SQUIRREL CREEK CROSS-SECTION MONITORING
October 23-25, 2009

This narrative report addresses channel monitoring of Squirrel Creek downstream of slope stabilization treatments constructed just below the _______ Mine. Steep sideslopes left behind after removal of an old tailings dam were treated with a variety of geotextile configurations during the summer or 2009 to minimize upslope erosion and sediment loading of the stream channel. Although the timeframe for channel response may be slow at this elevation, the intended outcome is establishment of bank vegetation along Squirrel Creek, with associated changes in channel morphology and ecology.

On October 24th and 25th, eleven cross sections were established across Squirrel Creek beginning in the middle of the treatment area and extending downstream to near the U.S. Forest Service road crossing below the site. Cross sections were placed at 100+/-foot intervals along the channel, beginning approximately 100 feet upstream of the fence line at the road crossing and extending upstream well into the treatment area. Cross sections ranged in length from 32 to 63 feet, and spacing ranged from 89 to 114 feet between sections.

Longitudinal Survey of Cross Section Headpins

Headpins for the cross sections consisted of varying lengths of ½" rebar set near ground surface at each end of each section. A longitudinal survey of the headpins tied them all together to generate a data set suitable for HEC-RAS modeling. The longitudinal survey of headpins proceeded from downstream to upstream; headpin elevations were then checked from upstream to downstream during the cross section surveys (see below). Maximum difference in headpin elevations between the longitudinal survey and the cross section surveys was .03 feet; thus, the rod-and-level survey technique used in 2009 yielded slightly greater accuracy than would be afforded by survey-grade GPS.

Since no reference-marks were provided for the study reach, the survey set the left head pin on the first cross section (LHP#1) at 100.00 feet, and all other headpins are related to this datum. During the field survey, a ***cadastral-survey*** corner marker was discovered just downstream of the headpin set on the right end of cross section 7 (RHP#7). No elevation was listed on the survey cap; however, if a true elevation has been established for this corner, the entire 2009 survey can be converted to true elevations. It might also be a good idea to use a survey-grade GPS to locate the headpin locations for future reference.

For the record, 'left' and 'right' designations in this survey are established facing downstream.

Recovery of Headpins for Future Surveys of Channel Cross Sections

Because of harsh conditions at this site (high altitude, chemical contamination, sparse channel vegetation, etc.), channel response to upland treatments likely will be slow. Repeat surveys could be done annually, but re-survey at 3- to 5-year intervals may be sufficient to document response. The challenge in any kind of repeat survey is finding the headpins from the original survey after a period of time has elapsed. The following procedure is recommended for this purpose and should probably occur late in the year (although not as late as this year) after vegetation leaf-off. Each time the survey is repeated, the headpins should be sprayed with fluorescent paint for subsequent surveys.

Longitudinal distances between cross sections were measured along the east side of the low-flow channel (right side as you look *upstream*). Beginning at the fence crossing the creek above the Forest Service road crossing, a tape measure should be used to locate the first cross section upstream using the distance provided in the field notes and spreadsheets. At the approximate location of the cross section, stretch a tape perpendicular to the channel with the zero point of the tape on the left bank (looking downstream to match the field notes), and the left edge of water at the distance indicated in the 2009 notes for left edge of water (LEW). Continue to stretch the tape to the entire headpin-to-headpin cross-section distance given in the 2009 notes. You should now be very close to the original headpins on both banks. If at least one of the pins is not discovered, check the headpin photographs that were provided with the 2009 survey. Most of these show at least one nearby feature for each pin. If neither headpin is discovered, a metal detector may be required to locate the rebar headpin on one or both banks. Generally, this will always be the case if the original pins are buried by a major flood event. Once a headpin has been located on one side of the stream, the pin-to-pin distances in the cross section notes can be used with the tape to find the pin on the other side of the stream. After the first cross section is properly located, the procedure is repeated to recover the headpins for each successive cross section.

Cross Section Surveys

As mentioned above, 11 channel cross sections were surveyed beginning at the top of the reach and continuing downstream to the first set of headpins. For all but the most downstream transect (#1), the sections were surveyed with a stadia rod and auto-level. For this reason, initial distance measurements were determined from stadia readings (i.e., [top – bottom] x 100 = distance) and represent distance from the survey instrument (auto-level). These distances were converted to horizontal station from left head pin (looking downstream) for cross section construction in Excel and HEC-RAS. For the most downstream transect, the cross section was surveyed with the laser level (for training purposes), and horizontal distances were taken from a Kevlar tag line. For all cross sections, horizontal station 0 is set on the left headpin (LHP).

In the spreadsheet containing all of the field data, the first "cross-section" tab contains all the transect data needed for plotting and comparison with later surveys. Later in the spreadsheet are two additional "xsec" tabs containing the data as entered into a spreadsheet from the Ohio Department of Natural Resources (ODNR). This tool turned out to be far less helpful than was originally anticipated

Pebble-Count for Determination of Bed-Material Particle-Size Distribution

A pebble count was completed for determining the particle-size distribution of bed materials in the study reach. The 2009 survey used a longitudinal sampling scheme whereby particles were retrieved every 4 to 10 steps, and particle size determined with an aluminum particle-size analyzer template. The results are presented in the field notes and spreadsheet. Whereas an adequate number of particles were sampled for the analysis, sampling was hindered by the extreme cold and the nature of the substrate in the low-flow channel. Channel substrate in the low-flow channel was mildly imbricated and extremely indurated, probably as a result of chemical reactions occurring between the water column and the substrate. An alternative sampling scheme for future characterization of the substrate is proposed below.

