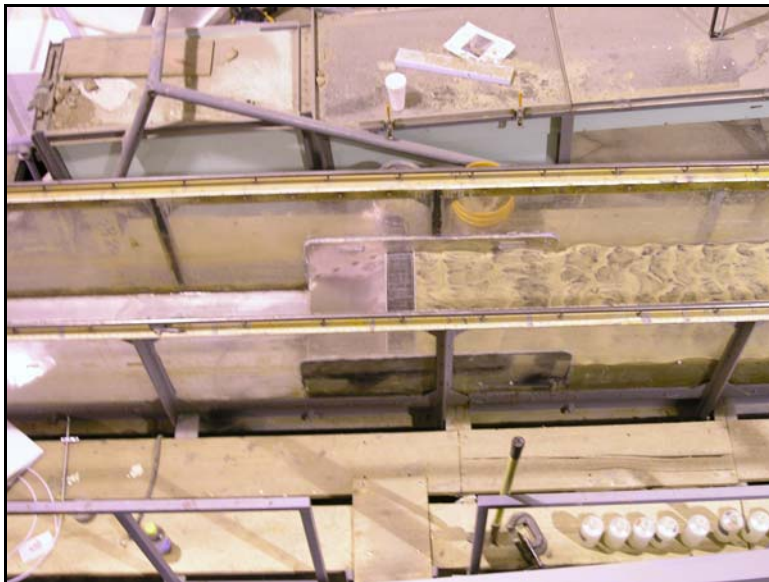


Removal Efficiency Testing of Streamside Systems' Bedload Monitoring Collector

Prepared for:
Streamside Systems



Prepared by:

Chad M. Lipscomb, PE,
Andrew Darrow,
Christopher I. Thornton, P.h.D., PE

Colorado State University
Engineering Research Center
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TABLE OF CONTENTS

1	INTRODUCTION	1
2	FACILITY.....	2
2.1	TEST UNIT.....	6
3	TESTING	8
4	ANALYSIS AND RESULTS	16
4.1	COLLECTOR EFFICIENCY.....	17
4.1.1	<i>Total Load Efficiency</i>	17
4.1.2	<i>Bedload Capture Efficiency</i>	21
4.1.2.1	Determination of Suspended Load Passing the Unit – Method 1	22
4.1.2.2	Determination of Suspended Load Passing the Unit – Method 2	22
4.1.2.3	Determination of Suspended Load Passing the Unit – Method 3	22
4.1.2.4	Computation of Bedload Capture Efficiency	25
4.2	BEDLOAD PREDICTION.....	28
4.3	HELLY-SMITH COMPARISON	29
4.4	CAPTURE EFFICIENCY BY SIZE FRACTION.....	32
4.5	MAXIMUM OPERABLE PARAMETERS	36
5	SUMMARY AND CONCLUSIONS	37
	APPENDIX A: RAW DATA	40

LIST OF FIGURES

Figure 1. Schematic of Testing Facility	3
Figure 2. Photograph of Bedload Monitoring Collector in Place	4
Figure 3. Photograph of Bypassed Sediment Collection Tank	4
Figure 4. Photograph of Bedload Monitoring Collector In Place with Sand Bed	5
Figure 5. Photograph of Test Facility	5
Figure 6. Schematic of Test Unit	6
Figure 7. Photographs of Collector Screens	7
Figure 8. Plot of Source Sediment Grain Size Distribution.....	9
Figure 9. Photograph of Bedload Monitoring Collector with Sand Bed in Place Prior to Testing	12
Figure 10. Photograph of Flow Over Control Weir During Testing.....	13
Figure 11. Photograph of Large Screen During Testing.....	13
Figure 12. Photograph of Small Screen During Testing.....	14
Figure 13. Photograph of Bypassed Sediment Detention Tank During Testing.....	14
Figure 14. Photograph of Bed at Conclusion of Testing	15
Figure 15. Plot of Total Load Efficiency versus Velocity	19
Figure 16. Plot of Total Load Efficiency versus Depth	20
Figure 17. Plot of Total Load Efficiency versus Sediment Discharge	21
Figure 19. Plot of Bedload Capture Efficiency versus Velocity.....	27
Figure 20. Plot of Bedload Capture Efficiency versus Velocity.....	27
Figure 21. Plot of Bedload Capture Efficiency versus Sediment Discharge	28
Figure 22. Plot of Total Bedload versus Captured Bedload	29
Figure 23. Plot of Helly-Smith versus Bedload Monitoring Collector – Material 1	30
Figure 24. Plot of Helly-Smith versus Bedload Monitoring Collector – Material 2	31
Figure 25. Plot of Helly-Smith versus Bedload Monitoring Collector – Material 3	31
Figure 27. Plot of Capture Efficiency by Grain Size, Material 2	35
Figure 28. Plot of Capture Efficiency by Grain Size, Material 3	35

LIST OF TABLES

Table 1. Test Matrix.....	8
Table 2. Grain Size and Collector Dimensions.....	12
Table 3. Summary Data	16
Table 4. Total Load Efficiency Results	18
Table 5. Example Determination of Suspended Portion Passing BMC for Single Size Fraction	23
Table 6. Example Determination of Suspended Portion Passing BMC for All Size Fractions...	24
Table 7. Bedload Efficiency Results.....	26
Table 8. Capture Efficiency by Size Fraction, Material 1	33
Table 9. Capture Efficiency by Size Fraction, Material 2	33
Table 10. Capture Efficiency by Size Fraction, Material 3	34

1 INTRODUCTION

Initiating in October of 2004, a testing program was developed and executed to evaluate the efficiency of Streamside Systems' Bedload Monitoring Collector (BMC). The objective of the study was to determine the percentage of total sediment load and bedload the collector would remove from sediment-laden flow under a variety of hydraulic conditions. Further, a preliminary comparison of results obtained with the Bedload Monitoring Collector and a Helly-Smith bedload collector was required. Testing was conducted in the Hydraulics Laboratory of Colorado State University (CSU) located at the Engineering Research Center (ERC). This report details the installation, testing, analysis and results of the study executed to meet the required scope of work dated June 24th, 2004 and serves to fulfill the obligations of CSU with respect to contractual agreements related to the scope of work.

2 FACILITY

The BMC was installed within an existing flume in the Hydraulics Laboratory located at the ERC. The test flume measured 2-feet wide, 60-feet long and 30-inches deep. Flow was supplied to the flume by a fifty horsepower, variable speed pump and was re-circulated upon discharge to the supply sump. Flow was measured using an inline, electromagnetic flow meter, accurate to $\pm 2\%$. Water surface elevations and bed elevations were measured using a calibrated point gage assembly mounted to a mobile data acquisition cart that traversed the width of the flume and could be positioned anywhere within the test facility. Velocities within the flow were measured using a pitot tube connected to a differential pressure transducer accurate to $\pm 2\%$.

The BMC was installed within the test flume, incorporated with a sand bed to supply a sediment load, and an adjustable weir downstream to control the water surface elevation and capture sediment passing the collector. The collector bypass line was secured to the collector and routed through the adjustable weir to a separate collection box placed adjacent to the test flume. Flow from the collector box was regulated by a sharp crested weir and discharged into the facility sump while sediment was retained within the collector box. Figure 1 presents a schematic of the BMC installed within the test facility and Figures 2 through 5 present a series of photographs of the BMC installed for testing.

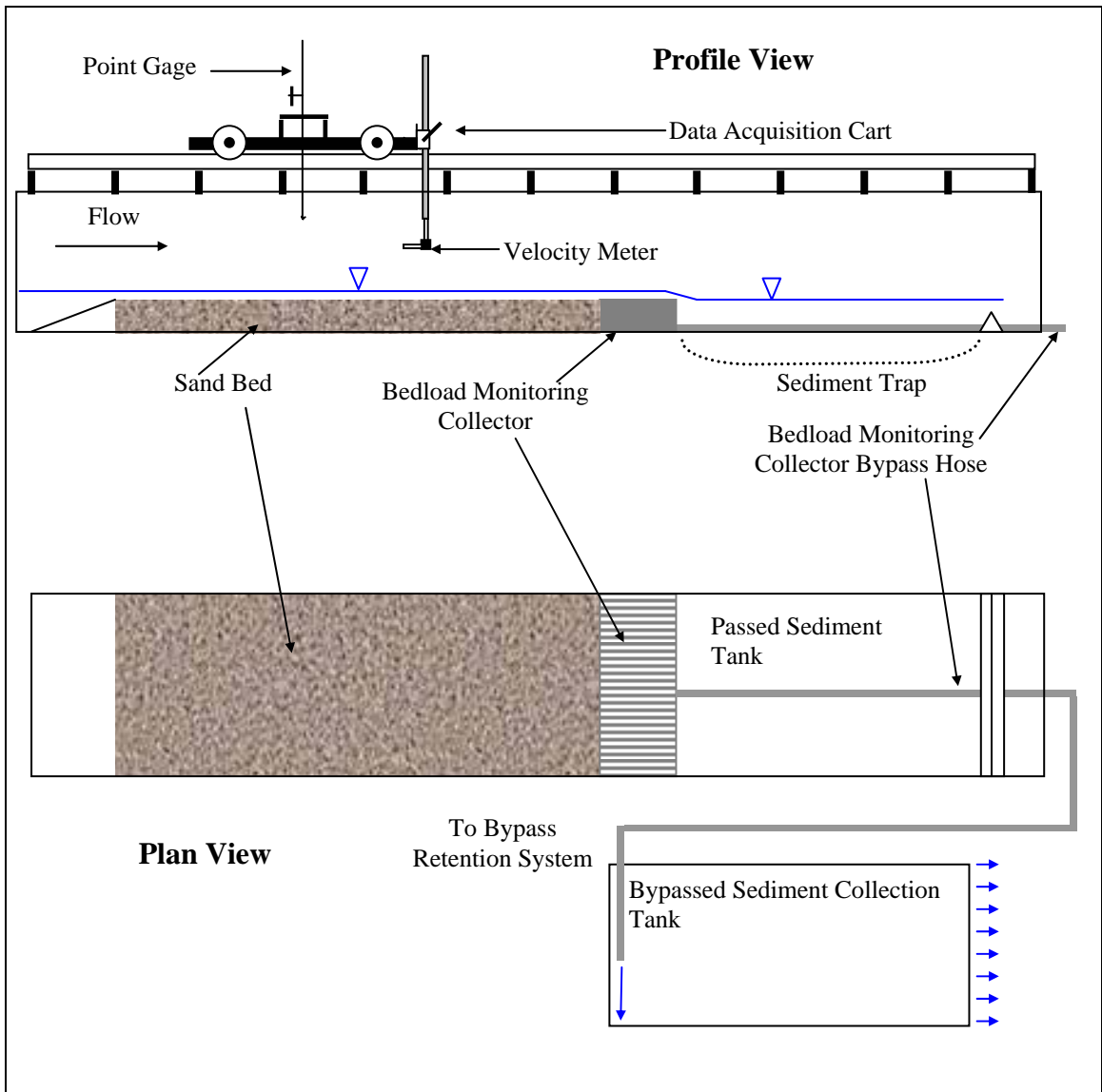


Figure 1. Schematic of Testing Facility



Figure 2. Photograph of BMC in Place



Figure 3. Photograph of Bypassed Sediment Collection Tank



Figure 4. Photograph of BMC in Place with Sand Bed

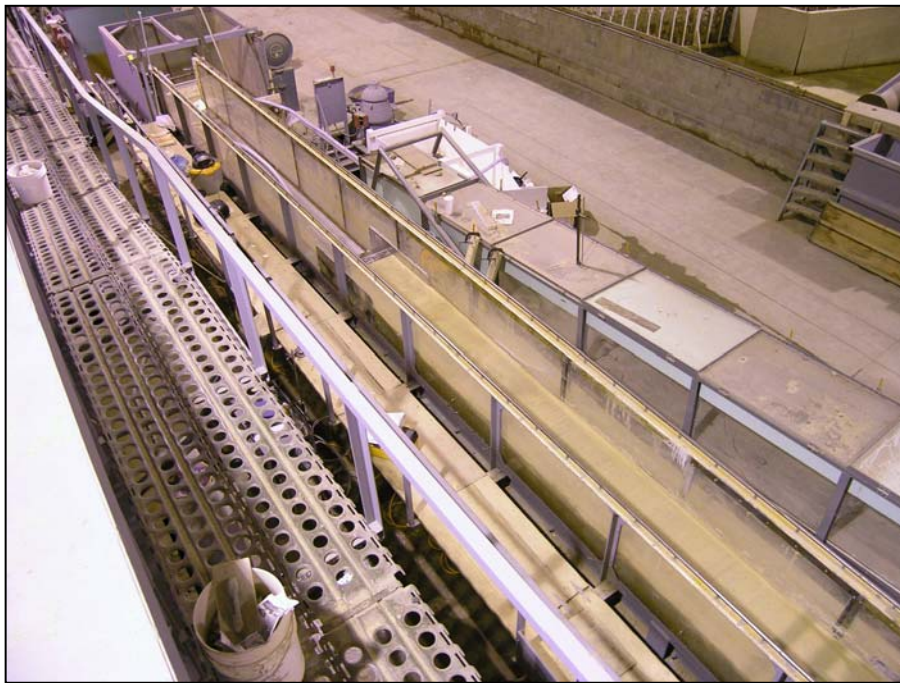


Figure 5. Photograph of Test Facility

2.1 TEST UNIT

The BMC functioned by screening bedload from the flow as sediment-laden water passed over the unit. Sediment screened from the flow was flushed into the unit and into the bypass hose. The bypass hose was routed to a collection tank, which retained the flow from the collector sufficiently to deposit the bypassed sediments. The BMC was constructed of stainless steel and was provided by Streamside Systems, manufactured to fit the dimensions of the test facility. Two separate screens were provided with the unit, which measured 3.75-feet long and 1.0-foot high at the screen and spanned the width of the flume. The first screen incorporated an opening width of 1.0 inches (25.4mm) and the second screen incorporated an opening width of 0.25 inches (6.35mm). Both screens utilized a rectangular opening spanning the length of the screen opening. Figure 6 presents a schematic of the test unit and Figure 7 presents a photograph of each screen.

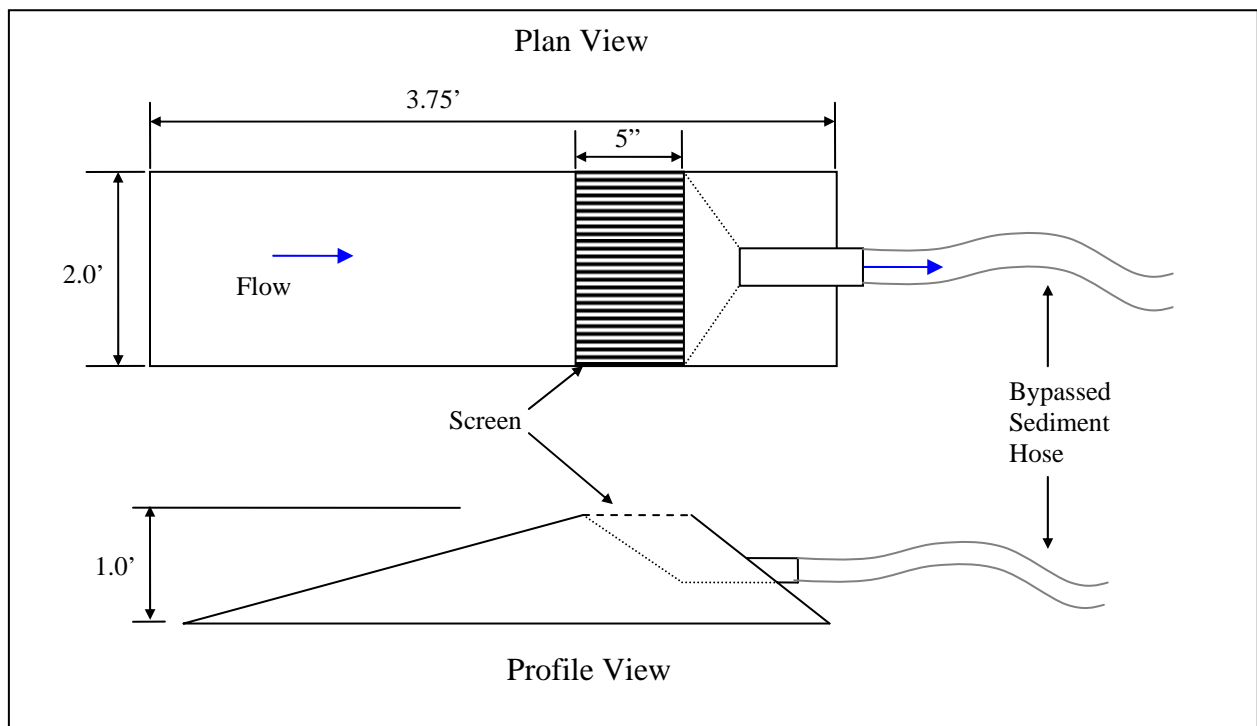


Figure 6. Schematic of Test Unit

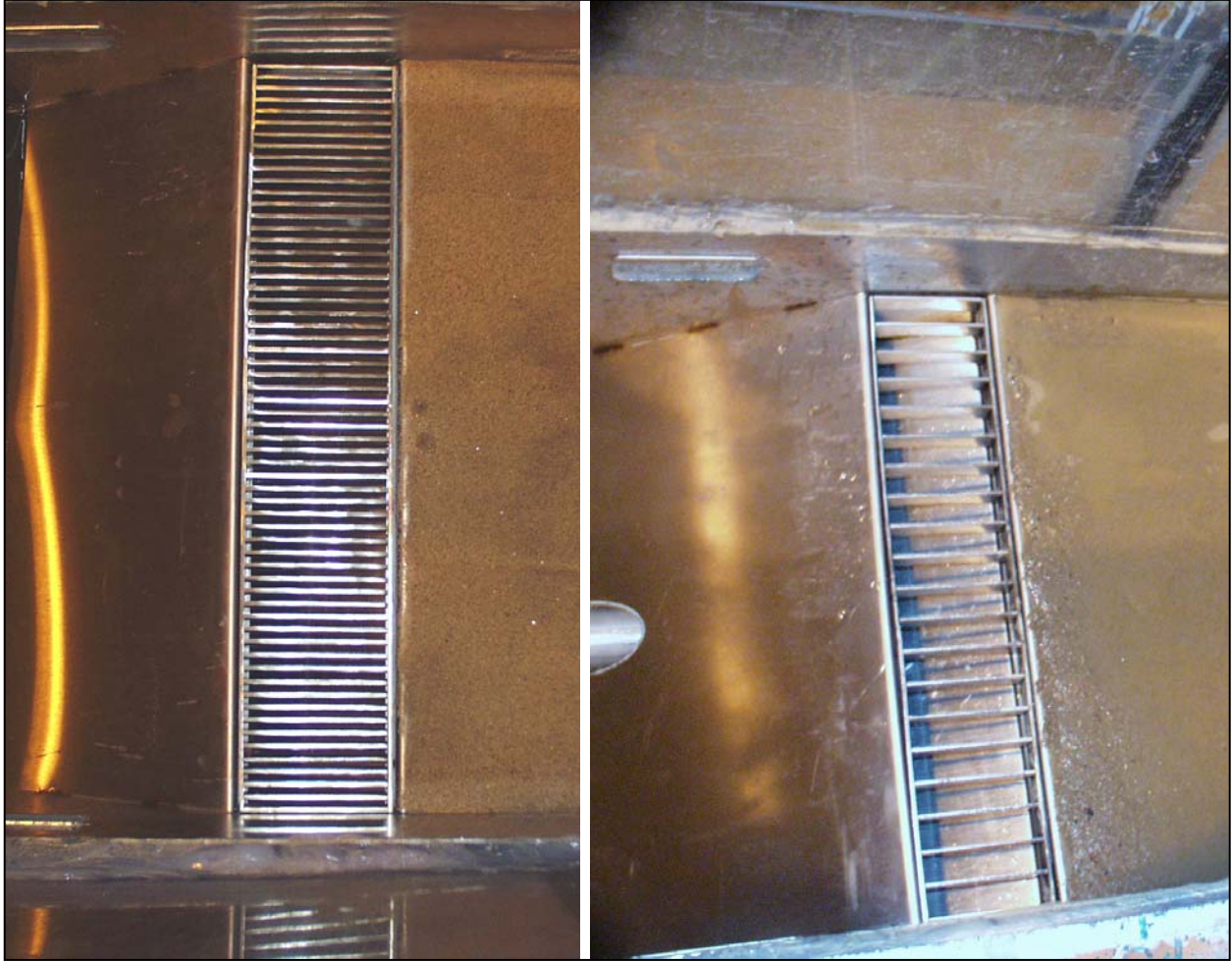


Figure 7. Photographs of Collector Screens

3 TESTING

A series of tests was performed to evaluate the efficiency of the BMC with respect to removing sediment from flow. Further, a series of tests was conducted to compare the results obtained with the bedload monitoring collector and a Helly-Smith Sampler. Depth and velocity were systematically varied to produce a variety of hydraulic conditions for testing. Three gradations of sand and two screen sizes were incorporated into the test matrix. Table 1 presents the test matrix. Figure 8 presents a plot of the three grain size distributions of the test material.

Table 1. Test Matrix

Test	Target		Grain Distribution	Screen Size	Total Test Time hrs	Collector Evaluated
	Average	Average				
	Flow	Cross-Section				
	Depth	Average Velocity				
1	0.30	1.3	Material 1	Small	5.3	BMC
2	0.50	1.3	Material 1	Small	3.0	BMC
3	0.75	1.3	Material 1	Small	3.0	BMC
4	0.30	1.7	Material 1	Small	3.0	BMC
5	0.50	1.7	Material 1	Small	3.0	BMC
6	0.75	1.7	Material 1	Small	3.0	BMC
7	0.30	1.7	Material 2	Small	3.0	BMC
8	0.50	1.7	Material 2	Small	3.0	BMC
9	0.75	1.7	Material 2	Small	3.0	BMC
10	0.30	2.5	Material 2	Small	1.4	BMC
11	0.30	2.5	Material 2	Large	3.0	BMC
12	0.50	2.5	Material 2	Large	3.0	BMC
13	0.75	2.5	Material 2	Large	3.0	BMC
14	0.30	2.5	Material 3	Large	3.0	BMC
15	0.50	2.5	Material 3	Large	3.0	BMC
16	0.75	2.5	Material 3	Large	3.0	BMC
17	0.75	1.3	Material 3	Large	3.0	BMC
18	0.30	3.0	Material 3	Large	0.4	BMC
19	0.75	3.0	Material 3	Large	1.5	BMC
20	0.75	1.7	Material 3	Large	3.0	BMC

Test	Target		Grain Distribution	Collector Evaluated
	Average	Average		
	Flow	Cross-Section		
	Depth	Average Velocity		
21	0.30	1.3	Material 1	Helly-Smith
22	0.50	1.3	Material 1	Helly-Smith
23	0.75	1.3	Material 1	Helly-Smith
24	0.30	1.7	Material 1	Helly-Smith
25	0.50	1.7	Material 1	Helly-Smith
26	0.75	1.7	Material 1	Helly-Smith
27	0.30	1.7	Material 2	Helly-Smith
28	0.50	1.7	Material 2	Helly-Smith
29	0.75	1.7	Material 2	Helly-Smith
30	0.30	2.5	Material 2	Helly-Smith
31	0.50	2.5	Material 2	Helly-Smith
32	0.75	2.5	Material 2	Helly-Smith
33	0.30	2.5	Material 3	Helly-Smith
34	0.50	2.5	Material 3	Helly-Smith
35	0.75	2.5	Material 3	Helly-Smith
36	0.75	1.3	Material 3	Helly-Smith
37	0.75	3.0	Material 3	Helly-Smith
38	0.75	1.7	Material 3	Helly-Smith

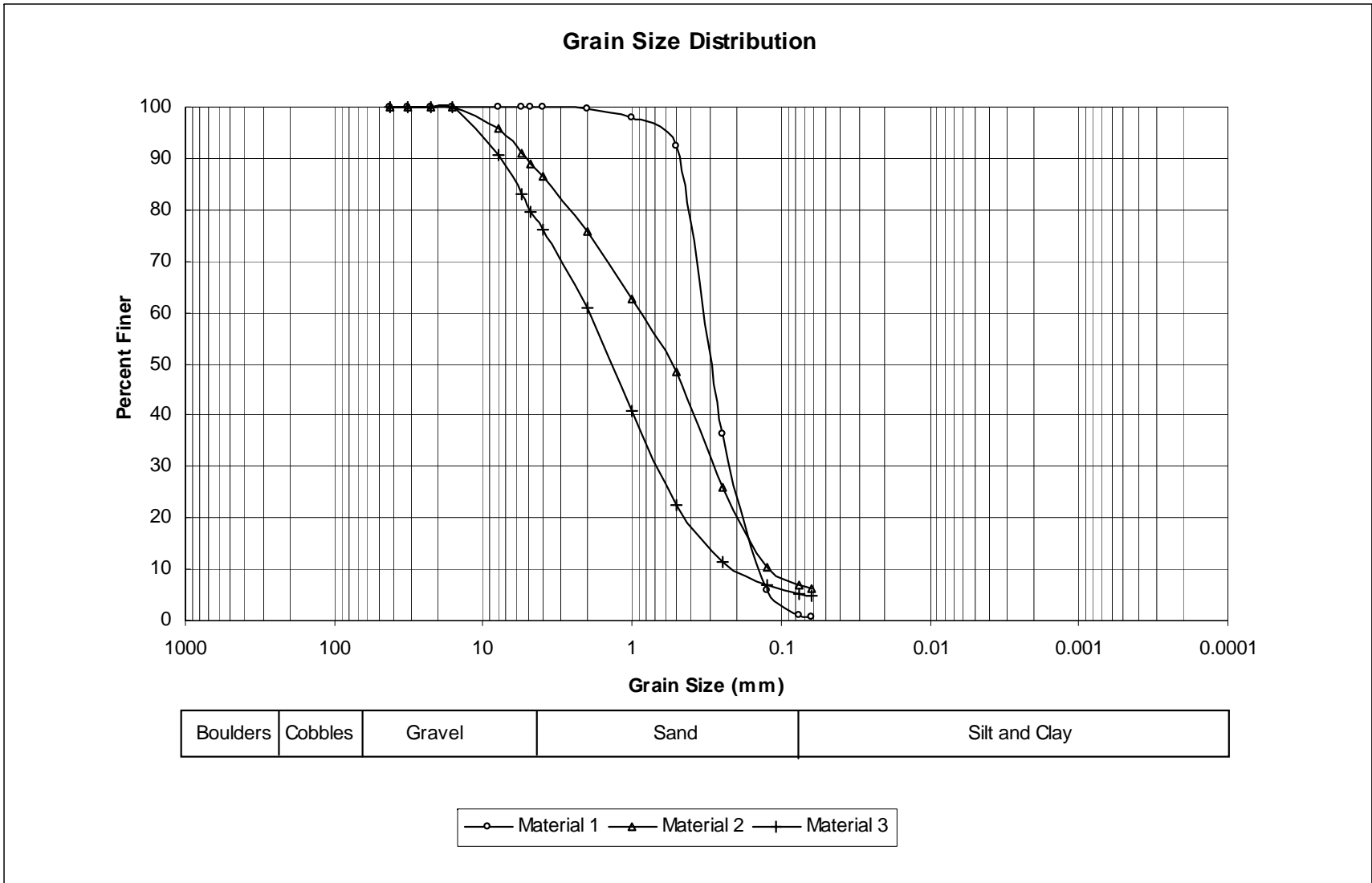


Figure 8. Plot of Source Sediment Grain Size Distribution

A protocol was developed and utilized to conduct performance testing of the BMC. Prior to each test, the sand bed was leveled and bed elevations were measured. The bypassed sediment collection tank and passed sediment collection tank were cleaned and the instrumentation was prepared. Flow within the facility was initiated slowly to minimize disturbance of the sand bed. Flow was increased to the target discharge and the adjustable weir was configured to achieve the target flow depth. Once the flow reached equilibrium, testing continued for three hours. Test duration was varied to reduce total sediment discharge when necessary. Over the course of each test, water surface elevation and flow velocity were measured, and suspended sediment samples were collected.

