitate discharge and sediment transport measurements during high flows.



Figure 1. Rapid River looking downstream from the measurement site.

Streamflow was recorded for water years 1986 through 1999. Estimated average annual streamflow (Q_a) for the stream is $162 \text{ ft}^3/\text{s}$ and the estimated bankfull discharge (Q_b) is $626 \text{ ft}^3/\text{s}$. Recorded stream discharge for this period ranged from $19.1 \text{ ft}^3/\text{s}$ to $1,357 \text{ ft}^3/\text{s}$. The largest instantaneous discharge recorded was $1,450 \text{ ft}^3/\text{s}$ on May 31, 1986.

Channel Profile and Cross-Section

Figure 2 shows the longitudinal profile for the channel bed in the center of the channel, the water surface elevations along each bank at the time of the survey and bankfull flow elevations (floodplains). The average gradient for the study reach is $0.0108 \text{ ft}/\text{ft}$. Cross-sections of the channel were surveyed at seven locations. Discharge and sediment transport measurements were made at cross-section 1 (XS1) at the cableway and the movement of painted rocks during the spring and early summer snowmelt flows in 1995 were measured at two transects about 49 ft and 125 ft upstream of XS3.

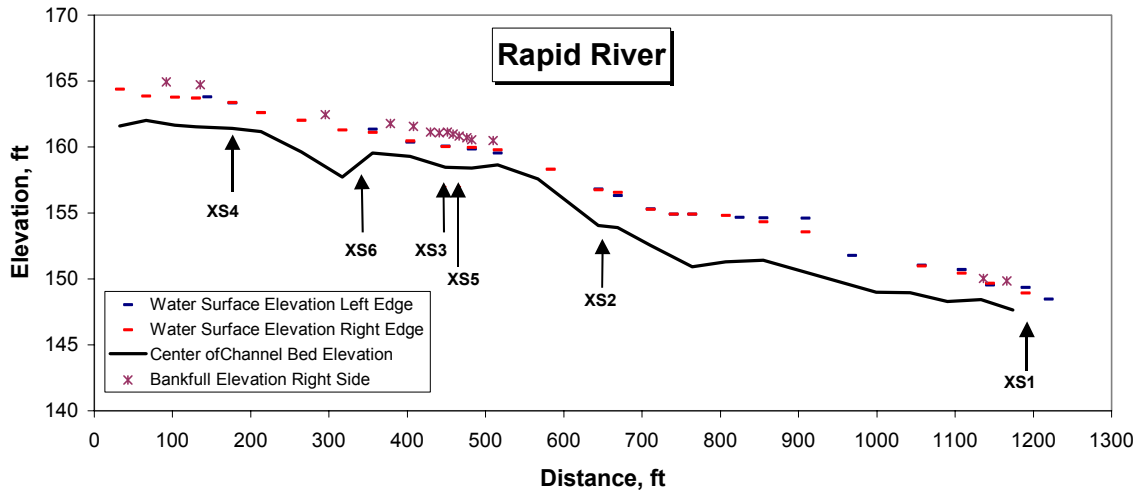


Figure 2. Longitudinal profile of the study reach in Rapid River.