Future Consideration for Sampling Bed Material for Size Analysis

Since bed material in the low flow channel is heavily indurated and difficult to sample, an alternative sampling scheme is proposed that would primarily sample particles outside the low-flow channel. Throughout most of the surveyed reach, the high-flow channel is significantly wider than the low flow channel and is characterized as having a similar range of bed-sediment sizes as occur in the low-flow channel, but without the cementation caused by chemical reactions with the water. In other words, bed sediments in the high-flow channel would be much easier to sample and would still represent particle sizes available for transport during high-flow events (which is the only time bed material is transported anyway). For this reason, the recommended sampling scheme for future pebble-counts should be to sample 10 or more particles along each cross section, rather than a strictly longitudinal survey down the low-flow channel. With such a scheme, only one or two clasts from each cross section would occur in the low-flow channel, but the overall particle-size distribution might be more representative of the total load available for transport.

Monitoring Reach

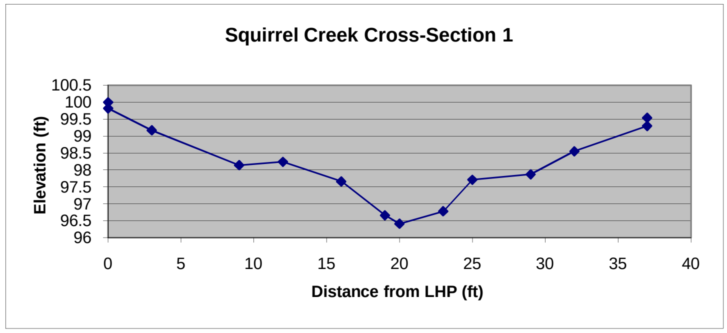
	Stream:	Squirrel Creek
	Watershed:	Kerber Creek
	Location:	Above Bonanza
(Approx.)	Latitude:	38.2947
(Approx.)	Longitude:	106.1417
	County:	Saguache
	Date:	10/24/2009
	Observers:	Jim Fogg Zach Fogg Sam Fogg

Channel Type: Rosgen A
Drainage Area (sq.mi)

BS	HI	FS	Elevation	Remarks	
14.15	114.15		100	LHP#1	(Elevation of LHP#1 arbitrarily set to 100.00)
	114.15	14.62	99.53	RHP#1	
	114.15	6.09	108.06	RHP#2	
	114.15	7.06	107.09	LHP#2	
	114.15	2.39	111.76	LHP#3	
	114.15	2.32	111.83	RHP#3	
13.45	125.21		111.76	LHP#3	(Backsight on LHP#3)
	125.21	7.72	117.49	RHP#4	
	125.21	6.25	118.96	LHP#4	
	125.21	2.82	122.39	LHP#5	
	125.21	2.15	123.06	RHP#5	
14.13	137.19		123.06		(Backsight on RHP#5)
	137.19	10.43	126.76	RHP#6	
	137.19	8.96	128.23	LHP#6	
	137.19	1.27	135.92	LHP#7	
	137.19	0.9	136.29	RHP#7	
16.13	152.42		136.29		(Backsight on RHP#7)
	152.42	13.51	138.91	Cadastral Survey Corner Marker	
	152.42	16.49	135.93	LHP#7	(check)
	152.42	10.49	141.93	LHP#8	
	152.42	8.5	143.92	RHP#8	
	152.42	5.03	147.39	RHP#9	
	152.42	4.14	148.28	LHP#9	
19.94	168.22		148.28		(Backsight on LHP#9)
	168.22	13.47	154.75	LHP#10	
	168.22	12.53	155.69	RHP#10	
	168.22	3.2	165.02	RHP#11	
	168.22	4.85	163.37	LHP#11	

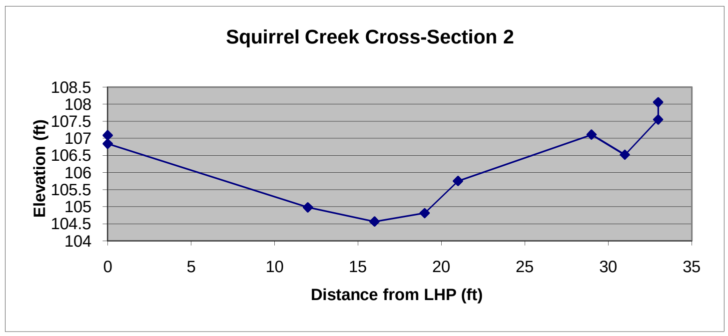
Section 1

Station	Elevation	Remarks
0	100	top LHP#1
0	99.82	GR at pin
3	99.17	
9	98.14	
12	98.24	
16	97.66	
19	96.66	LEW
20	96.41	thalweg
23	96.78	REW
25	97.71	
29	97.87	
32	98.55	
37	99.3	GR at pin
37	99.54	top RHP#1



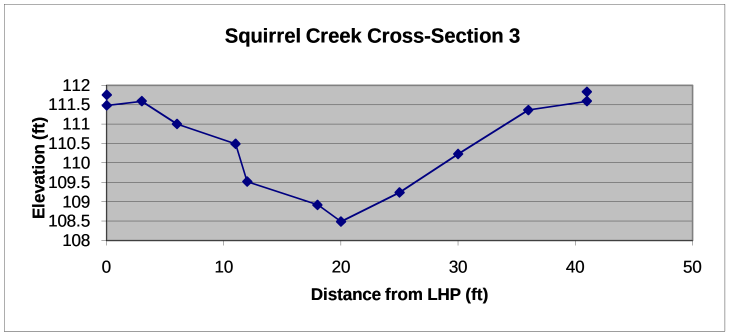
Section 2

Station	Elevation	Remarks
0	107.09	top LHP#2
0	106.84	GR at pin
12	104.98	LEW
16	104.56	thalweg
19	104.81	REW
21	105.75	
29	107.11	
31	106.52	
33	107.55	GR at pin
33	108.06	top RHP#2