Water surface elevation measurements were collected at 2-foot intervals using the point gage assembly. Flow velocities were measured using the pitot tube coupled with the differential pressure transducer at 4-foot intervals along the length of the sand bed and 2-feet upstream of the collector. Velocities were recorded at sixty percent of the flow depth from the water surface at each location. Flow velocity along the bed (ninety percent of the flow depth from the water surface) was also recorded 2-feet upstream of the collector. Suspended sediment samples were recorded at four locations along the test section. At each location, two samples were collected. The first sample was collected at the bed surface; the second sample was collected 0.10 foot above the bed. Approximately 1 liter of sediment and water was collected for each sample.

At the conclusion of the test duration, flow was suspended, and the facility and bypass sediment tank were de-watered. Material from the sediment trap and bypass sediment tank was removed and dried. Suspended samples were also dried.

Once all material from testing was collected and dried, the flow was initiated again and increased to the same target discharge and flow depth. Once the flow had reached equilibrium,

water surface elevations were recorded at 2-foot intervals along the test section. Six bed load samples were recorded using the Helly-Smith sampler. The Helly-Smith sampler utilized for testing consisted of a 3-inch square opening, which transitioned into a 250-micron mesh bag. Samples were collected at the longitudinal midpoint of the test section at three locations spaced equidistant across the width of the flume. Two series of samples were collected. A series of three samples was collected for ninety seconds. A second series of three samples was collected for 180 seconds. Flow was then suspended and the collected samples dried and weighed.

A series of samples was extracted from material collected in the passed sediment tank and bypass sediment tank to determine the grain size distribution of material passing the collector and captured by the collector. Suspended samples were also analyzed to determine the grain size distribution of suspended material. Grain size distributions were determined by mechanical method over a range of 0.063 mm and 42 mm for collected and bypassed sediments and 0.045 mm to 0.500 mm for suspended sediments. The BMC was operated under siphon conditions over the entirety of the test matrix. Discharge through the siphon was measured by direct volumetric calibration. The siphon discharge was determined to be approximately fifty gallons per minute. Table 2 presents a summary of grain size diameters and collector dimensions from the test matrix. Figures 9 through 14 present a series of photographs depicting testing of the BMC.

Table 2. Grain Size and Collector Dimensions

	Material 1	Material 2	Material 3
D ₅₀ (mm)	0.30	0.54	1.35
% < 2 mm (sand & finer)	100	76	61
% > 2 mm (gravel)	0	24	39
Helly-Smith mesh (mm)	0.25	0.25	0.25
% < 0.25 mm	36	26	11
% > 6.35 mm (small screen width)	0	5	13
% < 25.4 mm (large screen width)	100	100	100



Figure 9. Photograph of BMC with Sand Bed in Place Prior to Testing



Figure 10. Photograph of Flow over Control Weir During Testing



Figure 11. Photograph of Large Screen During Testing



Figure 12. Photograph of Small Screen During Testing



Figure 13. Photograph of Bypassed Sediment Detention Tank During Testing



Figure 14. Photograph of Bed at Conclusion of Testing

4 ANALYSIS AND RESULTS

A series of analyses was performed to determine the efficiency of the collector with respect to total sediment load, the total bedload and the correlation of results obtained using the BMC and the Helly-Smith sampler. Collector efficiency was evaluated with respect to hydraulic conditions and grain size distribution. Table 3 presents the summary data from testing. Raw data is provided in Appendix A.

Table 3. Summary Data

Test	Target		Actual		Grain Size Distribution	Screen Size	Total Mass Passed (kg)	Total Mass Captured (kg)
	Average Flow Depth (ft)	Average Cross-Section Velocity (ft/s)	Average Flow Depth (ft)	Average Cross-Section Velocity (ft/s)				
1	0.30	1.3	0.23	1.3	Material 1	Small	27.4	57.6
2	0.50	1.3	0.49	1.4	Material 1	Small	30.5	26.0
3	0.75	1.3	0.74	1.4	Material 1	Small	27.5	29.7
4	0.30	1.7	0.31	1.8	Material 1	Small	60.8	98.9
5	0.50	1.7	0.51	1.7	Material 1	Small	80.4	134.2
6	0.75	1.7	0.74	1.8	Material 1	Small	81.6	99.6
7	0.30	1.7	0.30	1.9	Material 2	Small	3.4	23.6
8	0.50	1.7	0.51	1.7	Material 2	Small	7.2	61.4
9	0.75	1.7	0.75	1.8	Material 2	Small	5.1	45.4
11	0.30	2.5	0.39	2.0	Material 2	Large	21.7	138.9
12	0.50	2.5	0.57	2.2	Material 2	Large	50.8	272.3
13	0.75	2.5	0.81	2.4	Material 2	Large	81.8	423.0
14	0.30	2.5	0.39	2.0	Material 3	Large	25.6	117.1
15	0.50	2.5	0.55	2.3	Material 3	Large	17.0	179.1
16	0.75	2.5	0.81	2.4	Material 3	Large	17.0	196.9
17	0.75	1.3	0.75	1.4	Material 3	Large	2.8	15.4
19	0.75	3.0	0.89	2.6	Material 3	Large	33.9	395.8
20	0.75	1.7	0.75	1.8	Material 3	Large	2.9	28.0

4.1 COLLECTOR EFFICIENCY

Collector efficiency was determined by two methods. The first method related the captured sediments to the total weight of sediment mobilized during testing. The second method related the captured sediments to the weight of sediment expected to be traveling as bedload. The two analyses are described in the proceeding sections.

4.1.1 TOTAL LOAD EFFICIENCY

Collected data were summarized and tabulated for analysis. Efficiency of the BMC was determined by comparison of the total weight of sediment captured by the unit and the total weight of sediment mobilized. Thus, efficiency was determined by relating captured sediment to the total sediment load. Efficiency computed as related to total load was termed the *Total Load Efficiency*. Total Load Efficiency was evaluated with respect to hydraulic conditions and total sediment load. Efficiency was computed using Equation 1.

$$\text{Total Load Efficiency} = \text{Mass Captured} / (\text{Mass Captured} + \text{Mass Passed}) \quad \text{Equation 1}$$

where:

Mass Captured = Total mass of sediments deposited in bypass collection tank (kg); and

Mass Passed = Total mass of sediments deposited in sediment trap downstream of
BMC (kg).

Total Load Efficiency was computed for each test. Table 4 presents a summary of the Total Load Efficiency results.

Table 4. Total Load Efficiency Results

	Target		Actual						
	Average	Average	Average	Average					
	Cross-Section	Cross-Section	Cross-Section	Cross-Section			Total	Total	Total
	Flow	Flow	Flow	Flow	Grain	Screen	Mass	Mass	Load
	Depth	Depth	Depth	Depth	Size	Size	Passed	Captured	Efficiency
Test	(ft)	(ft/s)	(ft)	(ft/s)	Distribution	Opening	(kg)	(kg)	(%)
1	0.30	1.3	0.23	1.3	Material 1	Small	27.4	57.6	68%
2	0.50	1.3	0.49	1.4	Material 1	Small	30.5	26.0	46%
3	0.75	1.3	0.74	1.4	Material 1	Small	27.5	29.7	52%
4	0.30	1.7	0.31	1.8	Material 1	Small	60.8	98.9	62%
5	0.50	1.7	0.51	1.7	Material 1	Small	80.4	134.2	63%
6	0.75	1.7	0.74	1.8	Material 1	Small	81.6	99.6	55%
7	0.30	1.7	0.30	1.9	Material 2	Small	3.4	23.6	87%
8	0.50	1.7	0.51	1.7	Material 2	Small	7.2	61.4	89%
9	0.75	1.7	0.75	1.8	Material 2	Small	5.1	45.4	90%
11	0.30	2.5	0.39	2.0	Material 2	Large	21.7	138.9	86%
12	0.50	2.5	0.57	2.2	Material 2	Large	50.8	272.3	84%
13	0.75	2.5	0.81	2.4	Material 2	Large	81.8	423.0	84%
14	0.30	2.5	0.39	2.0	Material 3	Large	25.6	117.1	82%
15	0.50	2.5	0.55	2.3	Material 3	Large	17.0	179.1	91%
16	0.75	2.5	0.81	2.4	Material 3	Large	17.0	196.9	92%
17	0.75	1.3	0.75	1.4	Material 3	Large	2.8	15.4	84%
19	0.75	3.0	0.89	2.6	Material 3	Large	33.9	395.8	92%
20	0.75	1.7	0.75	1.8	Material 3	Large	2.9	28.0	91%

Twenty tests were performed with the BMC. Test 10 and Test 18 were terminated prematurely due to clogging of the unit. During Test 10, the screen became clogged. Flow was suspended and the system was inspected. The test was then repeated with the larger screen size (Test 11). During Test 18, the collector hose filled sufficiently to clog and not allow flow into the bypassed sediment collection tank. Thus Test 10 and Test 18 were not considered for efficiency analysis, however were considered for determination of maximum operation parameters (Section 4.4).

Analysis of Table 3 showed Total Load Efficiency to range between eighty-two and ninety-two percent for Material 2 and Material 3. Total Load Efficiency for Material 1 ranged between forty-six and sixty-eight percent. Material 1 consisted of uniform, fine sand, thus, a

relatively lower efficiency was not unexpected. Total Load Efficiency values were examined with respect to hydraulic conditions. Velocity and flow depth were used to evaluate the relationship of Total Load Efficiency to hydraulic conditions. Figure 15 presents a plot of velocity versus Total Load Efficiency and Figure 16 presents a plot of flow depth versus Total Load Efficiency.

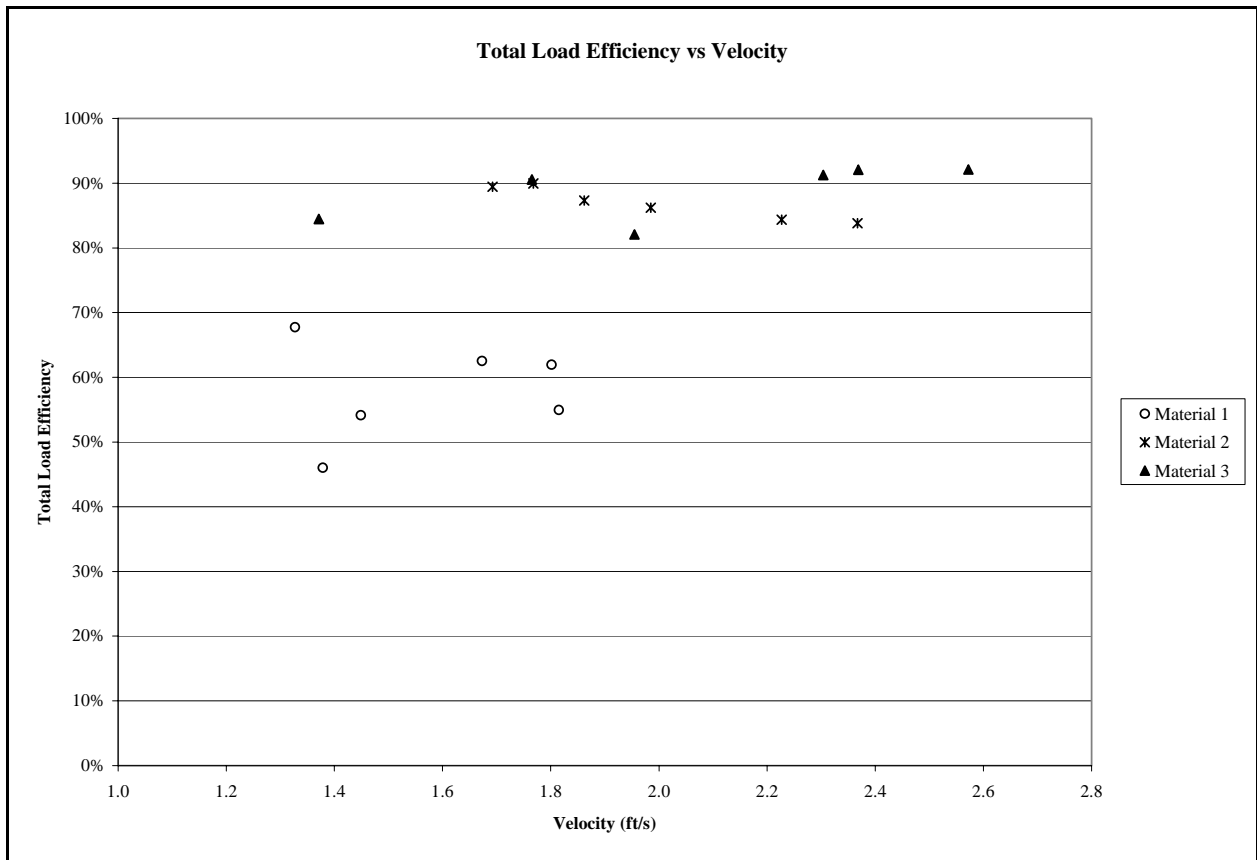


Figure 15. Plot of Total Load Efficiency versus Velocity

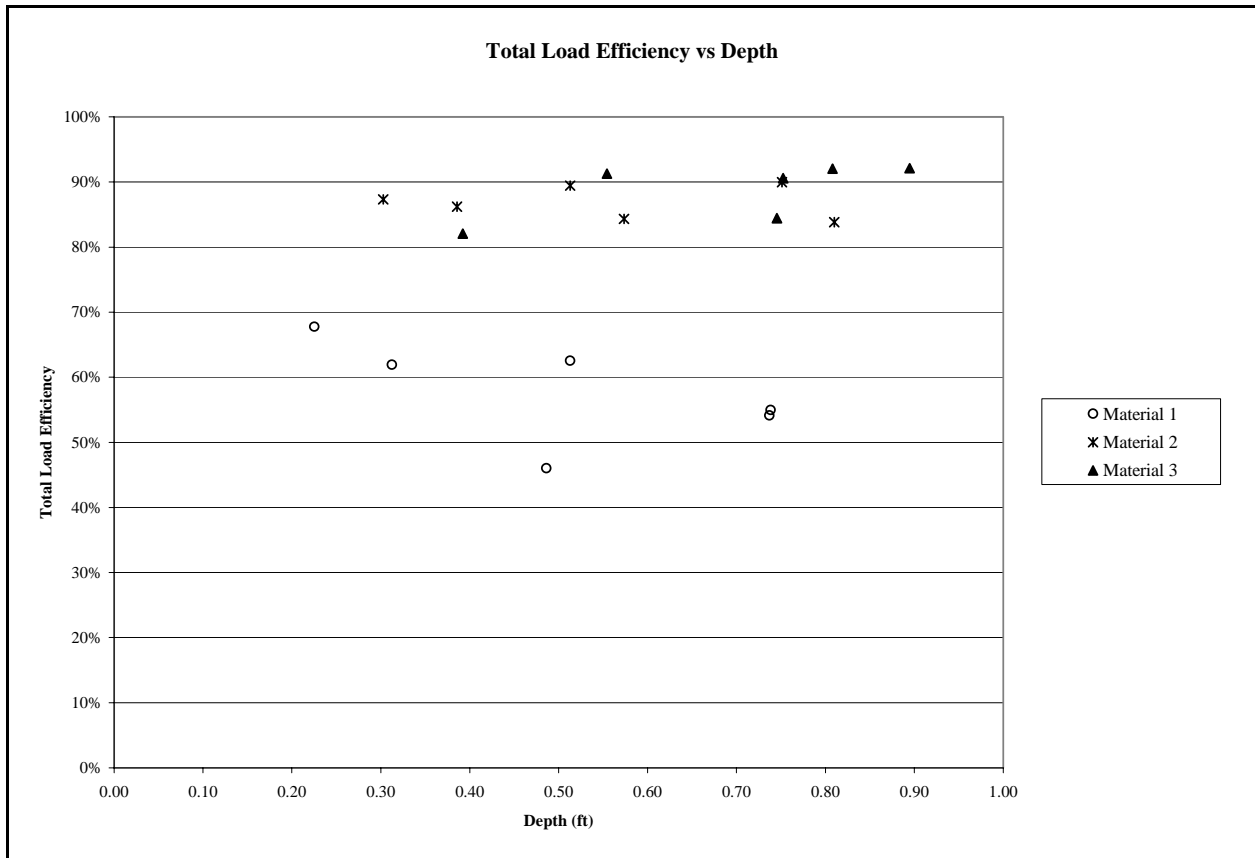


Figure 16. Plot of Total Load Efficiency versus Depth

Evaluation of Figures 15 and 16, and Table 3 revealed no significant trend related in hydraulic conditions over the entirety of the data set. The BMC’s efficiency was affected by flow depth for Material 1. Efficiency of the unit decreased as flow depth increased for Material 1. However, Material 2 and Material 3 demonstrated no trend in depth. Since the efficiency of the unit appeared to have minimal dependence on hydraulic conditions, it was determined that the unit’s efficiency was more dependent on the grain size of the material. Examination of results obtained with Material 1 in comparison to Material 2 and Material 3 revealed a lower efficiency at the smallest grain size.

Total Load Efficiency was also evaluated as a function of sediment discharge. Figure 17 presents a plot of Total Load Efficiency versus sediment discharge.

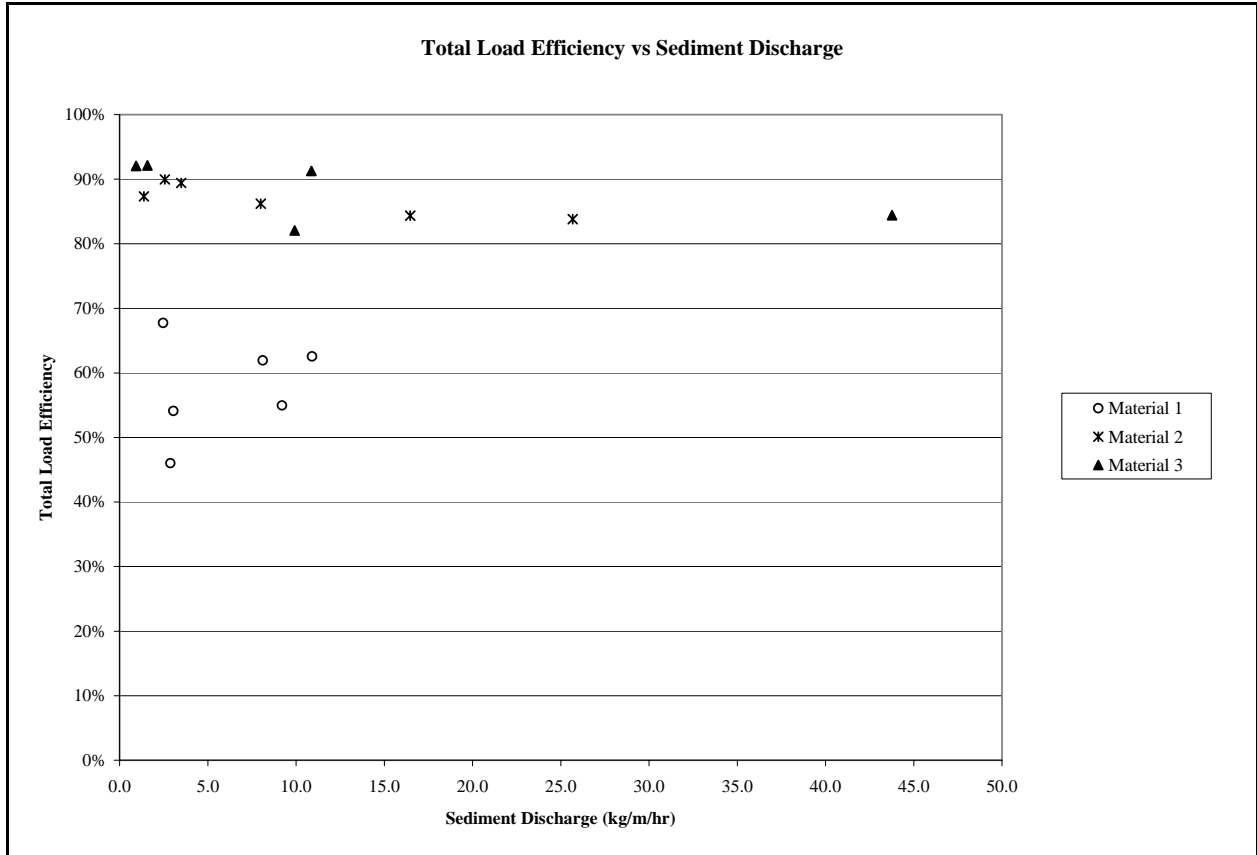


Figure 17. Plot of Total Load Efficiency versus Sediment Discharge

Analysis of Figure 17 showed a decreasing trend in Total Load Efficiency versus Sediment Discharge for Materials 2 and 3. Total Load Efficiency did not appear to be systematically affected by sediment discharge.

4.1.2 BEDLOAD CAPTURE EFFICIENCY

Efficiency of the unit with respect to the bedload transported in the system was termed the *Bedload Capture Efficiency*. Bedload Capture Efficiency was determined by evaluation of the sediments passing the unit as bedload in comparison to the sediment captured by the unit. In order to determine the proportion of sediment passing the unit as bedload, the proportion of sediment passing the unit as suspended sediment was determined. Several methodologies were evaluated to determine the proportion of sediment passing the unit in suspension.

4.1.2.1 DETERMINATION OF SUSPENDED LOAD PASSING THE UNIT – METHOD 1

First, the grain size distribution of the suspended sediment samples was evaluated to determine the maximum grain size in suspension. Analysis of the suspended samples showed the maximum grain size in suspension to typically be approximately 0.5mm. Since the maximum grain size in suspension was present in both the passed sediment and bypassed sediment, it was impossible to determine the proportion of sediment passing the collector as bedload by evaluation of the grain size distribution of the suspended sediment samples.

4.1.2.2 DETERMINATION OF SUSPENDED LOAD PASSING THE UNIT – METHOD 2

A second methodology was employed to determine the proportion of material passing the unit in suspension. The suspended sediment discharge was computed by evaluating the concentration of sediment within the suspended sediment samples. Total suspended sediment was then computed for the entire test duration by assuming a constant suspended sediment discharge. Values of total suspended sediment computed from suspended sediment concentration were greater than the total mass of sediment mobilized during testing. It was determined the overestimation of the total material in suspension by extrapolation of suspended sediment concentration was due to sensitivity in timing of the collection of suspended sediment samples. Suspended sediment samples were collected within the first hour of the test duration, when the suspended sediment discharge was greatest. As the test duration continued, the bed armored, reducing the sediment discharge within the system. Thus, it was determined the assumption of a constant sediment discharge within the system was invalid.

4.1.2.3 DETERMINATION OF SUSPENDED LOAD PASSING THE UNIT – METHOD 3

Finally, an alternative methodology was employed to estimate the portion of material passing the collector as suspended load. Sediment within each size fraction passing the BMC

was evaluated to determine the portion transported as suspended load. Within each size fraction, the portion transported as suspended load was determined as the difference of the percentage passing the BMC and the percentage passing as bedload. Material collected by the BMC was assumed to be bedload, thus, the percentage of material in each size fraction passing the BMC as suspended load was computed as the difference in percentage for each size fraction. Table 5 presents an example of determination of suspended load for a single size fraction.

Table 5. Determination of Suspended Portion Passing the BMC for a Single Size Fraction

Size Fraction (mm)	% of Total Sediment		% of
	Collected Sediment	Passed Sediment	Total Suspended
0.075 - 0.125	2%	14%	12%

For the given size fraction, 0.075 mm to 0.125 mm shown in Table 5, two percent of the collected sediment was classified within the size fraction. For the same size fraction, fourteen percent of material passing the BMC was classified within the range of particle sizes. Thus, it was determined twelve percent (14% minus 2%) of the material passing the BMC was transported as suspended load. The computation of suspended load was repeated for each size fraction. Table 6 presents an example of determination of suspended load for all size fractions.

Table 6. Example Determination of Suspended Portion Passing BMC for All Size Fractions

Size Fraction (mm)	% of Total Sediment		% of
	Collected Sediment	Passed Sediment	Total Suspended
32 - 42	0%	0%	0%
22.4 - 32	0%	0%	0%
16 - 22.4	0%	0%	0%
8 - 16	0%	0%	0%
5.6 - 8	0%	0%	0%
4.75 - 5.6	0%	0%	0%
4 - 4.75	0%	0%	0%
2 - 4	13%	2%	0%
1 - 2	21%	0%	0%
0.5 - 1	23%	0%	0%
0.25 - 0.5	27%	3%	0%
0.125 - 0.25	13%	72%	59%
0.075 - 0.125	2%	14%	12%
0.063 - 0.075	0%	1%	1%
<0.063 - 0.063	1%	7%	6%
Percent Passing BMC as Suspended Load (SLRF)			79%

Evaluation of Table 6 shows material passing the BMC during the example test consisted primarily of particles smaller than 0.25 mm. Approximately thirteen percent of material collected by the BMC was smaller than 0.25 mm, thus it was determined a significant portion of material passing the BMC was in suspension. As shown in Table 6, the BMC failed to collect two percent in the 2 mm to 4 mm size fraction and 3% within the 0.25 mm to 0.5 mm size fraction. Further, of the sediments passing the BMC, approximately sixteen percent of the material was assumed to be bedload with a grain size less than 0.25 mm. Thus, the approximately twenty-one percent of the material that passed the unit was determined to have been transported as bedload. The remaining seventy-nine percent of the material passing the BMC was considered suspended load and subtracted from the passed sediment to determine the bedload efficiency.

4.1.2.4 COMPUTATION OF BEDLOAD CAPTURE EFFICIENCY

Utilizing the methodology described in Section 4.1.2.3, the percentage of material passing the BMC as suspended load was determined for each test. Bedload Capture Efficiency was then computed for each test. Bedload efficiency was computed as shown in Equation 2:

$$\text{Bedload Capture Efficiency} = \frac{\text{Mass Captured}}{\text{Mass Captured} + \text{Mass Passed} * (1 - \text{SLR}_F)} \quad \text{Equation 2}$$

where:

SLR_F = Suspended load reduction factor;

Mass Captured = Total mass of sediments deposited in bypass collection tank (kg);

and

Mass Passed = Total mass of sediments deposited in sediment trap downstream of BMC (kg).

SLR_F was computed as shown in Table 6. Table 7 presents the Bedload Capture Efficiency results along with the Total Load Efficiency and the hydraulic conditions for each test for comparison.

Table 7. Bedload Efficiency Results

Test	Target		Actual		Grain Size Distribution	Screen Size Opening	Total Mass Passed (kg)	Total Mass Captured (kg)	Total Load Efficiency (%)	Passed Sediment Percent Suspended Transport (%)	Bed Load Efficiency (%)
	Average	Average	Average	Average							
	Cross-Section	Cross-Section	Cross-Section	Cross-Section							
	Flow	Flow	Flow	Flow							
Depth	Velocity	Depth	Velocity								
	(ft)	(ft/s)	(ft)	(ft/s)							
1	0.30	1.3	0.23	1.3	Material 1	Small	27.4	57.6	68%	34%	76%
2	0.50	1.3	0.49	1.4	Material 1	Small	30.5	26.0	46%	28%	54%
3	0.75	1.3	0.74	1.4	Material 1	Small	27.5	29.7	52%	36%	63%
4	0.30	1.7	0.31	1.8	Material 1	Small	60.8	98.9	62%	42%	74%
5	0.50	1.7	0.51	1.7	Material 1	Small	80.4	134.2	63%	45%	75%
6	0.75	1.7	0.74	1.8	Material 1	Small	81.6	99.6	55%	41%	67%
7	0.30	1.7	0.30	1.9	Material 2	Small	3.4	23.6	87%	72%	96%
8	0.50	1.7	0.51	1.7	Material 2	Small	7.2	61.4	89%	79%	98%
9	0.75	1.7	0.75	1.8	Material 2	Small	5.1	45.4	90%	73%	97%
11	0.30	2.5	0.39	2.0	Material 2	Large	21.7	138.9	86%	91%	99%
12	0.50	2.5	0.57	2.2	Material 2	Large	50.8	272.3	84%	60%	93%
13	0.75	2.5	0.81	2.4	Material 2	Large	81.8	423.0	84%	60%	93%
14	0.30	2.5	0.39	2.0	Material 3	Large	25.6	117.1	82%	70%	94%
15	0.50	2.5	0.55	2.3	Material 3	Large	17.0	179.1	91%	72%	97%
16	0.75	2.5	0.81	2.4	Material 3	Large	17.0	196.9	92%	76%	98%
17	0.75	1.3	0.75	1.4	Material 3	Large	2.8	15.4	84%	76%	96%
19	0.75	3.0	0.89	2.6	Material 3	Large	33.9	395.8	92%	69%	97%
20	0.75	1.7	0.75	1.8	Material 3	Large	2.9	28.0	91%	67%	97%

Evaluation of Table 7 showed capture efficiency of the unit to range from ninety-three to ninety-nine percent for Materials 2 and 3 and fifty-four and seventy-five percent for Material 1. Similar to Total Load Efficiency, Bedload Capture Efficiency was evaluated with respect to velocity and depth of flow during testing. Figures 19 and 20 present a plot of Bedload Capture Efficiency related to velocity and depth, respectively.