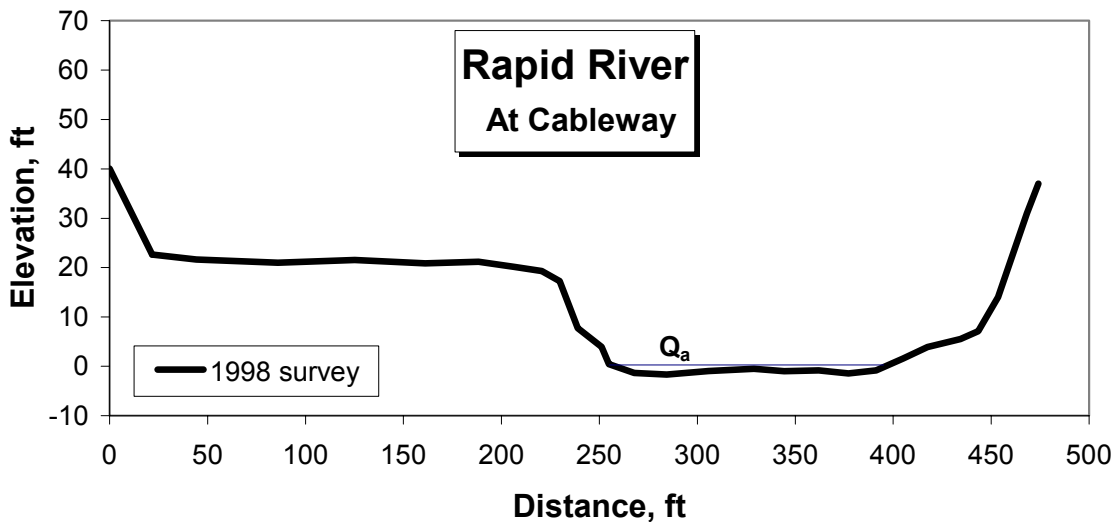


Figure 3. Cross-section of Rapid River at the cableway site.

Channel Geometry

Figure 3 shows the cross-section at the sediment transport measurement site, cross-section 1. The channel geometry relationships for this cross-section are shown in Figure 4. All data collected during discharge measurements in 1986 through 1999 were used to develop the displayed power relationships with discharge (Figure 4). Over the range of discharges when sediment transport was measured (32.3 to 1,300 ft³/s) estimated stream width, estimated average depth and estimated average velocity varied from 42.2 to 65.9 ft, 0.72 to 2.74 ft, and 1.1 to 7.2 ft/s, respectively. The average reach gradient is 0.0108 ft/ft.