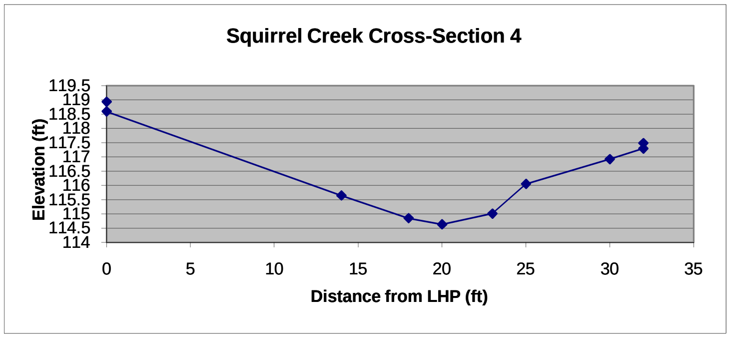
Section 3

Station	Elevation	Remarks
0	111.75	top LHP#3
0	111.48	GR at pin
3	111.59	
6	111	
11	110.49	
12	109.52	
18	108.92	LEW
20	108.49	thalweg
25	109.24	REW
30	110.23	
36	111.36	
41	111.59	GR at pin
41	111.83	top RHP#3



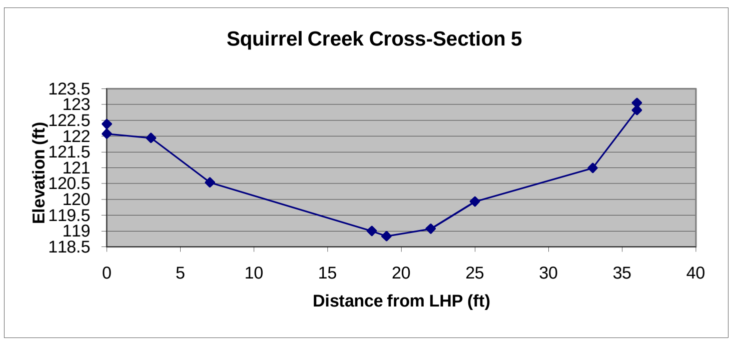
Section 4

Station	Elevation	Remarks
0	118.93	top LHP#4
0	118.59	GR at pin
14	115.64	
18	114.85	LEW
20	114.63	thalweg
23	115.01	REW
25	116.05	
30	116.92	
32	117.29	Gr at pin
32	117.48	top RHP#4



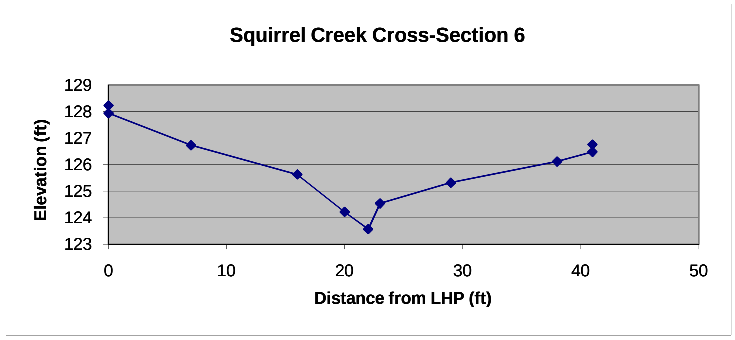
Section 5

Station	Elevation	Remarks
0	122.38	top LHP#5
0	122.07	GR at pin
3	121.94	
7	120.53	
18	119	LEW
19	118.83	thalweg
22	119.07	REW
25	119.93	
33	120.99	
36	122.82	GR at pin
36	123.05	top RHP#5



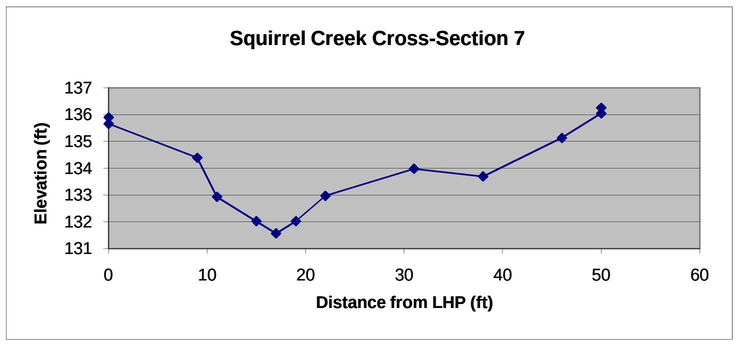
Section 6

Station	Elevation	Remarks
0	128.23	top LHP#6
0	127.94	GR at pin
7	126.73	
16	125.63	
20	124.22	LEW
22	123.57	thalweg
23	124.54	REW
29	125.32	
38	126.12	
41	126.48	GR at pin
41	126.76	top RHP#6



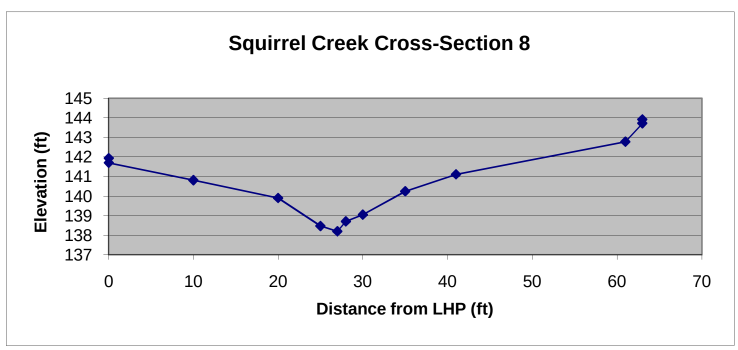
Section 7

Station	Elevation	Remarks
0	135.9	top LHP#7
0	135.66	GR at pin
9	134.39	
11	132.93	LEW
15	132.02	thalweg
17	131.56	REW
19	132.02	
22	132.97	
31	133.98	
38	133.69	
46	135.13	
50	136.05	GR at pin
50	136.26	top RHP#7
	138.88	Cadastral Survey Corner Marker