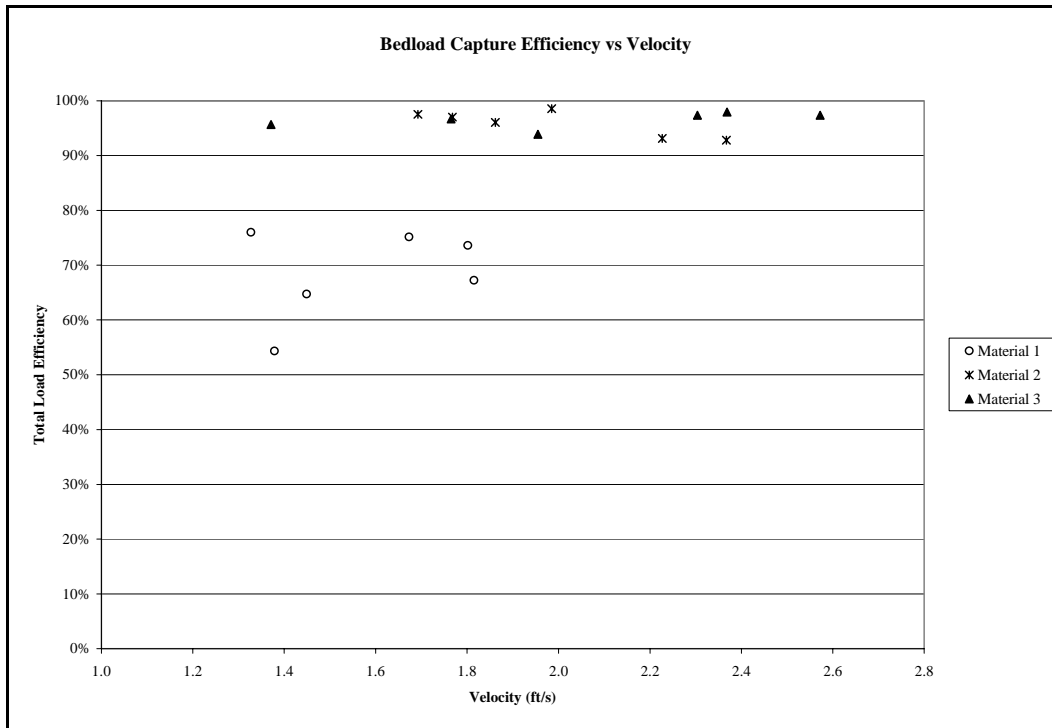


Figure 19. Plot of Bedload Capture Efficiency versus Velocity

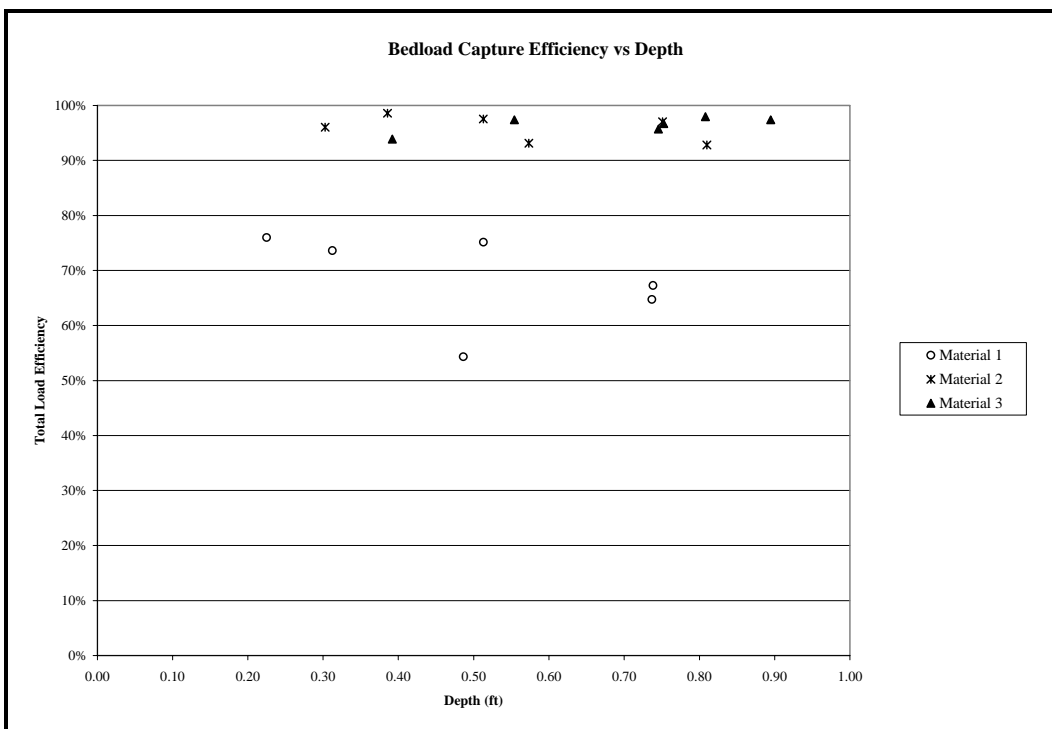


Figure 20. Plot of Bedload Capture Efficiency versus Depth

Bedload Capture Efficiency was also evaluated with respect to sediment discharge.

Figure 21 presents a plot of Bed Capture Efficiency versus sediment discharge.

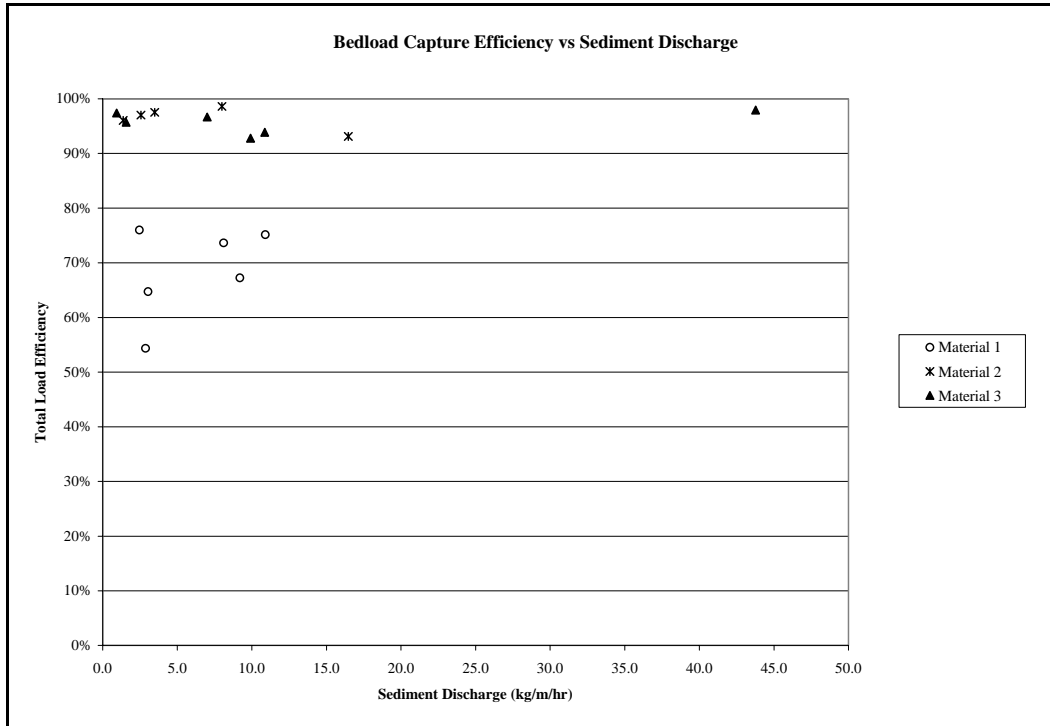


Figure 21. Plot of Bedload Capture Efficiency versus Sediment Discharge

Analysis of Figure 21 showed a decreasing trend in Bedload Capture Efficiency versus sediment discharge for Materials 2 and 3 for sediment discharges less than 20 kg/m/hr. Bedload Capture Efficiency for Material 1 did not vary systematically as a function of sediment discharge.

4.2 BEDLOAD PREDICTION

Collected data were analyzed to determine a relationship between the captured sediment and the total computed bedload during testing. Figure 22 presents the relationship between sediment captured by the BMC and the total sediment mobilized during testing.

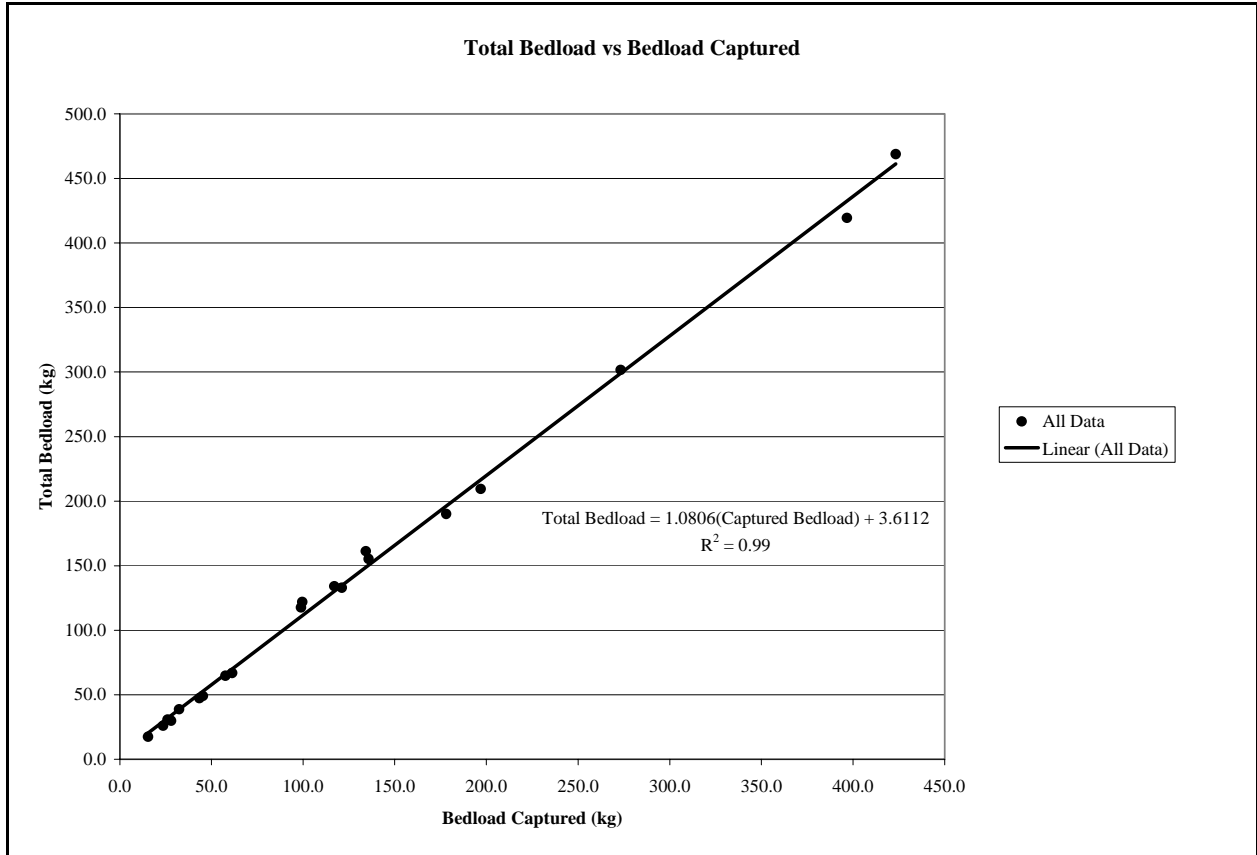


Figure 22. Plot of Total Bedload versus Captured Bedload

The relationship shown in Figure 22 includes all data from testing. Thus, relationship of the Bedload Capture Efficiency to total bedload shown, accounts for grain size, velocity or depth as varied within the test matrix. The relationship in Figure 22 allows for the prediction of actual bed load utilizing the BMC as a gauging instrument.

4.3 HELLY-SMITH COMPARISON

A preliminary comparison of data collected with the BMC and the Helly-Smith Collector was performed. The relationships determined for each sand size are indicative of the testing conditions and may not be applicable in field conditions, however, demonstrate a correlation between the Helly-Smith and Streamside Systems' collector. For purposes of comparison, the six Helly-Smith samples were averaged and normalized to represent a unit width. Further, the

BMC was also normalized to a unit width and utilized the prediction function described in section 4.2. Figures 23 through 25 present a plot of the correlation for each grain size. Raw Helly-Smith data are provided in Appendix A.

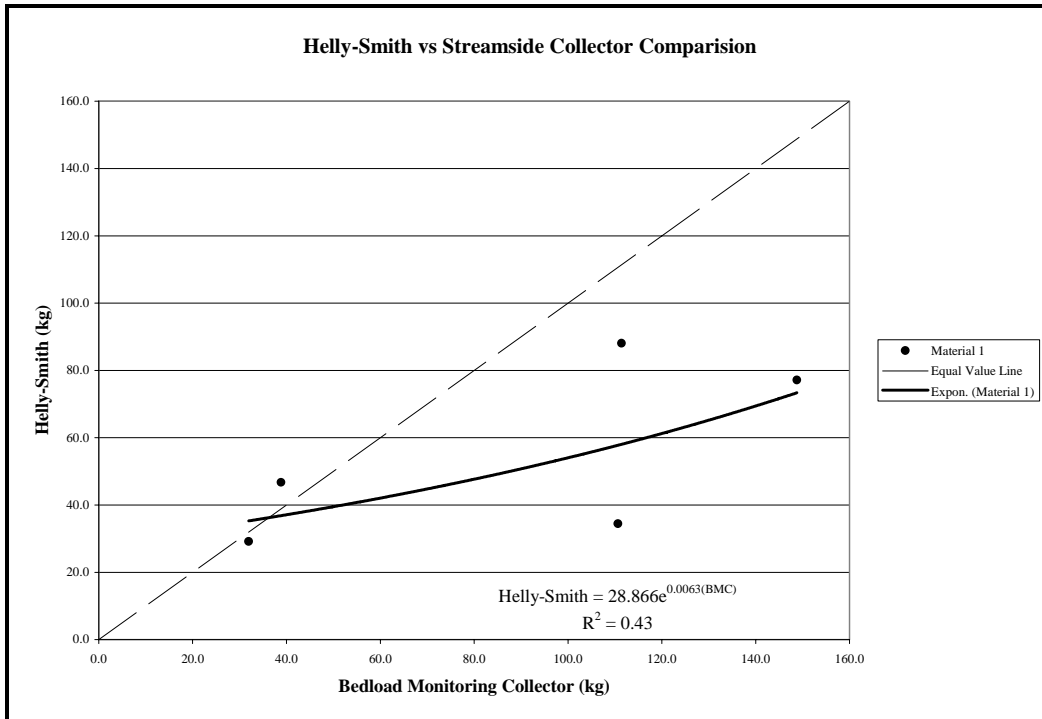


Figure 23. Plot of Helly-Smith Collector versus BMC – Material 1

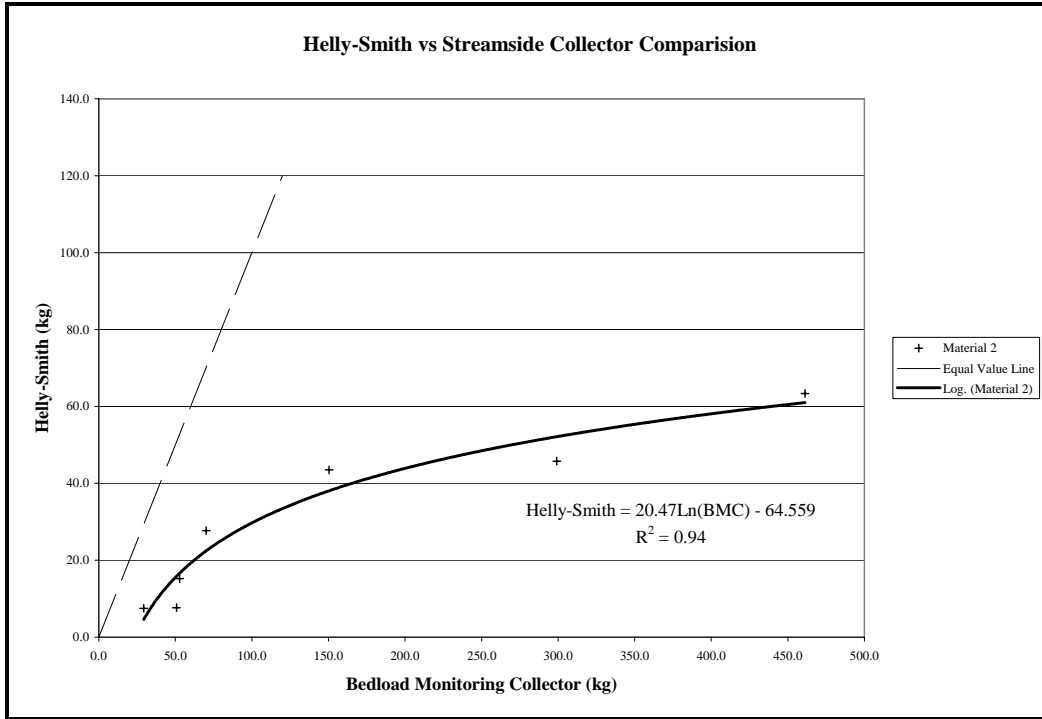


Figure 24. Plot of Helly-Smith Collector versus BMC – Material 2

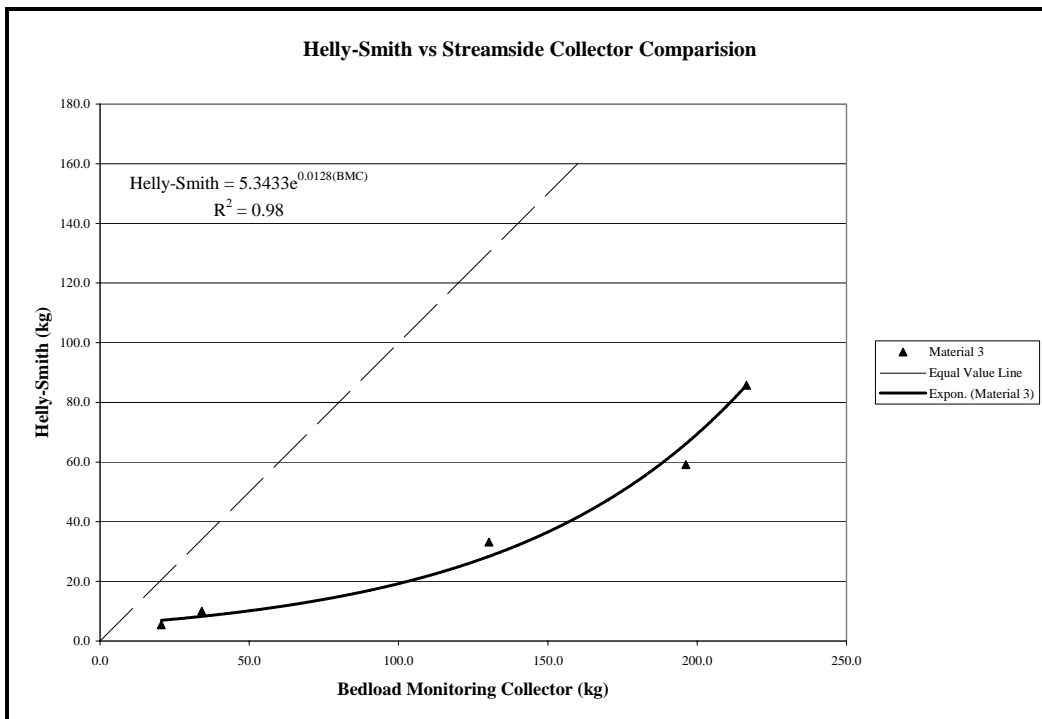


Figure 25. Plot of Helly-Smith Collector versus BMC – Material 3

Analysis of Figures 23 through 25 shows the Helly-Smith results to generally be less than the BMC. Differences noted between the Helly-Smith Sampler and the BMC were attributed to several factors. Timing of sample collection, length of sample collection and configuration of each sampler were considered as potentially influencing the results obtained from each sampler.

4.4 CAPTURE EFFICIENCY BY SIZE FRACTION

Evaluation of collected material was conducted with respect to material passing the BMC by size fraction. Efficiency by size fraction was determined as the proportion of material collected for each size fraction. Equation 3 presents the computation of efficiency by size fraction:

$$\text{Capture Efficiency (SF)} = \frac{\text{Mass Captured (SF)}}{\text{Mass Captured (SF)} + \text{Mass Passed (SF)}} \quad \text{Equation 3}$$

where:

Capture Efficiency (SF) = Efficiency by size fraction;

Mass Captured (SF) = Total mass of sediments deposited in bypass collection tank within size fraction (kg); and

Mass Passed (SF) = Total mass of sediments deposited in sediment trap downstream of bedload monitoring collector within size fraction (kg).

Tables 8 through 10 present the size fraction efficiency data. Figures 26 through 28 present the size fraction efficiency data in graphical form.

Table 8. Capture Efficiency by Size Fraction, Material 1

Size Fraction Range (mm)	Plotting Grain Size (mm)	Percent Collected in Size Fraction Range					
		Test Number					
		1	2	3	4	5	6
32 - 42	32	100%	100%	100%	100%	100%	100%
22.4 - 32	22.4	100%	100%	100%	100%	100%	100%
16 - 22.4	16	100%	100%	100%	100%	100%	100%
8 - 16	8	100%	100%	100%	100%	100%	100%
5.6 - 8	5.6	100%	100%	100%	100%	100%	100%
4.75 - 5.6	4.75	100%	100%	100%	100%	100%	100%
4 - 4.75	4	100%	100%	100%	100%	100%	100%
2 - 4	2	100%	88%	96%	100%	96%	88%
1 - 2	1	99%	99%	99%	100%	99%	98%
0.5 - 1	0.5	98%	99%	98%	99%	99%	97%
0.25 - 0.5	0.25	88%	91%	92%	78%	76%	76%
0.125 - 0.25	0.125	49%	58%	48%	38%	34%	38%
0.075 - 0.125	0.075	50%	62%	53%	40%	33%	38%
0.063 - 0.075	0.063	42%	60%	50%	33%	34%	35%

Table 9. Capture Efficiency by Size Fraction, Material 2

Size Fraction Range (mm)	Plotting Grain Size (mm)	Percent Collected in Size Fraction Range					
		Test Number					
		7	8	9	11	12	13
32 - 42	32	100%	100%	100%	100%	100%	100%
22.4 - 32	22.4	100%	100%	100%	100%	100%	100%
16 - 22.4	16	100%	100%	100%	100%	100%	100%
8 - 16	8	100%	100%	100%	100%	100%	100%
5.6 - 8	5.6	100%	100%	100%	100%	100%	100%
4.75 - 5.6	4.75	100%	100%	100%	100%	100%	100%
4 - 4.75	4	100%	100%	100%	100%	100%	100%
2 - 4	2	72%	96%	78%	100%	100%	99%
1 - 2	1	98%	100%	99%	100%	100%	100%
0.5 - 1	0.5	97%	100%	99%	100%	99%	99%
0.25 - 0.5	0.25	89%	97%	94%	92%	84%	70%
0.125 - 0.25	0.125	20%	36%	29%	54%	51%	58%
0.075 - 0.125	0.075	16%	28%	24%	44%	47%	56%
0.063 - 0.075	0.063	20%	39%	29%	47%	54%	54%

Table 10. Capture Efficiency by Size Fraction, Material 3

Size Fraction Range (mm)	Plotting Grain Size (mm)	Percent Collected in Size Fraction Range					
		Test Number					
		14	15	16	17	19	20
32 - 42	32	100%	100%	100%	100%	100%	100%
22.4 - 32	22.4	100%	100%	100%	100%	100%	100%
16 - 22.4	16	100%	100%	100%	100%	100%	100%
8 - 16	8	100%	100%	100%	88%	100%	100%
5.6 - 8	5.6	100%	100%	100%	80%	100%	100%
4.75 - 5.6	4.75	100%	100%	100%	91%	100%	100%
4 - 4.75	4	100%	100%	100%	88%	100%	100%
2 - 4	2	99%	98%	99%	94%	97%	94%
1 - 2	1	100%	100%	100%	97%	99%	99%
0.5 - 1	0.5	100%	98%	99%	96%	96%	98%
0.25 - 0.5	0.25	90%	71%	75%	77%	63%	81%
0.125 - 0.25	0.125	29%	40%	44%	15%	44%	12%
0.075 - 0.125	0.075	52%	41%	46%	12%	47%	11%
0.063 - 0.075	0.063	81%	49%	56%	18%	61%	19%