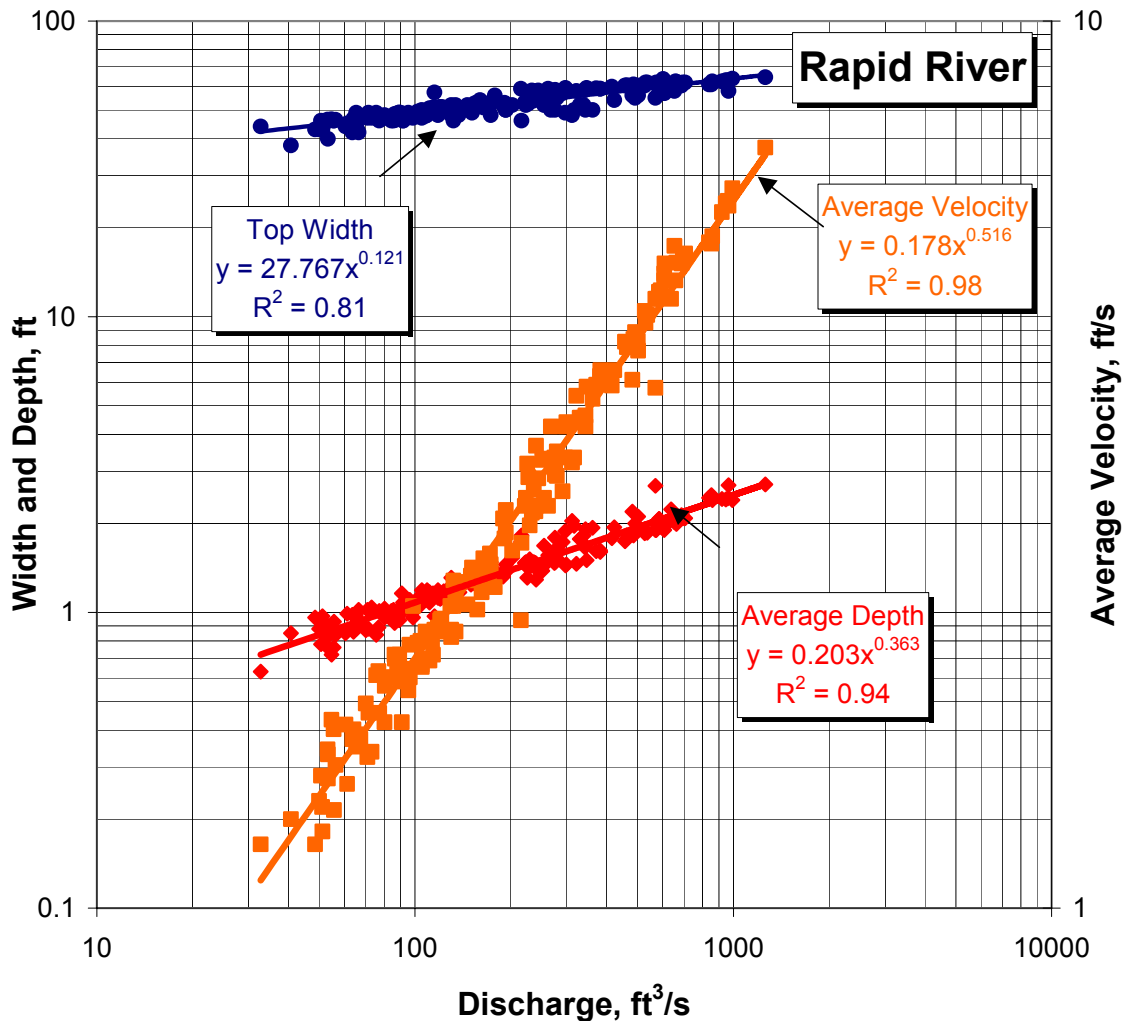


Figure 4. Width, average depth and average velocity versus stream discharge at the measurement cross section on Rapid River.

Channel Material

A surface pebble count was made at cross-section 1 in July 1994. In October 1995 additional surface pebble counts were made at four cross-sections and four cores of subsurface material were collected. The average D_{50} and D_{90} for the 1994 pebble counts were 94 mm and 181 mm, respectively. The average D_{50} and D_{90} for the surface material in the reach in 1995 were 63 mm and 220 mm, respectively (Figure 5). The average D_{50} and D_{90} for the subsurface material (1995) were 16 mm and 113 mm, respectively. About 10% of the surface material is sand (2 mm) size or smaller. The particle size distribution of the floodplain surface strata was quite variable. The median diameter of the floodplain subsurface strata material was smaller than 0.25 mm.