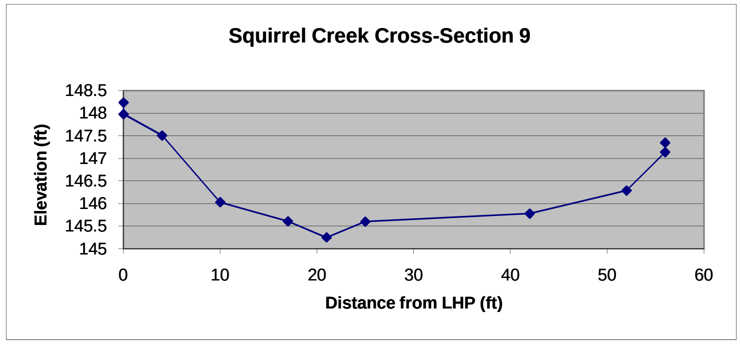
Section 8

Station	Elevation	Remarks
0	141.93	top LHP#8
0	141.7	GR at pin
10	140.81	
20	139.9	
25	138.47	LEW
27	138.2	thalweg
28	138.71	REW
30	139.05	
35	140.24	
41	141.11	
61	142.77	
63	143.71	GR at pin
63	143.91	top RHP#8



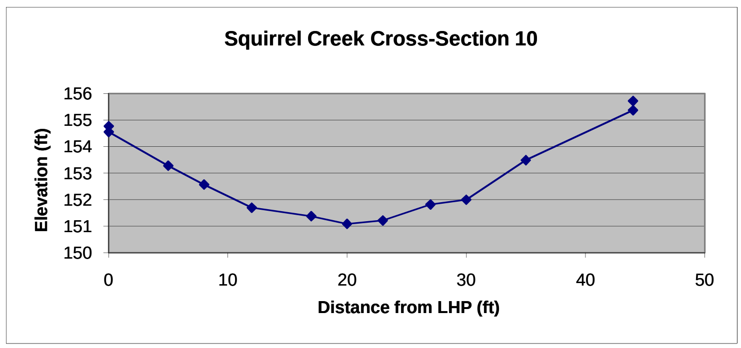
Section 9

Station	Elevation	Remarks
0	148.24	top LHP#9
0	147.98	GR at pin
4	147.51	
10	146.03	
17	145.61	LEW
21	145.25	thalweg
25	145.6	REW
42	145.78	
52	146.29	
56	147.14	GR at pin
56	147.35	top RHP#9



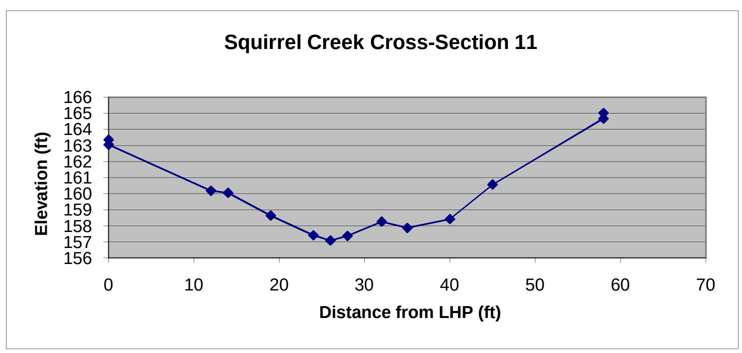
Section 10

Station	Elevation	Remarks
0	154.77	top LHP#10
0	154.55	GR at pin
5	153.28	
8	152.57	
12	151.7	
17	151.38	LEW
20	151.09	thalweg
23	151.22	REW
27	151.82	
30	152	
35	153.49	
44	155.37	GR at pin
44	155.72	top RHP#10



Section 11

Station	Elevation	Remarks
0	163.36	top LHP#11
0	163.05	GR at pin
12	160.18	
14	160.05	
19	158.64	
24	157.41	LEW
26	157.08	thalweg
28	157.37	REW
32	158.26	
35	157.87	
40	158.42	
45	160.57	
58	164.68	GR at pin
58	165.03	top RHP#11



Reference Reach

Stream:	Squirrel Creek
Watershed:	Kerber Creek
Location:	Above Bonanza
Latitude:	38.2947
Longitude:	106.1417
County:	Saguache
Date:	10/24/2009
Observers:	Jim Fogg Zach Fogg Sam Fogg
Channel Type:	Rosgen A
Drainage Area (sq.mi)	---