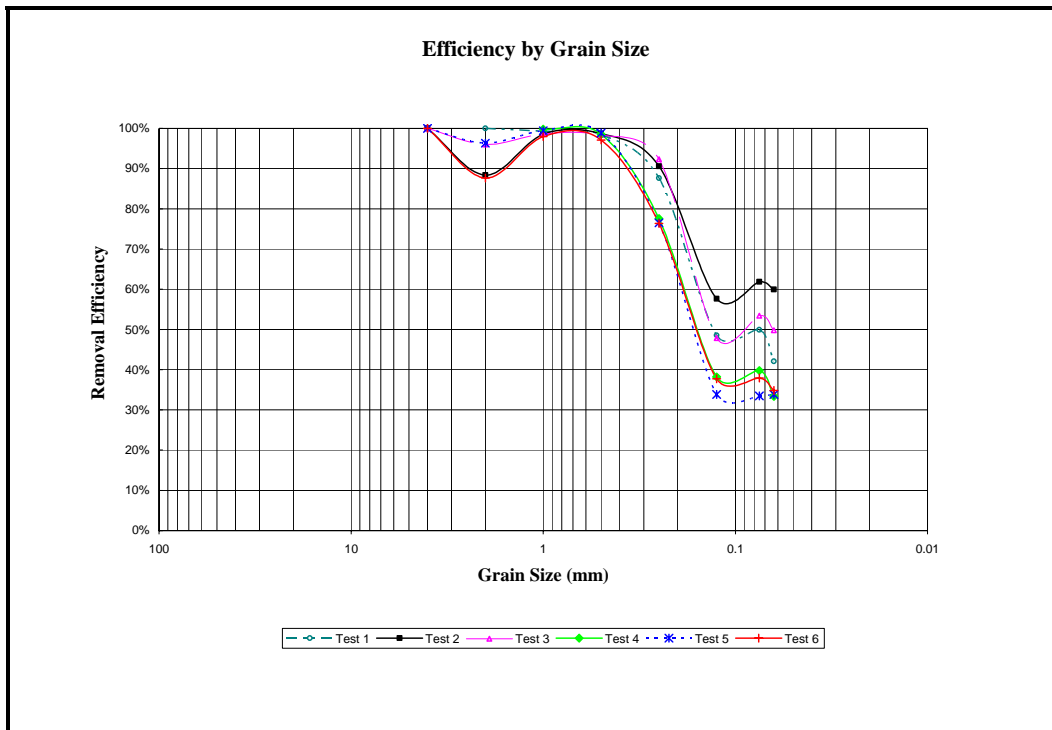


Figure 26. Plot of Capture Efficiency by Grain Size, Material 1

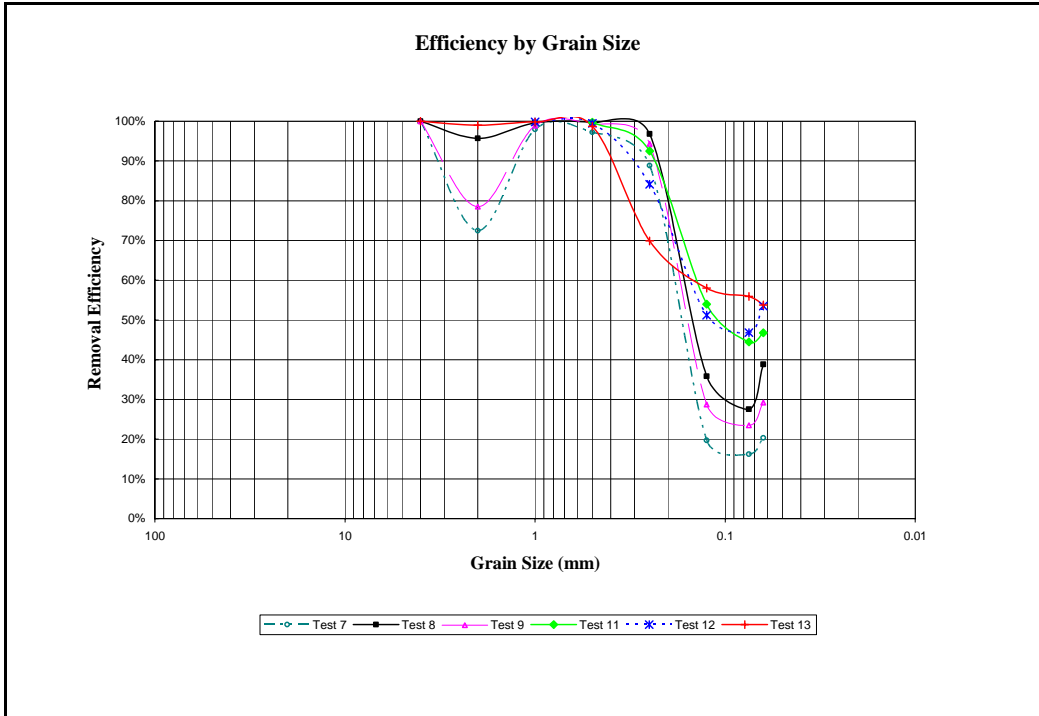


Figure 27. Plot of Capture Efficiency by Grain Size, Material 2

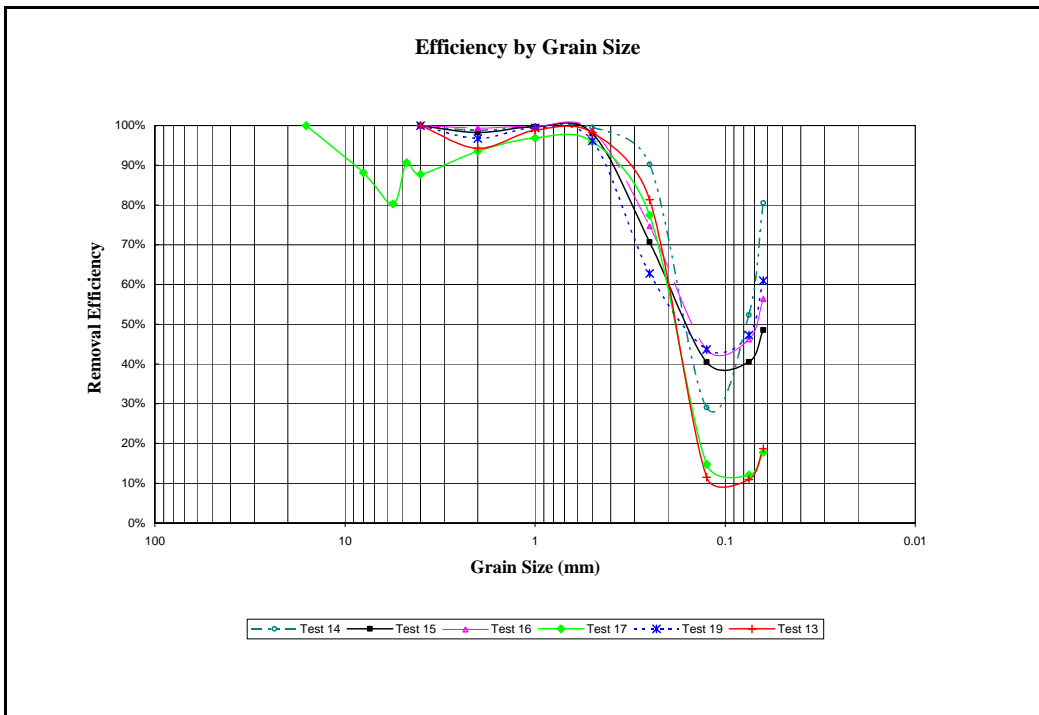


Figure 28. Plot of Capture Efficiency by Grain Size, Material 3

4.5 MAXIMUM OPERABLE PARAMETERS

During the course of testing, the unit failed to function due to sediment clogging on two occasions. The collector screen clogged on one occasion and the collector hose clogged on a separate occasion.

First, the 0.25-inch opening screen became clogged with sediments while testing Material 2 at a target flow depth of 0.30 foot and target velocity of 2.5 ft/s. The sediment discharge during the test was computed to be 12.1 kg/m/hr. The screen was replaced with the larger opening screen and the test was repeated. During testing of the larger screen, sediment was collected successfully throughout the duration of the test. For Material 2, the maximum velocity tested prior to clogging was 1.7 ft/s.

Second, the collector hose became impacted with sediments and forced termination of testing while testing Material 3 at a target flow depth of 0.30 foot and a target velocity of 3.0 ft/s. The sediment discharge was computed to be 99.1 kg/m/hr. The hose was cleared and a consecutive test using a greater flow depth (0.75 foot) and a target velocity of 3.0 ft/s was conducted. During testing of the increased flow depth, sediment was collected successfully throughout the test duration. The maximum sediment discharge the unit continually operated under was 43.8 kg/m/hr. Utilizing the estimated siphon discharge of approximately 50 gpm, the siphon sediment discharge of 2.2 kg per minute was determined to be approximately 0.5% of the siphon discharge.

Based on the two incidents with unit clogging noted during testing, it was determined the critical conditions for unit operation are relatively low flow depth with relatively high velocity. On both occasions the unit became impacted with sediment and failed to function during testing of the lowest flow depth and highest velocity for the given material.

5 SUMMARY AND CONCLUSIONS

Efficiency of Streamside Systems' Bedload Monitoring Collector was evaluated with respect to three grain size distributions of source material and a variety of hydraulic conditions. A predictive model was developed to compute the actual bedload within the testing flume utilizing the mass of sediment captured by the collector. Finally, a comparison of results obtained using a Helly-Smith collector versus the Streamside Systems' Bedload Monitoring Collector.

The Bedload Capture Efficiency of the BMC for Materials 2 and 3 ranged from ninety three to ninety-nine percent. Material 2 consisted of sand and gravel with a median diameter of approximately 0.5mm and Material 3 consisted of sand and gravel with a median grain size diameter of approximately 1.3mm. Thus, for material tested with a median grain size of 0.5 mm or greater, the BMC collected between ninety-three and ninety-nine percent of the total bedload mobilized within the system. Bedload Capture Efficiency for Material 1 ranged from fifty-four and seventy-five percent. Bedload Capture Efficiency was determined to be affected by flow depth for Material 1, however no other trends with respect to hydraulic conditions were developed. Correlation of the Helly-Smith and Streamside collector results were found to produce unique relationships for each grain size.

Testing of Streamside Systems smallest Bed Load Monitoring Collector included three grain size distributions with median grain sizes ranging from 0.25 to 1.35mm in flow velocities

ranging from 1.3 ft/s to 3.0 ft/s. The BMC was shown to collect a maximum of ninety-nine percent of bedload during testing.

APPENDIX A: RAW DATA

Source Material Grain Size Distributions

Grain Size (mm)	Percent Finer		
	Material 1	Material 2	Material 3
42	100	100	100
32	100	100	100
22.4	100	100	100
16	100	100	100
8	100	96	91
5.6	100	91	83
4.75	100	89	80
4	100	86	76
2	100	76	61
1	98	63	41
0.5	92	49	22
0.25	36	26	11
0.125	6	10	7
0.075	1	7	5
0.063	1	6	5

Streamside Bedload Collector Testing

Helly - Smith Sediment Samples

Sample #	Test	Position	Time (sec)	Weight (g)	Sample #	Test	Position	Time (sec)	Weight (g)
HS1	2	Left	90	71.9	HS61	11	Left	90	314.6
HS2	2	Center	90	165.8	HS62	11	Center	90	242.0
HS3	2	Right	90	309.3	HS63	11	Right	90	300.6
HS4	2	Left	180	272.6	HS64	11	Left	180	486.1
HS5	2	Center	180	259.8	HS65	11	Center	180	273.4
HS6	2	Right	180	336.4	HS66	11	Right	180	449.4
HS7	3	Left	90	455.9	HS67	12	Left	90	421.3
HS8	3	Center	90	242.7	HS68	12	Center	90	280.4
HS9	3	Right	90	223.1	HS69	12	Right	90	210.0
HS10	3	Left	180	465.0	HS70	12	Left	180	509.2
HS11	3	Center	180	447.5	HS71	12	Center	180	414.9
HS12	3	Right	180	386.4	HS72	12	Right	180	332.3
HS13	4	Left	90	189.1	HS73	13	Left	90	344.0
HS14	4	Center	90	357.9	HS74	13	Center	90	529.7
HS15	4	Right	90	60.6	HS75	13	Right	90	285.0
HS16	4	Left	180	232.5	HS76	13	Left	180	566.1
HS17	4	Center	180	530.0	HS77	13	Center	180	811.0
HS18	4	Right	180	339.2	HS78	13	Right	180	568.8
HS19	N/A	Left	N/A	N/A	HS79	14	Left	90	357.5
HS20	N/A	Center	N/A	N/A	HS80	14	Center	90	125.1
HS21	N/A	Right	N/A	N/A	HS81	14	Right	90	102.9
HS22	N/A	Left	N/A	N/A	HS82	14	Left	180	580.9
HS23	N/A	Center	N/A	N/A	HS83	14	Center	180	347.3
HS24	N/A	Right	N/A	N/A	HS84	14	Right	180	130.5
HS25	5	Left	90	479.1	HS85	15	Left	90	664.7
HS26	5	Center	90	542.6	HS86	15	Center	90	176.8
HS27	5	Right	90	409.9	HS87	15	Right	90	159.4
HS28	5	Left	180	915.7	HS88	15	Left	180	984.2
HS29	5	Center	180	941.3	HS89	15	Center	180	772.7
HS30	5	Right	180	465.6	HS90	15	Right	180	216.7
HS31	6	Left	90	341.9	HS91	16	Left	90	225.0
HS32	6	Center	90	709.7	HS92	16	Center	90	506.1
HS33	6	Right	90	625.1	HS93	16	Right	90	812.7
HS34	6	Left	180	685.7	HS94	16	Left	180	971.3
HS35	6	Center	180	1106.9	HS95	16	Center	180	689.5
HS36	6	Right	180	774.3	HS96	16	Right	180	1016.1
HS37	7	Left	90	63.1	HS97	17	Left	90	40.8
HS38	7	Center	90	42.0	HS98	17	Center	90	54.8
HS39	7	Right	90	56.6	HS99	17	Right	90	18.2
HS40	7	Left	180	95.6	HS100	17	Left	180	35.5
HS41	7	Center	180	56.0	HS101	17	Center	180	74.2
HS42	7	Right	180	28.0	HS102	17	Right	180	31.4
HS43	8	Left	90	200.8	HS103	18	Left	90	N/A
HS44	8	Center	90	128.4	HS104	18	Center	90	N/A
HS45	8	Right	90	145.6	HS105	18	Right	90	N/A
HS46	8	Left	180	390.6	HS106	18	Left	180	N/A
HS47	8	Center	180	277.0	HS107	18	Center	180	N/A
HS48	8	Right	180	244.8	HS108	18	Right	180	N/A
HS49	9	Left	90	71.7	HS109	19	Left	90	326.0
HS50	9	Center	90	84.0	HS110	19	Center	90	638.5
HS51	9	Right	110	84.1	HS111	19	Right	90	442.9
HS52	9	Left	180	147.6	HS112	19	Left	180	614.2
HS53	9	Center	180	158.3	HS113	19	Center	180	1005.8
HS54	9	Right	180	267.0	HS114	19	Right	180	690.7
HS55	10	Left	90	59.7	HS115	20	Left	90	19.5
HS56	10	Center	90	84.7	HS116	20	Center	90	86.5
HS57	10	Right	90	110.5	HS117	20	Right	90	27.1
HS58	10	Left	180	190.8	HS118	20	Left	180	37.3
HS59	10	Center	180	163.4	HS119	20	Center	180	182.0
HS60	10	Right	180	228.2	HS120	20	Right	180	116.0

Test	Target		Actual		Grain Size Distributin	Screen Size (in.)	Total Mass Passed (kg)	Total Mass Captured (kg)	Total Load Efficiency (%)	Bed Load Efficiency (%)	Comments	Total Sediment Load (kg)	Total Test Time HRS	Average Sediment Discharge (kg/hr/m)	Average Capture Rate (kg/hr/m)	Total Actual Bed Load (kg)	Predicted Bed Load (kg)
	Average Flow Depth (ft)	Average Cross Section Average Velocity (ft/s)	Average Flow Depth (ft)	Average Cross Section Average Velocity (ft/s)													
1	0.30	1.3	0.23	1.3	Material 1	0.25	27.4	57.6	68%	76%		85.1	5.25	2.5	1.7	64.7	65.9
2	0.50	1.3	0.49	1.4	Material 1	0.25	30.5	26.0	46%	54%		56.6	3	2.9	1.3	30.7	31.7
3	0.75	1.3	0.74	1.4	Material 1	0.25	27.5	32.4	52%	63%		59.9	3	3.0	1.6	38.8	38.7
4	0.30	1.7	0.31	1.8	Material 1	0.25	60.8	98.9	62%	74%		159.7	3	8.1	5.0	117.6	110.5
5	0.50	1.7	0.51	1.7	Material 1	0.25	80.4	134.2	63%	75%		214.6	3	10.9	6.8	161.3	148.6
6	0.75	1.7	0.74	1.8	Material 1	0.25	81.6	99.6	55%	67%		181.2	3	9.2	5.1	121.9	111.2
7	0.30	1.7	0.30	1.9	Material 2	0.25	3.4	23.6	87%	96%		27.0	3	1.4	1.2	26.0	29.1
8	0.50	1.7	0.51	1.7	Material 2	0.25	7.2	61.4	89%	98%		68.6	3	3.5	3.1	66.9	69.9
9	0.75	1.7	0.75	1.8	Material 2	0.25	5.1	45.4	90%	97%		50.4	3	2.6	2.3	48.9	52.6
10	0.30	2.5	0.41	1.9	Material 2	0.25	69.2	43.5	39%	42%	Screen Jam	112.7	1.4	12.1	4.7	47.4	50.6
11	0.30	2.5	0.39	2.0	Material 2	1.00	21.7	135.7	86%	99%		157.4	3	8.0	6.9	155.2	150.3
12	0.50	2.5	0.57	2.2	Material 2	1.00	50.8	273.3	84%	93%		324.0	3	16.5	13.9	301.7	298.9
13	0.75	2.5	0.81	2.4	Material 2	1.00	81.8	423.4	84%	93%		505.2	3	25.7	21.5	468.9	461.2
14	0.30	2.5	0.39	2.0	Material 3	1.00	25.6	117.1	82%	94%		142.7	3	7.3	6.0	134.0	130.2
15	0.50	2.5	0.55	2.3	Material 3	1.00	17.0	178.1	91%	97%		195.1	3	9.9	9.0	190.0	196.1
16	0.75	2.5	0.81	2.4	Material 3	1.00	17.0	196.9	92%	98%		213.9	3	10.9	10.0	209.5	216.4
17	0.75	1.3	0.75	1.4	Material 3	1.00	2.8	15.4	84%	96%		18.3	3	0.9	0.8	17.5	20.3
18	0.30	3.0	0.36	2.6	Material 3	1.00	117.4	121.1	51%	56%	Hose Jam	238.5	0.4	99.1	50.4	132.8	134.5
19	0.75	3.0	0.89	2.6	Material 3	1.00	33.9	396.8	92%	97%		430.7	1.5	43.8	40.3	419.4	432.4
20	0.75	1.7	0.75	1.8	Material 3	1.00	2.9	28.0	91%	97%		30.9	3	1.6	1.4	29.9	33.9

Hydraulic and Bed Elevation Data
Streamside Testing
Colorado State University - March 2005

Test Number 1
Discharge 0.58 cfs
Bed Slope 0.6%

Station (ft)	Initial Conditions Bed Elevation			Final Conditions Bed Elevation			Water Surface Elevation (ft)	Continuity Velocity (ft/s)
	Left (ft)	Center (ft)	Right (ft)	Left (ft)	Center (ft)	Right (ft)		
8.54	97.766	97.765	97.763	97.724	97.759	97.698	97.958	1.5
10.54	97.756	97.745	97.743	97.680	97.688	97.706	97.956	1.4
12.54	97.742	97.738	97.734	97.771	97.720	97.754	97.942	1.5
14.54	97.732	97.724	97.723	97.718	97.702	97.740	97.932	1.4
16.54	97.722	97.715	97.714	97.673	97.667	97.606	97.910	1.5
18.54	97.708	97.700	97.699	97.656	97.697	97.718	97.904	1.5
20.54	97.687	97.691	97.688	97.720	97.718	97.691	97.895	1.4
22.54	97.685	97.683	97.679	97.693	97.661	97.618	97.882	1.5
24.54	97.671	97.670	97.664	97.643	97.635	97.668	97.877	1.4
26.54	97.662	97.657	97.651	97.606	97.635	97.639	97.868	1.4
28.54	97.653	97.648	97.643	97.522	97.697	97.678	97.855	1.4
30.54	97.640	97.639	97.637	97.561	97.610	97.657	97.846	1.4
32.54	97.634	97.635	97.631	97.638	97.635	97.631	97.846	1.4

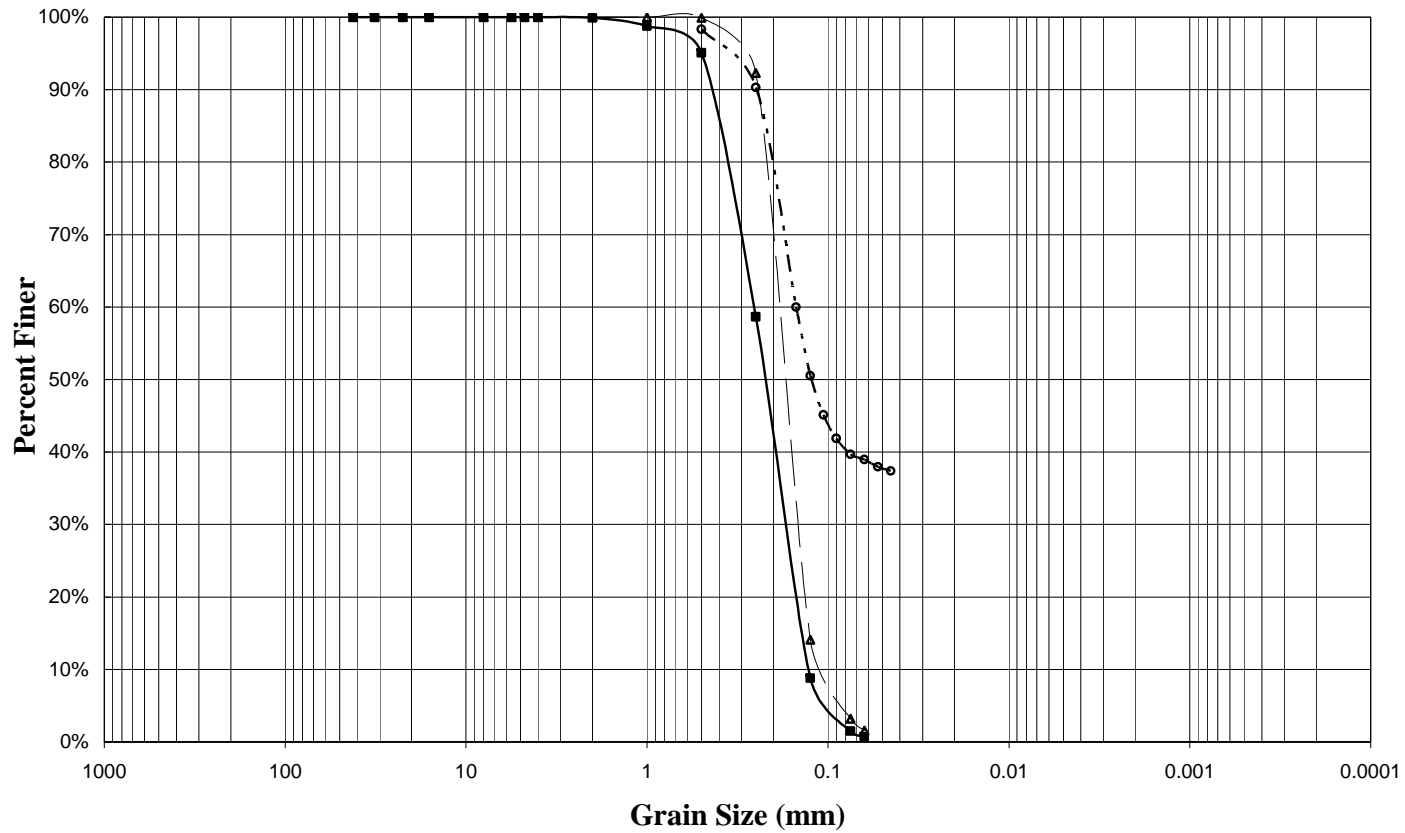
Grain Size Distribution Data
Streamside Testing
Colorado State University - March 2005

Test Number 1

Collected and Passed Sediments					Suspended Sediments		
Grain Size (mm)	Cumulative Weight Passed (g)		Percent Finer		Grain Size (mm)	Cumulative Weight Suspended Sediment	Percent Finer Suspended Sediment
	Aggregate Collected Sediment	Aggregate Passed Sediment	Aggregate Collected Sediment	Aggregate Passed Sediment			
42	0.0	0.0	100%	100%	0.500	0.0311	98%
32	0.0	0.0	100%	100%	0.250	0.1805	90%
22.4	0.0	0.0	100%	100%	0.150	0.7439	60%
16	0.0	0.0	100%	100%	0.125	0.9200	51%
8	0.0	0.0	100%	100%	0.106	1.0197	45%
5.6	0.0	0.0	100%	100%	0.090	1.0804	42%
4.75	0.0	0.0	100%	100%	0.075	1.1214	40%
4	0.0	0.0	100%	100%	0.063	1.1351	39%
2	4.0	0.0	100%	100%	0.053	1.1531	38%
1	57.5	0.4	99%	100%	0.045	1.1644	37%
0.5	226.2	3.1	95%	100%			
0.25	1896.4	237.9	59%	92%	Total Mass	1.8589	
0.125	4180.2	2658.7	9%	14%			
0.075	4516.8	2996.3	1%	3%			
0.063	4552.6	3045.6	1%	2%			
Pan	4583.6	3094.5	0%	0%			
Total Mass	4584.5	3094.8	N/A	N/A			

Grain Size Distribution

Test 1 Grain Size Distribution Plot



Boulders	Cobbles	Gravel	Sand	Silt and Clay
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—○— Suspended Sediment —■— Collected Sediment —▲— Passed Sediment

Hydraulic and Bed Elevation Data
Streamside Testing
Colorado State University - March 2005

Test Number 2
Discharge 1.31 cfs
Bed Slope 0.6%

Station (ft)	Initial Conditions Bed Elevation			Final Conditions Bed Elevation			Water Surface Elevation (ft)	Continuity Velocity (ft/s)
	Left (ft)	Center (ft)	Right (ft)	Left (ft)	Center (ft)	Right (ft)		
8.54	97.754	97.744	97.744	97.674	97.681	97.663	98.198	1.5
10.54	97.753	97.733	97.723	97.689	97.683	97.677	98.195	1.5
12.54	97.732	97.732	97.722	97.688	97.681	97.709	98.190	1.4
14.54	97.720	97.720	97.720	97.710	97.675	97.696	98.179	1.5
16.54	97.719	97.709	97.709	97.682	97.766	97.677	98.171	1.5
18.54	97.697	97.697	97.687	97.632	97.708	97.701	98.166	1.4
20.54	97.696	97.686	97.676	97.694	97.768	97.708	98.164	1.4
22.54	97.675	97.665	97.665	97.712	97.669	97.733	98.160	1.4
24.54	97.673	97.663	97.653	97.739	97.691	97.700	98.157	1.4
26.54	97.652	97.662	97.652	97.656	97.684	97.632	98.154	1.3
28.54	97.650	97.650	97.650	97.632	97.617	97.626	98.148	1.3
30.54	97.639	97.639	97.639	97.641	97.657	97.684	98.145	1.3
32.54	97.638	97.638	97.638	97.639	97.636	97.633	98.142	1.3

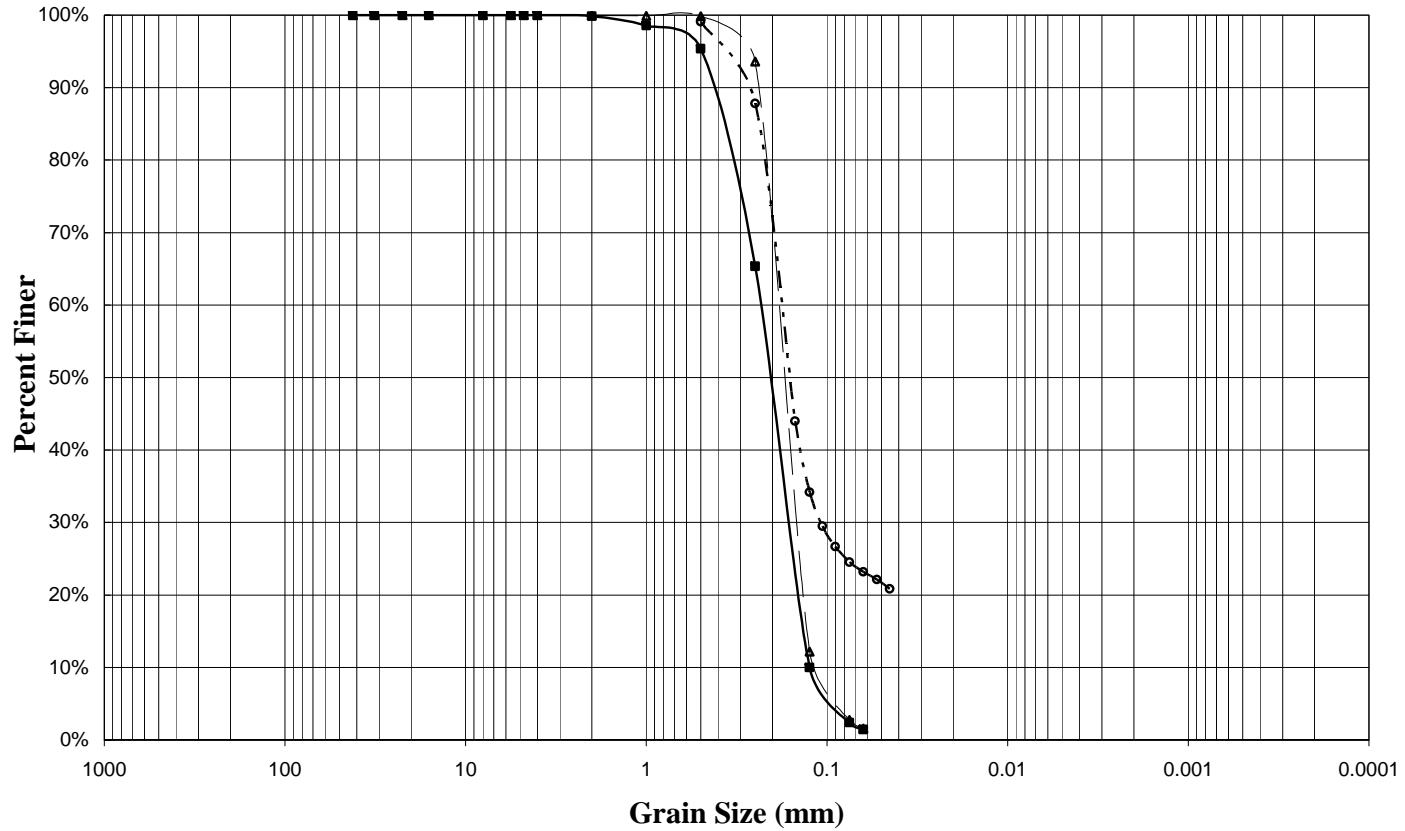
Grain Size Distribution Data
Streamside Testing
Colorado State University - March 2005