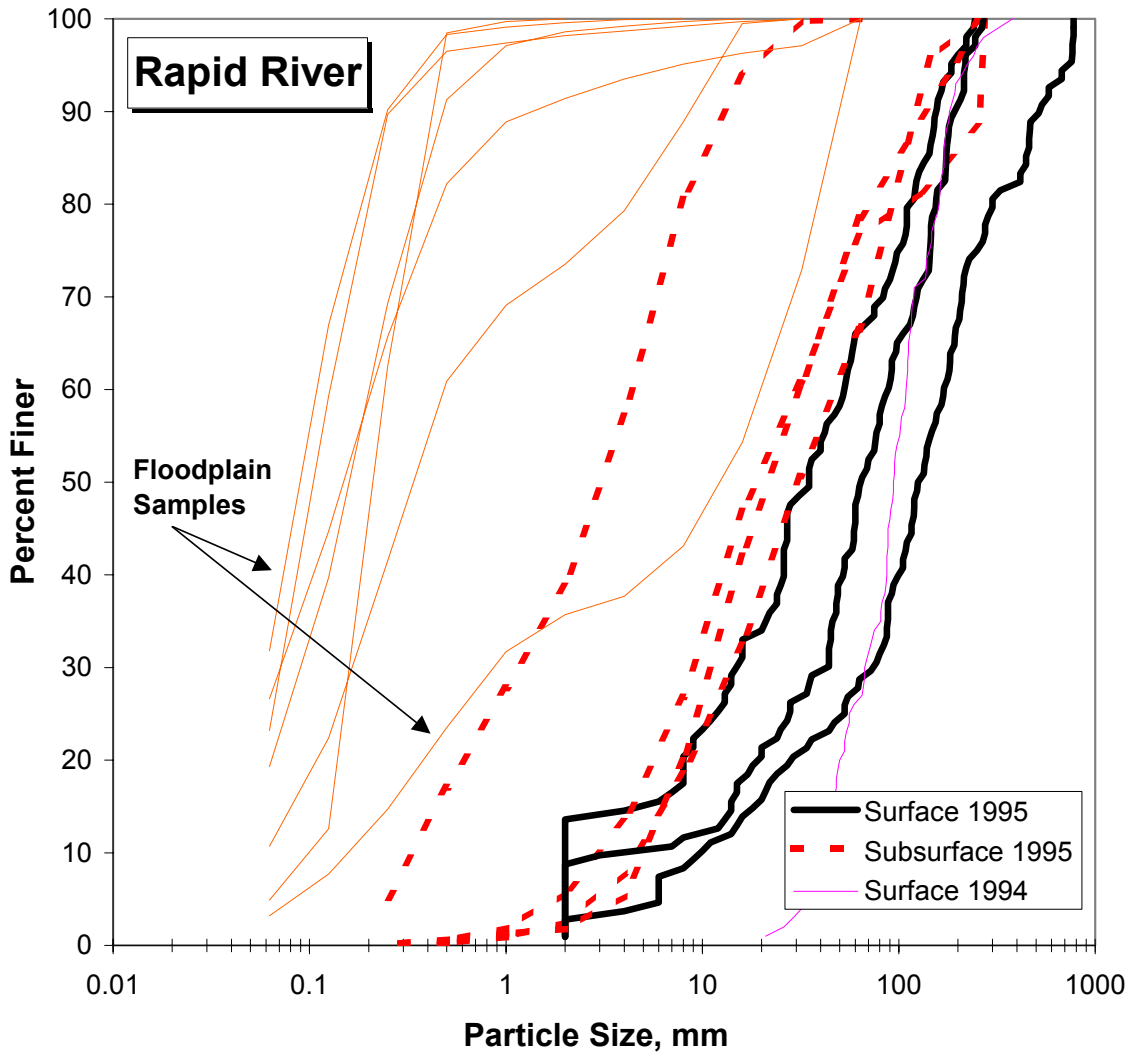


Figure 5. Particle size distribution for surface and subsurface material samples and for floodplain material samples collected in Rapid River.

Sediment Transport

The bedload and suspended load measurements in water years 1986 through 2000 were all made in the vicinity of the cableway. The sediment transport data includes 191 measurements of bedload transport and 85 measurements of suspended sediment. Sediment transport measurements spanned a range of stream discharges from 32.3 ft³/s (0.20Q_a; 0.05Q_b) to 1,300 ft³/s (8.02Q_a; 2.08Q_b). Bedload transport ranged from 0.00270 to 465 t/d and suspended transport ranged from 0.05 to 1,919 t/d. Over the range of measured discharges, suspended transport accounts for the majority of the material in transport with approximately four fold difference at the lowest discharge and over an order of magnitude difference at the highest discharge (Figure 6).