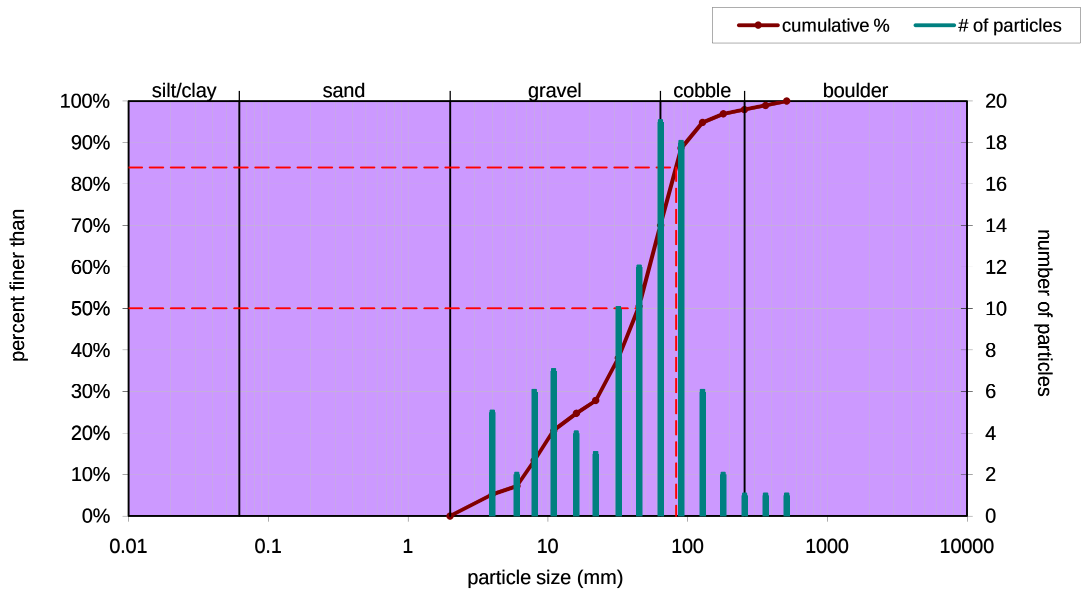
Channel Materials

	Bed Surface			
D16 (mm)	9	---	---	---
D35 (mm)	29	---	---	---
D50 (mm)	44	---	---	---
D65 (mm)	58	---	---	---
D84 (mm)	83	---	---	---
D95 (mm)	130	---	---	---
mean (mm)	27.3			---
dispersion	3.4			---
skewness	-0.21			---
Shape Facto	---			
% Silt/Clay	0%	---	---	---
% Sand	0%	---	---	---
% Gravel	68%	---	---	---
% Cobble	27%	---	---	---
% Boulder	2%	---	---	---
% Bedrock	3%	---		---
% Clay Hard		---		---
% Detritus/W		---		---
% Artificial		---		---
Largest Mob	---			

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	
very fine sand	0.062 - 0.125	
fine sand	0.125 - 0.25	
medium sand	0.25 - 0.5	
coarse sand	0.5 - 1	
very coarse sand	1 - 2	
very fine gravel	2 - 4	5
fine gravel	4 - 6	2
fine gravel	6 - 8	6
medium gravel	8 - 11	7
medium gravel	11 - 16	4
coarse gravel	16 - 22	3
coarse gravel	22 - 32	10
very coarse gravel	32 - 45	12
very coarse gravel	45 - 64	19
small cobble	64 - 90	18
medium cobble	90 - 128	6
large cobble	128 - 180	2
very large cobble	180 - 256	1
small boulder	256 - 362	1
small boulder	362 - 512	1
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
	total particle count:	97
bedrock	-------------	3
clay hardpan	-------------	
detritus/wood	-------------	
artificial	-------------	
	total count:	100

Note:

Bed Surface Pebble Count, Squirrel Creek



Size (mm)	
D16	9
D35	29
D50	44
D65	58
D84	83
D95	130

Size Distribution	
mean	27.3
dispersion	3.4
skewness	-0.21

Type			
silt/clay	0%	bedrock	3%
sand	0%		
gravel	68%		
cobble	27%		
boulder	2%		

Cross Sectional Dimension

This Worksheet:

1) Start by entering the sections "Reference ID" used on the profile sheet.

2) Entering surveyed values for "Distance" and "FS" in the worksheets to the right.

3) The "BS" column can be ignored unless the instrument was moved in the midst of surveying a cross section, in which case a turning point FS and BS are

4) The spreadsheet provides values inferred from the data entered however these should be checked. Values entered take precedence.

Reach: (min / max)
- slope (%) ---
- discharge rate
- width flood prone area --- ---
- low bank height --- ---

Riffle - Run: (min / max)
- x-area bankfull --- ---
- width bankfull --- ---
- mean depth --- (--- ---)
- max depth --- ---
- hydraulic radius
- width depth ratio --- (--- ---)

Pool: (min / max)
- x-area pool
- width pool
- max depth pool
- hydraulic radius

Reference Reach (hints)

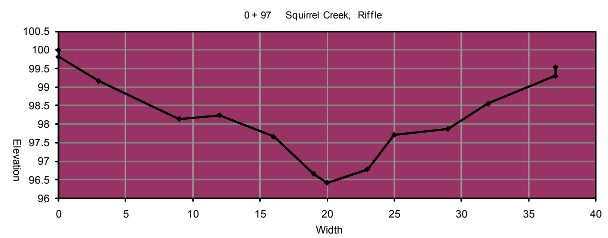
Stream:	Squirrel Creek
Watershed:	Kerber Creek
Location:	Above Bonanza
Latitude:	38.2947
Longitude:	106.1417
County:	Saguache
Date:	October 24, 2009
Observers:	Jim Fogg Zach Fogg Sam Fogg
Channel type:	Rosgen A
Drainage area (sq.km)	---

Dimension		bankfull channel typical	min	max
floodplain:	width flood prone area (ft)	---	---	---
	low bank height (ft)	---	---	---
riffle - run	x-area bankfull (sq.ft)	---	---	---
	width bankfull (ft)	---	---	---
	mean depth (ft)	---	---	---
	max depth (ft)	---	---	---
	hydraulic radius (ft)	---		
pool:	x-area pool (sq.ft)	---	---	---
	width pool (ft)	---	---	---
	max depth pool (ft)	---	---	---
	hydraulic radius (ft)	---		
dimensionless ratios:		typical	min	max
	width depth ratio	---	---	---
	entrenchment ratio	---	---	---
	bank height ratio	---	---	---
	riffle max depth ratio	---	---	---
	pool area ratio	---	---	---
	pool width ratio	---	---	---
	pool max depth ratio	---	---	---

hydraulics:	bankfull channel		
discharge rate (cfs)		---	
channel slope (%)	---		
	riffle-run & (range)		pool
velocity (ft/s)	---	---	---
Froude number	---	---	---
shear stress (lbs/sq.ft)	---	---	---
shear velocity (ft/s)	---	---	---
stream power (lb/s)	---	(-------)	
unit stream power (lb/s/ft)	---	---	
relative roughness	---	(-------)	
friction factor u/u*	---	---	
threshold grain size (t*=0.06) (mm)	---	---	
Shield's parameter	---		