Test Number 2

Collected and Passed Sediments					Suspended Sediments		
Grain Size (mm)	Cumulative Weight Passed (g)		Percent Finer		Grain Size (mm)	Cumulative Weight Suspended Sediment	Percent Finer Suspended Sediment
	Aggregate Collected Sediment	Aggregate Passed Sediment	Aggregate Collected Sediment	Aggregate Passed Sediment			
42	0.0	0.0	100%	100%	0.500	0.0196	99%
32	0.0	0.0	100%	100%	0.250	0.2604	88%
22.4	0.0	0.0	100%	100%	0.150	1.1982	44%
16	0.0	0.0	100%	100%	0.125	1.4083	34%
8	0.0	0.0	100%	100%	0.106	1.5079	30%
5.6	0.0	0.0	100%	100%	0.090	1.5683	27%
4.75	0.0	0.0	100%	100%	0.075	1.6146	25%
4	0.0	0.0	100%	100%	0.063	1.6427	23%
2	3.8	0.5	100%	100%	0.053	1.6659	22%
1	43.3	1.1	99%	100%	0.045	1.6932	21%
0.5	139.3	2.4	95%	100%			
0.25	1040.1	96.0	65%	94%	Total Mass	2.139	
0.125	2702.1	1318.2	10%	12%			
0.075	2930.6	1459.3	2%	3%			
0.063	2958.3	1477.8	1%	2%			
Pan	2999.2	1500.8	0%	0%			
Total Mass	3001.8	1501.2	N/A	N/A			

Grain Size Distribution

Test 2 Grain Size Distribution Plot



Boulders	Cobbles	Gravel	Sand	Silt and Clay
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—○— Suspended Sediment —■— Collected Sediment —▲— Passed Sediment

Hydraulic and Bed Elevation Data
Streamside Testing
Colorado State University - March 2005

Test Number 3
Discharge 2.08 cfs
Bed Slope 0.6%

Station (ft)	Initial Conditions Bed Elevation			Final Conditions Bed Elevation			Water Surface Elevation (ft)	Continuity Velocity (ft/s)
	Left (ft)	Center (ft)	Right (ft)	Left (ft)	Center (ft)	Right (ft)		
8.54	97.764	97.758	97.752	97.724	97.767	97.705	98.454	1.5
10.54	97.748	97.745	97.743	97.738	97.708	97.713	98.456	1.5
12.54	97.742	97.739	97.727	97.741	97.636	97.739	98.452	1.5
14.54	97.729	97.724	97.718	97.688	97.727	97.695	98.437	1.5
16.54	97.718	97.718	97.713	97.766	97.739	97.621	98.432	1.5
18.54	97.709	97.702	97.699	97.731	97.742	97.700	98.426	1.5
20.54	97.697	97.694	97.684	97.701	97.752	97.714	98.428	1.4
22.54	97.685	97.682	97.677	97.733	97.758	97.665	98.427	1.4
24.54	97.674	97.668	97.664	97.727	97.643	97.679	98.428	1.4
26.54	97.662	97.657	97.645	97.644	97.655	97.751	98.425	1.4
28.54	97.650	97.649	97.640	97.657	97.638	97.646	98.422	1.4
30.54	97.656	97.644	97.637	97.704	97.639	97.649	98.420	1.4
32.54	97.639	97.637	97.638	97.640	97.638	97.635	98.424	1.4

Grain Size Distribution Data
Streamside Testing
Colorado State University - March 2005

Test Number 3

Collected and Passed Sediments					Suspended Sediments		
Grain Size (mm)	Cumulative Weight Passed (g)		Percent Finer		Grain Size (mm)	Cumulative Weight Suspended Sediment	Percent Finer Suspended Sediment
	Aggregate Collected Sediment	Aggregate Passed Sediment	Aggregate Collected Sediment	Aggregate Passed Sediment			
42	0.0	0.0	100%	100%	0.500	0.0293	97%
32	0.0	0.0	100%	100%	0.250	0.1494	85%
22.4	0.0	0.0	100%	100%	0.150	0.2702	74%
16	0.0	0.0	100%	100%	0.125	0.4156	59%
8	0.0	0.0	100%	100%	0.106	0.4922	52%
5.6	0.0	0.0	100%	100%	0.090	0.5745	44%
4.75	0.0	0.0	100%	100%	0.075	0.6187	39%
4	0.0	0.0	100%	100%	0.063	0.6431	37%
2	4.8	0.2	100%	100%	0.053	0.6799	33%
1	47.8	0.8	99%	100%	0.045	0.6882	33%
0.5	163.3	2.7	96%	100%			
0.25	1814.5	140.0	60%	95%	Total Mass	1.021	
0.125	4106.8	2637.2	9%	12%			
0.075	4427.3	2916.7	2%	3%			
0.063	4463.1	2952.8	1%	2%			
Pan	4500.8	3003.0	0%	0%			
Total Mass	4505.5	3003.7	N/A	N/A			

Hydraulic and Bed Elevation Data
Streamside Testing
Colorado State University - March 2005

Test Number 4
Discharge 1.1 cfs
Bed Slope 0.6%

Station (ft)	Initial Conditions Bed Elevation			Final Conditions Bed Elevation			Water Surface Elevation (ft)	Continuity Velocity (ft/s)
	Left (ft)	Center (ft)	Right (ft)	Left (ft)	Center (ft)	Right (ft)		
8.54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10.54	98.125	98.118	98.111	98.143	98.125	97.989	98.375	2.2
12.54	98.108	98.103	98.095	98.086	98.072	98.035	98.373	2.1
14.54	98.103	98.098	98.093	97.966	98.074	98.136	98.361	2.1
16.54	98.085	98.084	98.076	98.073	98.013	98.030	98.364	2.0
18.54	98.081	98.074	98.069	98.098	98.065	98.055	98.357	2.0
20.54	98.064	98.057	98.052	98.082	98.099	98.006	98.356	1.9
22.54	98.056	98.051	98.044	98.029	98.082	98.033	98.351	1.9
24.54	98.039	98.037	98.026	98.063	98.044	98.007	98.356	1.7
26.54	98.035	98.025	98.024	97.993	98.028	98.056	98.355	1.7
28.54	98.023	98.016	98.010	98.024	97.985	98.118	98.352	1.7
30.54	98.023	98.010	98.002	97.988	97.995	98.090	98.343	1.7
32.54	98.010	98.009	98.005	98.010	98.009	98.005	98.351	1.6

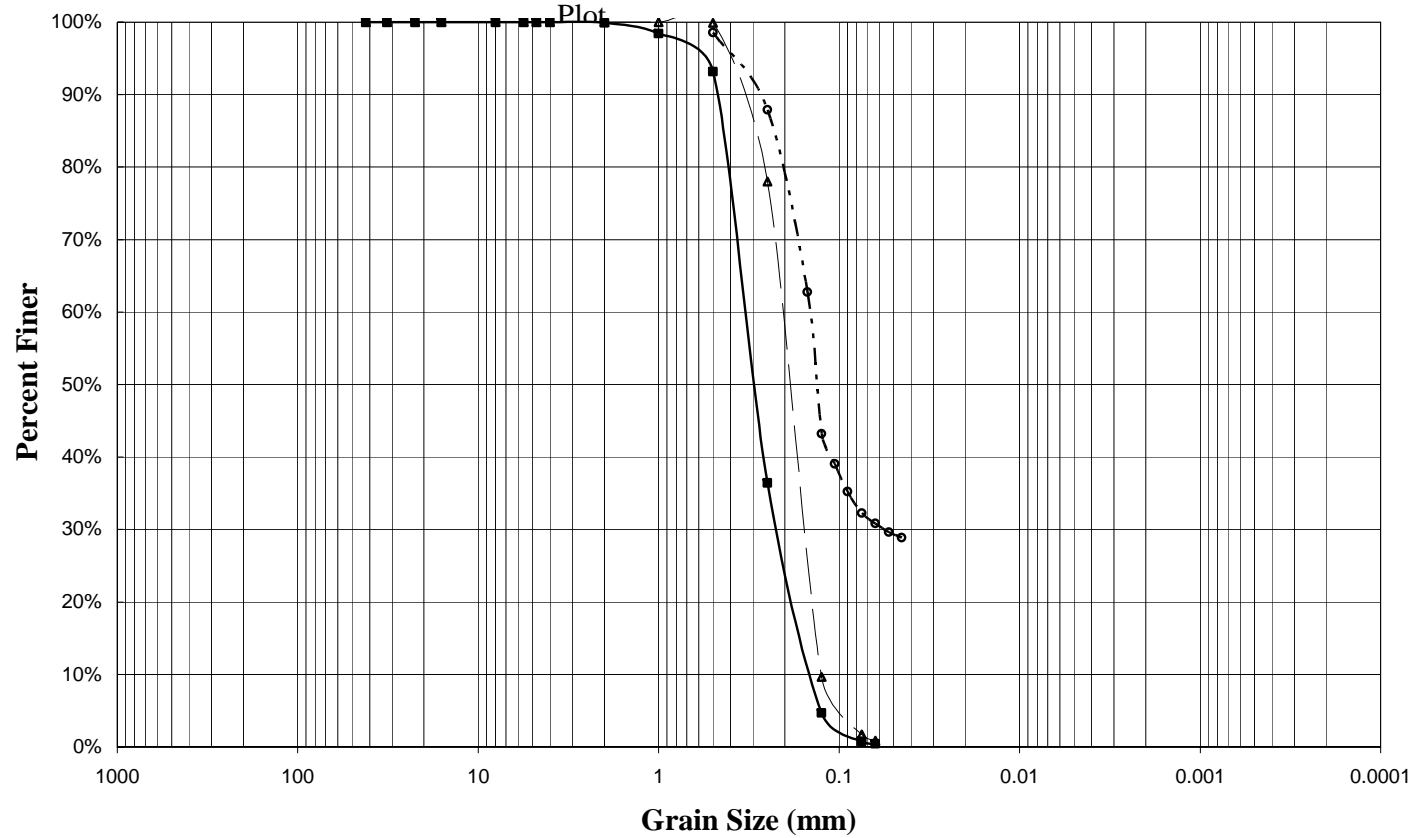
Grain Size Distribution Data
Streamside Testing
Colorado State University - March 2005

Test Number 4

Collected and Passed Sediments					Suspended Sediments		
Grain Size (mm)	Cumulative Weight Passed (g)		Percent Finer		Grain Size (mm)	Cumulative Weight Suspended Sediment	Percent Finer Suspended Sediment
	Aggregate Collected Sediment	Aggregate Passed Sediment	Aggregate Collected Sediment	Aggregate Passed Sediment			
42	0.0	0.0	100%	100%	0.500	0.0229	99%
32	0.0	0.0	100%	100%	0.250	0.1930	88%
22.4	0.0	0.0	100%	100%	0.150	0.5939	63%
16	0.0	0.0	100%	100%	0.125	0.9056	43%
8	0.0	0.0	100%	100%	0.106	0.9717	39%
5.6	0.0	0.0	100%	100%	0.090	1.0330	35%
4.75	0.0	0.0	100%	100%	0.075	1.0804	32%
4	0.0	0.0	100%	100%	0.063	1.1033	31%
2	5.4	0.0	100%	100%	0.053	1.1226	30%
1	94.2	0.2	98%	100%	0.045	1.1346	29%
0.5	409.4	4.9	93%	100%			
0.25	3817.1	990.4	36%	78%	Total Mass	1.5949	
0.125	5724.6	4073.5	5%	10%			
0.075	5960.3	4430.7	1%	2%			
0.063	5979.6	4469.2	0%	1%			
Pan	6002.3	4509.9	0%	0%			
Total Mass	6006.2	4507.9	N/A	N/A			

Grain Size Distribution

Test 4 Grain Size Distribution



Boulders	Cobbles	Gravel	Sand	Silt and Clay
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—○— Suspended Sediment —■— Collected Sediment —▲— Passed Sediment

Hydraulic and Bed Elevation Data
Streamside Testing
Colorado State University - March 2005

Test Number 5
Discharge 1.68 cfs
Bed Slope 0.6%

Station (ft)	Initial Conditions Bed Elevation			Final Conditions Bed Elevation			Water Surface Elevation (ft)	Continuity Velocity (ft/s)
	Left (ft)	Center (ft)	Right (ft)	Left (ft)	Center (ft)	Right (ft)		
8.54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10.54	98.121	98.119	98.111	98.011	97.977	98.060	98.572	1.9
12.54	98.107	98.102	98.109	98.029	98.031	97.984	98.561	1.9
14.54	98.101	98.097	98.096	97.994	98.046	98.016	98.542	1.9
16.54	98.088	98.096	98.081	98.022	97.952	98.057	98.528	1.9
18.54	98.080	98.073	98.071	98.022	98.013	98.058	98.545	1.8
20.54	98.068	98.058	98.058	98.000	98.050	98.046	98.546	1.8
22.54	98.051	98.051	98.045	98.076	98.034	98.036	98.546	1.7
24.54	98.040	98.039	98.031	98.070	98.067	98.071	98.545	1.7
26.54	98.032	98.028	98.025	98.009	98.024	98.024	98.544	1.7
28.54	98.032	98.022	98.015	98.073	98.046	97.968	98.540	1.7
30.54	98.007	98.008	98.019	98.028	98.074	98.029	98.535	1.6
32.54	98.010	98.008	98.005	98.009	98.008	98.005	98.535	1.6

Grain Size Distribution Data
Streamside Testing
Colorado State University - March 2005

Test Number 5

Collected and Passed Sediments					Suspended Sediments		
Grain Size (mm)	Cumulative Weight Passed (g)		Percent Finer		Grain Size (mm)	Cumulative Weight Suspended Sediment	Percent Finer Suspended Sediment
	Aggregate Collected Sediment	Aggregate Passed Sediment	Aggregate Collected Sediment	Aggregate Passed Sediment			
42	0.0	0.0	100%	100%	0.500	0.018	99%
32	0.0	0.0	100%	100%	0.250	0.2932	87%
22.4	0.0	0.0	100%	100%	0.150	1.2243	45%
16	0.0	0.0	100%	100%	0.125	1.6212	28%
8	0.0	0.0	100%	100%	0.106	1.7977	20%
5.6	0.0	0.0	100%	100%	0.090	1.9369	13%
4.75	0.0	0.0	100%	100%	0.075	2.0289	9%
4	0.0	0.0	100%	100%	0.063	2.0672	8%
2	15.4	0.6	100%	100%	0.053	2.1018	6%
1	177.6	1.5	98%	100%	0.045	2.1177	5%
0.5	673.9	7.4	93%	100%			
0.25	6007.8	1647.0	33%	78%	Total Mass	2.2391	
0.125	8588.1	6688.4	5%	11%			
0.075	8927.3	7363.0	1%	2%			
0.063	8960.1	7427.1	0%	1%			
Pan	8999.0	7501.6	0%	0%			
Total Mass	9002.3	7502.1	N/A	N/A			

Hydraulic and Bed Elevation Data
Streamside Testing
Colorado State University - March 2005

Test Number 6
Discharge 2.62 cfs
Bed Slope 0.6%

Station (ft)	Initial Conditions Bed Elevation			Final Conditions Bed Elevation			Water Surface Elevation (ft)	Continuity Velocity (ft/s)
	Left (ft)	Center (ft)	Right (ft)	Left (ft)	Center (ft)	Right (ft)		
8.54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10.54	98.128	98.121	98.118	97.971	98.006	98.059	98.830	1.9
12.54	98.112	98.110	98.100	98.030	98.049	98.037	98.826	1.9
14.54	98.105	98.103	98.098	98.088	97.983	98.038	98.820	1.9
16.54	98.094	98.089	98.082	98.066	98.013	98.076	98.813	1.8
18.54	98.081	98.079	98.073	98.077	98.135	98.109	98.810	1.8
20.54	98.071	98.067	98.063	98.046	98.107	98.078	98.806	1.8
22.54	98.061	98.057	98.054	98.161	98.106	98.051	98.805	1.8
24.54	98.041	98.042	98.044	98.048	98.034	98.098	98.803	1.8
26.54	98.039	98.036	98.033	98.076	98.139	98.122	98.806	1.7
28.54	98.028	98.023	98.020	98.178	98.119	98.030	98.801	1.7
30.54	98.013	98.016	98.014	97.991	98.060	98.141	98.799	1.7
32.54	98.010	98.008	98.007	98.010	98.008	98.004	98.803	1.7

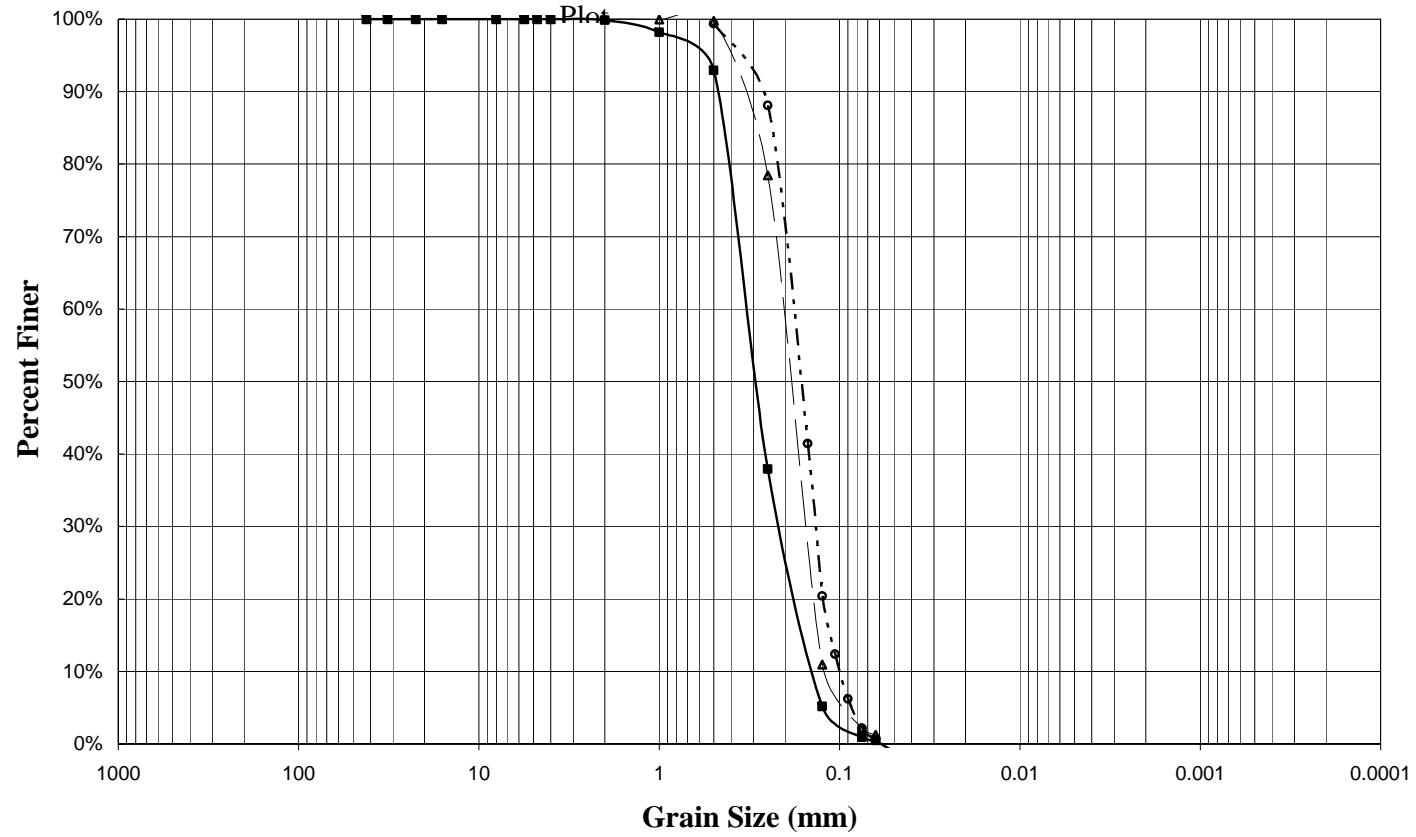
Grain Size Distribution Data
Streamside Testing
Colorado State University - March 2005

Test Number 6

Grain Size (mm)	Collected and Passed Sediments				Suspended Sediments		
	Cumulative Weight Passed (g)		Percent Finer		Grain Size (mm)	Cumulative Weight Suspended Sediment	Percent Finer Suspended Sediment
	Aggregate Collected Sediment	Aggregate Passed Sediment	Aggregate Collected Sediment	Aggregate Passed Sediment			
42	0.0	0.0	100%	100%	0.500	0.0147	99%
32	0.0	0.0	100%	100%	0.250	0.2906	88%
22.4	0.0	0.0	100%	100%	0.150	1.4315	41%
16	0.0	0.0	100%	100%	0.125	1.9448	20%
8	0.0	0.0	100%	100%	0.106	2.1412	12%
5.6	0.0	0.0	100%	100%	0.090	2.2928	6%
4.75	0.0	0.0	100%	100%	0.075	2.3914	2%
4	0.0	0.0	100%	100%	0.063	2.4314	1%
2	9.4	1.3	100%	100%	0.053	2.4606	-1%
1	136.1	4.0	98%	100%	0.045	2.4815	-2%
0.5	529.6	15.6	93%	100%			
0.25	4658.7	1293.3	38%	78%	Total Mass	2.4441	
0.125	7113.7	5344.0	5%	11%			
0.075	7434.7	5869.2	1%	2%			
0.063	7465.6	5927.0	0%	1%			
Pan	7500.7	6002.6	0%	0%			
Total Mass	7502.2	6002.1	N/A	N/A			

Grain Size Distribution

Test 6 Grain Size Distribution



Boulders	Cobbles	Gravel	Sand	Silt and Clay
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—○— Suspended Sediment —■— Collected Sediment —▲— Passed Sediment

Hydraulic and Bed Elevation Data
Streamside Testing
Colorado State University - March 2005

Test Number 7
Discharge 1.1 cfs
Bed Slope 0.6%

Station (ft)	Initial Conditions Bed Elevation			Final Conditions Bed Elevation			Water Surface Elevation (ft)	Continuity Velocity (ft/s)
	Left (ft)	Center (ft)	Right (ft)	Left (ft)	Center (ft)	Right (ft)		
8.54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10.54	98.134	98.126	98.119	98.106	98.117	98.106	98.387	2.2
12.54	98.116	98.114	98.106	98.102	98.107	98.100	98.375	2.1
14.54	98.101	98.098	98.095	98.104	98.073	98.088	98.373	2.0
16.54	98.091	98.086	98.081	98.073	98.084	98.078	98.369	2.0
18.54	98.084	98.079	98.074	98.069	98.090	98.064	98.362	2.0
20.54	98.067	98.063	98.059	98.058	98.071	98.050	98.354	1.9
22.54	98.056	98.053	98.046	98.057	98.056	98.072	98.354	1.9
24.54	98.037	98.033	98.028	98.041	98.051	98.031	98.351	1.8
26.54	98.034	98.028	98.023	98.047	98.042	98.032	98.359	1.7
28.54	98.021	98.015	98.012	98.039	98.047	98.054	98.359	1.6
30.54	98.015	98.014	98.018	98.024	98.048	98.042	98.358	1.6
32.54	98.010	98.008	98.006	98.015	98.007	98.012	98.359	1.6

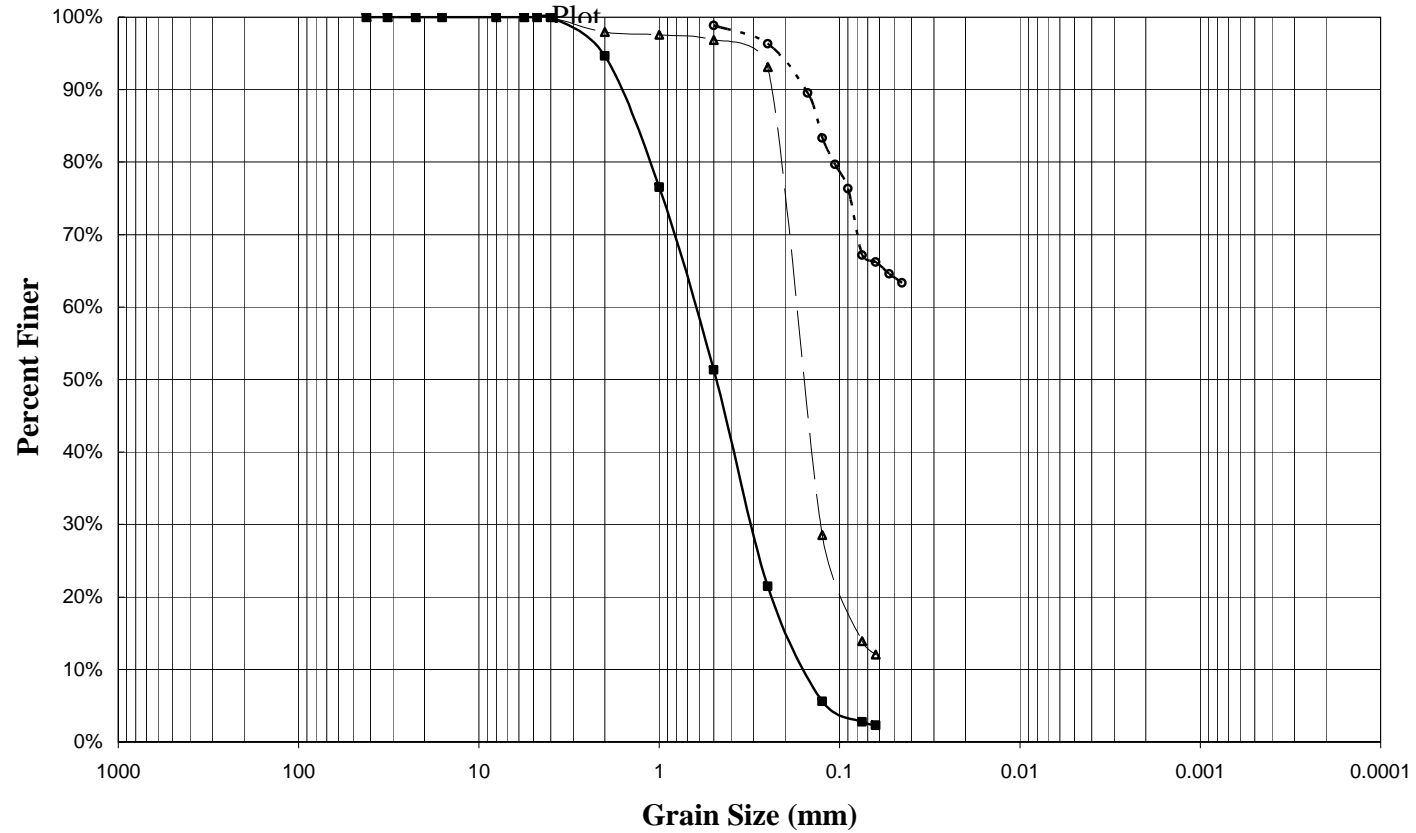
Grain Size Distribution Data
Streamside Testing
Colorado State University - March 2005