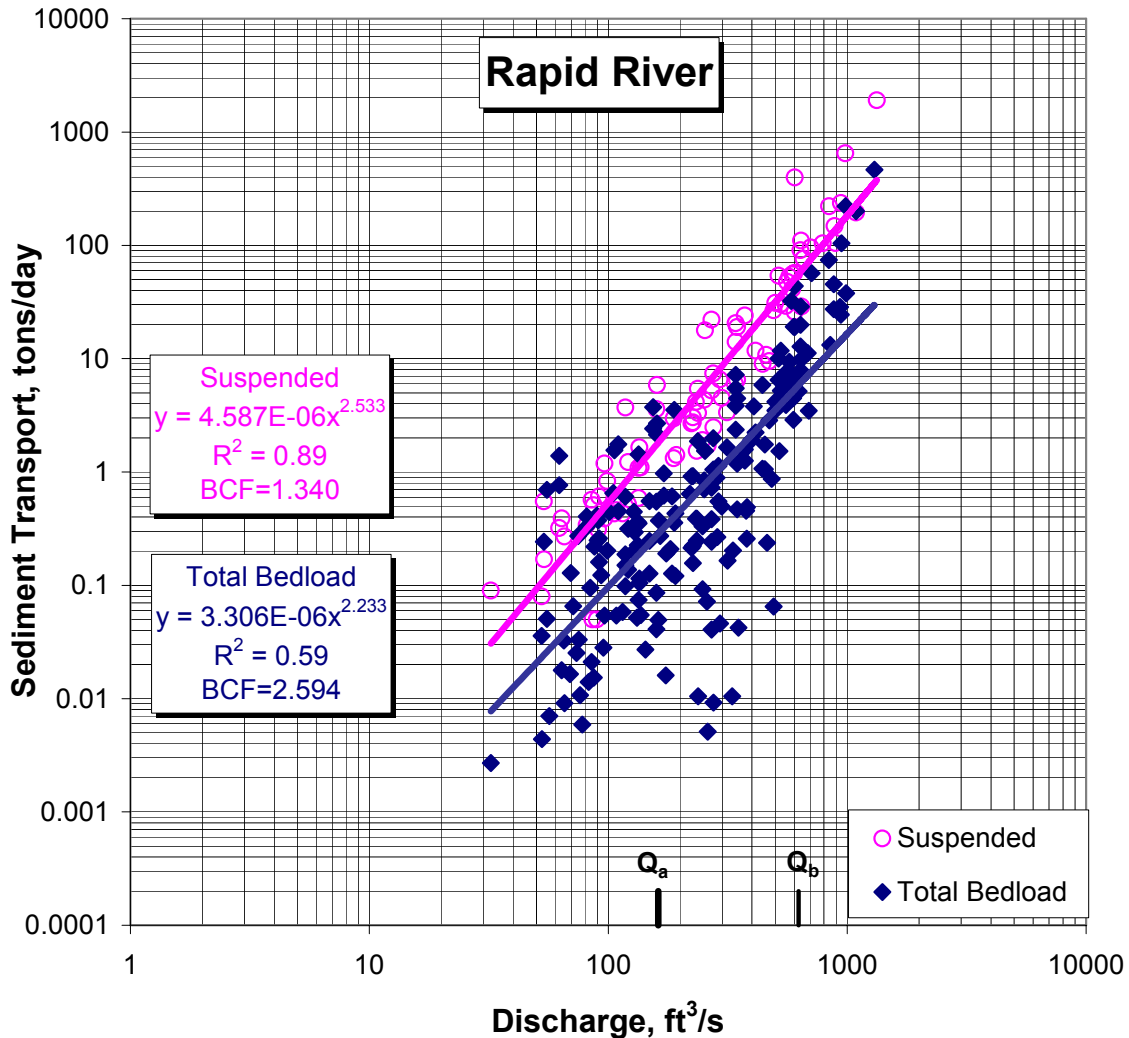


Figure 6. Bedload and suspended load transport rate versus discharge.

The bedload transport rates by size class (Figure 7) shows that the larger rates are usually associated with material in the 0.5 to 2mm diameter size class. At the highest range of flows material larger than 32mm make up a larger portion of the material in transport. Twelve of the bedload samples contained material larger than 32 mm diameter all at discharges equal or greater than 346 ft³/s.