Cross Section 1

0 + 97 Squirrel Creek, Riffle



Bankfull Dimensions		Flood Dimensions		Materials	
0.0	x-section area (ft.sq.)	---	W flood prone area (ft)	44	D50 Bed (mm)
0.0	width (ft)	---	entrenchment ratio	83	D84 Bed (mm)
0.0	mean depth (ft)	---	low bank height (ft)	---	threshold grain size (mm):
0.0	max depth (ft)	---	low bank height ratio		
0.0	wetted parimeter (ft)				
0.0	hyd radi (ft)				
0.0	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
---	velocity (ft/s)	---	Manning's roughness	---	channel slope (%)
---	discharge rate (cfs)	---	D'Arcy-Weisbach fric.	---	shear stress (lb/sq.ft.)
---	Froude number	---	resistance factor u/u*	---	shear velocity (ft/s)
		---	relative roughness	---	unit strm power (lb/ft/s)

Cross Section: Riffle; reference ID 1; instrument height 114.53; longitudinal station 97

Bankfull Stage: FS ---; elevation ---

Low Bank Height: FS ---; elevation

Flood Prone Area: width fpa ---

Channel Slope: percent slope ---

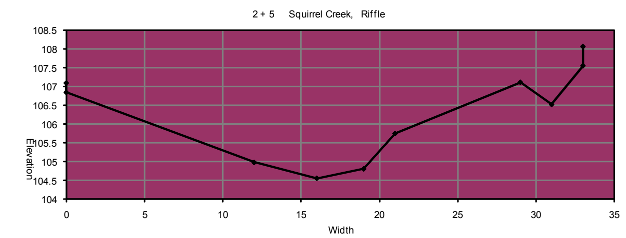
Flow Resistance: Manning's "n" ---; D'Arcy - Weisbach "f" ---

Note:

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
		114.53	14.53	100		top LHP#1
0		114.53	14.71	99.82		GR at pin
3		114.53	15.36	99.17		
9		114.53	16.39	98.14		
12		114.53	16.29	98.24		
16		114.53	16.87	97.66		
19		114.53	17.87	96.66		LEW
20		114.53	18.12	96.41		thalweg
23		114.53	17.75	96.78		REW
25		114.53	16.82	97.71		
29		114.53	16.66	97.87		
32		114.53	15.98	98.55		
37		114.53	15.23	99.3		GR at pin
37		114.53	14.99	99.54		top RHP#1

Cross Section 2

2 + 5 Squirrel Creek, Riffle



Bankfull Dimensions		Flood Dimensions		Materials	
0.0	x-section area (ft.sq.)	---	W flood prone area (ft)	44	D50 Bed (mm)
0.0	width (ft)	---	entrenchment ratio	83	D84 Bed (mm)
0.0	mean depth (ft)	---	low bank height (ft)	---	threshold grain size (mm):
0.0	max depth (ft)	---	low bank height ratio		
0.0	wetted parimeter (ft)				
0.0	hyd radi (ft)				
0.0	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
---	velocity (ft/s)	---	Manning's roughness	---	channel slope (%)
---	discharge rate (cfs)	---	D'Arcy-Weisbach fric.	---	shear stress (lb/sq.ft.)
---	Froude number	---	resistance factor u/u*	---	shear velocity (ft/s)
		---	relative roughness	---	unit strm power (lb/ft/s)

Cross Section: Riffle; reference ID 2; instrument height 116.34; longitudinal station 205

Bankfull Stage: FS ---; elevation ---

Low Bank Height: FS ---; elevation

Flood Prone Area: width fpa ---

Channel Slope: percent slope ---

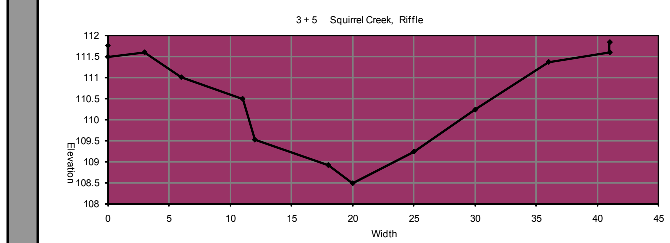
Flow Resistance: Manning's "n" ---; D'Arcy - Weisbach "f" ---

Note:

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
		116.34	9.25	107.09		top LHP#2
0		116.34	9.5	106.84		GR at pin
12		116.34	11.36	104.98		LEW
16		116.34	11.78	104.56		thalweg
19		116.34	11.53	104.81		REW
21		116.34	10.59	105.75		
29		116.34	9.23	107.11		
31		116.34	9.82	106.52		
33		116.34	8.79	107.55		GR at pin
33		116.34	8.28	108.06		top RHP#2

Cross Section 3

3 + 5 Squirrel Creek, Riffle



Bankfull Dimensions		Flood Dimensions		Materials	
0.0	x-section area (ft.sq.)	---	W flood prone area (ft)	44	D50 Bed (mm)
0.0	width (ft)	---	entrenchment ratio	83	D84 Bed (mm)
0.0	mean depth (ft)	---	low bank height (ft)	---	threshold grain size (mm):
0.0	max depth (ft)	---	low bank height ratio		
0.0	wetted parimeter (ft)				
0.0	hyd radi (ft)				
0.0	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
---	velocity (ft/s)	---	Manning's roughness	---	channel slope (%)
---	discharge rate (cfs)	---	D'Arcy-Weisbach fric.	---	shear stress (lb/sq.ft.)
---	Froude number	---	resistance factor u/u*	---	shear velocity (ft/s)
		---	relative roughness	---	unit strm power (lb/ft/s)

Cross Section: Riffle; reference ID 3; instrument height 120.51; longitudinal station 305