Test Number 7

Grain Size (mm)	Collected and Passed Sediments				Suspended Sediments		
	Cumulative Weight Passed (g)		Percent Finer		Grain Size (mm)	Cumulative Weight Suspended Sediment	Percent Finer Suspended Sediment
Aggregate Collected Sediment	Aggregate Passed Sediment	Aggregate Collected Sediment	Aggregate Passed Sediment				
42	0.0	0.0	100%	100%	0.500	0.0063	99%
32	0.0	0.0	100%	100%	0.250	0.0201	96%
22.4	0.0	0.0	100%	100%	0.150	0.0571	90%
16	0.0	0.0	100%	100%	0.125	0.0910	83%
8	0.0	0.0	100%	100%	0.106	0.1109	80%
5.6	0.0	0.0	100%	100%	0.090	0.1290	76%
4.75	0.0	0.0	100%	100%	0.075	0.1791	67%
4	0.0	0.0	100%	100%	0.063	0.1843	66%
2	80.5	30.6	95%	98%	0.053	0.1932	65%
1	352.1	36.4	77%	98%	0.045	0.2001	63%
0.5	730.0	47.2	51%	97%			
0.25	1178.9	103.6	21%	93%	Total Mass	0.5455	
0.125	1416.7	1072.6	6%	29%			
0.075	1459.3	1292.0	3%	14%			
0.063	1466.5	1320.2	2%	12%			
Pan	1498.9	1499.9	0%	0%			
Total Mass	1500.8	1500.8	N/A	N/A			

Grain Size Distribution

Test 7 Grain Size Distribution



Boulders	Cobbles	Gravel	Sand	Silt and Clay
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—○— Suspended Sediment —■— Collected Sediment —▲— Passed Sediment

Hydraulic and Bed Elevation Data
Streamside Testing
Colorado State University - March 2005

Test Number 8
Discharge 1.7 cfs
Bed Slope 0.6%

Station (ft)	Initial Conditions Bed Elevation			Final Conditions Bed Elevation			Water Surface Elevation (ft)	Continuity Velocity (ft/s)
	Left (ft)	Center (ft)	Right (ft)	Left (ft)	Center (ft)	Right (ft)		
8.54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10.54	98.123	98.109	98.106	98.085	98.107	98.083	98.580	1.9
12.54	98.107	98.094	98.093	98.065	98.070	98.085	98.570	1.8
14.54	98.097	98.093	98.090	98.076	98.070	98.073	98.564	1.8
16.54	98.085	98.083	98.081	98.054	98.058	98.050	98.554	1.8
18.54	98.075	98.071	98.064	98.052	98.058	98.042	98.550	1.8
20.54	98.055	98.053	98.050	98.033	98.046	98.031	98.547	1.8
22.54	98.053	98.049	98.043	98.022	98.041	98.036	98.543	1.8
24.54	98.034	98.030	98.020	98.017	98.035	98.010	98.538	1.7
26.54	98.029	98.026	98.022	98.019	98.032	98.006	98.532	1.7
28.54	98.007	98.004	98.001	98.009	98.030	97.992	98.541	1.6
30.54	98.013	98.014	98.016	98.005	98.004	97.995	98.543	1.6
32.54	98.010	98.008	98.005	98.010	98.008	98.006	98.540	1.6

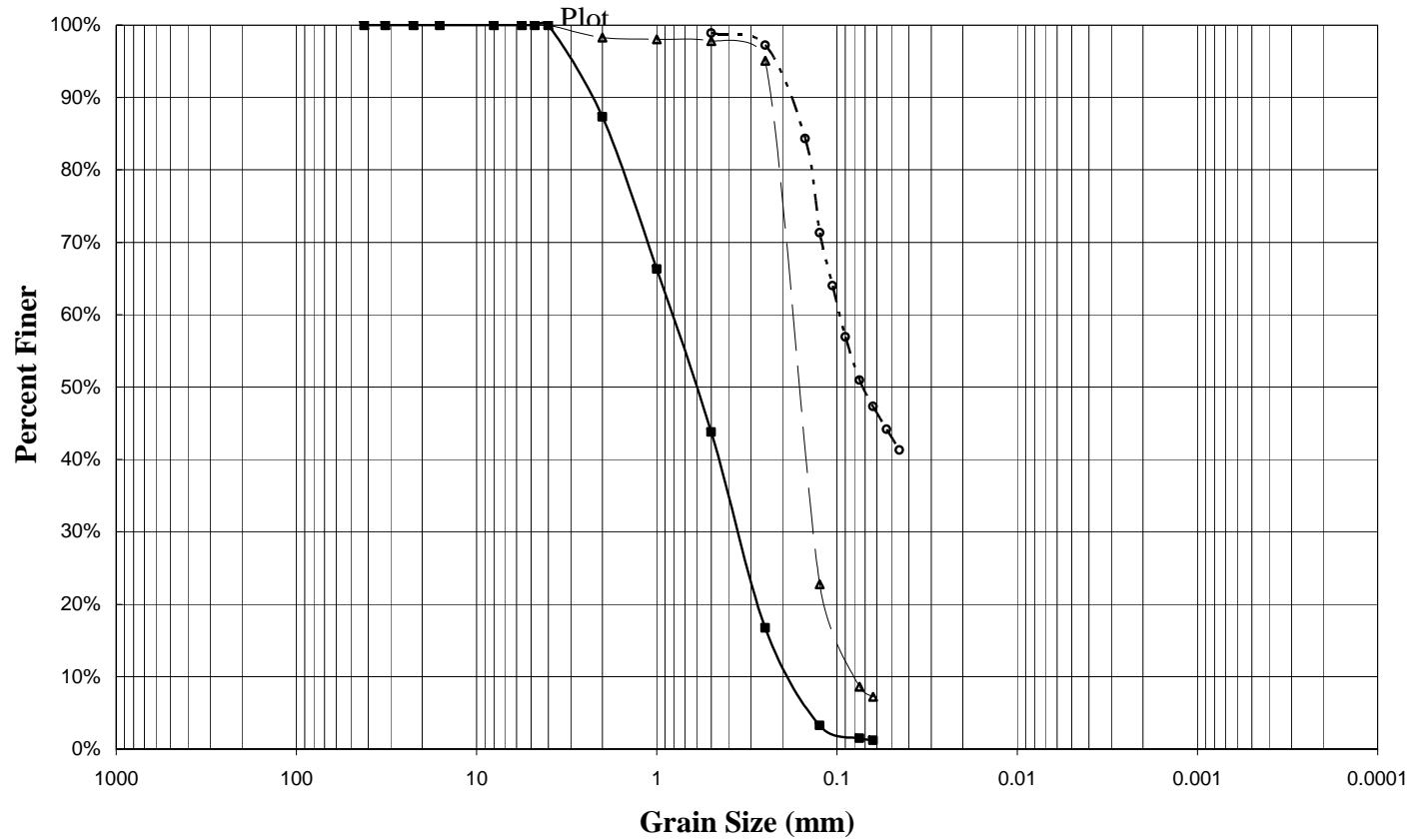
Grain Size Distribution Data
Streamside Testing
Colorado State University - March 2005

Test Number 8

Grain Size (mm)	Collected and Passed Sediments				Suspended Sediments		
	Cumulative Weight Passed (g)		Percent Finer		Grain Size (mm)	Cumulative Weight Suspended Sediment	Percent Finer Suspended Sediment
Aggregate Collected Sediment	Aggregate Passed Sediment	Aggregate Collected Sediment	Aggregate Passed Sediment				
42	0.0	0.0	100%	100%	0.500	0.0089	99%
32	0.0	0.0	100%	100%	0.250	0.0226	97%
22.4	0.0	0.0	100%	100%	0.150	0.1271	84%
16	0.0	0.0	100%	100%	0.125	0.2324	71%
8	0.0	0.0	100%	100%	0.106	0.2914	64%
5.6	0.0	0.0	100%	100%	0.090	0.3489	57%
4.75	0.0	0.0	100%	100%	0.075	0.3974	51%
4	0.0	0.0	100%	100%	0.063	0.4265	47%
2	569.9	25.7	87%	98%	0.053	0.4521	44%
1	1517.5	29.8	66%	98%	0.045	0.4756	41%
0.5	2530.7	33.2	44%	98%			
0.25	3749.4	73.8	17%	95%	Total Mass	0.8100	
0.125	4355.0	1159.0	3%	23%			
0.075	4435.7	1371.6	1%	9%			
0.063	4448.6	1391.9	1%	7%			
Pan	4494.6	1501.2	0%	0%			
Total Mass	4501.7	1500.4	N/A	N/A			

Grain Size Distribution

Test 8 Grain Size Distribution



Boulders	Cobbles	Gravel	Sand	Silt and Clay
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—○— Suspended Sediment —■— Collected Sediment —△— Passed Sediment

Hydraulic and Bed Elevation Data
Streamside Testing
Colorado State University - March 2005

Test Number 9
Discharge 2.6 cfs
Bed Slope 0.6%

Station (ft)	Initial Conditions Bed Elevation			Final Conditions Bed Elevation			Water Surface Elevation (ft)	Continuity Velocity (ft/s)
	Left (ft)	Center (ft)	Right (ft)	Left (ft)	Center (ft)	Right (ft)		
8.54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10.54	98.128	98.122	98.118	98.093	98.096	98.098	98.816	1.9
12.54	98.105	98.107	98.101	98.068	98.087	98.083	98.813	1.9
14.54	98.101	98.101	98.100	98.073	98.087	98.082	98.805	1.9
16.54	98.093	98.089	98.089	98.072	98.081	98.077	98.799	1.9
18.54	98.082	98.076	98.075	98.058	98.068	98.061	98.794	1.9
20.54	98.067	98.064	98.060	98.037	98.059	98.064	98.799	1.8
22.54	98.059	98.057	98.052	98.049	98.062	98.061	98.800	1.8
24.54	98.041	98.038	98.037	98.011	98.052	98.048	98.798	1.7
26.54	98.036	98.028	98.029	98.028	98.047	98.045	98.797	1.7
28.54	98.030	98.016	98.013	98.006	98.040	98.032	98.794	1.7
30.54	98.020	98.015	98.009	98.005	98.019	98.021	98.797	1.7
32.54	98.011	98.009	98.006	98.011	98.009	98.007	98.802	1.7

Grain Size Distribution Data
Streamside Testing
Colorado State University - March 2005

Test Number 9

Grain Size (mm)	Collected and Passed Sediments				Suspended Sediments		
	Cumulative Weight Passed (g)		Percent Finer		Grain Size (mm)	Cumulative Weight Suspended Sediment	Percent Finer Suspended Sediment
Aggregate Collected Sediment	Aggregate Passed Sediment	Aggregate Collected Sediment	Aggregate Passed Sediment				
42	0.0	0.0	100%	100%	0.500	0.003	99%
32	0.0	0.0	100%	100%	0.250	0.0127	97%
22.4	0.0	0.0	100%	100%	0.150	0.0555	88%
16	0.0	0.0	100%	100%	0.125	0.0871	82%
8	0.0	0.0	100%	100%	0.106	0.1032	78%
5.6	0.0	0.0	100%	100%	0.090	0.1186	75%
4.75	0.0	0.0	100%	100%	0.075	0.1341	72%
4	0.0	0.0	100%	100%	0.063	0.144	70%
2	294.7	80.7	90%	95%	0.053	0.1553	68%
1	834.2	86.8	72%	94%	0.045	0.1624	66%
0.5	1528.5	92.0	49%	94%			
0.25	2463.3	148.0	18%	90%	Total Mass	0.4798	
0.125	2902.2	1236.6	3%	18%			
0.075	2956.5	1413.3	1%	6%			
0.063	2965.0	1433.9	1%	4%			
Pan	2995.7	1502.4	0%	0%			
Total Mass	3000.8	1500.5	N/A	N/A			

Hydraulic and Bed Elevation Data
Streamside Testing
Colorado State University - March 2005

Test Number 10
Discharge 1.5 cfs
Bed Slope 0.6%

Station (ft)	Initial Conditions Bed Elevation			Final Conditions Bed Elevation			Water Surface Elevation (ft)	Continuity Velocity (ft/s)
	Left (ft)	Center (ft)	Right (ft)	Left (ft)	Center (ft)	Right (ft)		
8.54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10.54	98.139	98.138	98.147	98.107	98.105	98.111	98.488	2.2
12.54	98.121	98.119	98.121	98.076	98.090	98.058	98.480	2.1
14.54	98.109	98.110	98.111	98.078	98.077	98.075	98.468	2.1
16.54	98.099	98.100	98.101	98.051	98.099	98.051	98.458	2.1
18.54	98.088	98.093	98.088	98.068	98.064	98.031	98.453	2.1
20.54	98.076	98.081	98.076	98.041	98.062	98.055	98.446	2.1
22.54	98.063	98.073	98.073	98.022	98.044	98.049	98.447	2.0
24.54	98.061	98.054	98.051	98.018	98.042	98.040	98.440	2.0
26.54	98.041	98.050	98.049	98.031	98.041	98.030	98.440	1.9
28.54	98.024	98.028	98.029	98.010	98.031	98.041	98.438	1.9
30.54	98.007	98.011	98.009	97.998	98.022	97.980	98.431	1.8
32.54	98.008	98.008	98.006	98.010	98.008	98.006	98.431	1.8

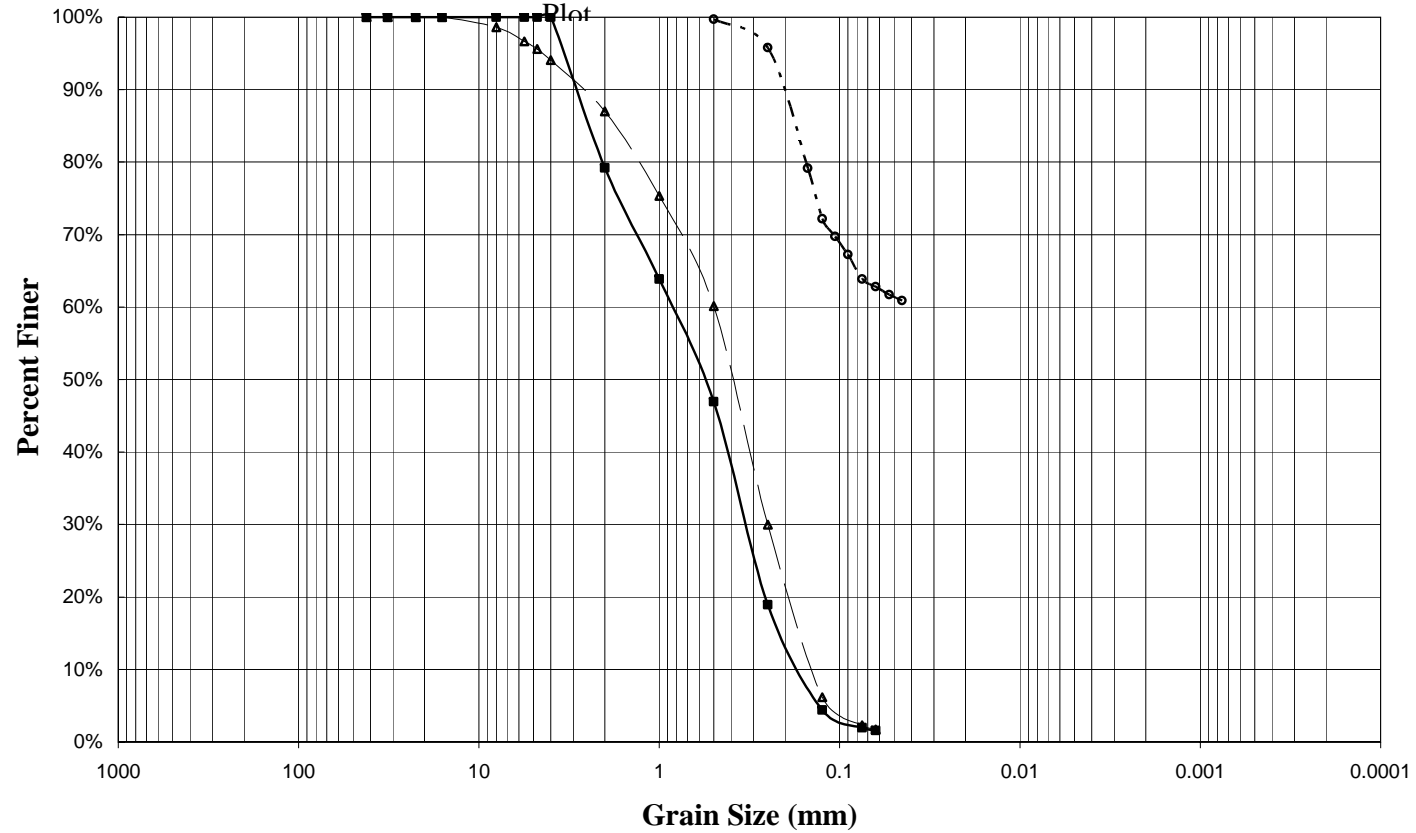
Grain Size Distribution Data
Streamside Testing
Colorado State University - March 2005

Test Number 10

Grain Size (mm)	Collected and Passed Sediments				Suspended Sediments		
	Cumulative Weight Passed (g)		Percent Finer		Grain Size (mm)	Cumulative Weight Suspended Sediment	Percent Finer Suspended Sediment
Aggregate Collected Sediment	Aggregate Passed Sediment	Aggregate Collected Sediment	Aggregate Passed Sediment				
42	0.0	0.0	100%	100%	0.500	0.004	100%
32	0.0	0.0	100%	100%	0.250	0.0637	96%
22.4	0.0	0.0	100%	100%	0.150	0.3163	79%
16	0.0	0.0	100%	100%	0.125	0.4223	72%
8	0.0	91.0	100%	99%	0.106	0.4597	70%
5.6	0.0	217.4	100%	97%	0.090	0.4976	67%
4.75	0.0	284.2	100%	96%	0.075	0.5485	64%
4	0.0	384.2	100%	94%	0.063	0.5645	63%
2	622.8	842.4	79%	87%	0.053	0.5811	62%
1	1083.2	1599.6	64%	75%	0.045	0.5938	61%
0.5	1591.3	2585.2	47%	60%			
0.25	2430.6	4538.6	19%	30%	Total Mass	1.5186	
0.125	2866.3	6082.5	4%	6%			
0.075	2938.6	6331.9	2%	2%			
0.063	2951.2	6370.8	2%	2%			
Pan	2993.5	6476.6	0%	0%			
Total Mass	2997.9	6481.5	N/A	N/A			

Grain Size Distribution

Test 10 Grain Size Distribution



Boulders	Cobbles	Gravel	Sand	Silt and Clay
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—○— Suspended Sediment —■— Collected Sediment —▲— Passed Sediment

Hydraulic and Bed Elevation Data
Streamside Testing
Colorado State University - March 2005

Test Number 11
Discharge 1.5 cfs
Bed Slope 0.6%

Station (ft)	Initial Conditions Bed Elevation			Final Conditions Bed Elevation			Water Surface Elevation (ft)	Continuity Velocity (ft/s)
	Left (ft)	Center (ft)	Right (ft)	Left (ft)	Center (ft)	Right (ft)		
8.54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10.54	98.114	98.120	98.114	98.101	98.086	98.087	98.461	2.2
12.54	98.096	98.091	98.094	98.070	98.083	98.065	98.456	2.1
14.54	98.093	98.095	98.094	98.050	98.044	98.059	98.437	2.2
16.54	98.061	98.061	98.063	98.038	98.044	98.038	98.430	2.1
18.54	98.073	98.067	98.056	98.044	98.017	98.039	98.414	2.2
20.54	98.059	98.054	98.053	98.029	98.004	98.040	98.411	2.2
22.54	98.030	98.038	98.043	98.017	97.995	98.030	98.402	2.1
24.54	98.035	98.031	98.023	98.029	98.036	97.999	98.398	2.1
26.54	98.026	98.022	98.019	98.025	98.003	98.005	98.400	2.0
28.54	98.034	98.030	98.028	98.003	98.003	98.016	98.401	2.1
30.54	98.012	98.006	97.999	97.978	98.001	97.966	98.397	2.0
32.54	98.013	98.012	98.010	98.008	98.006	98.002	98.391	2.0

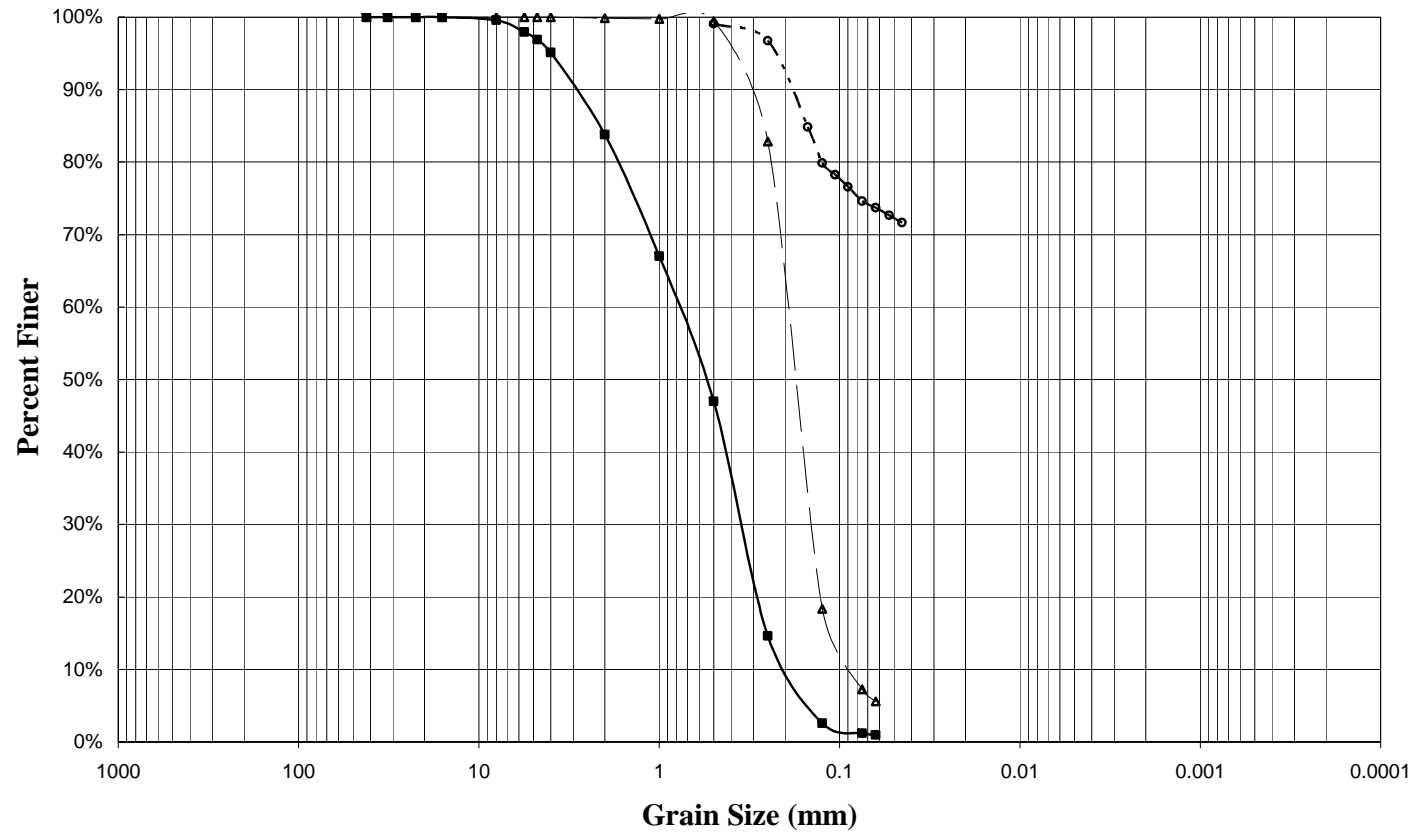
Grain Size Distribution Data
Streamside Testing
Colorado State University - March 2005

Test Number 11

Grain Size (mm)	Collected and Passed Sediments				Suspended Sediments		
	Cumulative Weight Passed (g)		Percent Finer		Grain Size (mm)	Cumulative Weight Suspended Sediment	Percent Finer Suspended Sediment
Aggregate Collected Sediment	Aggregate Passed Sediment	Aggregate Collected Sediment	Aggregate Passed Sediment				
42	0.0	0.0	100%	100%	0.500	0.0115	99%
32	0.0	0.0	100%	100%	0.250	0.0419	97%
22.4	0.0	0.0	100%	100%	0.150	0.1942	85%
16	0.0	0.0	100%	100%	0.125	0.2579	80%
8	41.3	0.0	100%	100%	0.106	0.2792	78%
5.6	192.2	0.0	98%	100%	0.090	0.3002	77%
4.75	294.0	0.0	97%	100%	0.075	0.3253	75%
4	458.7	0.0	95%	100%	0.063	0.3370	74%
2	1528.4	2.3	84%	100%	0.053	0.3508	73%
1	3104.8	3.5	67%	100%	0.045	0.3635	72%
0.5	4991.1	8.9	47%	99%			
0.25	8038.6	257.2	15%	83%	Total Mass	1.2827	
0.125	9172.8	1224.6	3%	18%			
0.075	9306.3	1391.4	1%	7%			
0.063	9327.9	1416.0	1%	6%			
Pan	7255.5	1498.2	23%	0%			
Total Mass	9417.9	1500.2	N/A	N/A			

Grain Size Distribution

Test 11 Grain Size Distribution Plot



Boulders	Cobbles	Gravel	Sand	Silt and Clay
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—○— Suspended Sediment —■— Collected Sediment —▲— Passed Sediment

Hydraulic and Bed Elevation Data
Streamside Testing
Colorado State University - March 2005

Test Number 12
Discharge 2.5 cfs
Bed Slope 0.6%

Station (ft)	Initial Conditions Bed Elevation			Final Conditions Bed Elevation			Water Surface Elevation (ft)	Continuity Velocity (ft/s)
	Left (ft)	Center (ft)	Right (ft)	Left (ft)	Center (ft)	Right (ft)		
8.54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10.54	98.117	98.107	98.117	98.007	98.010	98.006	98.637	2.4
12.54	98.108	98.110	98.110	98.021	98.052	98.049	98.625	2.5
14.54	98.106	98.098	98.106	97.998	98.006	98.041	98.612	2.5
16.54	98.101	98.099	98.097	97.973	97.973	98.033	98.603	2.5
18.54	98.092	98.086	98.084	97.955	97.994	98.006	98.578	2.6
20.54	98.078	98.074	98.078	97.995	97.979	98.008	98.572	2.6
22.54	98.059	98.058	98.063	98.013	97.971	98.026	98.556	2.6
24.54	98.037	98.040	98.038	97.981	97.965	98.015	98.556	2.5
26.54	98.042	98.046	98.043	98.039	97.988	97.999	98.560	2.5
28.54	98.031	98.035	98.031	98.006	98.008	98.003	98.551	2.5
30.54	98.023	98.023	98.022	97.987	97.969	97.961	98.545	2.4
32.54	98.008	98.007	98.003	98.007	98.005	97.972	98.549	2.3