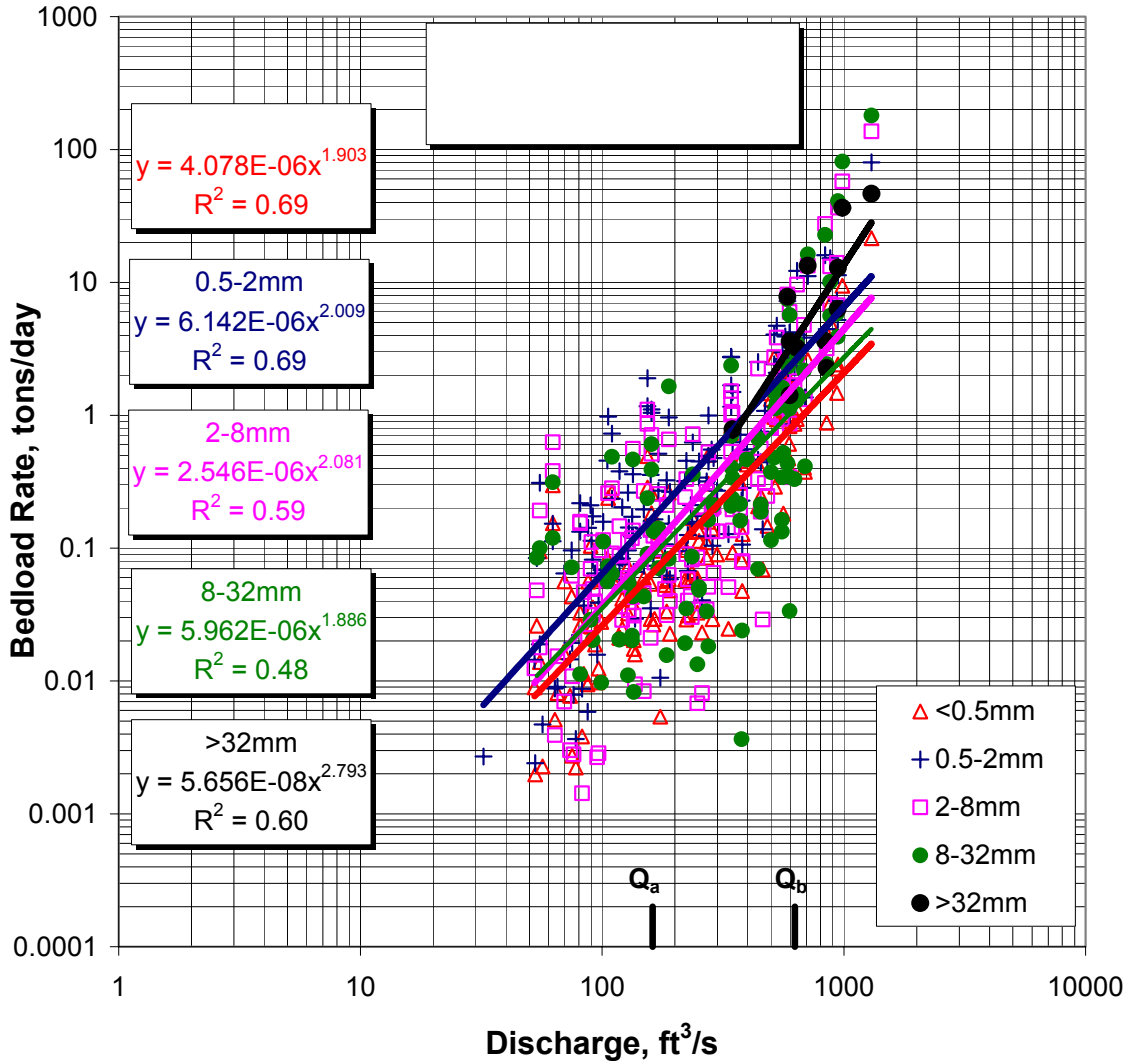


Figure 7. Bedload transport rate versus discharge for selected size classes

There was a trend of increasing size of the largest particle in the bedload sample with increasing discharge (Figure 8). The largest particle measured in the bedload sample was 62 mm at a discharge of 638 ft³/s. There was also a weak trend of increase median size of the bedload sample with increasing discharge. The largest median size of a sample was 37.2 mm at a discharge of 597 ft³/s. The information on the largest particle in the bedload sample and observations of painted rock movement and recently moved large particles suggest that discharges near bankfull discharge are capable of moving the median diameter particles on the channel surface.