Bankfull Stage: FS ---; elevation ---

Low Bank Height: FS ---; elevation

Flood Prone Area: width fpa ---

Channel Slope: percent slope ---

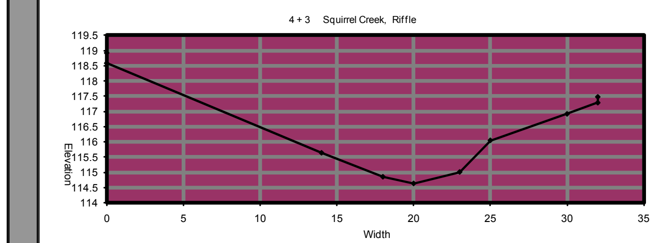
Flow Resistance: Manning's "n" ---; D'Arcy - Weisbach "f" ---

Note:

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
		120.51	8.76	111.75		top LHP#3
0		120.51	9.03	111.48		GR at pin
3		120.51	8.92	111.59		
6		120.51	9.51	111		
11		120.51	10.02	110.49		
12		120.51	10.99	109.52		
18		120.51	11.59	108.92		LEW
20		120.51	12.02	108.49		thalweg
25		120.51	11.27	109.24		REW
30		120.51	10.28	110.23		
36		120.51	9.15	111.36		
41		120.51	8.92	111.59		GR at pin
41		120.51	8.68	111.83		top RHP#3

Cross Section 4

4 + 3 Squirrel Creek, Riffle



Bankfull Dimensions		Flood Dimensions		Materials	
0.0	x-section area (ft.sq.)	---	W flood prone area (ft)	44	D50 Bed (mm)
0.0	width (ft)	---	entrenchment ratio	83	D84 Bed (mm)
0.0	mean depth (ft)	---	low bank height (ft)	---	threshold grain size (mm):
0.0	max depth (ft)	---	low bank height ratio		
0.0	wetted parimeter (ft)				
0.0	hyd radi (ft)				
0.0	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
---	velocity (ft/s)	---	Manning's roughness	---	channel slope (%)
---	discharge rate (cfs)	---	D'Arcy-Weisbach fric.	---	shear stress (lb/sq.ft.)
---	Froude number	---	resistance factor u/u*	---	shear velocity (ft/s)
		---	relative roughness	---	unit strm power (lb/ft/s)

Cross Section: Riffle; reference ID 4; instrument height 126.18; longitudinal station 403

Bankfull Stage: FS ---; elevation ---

Low Bank Height: FS ---; elevation

Flood Prone Area: width fpa ---

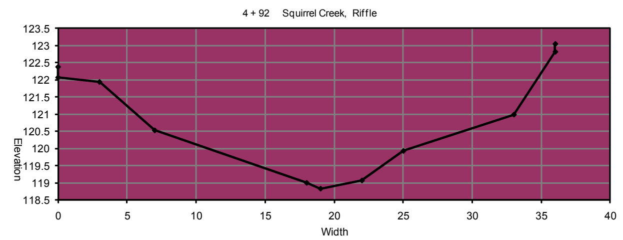
Channel Slope: percent slope ---

Flow Resistance: Manning's "n" ---; D'Arcy - Weisbach "f" ---

Note:

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
		126.18	7.25	118.93		top LHP#4
0		126.18	7.59	118.59		GR at pin
14		126.18	10.54	115.64		
18		126.18	11.33	114.85		LEW
20		126.18	11.55	114.63		thalweg
23		126.18	11.17	115.01		REW
25		126.18	10.13	116.05		
30		126.18	9.26	116.92		
32		126.18	8.89	117.29		Gr at pin
32		126.18	8.7	117.48		top RHP#4

Cross Section 5



Bankfull Dimensions
- 0.0 x-section area (ft.sq.)
- 0.0 width (ft)
- 0.0 mean depth (ft)
- 0.0 max depth (ft)
- 0.0 wetted parimeter (ft)
- 0.0 hyd radi (ft)
- 0.0 width-depth ratio

Flood Dimensions
- --- W flood prone area (ft)
- --- entrenchment ratio
- --- low bank height (ft)
- --- low bank height ratio

Materials
- 44 D50 Bed (mm)
- 83 D84 Bed (mm)
- --- threshold grain size (mm):

Bankfull Flow
- --- velocity (ft/s)
- --- discharge rate (cfs)
- --- Froude number

Flow Resistance
- --- Manning's roughness
- --- D'Arcy-Weisbach fric.
- --- resistance factor u/u*
- --- relative roughness

Forces & Power
- --- channel slope (%)
- --- shear stress (lb/sq.ft.)
- --- shear velocity (ft/s)
- --- unit strm power (lb/ft/s)

Cross Section: Riffle
- reference ID: 5
- instrument height: 131.81
- longitudinal station: 492

Bankfull Stage
- FS: ---
- elevation: ---

Low Bank Height
- FS: ---
- elevation:

Flood Prone Area
- width fpa: ---

Channel Slope
- percent slope: ---

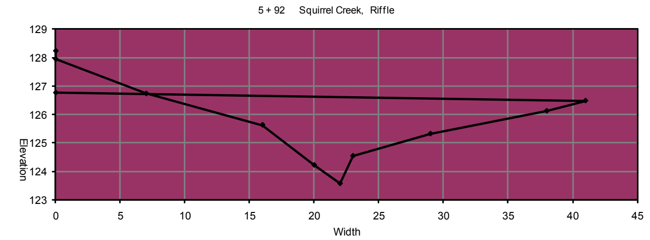
Flow Resistance
- Manning's "n": ---
- D'Arcy - Weisbach "f": ---

Note:

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
		131.81	9.43	122.38		top LHP#5
0		131.81	9.74	122.07		GR at pin
3		131.81	9.87	121.94		
7		131.81	11.28	120.53		
18		131.81	12.81	119		LEW
19		131.81	12.98	118.83		thalweg
22		131.81	12.74	119.07		REW
25		131.81	11.88	119.93		
33		131.81	10.82	120.99		
36		131.81	8.99	122.82		GR at pin
36		131.81	8.76	123.05		top RHP#5