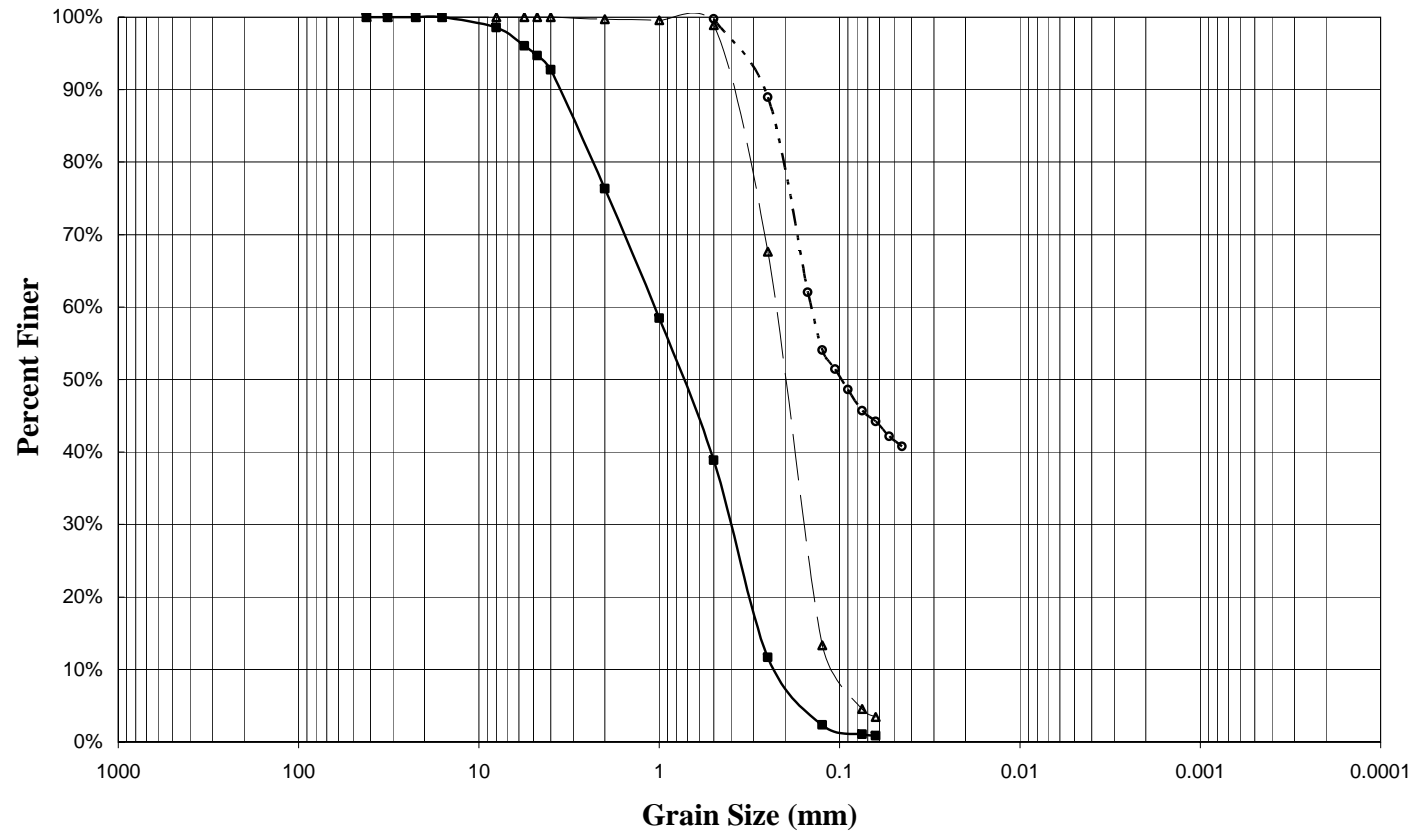
Grain Size Distribution Data
Streamside Testing
Colorado State University - March 2005

Test Number 12

Grain Size (mm)	Collected and Passed Sediments				Suspended Sediments		
	Cumulative Weight Passed (g)		Percent Finer		Grain Size (mm)	Cumulative Weight Suspended Sediment	Percent Finer Suspended Sediment
Aggregate Collected Sediment	Aggregate Passed Sediment	Aggregate Collected Sediment	Aggregate Passed Sediment				
42	0.0	0.0	100%	100%	0.500	0.0095	100%
32	0.0	0.0	100%	100%	0.250	0.4117	89%
22.4	0.0	0.0	100%	100%	0.150	1.4149	62%
16	0.0	0.0	100%	100%	0.125	1.7130	54%
8	261.2	0.0	99%	100%	0.106	1.8101	51%
5.6	723.8	0.0	96%	100%	0.090	1.9154	49%
4.75	971.9	0.0	95%	100%	0.075	2.0254	46%
4	1333.3	0.0	93%	100%	0.063	2.0805	44%
2	4335.3	8.3	76%	100%	0.053	2.1567	42%
1	7612.0	13.4	58%	100%	0.045	2.2092	41%
0.5	11206.2	33.1	39%	99%			
0.25	16188.3	971.2	12%	68%	Total Mass	3.7287	
0.125	17898.2	2600.6	2%	13%			
0.075	18129.7	2863.3	1%	5%			
0.063	18168.6	2897.1	1%	3%			
Pan	18308.7	3000.8	0%	0%			
Total Mass	18326.7	3000.2	N/A	N/A			

Grain Size Distribution

Test 12 Grain Size Distribution Plot



Boulders	Cobbles	Gravel	Sand	Silt and Clay
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—○— Suspended Sediment —■— Collected Sediment —△— Passed Sediment

Hydraulic and Bed Elevation Data
Streamside Testing
Colorado State University - March 2005

Test Number 13
Discharge 3.75 cfs
Bed Slope 0.6%

Station (ft)	Initial Conditions Bed Elevation			Final Conditions Bed Elevation			Water Surface Elevation (ft)	Continuity Velocity (ft/s)
	Left (ft)	Center (ft)	Right (ft)	Left (ft)	Center (ft)	Right (ft)		
8.54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10.54	98.133	98.128	98.125	97.889	97.900	97.932	98.842	2.7
12.54	98.125	98.118	98.115	97.892	97.920	97.977	98.844	2.6
14.54	98.111	98.109	98.106	98.009	98.013	98.022	98.818	2.7
16.54	98.103	98.101	98.096	98.016	98.012	98.001	98.798	2.7
18.54	98.093	98.089	98.083	97.983	97.989	98.004	98.798	2.7
20.54	98.084	98.078	98.074	97.961	98.000	98.002	98.793	2.7
22.54	98.071	98.068	98.063	97.983	97.970	98.005	98.782	2.7
24.54	98.055	98.051	98.047	97.960	97.978	97.970	98.774	2.6
26.54	98.048	98.042	98.041	97.932	97.980	97.995	98.775	2.6
28.54	98.034	98.032	98.028	97.975	97.959	97.952	98.768	2.6
30.54	98.020	98.017	98.013	97.947	97.910	97.948	98.758	2.6
32.54	98.011	98.010	98.006	98.007	98.004	98.003	98.760	2.5

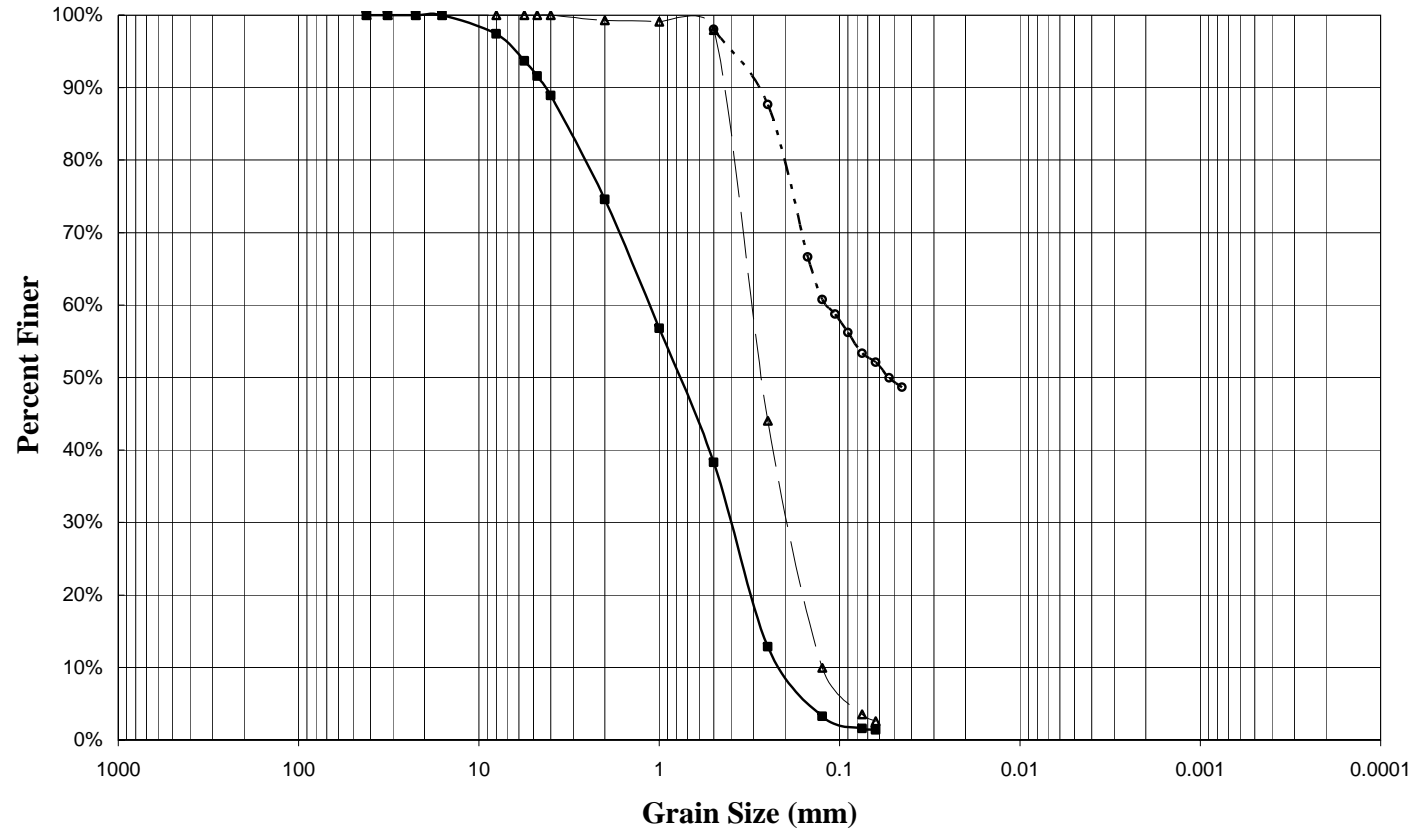
Grain Size Distribution Data
Streamside Testing
Colorado State University - March 2005

Test Number 13

Grain Size (mm)	Collected and Passed Sediments				Suspended Sediments		
	Aggregate Collected Sediment	Aggregate Passed Sediment	Percent Finer Collected Sediment	Percent Finer Passed Sediment	Grain Size (mm)	Cumulative Weight Suspended Sediment	Percent Finer Suspended Sediment
42	0.0	0.0	100%	100%	0.500	0.0652	98%
32	0.0	0.0	100%	100%	0.250	0.4072	88%
22.4	0.0	0.0	100%	100%	0.150	1.1031	67%
16	0.0	0.0	100%	100%	0.125	1.2975	61%
8	720.5	0.0	97%	100%	0.106	1.3640	59%
5.6	1777.7	0.0	94%	100%	0.090	1.4476	56%
4.75	2368.4	0.0	92%	100%	0.075	1.5414	53%
4	3121.7	0.0	89%	100%	0.063	1.5827	52%
2	7163.1	41.5	75%	99%	0.053	1.6535	50%
1	12167.2	51.8	57%	99%	0.045	1.6977	49%
0.5	17374.4	118.1	38%	98%			
0.25	24548.5	3212.2	13%	44%	Total Mass	3.3054	
0.125	27248.7	5166.1	3%	10%			
0.075	27714.2	5533.4	2%	4%			
0.063	27776.9	5587.3	1%	3%			
Pan	28063.8	5731.7	0%	0%			
Total Mass	28163.8	5736.2	N/A	N/A			

Grain Size Distribution

Test 13 Grain Size Distribution Plot



Boulders	Cobbles	Gravel	Sand	Silt and Clay
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—○— Suspended Sediment —■— Collected Sediment —▲— Passed Sediment

Hydraulic and Bed Elevation Data
Streamside Testing
Colorado State University - March 2005

Test Number 14
Discharge 1.5 cfs
Bed Slope 0.6%

Station (ft)	Initial Conditions Bed Elevation			Final Conditions Bed Elevation			Water Surface Elevation (ft)	Continuity Velocity (ft/s)
	Left (ft)	Center (ft)	Right (ft)	Left (ft)	Center (ft)	Right (ft)		
8.54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10.54	98.131	98.116	98.117	98.139	98.122	98.100	98.468	2.2
12.54	98.109	98.105	98.107	98.096	98.086	98.090	98.465	2.1
14.54	98.115	98.106	98.108	98.080	98.070	98.080	98.444	2.3
16.54	98.106	98.104	98.096	98.073	98.063	98.046	98.443	2.2
18.54	98.095	98.094	98.087	98.056	98.061	98.034	98.442	2.2
20.54	98.081	98.081	98.075	98.051	98.043	98.058	98.437	2.1
22.54	98.081	98.069	98.069	98.026	98.046	98.041	98.426	2.2
24.54	98.057	98.051	98.052	98.018	98.036	98.016	98.419	2.1
26.54	98.049	98.043	98.045	98.018	98.036	98.024	98.413	2.1
28.54	98.037	98.028	98.030	98.022	98.020	98.004	98.419	2.0
30.54	98.033	98.032	98.029	97.988	98.002	97.979	98.421	2.0
32.54	98.017	98.006	98.004	98.008	98.006	98.003	98.411	1.9

Grain Size Distribution Data
Streamside Testing
Colorado State University - March 2005

Test Number 14

Grain Size (mm)	Collected and Passed Sediments				Suspended Sediments		
	Cumulative Weight Passed (g)		Percent Finer		Grain Size (mm)	Cumulative Weight Suspended Sediment	Percent Finer Suspended Sediment
Aggregate Collected Sediment	Aggregate Passed Sediment	Aggregate Collected Sediment	Aggregate Passed Sediment				
42	0.0	0.0	100%	100%	0.500	0.0157	99%
32	0.0	0.0	100%	100%	0.250	0.0523	97%
22.4	0.0	0.0	100%	100%	0.150	0.1952	90%
16	0.0	0.0	100%	100%	0.125	0.2871	85%
8	82.3	0.0	99%	100%	0.106	0.3169	84%
5.6	381.3	0.0	95%	100%	0.090	0.3586	81%
4.75	575.9	0.0	93%	100%	0.075	0.4188	78%
4	862.6	0.0	89%	100%	0.063	0.4599	76%
2	2182.0	16.2	72%	99%	0.053	0.5135	73%
1	3941.7	19.2	50%	99%	0.045	0.5605	71%
0.5	5659.3	27.4	28%	99%			
0.25	6839.8	155.3	13%	92%	Total Mass	1.9285	
0.125	7435.0	1609.9	5%	21%			
0.075	7649.7	1805.5	3%	12%			
0.063	7697.3	1817.0	2%	11%			
Pan	7850.2	1850.9	0%	10%			
Total Mass	7860.0	2050.0	N/A	N/A			

Hydraulic and Bed Elevation Data
Streamside Testing
Colorado State University - March 2005

Test Number 15
Discharge 2.5 cfs
Bed Slope 0.6%

Station (ft)	Initial Conditions Bed Elevation			Final Conditions Bed Elevation			Water Surface Elevation (ft)	Continuity Velocity (ft/s)
	Left (ft)	Center (ft)	Right (ft)	Left (ft)	Center (ft)	Right (ft)		
8.54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10.54	98.139	98.121	98.112	98.047	98.066	98.091	98.641	2.5
12.54	98.118	98.117	98.111	98.072	98.109	98.076	98.619	2.5
14.54	98.106	98.100	98.101	98.068	98.064	98.043	98.606	2.5
16.54	98.098	98.096	98.097	98.040	98.058	98.056	98.598	2.5
18.54	98.084	98.078	98.065	98.042	98.041	98.072	98.588	2.5
20.54	98.071	98.062	98.068	98.040	98.037	98.037	98.589	2.4
22.54	98.064	98.049	98.056	98.036	98.045	98.038	98.567	2.5
24.54	98.042	98.046	98.040	97.994	98.013	98.017	98.570	2.4
26.54	98.044	98.043	98.042	97.994	98.008	98.022	98.565	2.4
28.54	98.023	98.020	98.026	97.990	97.993	97.979	98.577	2.3
30.54	98.009	98.006	98.013	98.002	97.978	97.978	98.573	2.3
32.54	98.009	98.008	98.004	98.006	98.004	97.999	98.562	2.3

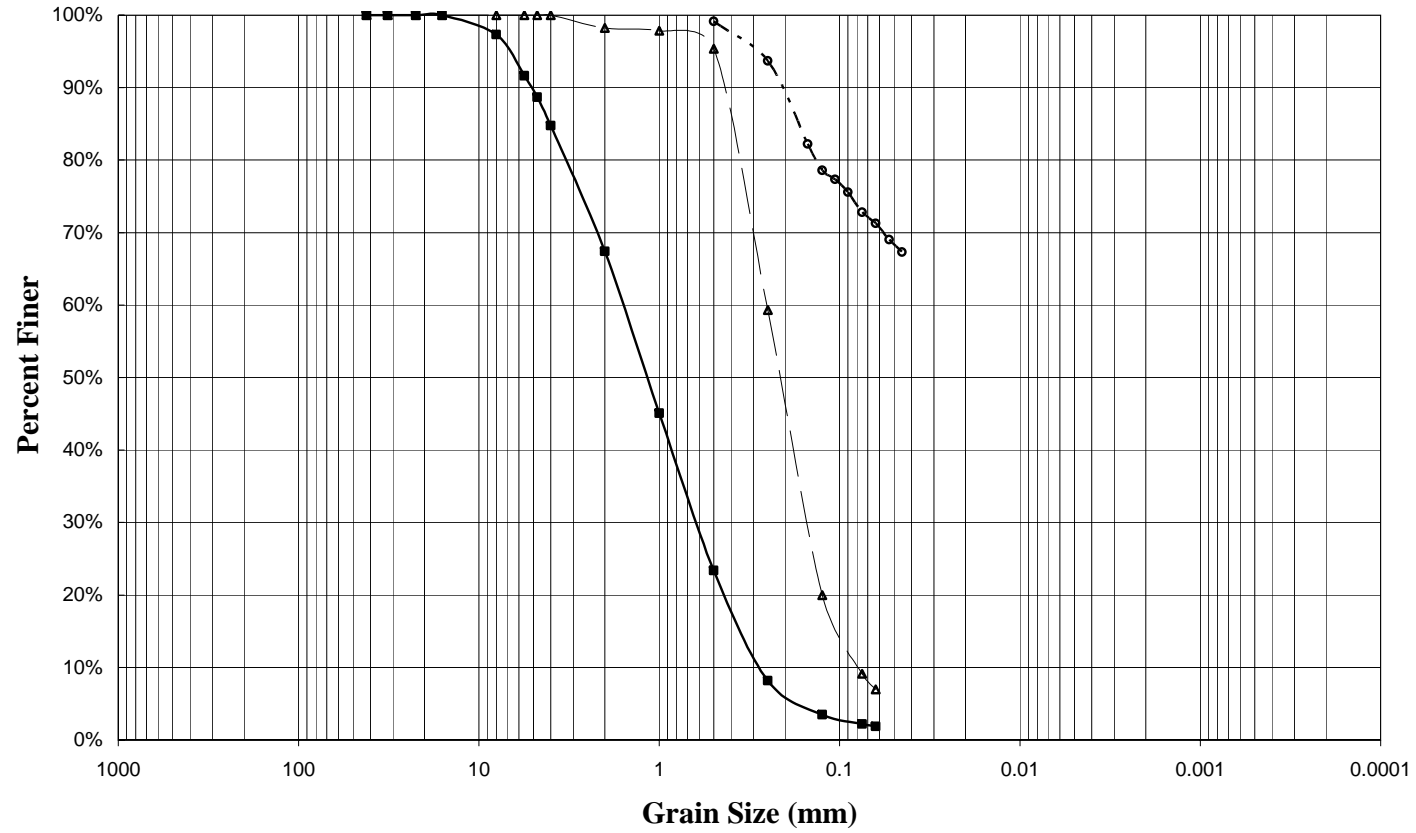
Grain Size Distribution Data
Streamside Testing
Colorado State University - March 2005

Test Number 15

Grain Size (mm)	Collected and Passed Sediments				Suspended Sediments		
	Cumulative Weight Passed (g)		Percent Finer		Grain Size (mm)	Cumulative Weight Suspended Sediment	Percent Finer Suspended Sediment
Aggregate Collected Sediment	Aggregate Passed Sediment	Aggregate Collected Sediment	Aggregate Passed Sediment				
42	0.0	0.0	100%	100%	0.500	0.0191	99%
32	0.0	0.0	100%	100%	0.250	0.1387	94%
22.4	0.0	0.0	100%	100%	0.150	0.3927	82%
16	0.0	0.0	100%	100%	0.125	0.4726	79%
8	325.6	0.0	97%	100%	0.106	0.4997	77%
5.6	1021.4	0.0	92%	100%	0.090	0.5387	76%
4.75	1380.6	0.0	89%	100%	0.075	0.5998	73%
4	1859.4	0.0	85%	100%	0.063	0.6339	71%
2	3971.5	37.3	67%	98%	0.053	0.6829	69%
1	6689.5	45.5	45%	98%	0.045	0.7212	67%
0.5	9336.0	99.0	23%	95%			
0.25	11185.0	866.8	8%	59%	Total Mass	2.2056	
0.125	11754.8	1705.8	4%	20%			
0.075	11912.5	1937.4	2%	9%			
0.063	11955.7	1983.2	2%	7%			
Pan	12165.1	2128.2	0%	0%			
Total Mass	12181.5	2131.7	N/A	N/A			

Grain Size Distribution

Test 15 Grain Size Distribution Plot



Boulders	Cobbles	Gravel	Sand	Silt and Clay
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—○— Suspended Sediment —■— Collected Sediment —▲— Passed Sediment

Hydraulic and Bed Elevation Data
Streamside Testing
Colorado State University - March 2005

Test Number 16
Discharge 3.75 cfs
Bed Slope 0.6%

Station (ft)	Initial Conditions Bed Elevation			Final Conditions Bed Elevation			Water Surface Elevation (ft)	Continuity Velocity (ft/s)
	Left (ft)	Center (ft)	Right (ft)	Left (ft)	Center (ft)	Right (ft)		
8.54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10.54	98.128	98.122	98.133	98.048	98.038	98.061	98.868	2.6
12.54	98.112	98.116	98.122	98.035	98.054	98.051	98.870	2.5
14.54	98.114	98.106	98.112	97.983	98.053	98.079	98.847	2.6
16.54	98.100	98.101	98.101	97.979	98.002	98.025	98.839	2.6
18.54	98.083	98.078	98.078	98.010	98.009	98.056	98.829	2.6
20.54	98.073	98.070	98.072	98.003	97.994	98.037	98.831	2.5
22.54	98.057	98.060	98.063	98.063	98.050	98.039	98.824	2.5
24.54	98.042	98.049	98.046	98.022	98.035	98.029	98.817	2.5
26.54	98.033	98.038	98.043	98.011	98.005	98.009	98.818	2.5
28.54	98.026	98.026	98.025	97.998	98.004	98.015	98.821	2.4
30.54	98.009	98.016	98.018	97.999	97.996	98.006	98.807	2.4
32.54	98.006	98.004	98.000	98.010	98.009	98.006	98.811	2.4

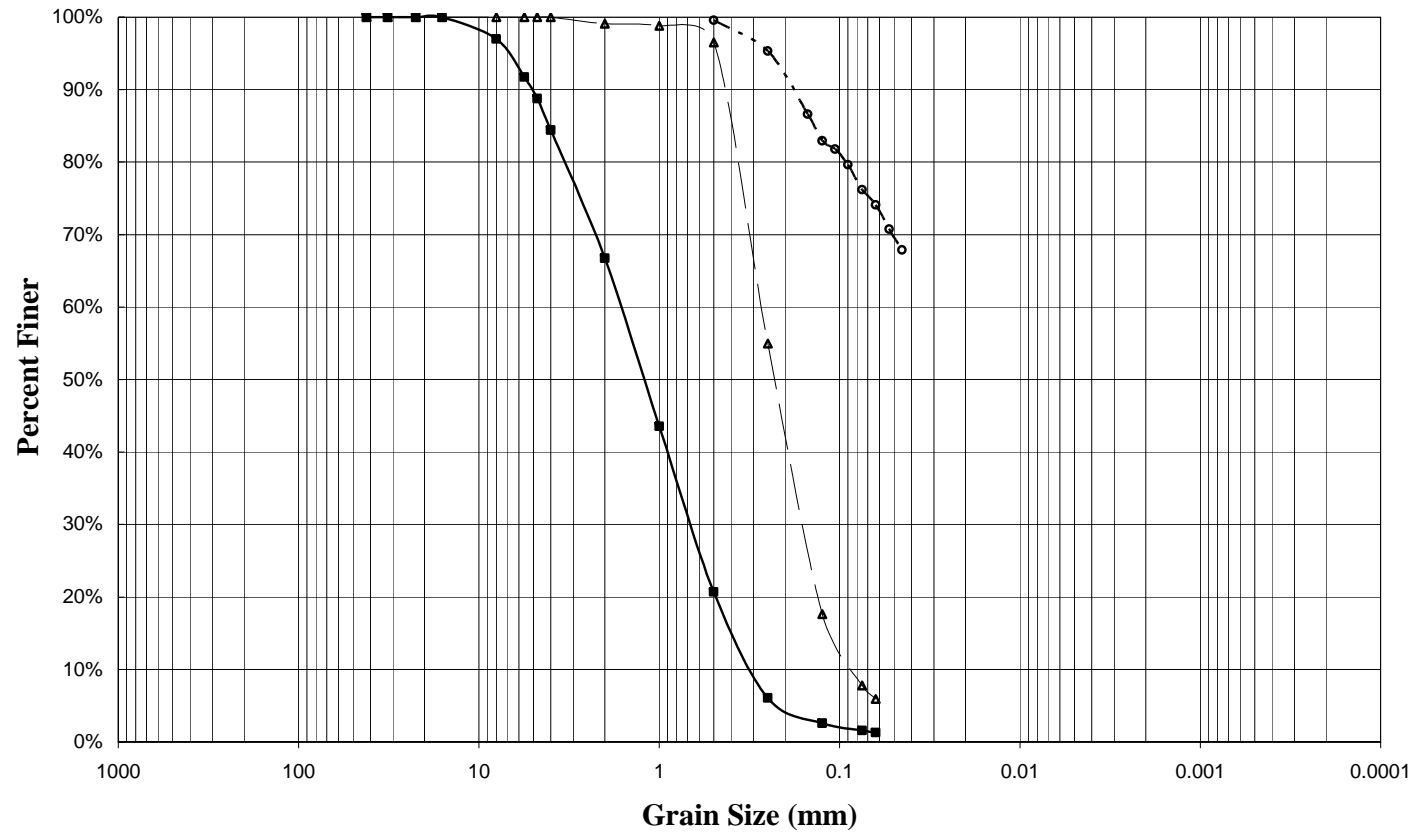
Grain Size Distribution Data
Streamside Testing
Colorado State University - March 2005

Test Number 16

Grain Size (mm)	Collected and Passed Sediments				Suspended Sediments		
	Aggregate Collected Sediment	Aggregate Passed Sediment	Percent Finer Collected Sediment	Percent Finer Passed Sediment	Grain Size (mm)	Cumulative Weight Suspended Sediment	Percent Finer Suspended Sediment
42	0.0	0.0	100%	100%	0.500	0.0112	100%
32	0.0	0.0	100%	100%	0.250	0.1231	95%
22.4	0.0	0.0	100%	100%	0.150	0.3504	87%
16	0.0	0.0	100%	100%	0.125	0.4475	83%
8	521.4	0.0	97%	100%	0.106	0.477	82%
5.6	1421.7	0.0	92%	100%	0.090	0.5331	80%
4.75	1931.2	0.0	89%	100%	0.075	0.6234	76%
4	2682.1	0.0	84%	100%	0.063	0.679	74%
2	5724.3	18.8	67%	99%	0.053	0.7669	71%
1	9714.1	25.0	44%	99%	0.045	0.8414	68%
0.5	13647.7	72.1	21%	97%			
0.25	16169.1	928.2	6%	55%	Total Mass	2.6210	
0.125	16764.9	1697.5	3%	18%			
0.075	16939.0	1900.2	2%	8%			
0.063	16989.8	1939.5	1%	6%			
Pan	17192.0	2057.1	0%	0%			
Total Mass	17211.4	2061.2	N/A	N/A			