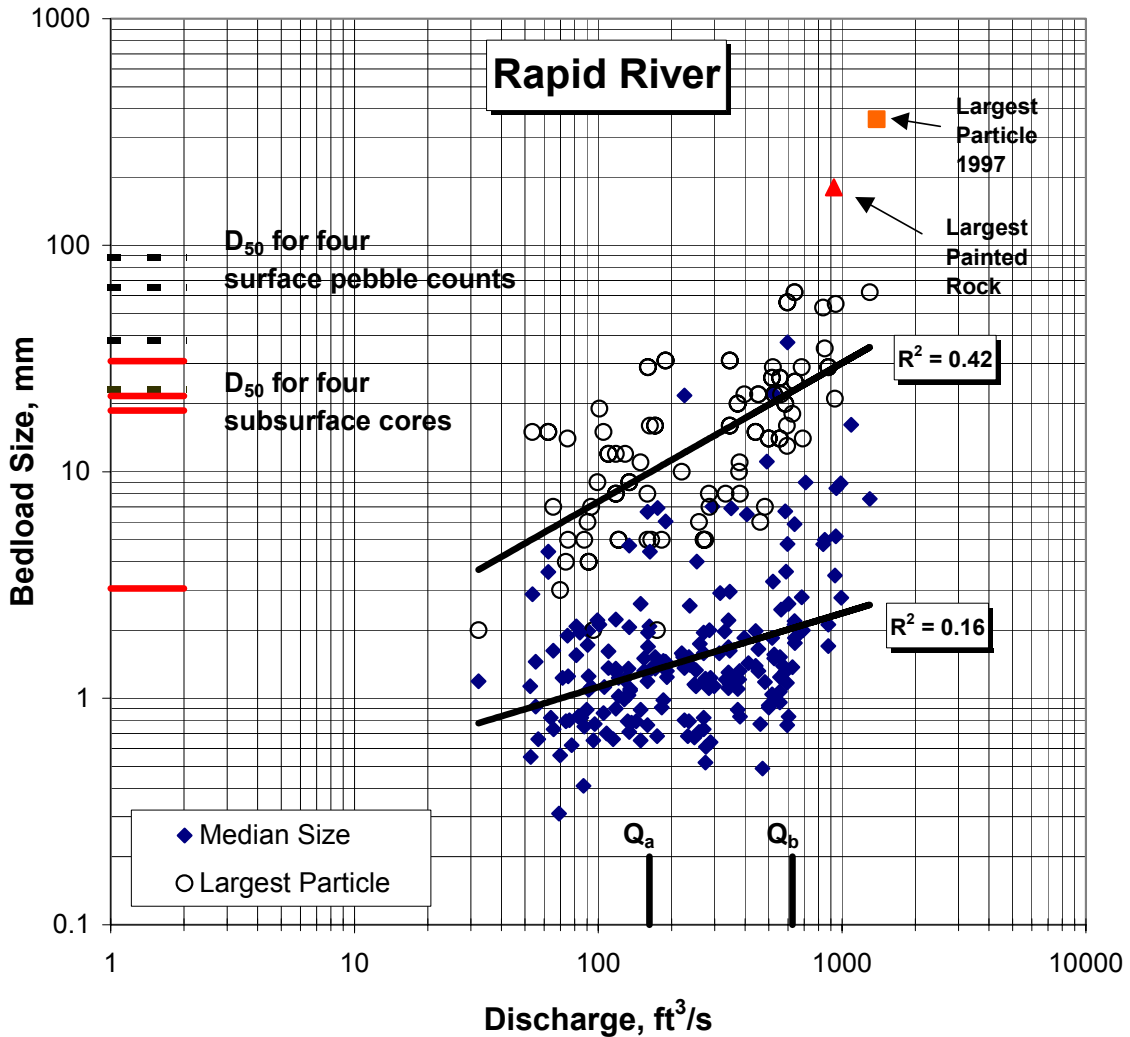


Figure 8. Largest particle in the bedload sample and median size of the sample versus stream discharge for Rapid River.

Painted Rock Transport

A total of forty painted rocks were placed across two transects (twenty per transect) on April 18, 1995. Daily mean discharge on the day of rock placement was 127 ft³/s. The size of the rocks ranged from 73 to 180 mm diameter (b-axis) which represents the D₅₃ up to the D₈₃ of the surface particle size distribution for the reach. Transport of the rocks as of September 18, 1995 are shown in Figures 9 and 10.