Grain Size Distribution

Test 16 Grain Size Distribution Plot



Boulders	Cobbles	Gravel	Sand	Silt and Clay
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—○— Suspended Sediment —■— Collected Sediment —△— Passed Sediment

Hydraulic and Bed Elevation Data
Streamside Testing
Colorado State University - March 2005

Test Number 17
Discharge 2 cfs
Bed Slope 0.6%

Station (ft)	Initial Conditions Bed Elevation			Final Conditions Bed Elevation			Water Surface Elevation (ft)	Continuity Velocity (ft/s)
	Left (ft)	Center (ft)	Right (ft)	Left (ft)	Center (ft)	Right (ft)		
8.54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10.54	98.135	98.133	98.131	98.116	98.130	98.116	98.830	1.5
12.54	98.116	98.125	98.123	98.097	98.114	98.113	98.828	1.4
14.54	98.103	98.105	98.104	98.096	98.110	98.096	98.817	1.4
16.54	98.101	98.095	98.095	98.092	98.114	98.098	98.814	1.4
18.54	98.092	98.089	98.091	98.093	98.098	98.090	98.809	1.4
20.54	98.080	98.081	98.081	98.087	98.100	98.081	98.806	1.4
22.54	98.069	98.068	98.073	98.073	98.083	98.064	98.809	1.4
24.54	98.056	98.054	98.054	98.042	98.066	98.047	98.811	1.3
26.54	98.043	98.039	98.045	98.032	98.063	98.051	98.810	1.3
28.54	98.035	98.033	98.037	98.031	98.050	98.033	98.810	1.3
30.54	98.028	98.022	98.019	98.027	98.034	98.012	98.810	1.3
32.54	98.009	98.009	98.004	98.008	98.007	98.005	98.812	1.3

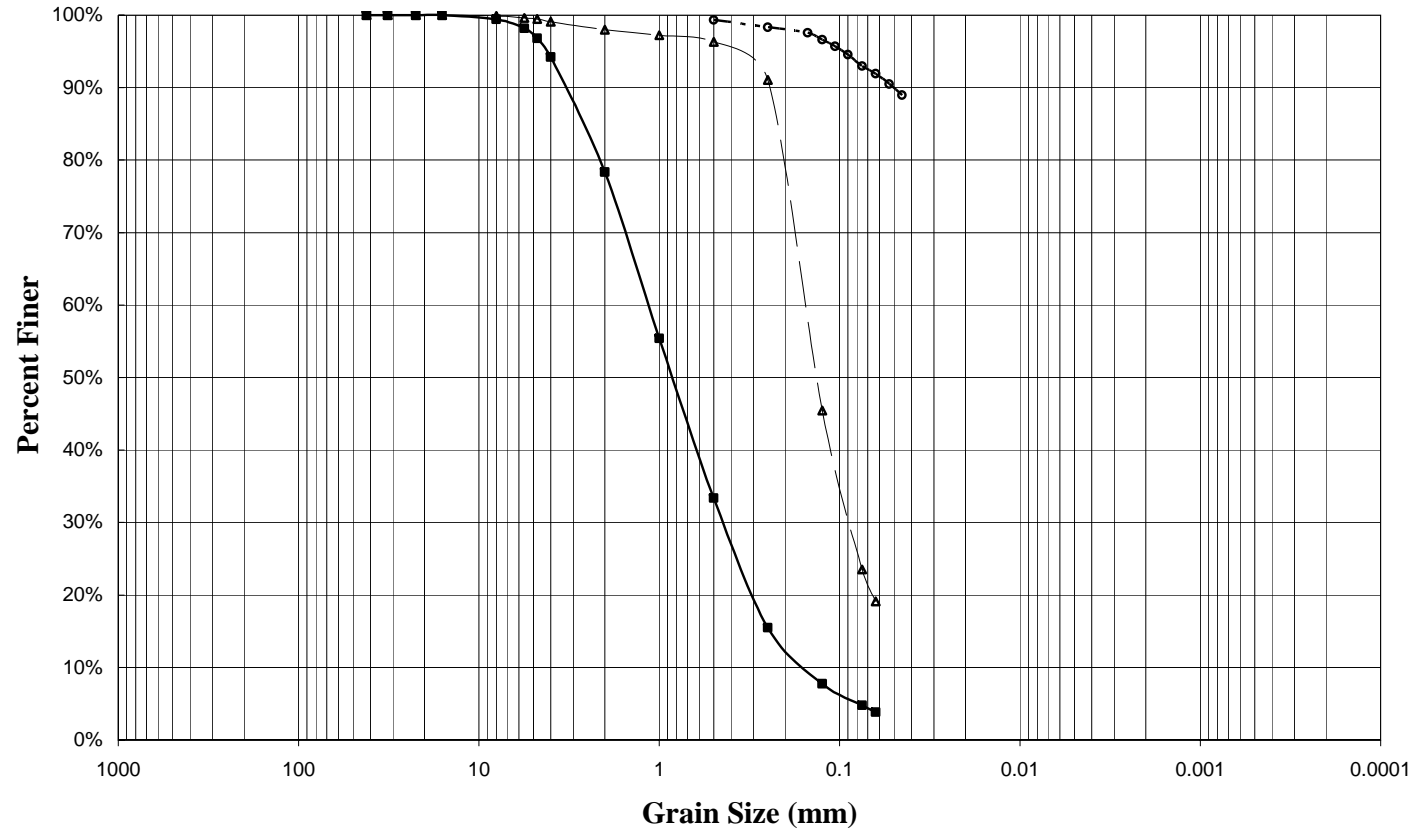
Grain Size Distribution Data
Streamside Testing
Colorado State University - March 2005

Test Number 17

Grain Size (mm)	Collected and Passed Sediments				Suspended Sediments		
	Cumulative Weight Passed (g)		Percent Finer		Grain Size (mm)	Cumulative Weight Suspended Sediment	Percent Finer Suspended Sediment
Aggregate Collected Sediment	Aggregate Passed Sediment	Aggregate Collected Sediment	Aggregate Passed Sediment				
42	0.0	0.0	100%	100%	0.500	0.0053	99%
32	0.0	0.0	100%	100%	0.250	0.0133	98%
22.4	0.0	0.0	100%	100%	0.150	0.0197	98%
16	0.0	0.0	100%	100%	0.125	0.0273	97%
8	9.1	1.2	99%	100%	0.106	0.0346	96%
5.6	29.5	6.2	98%	100%	0.090	0.0436	95%
4.75	52.3	8.6	97%	99%	0.075	0.0564	93%
4	93.9	14.4	94%	99%	0.063	0.0647	92%
2	351.0	32.2	78%	98%	0.053	0.0761	91%
1	723.4	44.0	55%	97%	0.045	0.0884	89%
0.5	1080.5	59.0	33%	96%			
0.25	1370.1	143.3	15%	91%	Total Mass	0.8015	
0.125	1496.2	872.6	8%	45%			
0.075	1544.2	1223.9	5%	24%			
0.063	1559.3	1293.8	4%	19%			
Pan	1615.3	1593.9	0%	0%			
Total Mass	1621.4	1600.0	N/A	N/A			

Grain Size Distribution

Test 17 Grain Size Distribution Plot



Boulders	Cobbles	Gravel	Sand	Silt and Clay
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—○— Suspended Sediment —■— Collected Sediment —▲— Passed Sediment

Hydraulic and Bed Elevation Data
Streamside Testing
Colorado State University - March 2005

Test Number 18
Discharge 1.8 cfs
Bed Slope 0.6%

Station (ft)	Initial Conditions Bed Elevation			Final Conditions Bed Elevation			Water Surface Elevation (ft)	Continuity Velocity (ft/s)
	Left (ft)	Center (ft)	Right (ft)	Left (ft)	Center (ft)	Right (ft)		
8.54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10.54	98.154	98.145	98.138	98.076	98.076	98.033	98.452	3.0
14.54	98.124	98.118	98.117	98.032	98.055	98.026	98.402	3.3
18.54	98.110	98.101	98.097	98.012	98.027	98.014	98.371	3.4
22.54	98.084	98.077	98.073	98.010	97.997	97.999	98.390	2.9
26.54	98.057	98.048	98.047	97.989	97.988	97.975	98.352	3.0
30.54	98.030	98.026	98.019	97.940	97.955	97.947	98.321	3.1
32.54	98.009	98.007	98.004	98.008	98.006	98.004	98.319	2.9
34.54	97.997	97.995	97.992	97.996	97.994	97.992	98.307	2.9
36.54	97.986	97.984	97.981	97.985	97.983	97.981	98.288	3.0
40.54	97.963	97.961	97.958	97.962	97.960	97.958	98.312	2.6
44.54	97.940	97.938	97.935	97.939	97.937	97.935	98.311	2.5
48.54	97.917	97.915	97.912	97.916	97.914	97.912	98.308	2.3

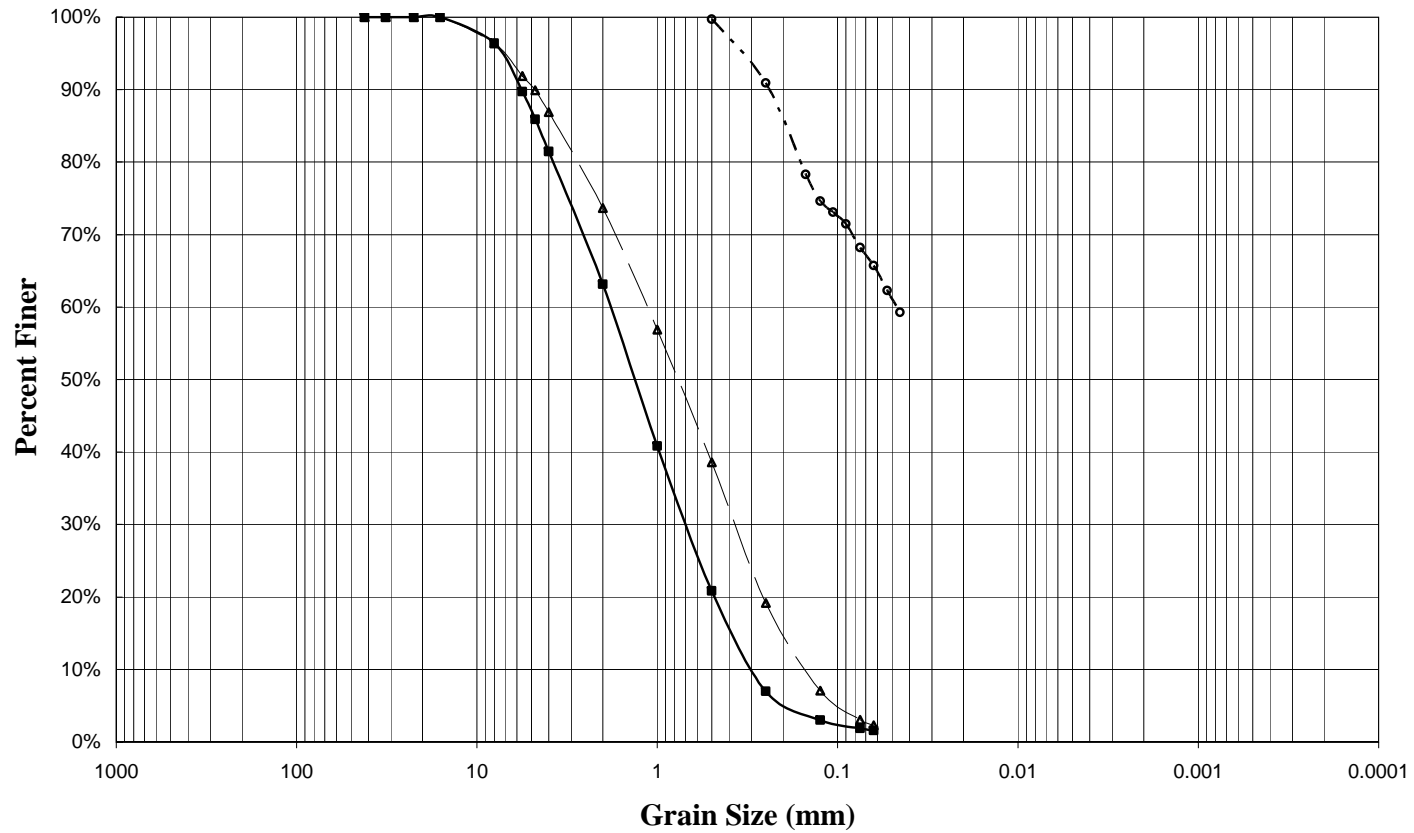
Grain Size Distribution Data
Streamside Testing
Colorado State University - March 2005

Test Number 18

Grain Size (mm)	Collected and Passed Sediments				Suspended Sediments		
	Aggregate Collected Sediment	Aggregate Passed Sediment	Percent Finer Collected Sediment	Percent Finer Passed Sediment	Grain Size (mm)	Cumulative Weight Suspended Sediment	Percent Finer Suspended Sediment
42	0.0	0.0	100%	100%	0.500	0.0084	100%
32	0.0	0.0	100%	100%	0.250	0.2902	91%
22.4	0.0	0.0	100%	100%	0.150	0.6924	78%
16	1.5	0.0	100%	100%	0.125	0.8110	75%
8	323.2	273.2	96%	96%	0.106	0.8598	73%
5.6	923.3	608.6	90%	92%	0.090	0.9112	71%
4.75	1269.1	757.5	86%	90%	0.075	1.015	68%
4	1668.1	981.0	81%	87%	0.063	1.0947	66%
2	3318.1	1974.2	63%	74%	0.053	1.2049	62%
1	5326.1	3235.6	41%	57%	0.045	1.3012	59%
0.5	7124.9	4607.1	21%	39%			
0.25	8375.7	6064.7	7%	19%	Total Mass	3.1938	
0.125	8733.0	6969.8	3%	7%			
0.075	8833.3	7270.0	2%	3%			
0.063	8859.0	7327.8	2%	2%			
Pan	8967.4	7480.9	0%	0%			
Total Mass	9003.1	7500.9	N/A	N/A			

Grain Size Distribution

Test 18 Grain Size Distribution Plot



Boulders	Cobbles	Gravel	Sand	Silt and Clay
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—○— Suspended Sediment —■— Collected Sediment —▲— Passed Sediment

Hydraulic and Bed Elevation Data
Streamside Testing
Colorado State University - March 2005

Test Number 19
Discharge 4.5 cfs
Bed Slope 0.6%

Station (ft)	Initial Conditions Bed Elevation			Final Conditions Bed Elevation			Water Surface Elevation (ft)	Continuity Velocity (ft/s)
	Left (ft)	Center (ft)	Right (ft)	Left (ft)	Center (ft)	Right (ft)		
8.54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10.54	98.123	98.127	98.124	97.883	97.870	97.932	98.934	2.8
12.54	98.114	98.114	98.118	97.969	97.952	97.939	98.929	2.8
14.54	98.104	98.109	98.112	97.942	97.931	97.967	98.906	2.9
16.54	98.095	98.095	98.096	97.967	97.969	97.974	98.889	2.9
18.54	98.083	98.083	98.085	97.950	97.980	98.011	98.893	2.8
20.54	98.070	98.066	98.071	97.953	97.930	97.974	98.888	2.8
22.54	98.064	98.067	98.067	98.003	97.983	98.008	98.873	2.8
24.54	98.049	98.049	98.051	98.000	98.025	98.009	98.863	2.8
26.54	98.038	98.037	98.042	97.996	98.017	98.019	98.872	2.8
28.54	98.023	98.027	98.022	98.003	98.011	98.007	98.849	2.8
30.54	98.014	98.012	98.006	97.960	97.988	97.986	98.847	2.7
32.54	98.010	98.009	98.006	98.008	98.006	98.002	98.847	2.7

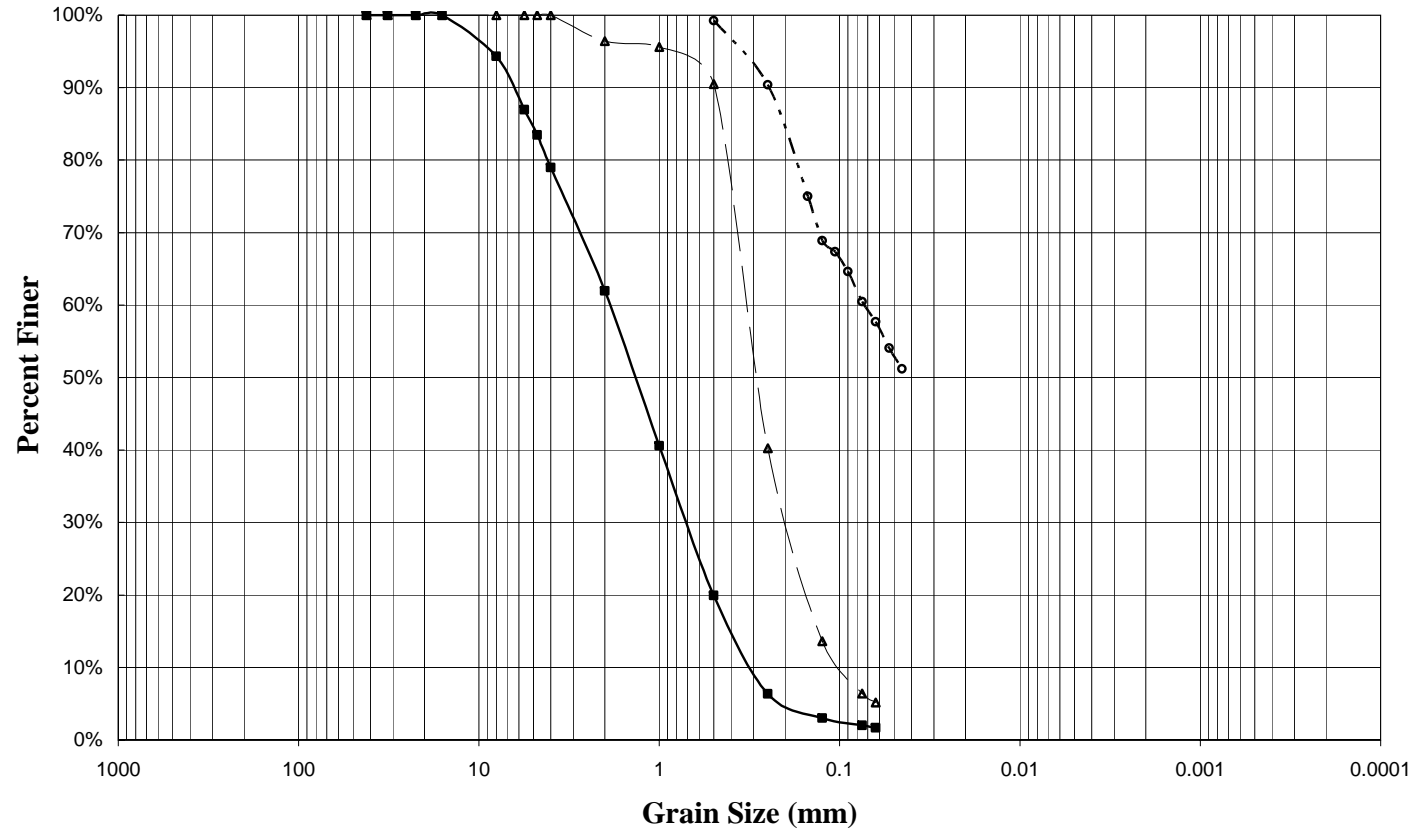
Grain Size Distribution Data
Streamside Testing
Colorado State University - March 2005

Test Number 19

Grain Size (mm)	Collected and Passed Sediments				Suspended Sediments		
	Cumulative Weight Passed (g)		Percent Finer		Grain Size (mm)	Cumulative Weight Suspended Sediment	Percent Finer Suspended Sediment
Aggregate Collected Sediment	Aggregate Passed Sediment	Aggregate Collected Sediment	Aggregate Passed Sediment				
42	0.0	0.0	100%	100%	0.500	0.0379	99%
32	0.0	0.0	100%	100%	0.250	0.4873	90%
22.4	0.0	0.0	100%	100%	0.150	1.2657	75%
16	0.0	0.0	100%	100%	0.125	1.5751	69%
8	1528.8	0.0	94%	100%	0.106	1.6538	67%
5.6	3498.1	0.0	87%	100%	0.090	1.7917	65%
4.75	4434.1	0.0	83%	100%	0.075	2.0016	60%
4	5646.0	0.0	79%	100%	0.063	2.1416	58%
2	10216.3	154.6	62%	96%	0.053	2.3265	54%
1	15954.0	188.8	41%	96%	0.045	2.4720	51%
0.5	21493.3	409.3	20%	90%			
0.25	25144.2	2570.2	6%	40%	Total Mass	5.0633	
0.125	26032.6	3715.1	3%	14%			
0.075	26310.9	4025.0	2%	6%			
0.063	26392.5	4077.3	2%	5%			
Pan	26574.0	4169.0	1%	3%			
Total Mass	26845.4	4300.0	N/A	N/A			

Grain Size Distribution

Test 19 Grain Size Distribution Plot



Boulders	Cobbles	Gravel	Sand	Silt and Clay
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—○— Suspended Sediment —■— Collected Sediment —△— Passed Sediment

Hydraulic and Bed Elevation Data
Streamside Testing
Colorado State University - March 2005

Test Number 20
Discharge 2.6 cfs
Bed Slope 0.6%

Station (ft)	Initial Conditions Bed Elevation			Final Conditions Bed Elevation			Water Surface Elevation (ft)	Continuity Velocity (ft/s)
	Left (ft)	Center (ft)	Right (ft)	Left (ft)	Center (ft)	Right (ft)		
8.54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10.54	98.119	98.120	98.118	98.096	98.111	98.121	98.831	1.9
12.54	98.103	98.105	98.102	98.103	98.099	98.085	98.820	1.9
14.54	98.094	98.095	98.097	98.091	98.090	98.092	98.805	1.9
16.54	98.088	98.088	98.087	98.065	98.077	98.073	98.801	1.9
18.54	98.076	98.075	98.072	98.064	98.066	98.062	98.797	1.8
20.54	98.065	98.063	98.062	98.058	98.054	98.059	98.796	1.8
22.54	98.061	98.057	98.055	98.048	98.048	98.065	98.795	1.8
24.54	98.036	98.037	98.035	98.030	98.035	98.028	98.796	1.7
26.54	98.031	98.029	98.030	98.015	98.027	98.064	98.799	1.7
28.54	98.026	98.025	98.021	98.009	98.019	98.020	98.800	1.7
30.54	98.002	98.001	97.997	98.006	98.006	97.992	98.796	1.7
32.54	98.010	98.009	98.006	98.009	98.008	98.005	98.797	1.7

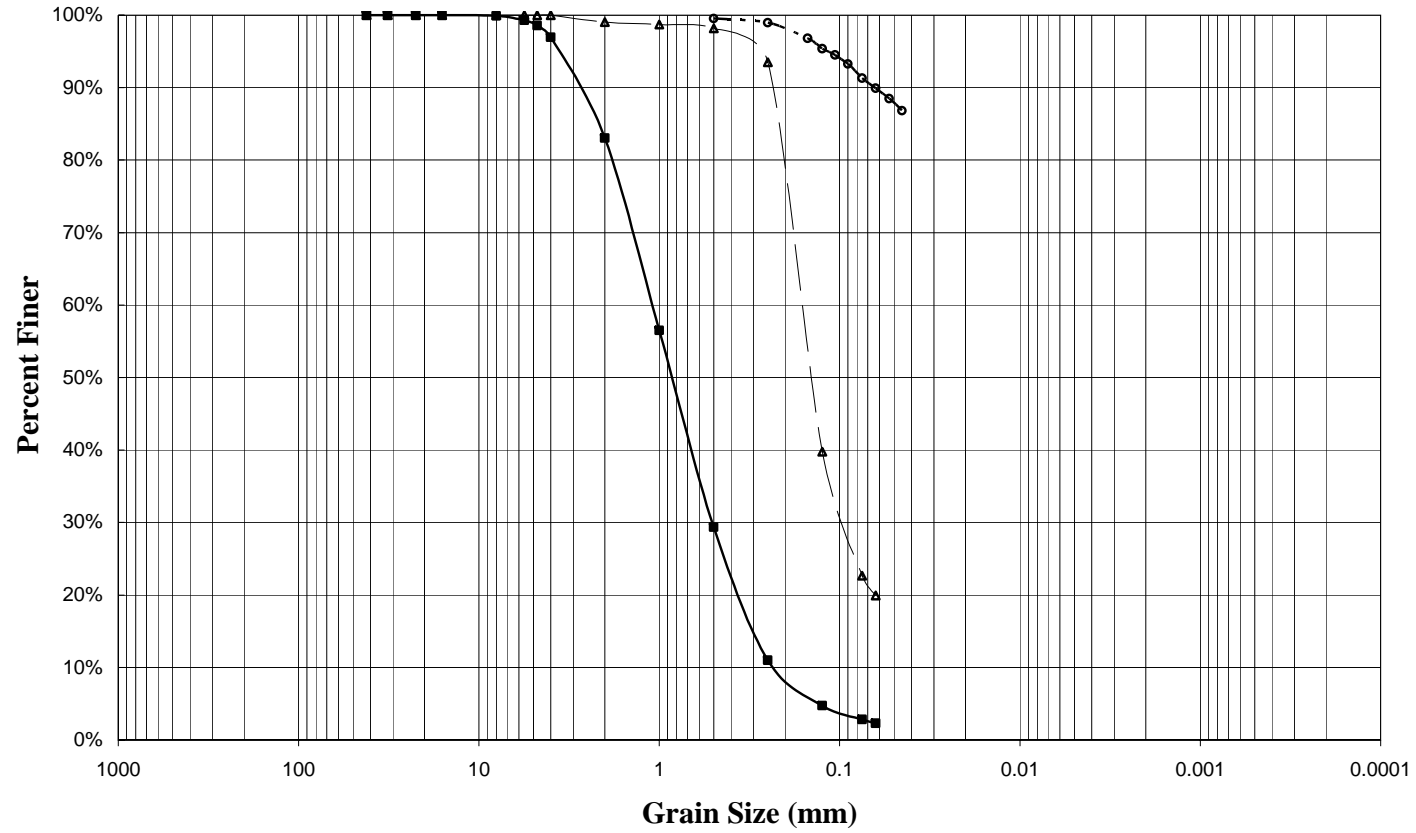
Grain Size Distribution Data
Streamside Testing
Colorado State University - March 2005

Test Number 20

Grain Size (mm)	Collected and Passed Sediments				Suspended Sediments		
	Aggregate Collected	Aggregate Passed	Aggregate Collected	Aggregate Passed	Grain Size (mm)	Cumulative Weight Suspended Sediment	Percent Finer Suspended Sediment
42	0.0	0.0	100%	100%	0.500	0.0039	100%
32	0.0	0.0	100%	100%	0.250	0.0088	99%
22.4	0.0	0.0	100%	100%	0.150	0.0272	97%
16	0.0	0.0	100%	100%	0.125	0.0396	95%
8	2.0	0.0	100%	100%	0.106	0.047	94%
5.6	15.8	0.0	99%	100%	0.090	0.0573	93%
4.75	32.0	0.0	99%	100%	0.075	0.0741	91%
4	67.7	0.0	97%	100%	0.063	0.0859	90%
2	377.4	18.8	83%	99%	0.053	0.0982	88%
1	968.2	25.7	56%	99%	0.045	0.1124	87%
0.5	1571.5	36.6	29%	98%			
0.25	1980.3	130.4	11%	93%	Total Mass	0.8525	
0.125	2120.0	1204.9	5%	40%			
0.075	2161.9	1547.0	3%	23%			
0.063	2174.3	1600.9	2%	20%			
Pan	2221.5	1686.8	0%	16%			
Total Mass	2225.0	2000.0	N/A	N/A			

Grain Size Distribution

Test 20 Grain Size Distribution Plot



Boulders	Cobbles	Gravel	Sand	Silt and Clay
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—○— Suspended Sediment —■— Collected Sediment —▲— Passed Sediment