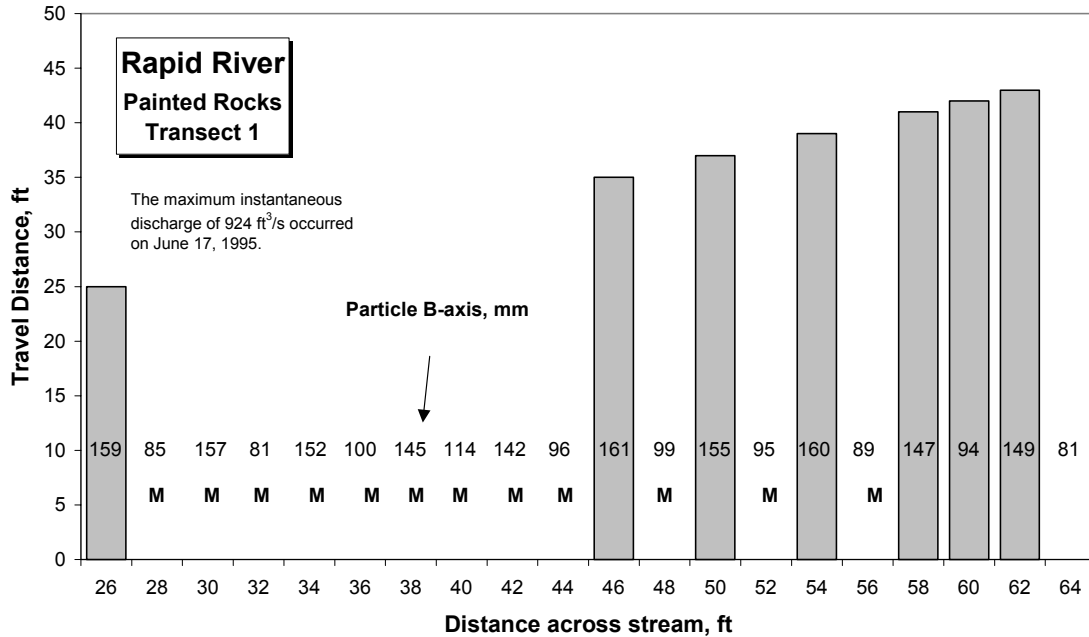


Figure 9. Transport distance of painted rocks at transect 1.

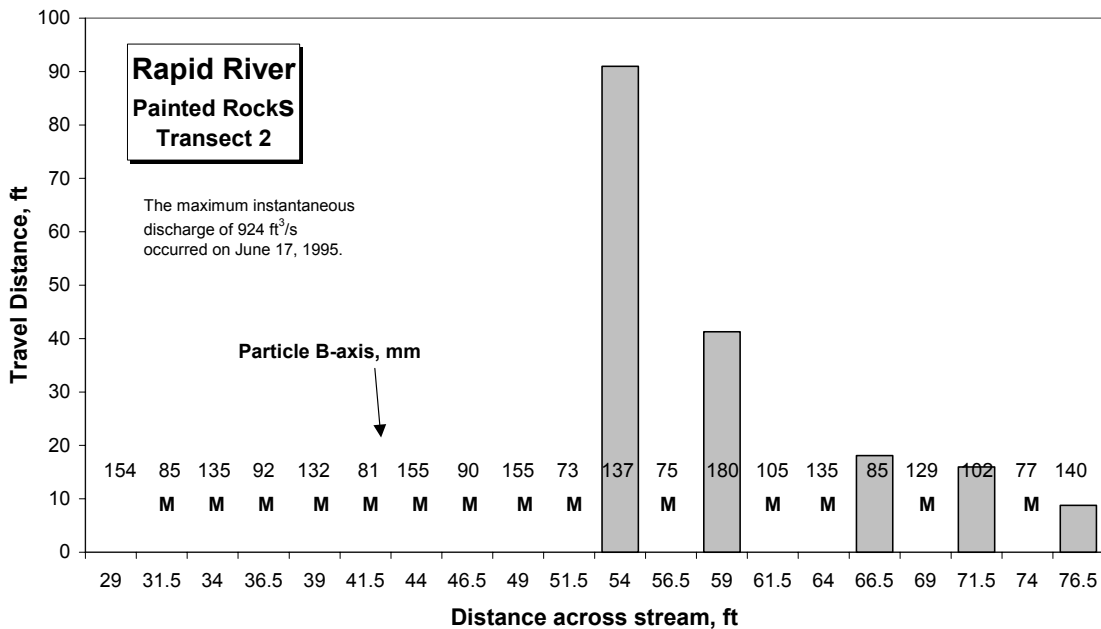


Figure 10 Transport distance of painted rocks at transect 2.

Fourteen of the forty rocks were found. Of those found, only two had not moved. The maximum transport distance was 91 ft for a 137 mm diameter rock and the average was transport distance was 31.2 ft. The largest daily mean discharge during this period was 841 ft³/s on June 18, 1995 and the largest instantaneous discharge was 924 ft³/s on June 17, 1995.