FPA	TRUE	BKHT	TRUE			D MAX	POWER	UNIT	FEATURE
#N/A		x lf bk	y lf bk	x rt bk	y rt bk	0	---	1	Riffle 4 + 92
0	#N/A	0	#N/A	#N/A	#N/A				Pool Squirrel Creek
36	#N/A	#N/A	#N/A	36	#N/A				Run Riffle
									Glide Kerber Creek

Cross Section 6



Bankfull Dimensions
- 0.0 x-section area (ft.sq.)
- 0.0 width (ft)
- 0.0 mean depth (ft)
- 0.0 max depth (ft)
- 0.0 wetted parimeter (ft)
- 0.0 hyd radi (ft)
- 0.0 width-depth ratio

Flood Dimensions
- --- W flood prone area (ft)
- --- entrenchment ratio
- --- low bank height (ft)
- --- low bank height ratio

Materials
- 44 D50 Bed (mm)
- 83 D84 Bed (mm)
- --- threshold grain size (mm):

Bankfull Flow
- --- velocity (ft/s)
- --- discharge rate (cfs)
- --- Froude number

Flow Resistance
- --- Manning's roughness
- --- D'Arcy-Weisbach fric.
- --- resistance factor u/u*
- --- relative roughness

Forces & Power
- --- channel slope (%)
- --- shear stress (lb/sq.ft.)
- --- shear velocity (ft/s)
- --- unit strm power (lb/ft/s)

Cross Section: Riffle
- reference ID: 6
- instrument height: 133.92
- longitudinal station: 592

Bankfull Stage
- FS: ---
- elevation: ---

Low Bank Height
- FS: ---
- elevation:

Flood Prone Area
- width fpa: ---

Channel Slope
- percent slope: ---

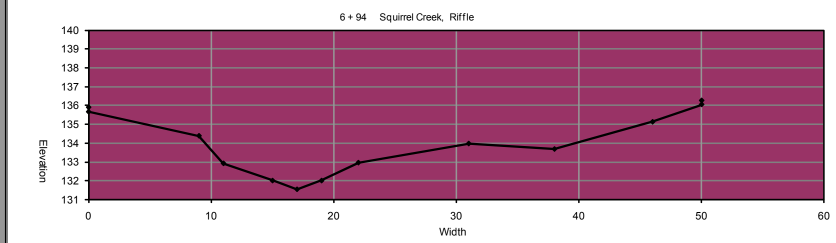
Flow Resistance
- Manning's "n": ---
- D'Arcy - Weisbach "f": ---

Note:

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
		133.92	5.69	128.23		top LHP#6
0		133.92	5.98	127.94		GR at pin
7		133.92	7.19	126.73		
16		133.92	8.29	125.63		
20		133.92	9.7	124.22		LEW
22		133.92	10.35	123.57		thalweg
23		133.92	9.38	124.54		REW
29		133.92	8.6	125.32		
38		133.92	7.8	126.12		
41		133.92	7.44	126.48		GR at pin
41		133.92	7.16	126.76		top RHP#6

FPA	TRUE	BKHT	TRUE			D MAX	POWER	UNIT	FEATURE
#N/A		x lf bk	y lf bk	x rt bk	y rt bk	0	---	1	Riffle 5 + 92
0	#N/A	0	#N/A	#N/A	#N/A				Pool Squirrel Creek
41	#N/A	#N/A	#N/A	41	#N/A				Run Riffle
									Glide Kerber Creek

Cross Section 7



Bankfull Dimensions
- 0.0 x-section area (ft.sq.)
- 0.0 width (ft)
- 0.0 mean depth (ft)
- 0.0 max depth (ft)
- 0.0 wetted parimeter (ft)
- 0.0 hyd radi (ft)
- 0.0 width-depth ratio

Flood Dimensions
- --- W flood prone area (ft)
- --- entrenchment ratio
- --- low bank height (ft)
- --- low bank height ratio

Materials
- 44 D50 Bed (mm)
- 83 D84 Bed (mm)
- --- threshold grain size (mm):

Bankfull Flow
- --- velocity (ft/s)
- --- discharge rate (cfs)
- --- Froude number

Flow Resistance
- --- Manning's roughness
- --- D'Arcy-Weisbach fric.
- --- resistance factor u/u*
- --- relative roughness

Forces & Power
- --- channel slope (%)
- --- shear stress (lb/sq.ft.)
- --- shear velocity (ft/s)
- --- unit strm power (lb/ft/s)

Cross Section: Riffle
- reference ID: 7
- instrument height: 142.24
- longitudinal station: 694

Bankfull Stage
- FS: ---
- elevation: ---

Low Bank Height
- FS: ---
- elevation:

Flood Prone Area
- width fpa: ---

Channel Slope
- percent slope: ---

Flow Resistance
- Manning's "n": ---
- D'Arcy - Weisbach "f": ---

Note:

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
		142.24	6.34	135.9		top LHP#7
0		142.24	6.58	135.66		GR at pin
9		142.24	7.85	134.39		
11		142.24	9.31	132.93		LEW
15		142.24	10.22	132.02		thalweg
17		142.24	10.68	131.56		REW
19		142.24	10.22	132.02		
22		142.24	9.27	132.97		
31		142.24	8.26	133.98		
38		142.24	8.55	133.69		
46		142.24	7.11	135.13		
50		142.24	6.19	136.05		GR at pin
50		142.24	5.98	136.26		top RHP#7
		142.24	3.36	138.88		Corner Cap

FPA	TRUE	BKHT	TRUE			D MAX	POWER	UNIT	FEATURE
#N/A		x lf bk	y lf bk	x rt bk	y rt bk	0	---	1	Riffle 6 + 94
0	#N/A	0	#N/A	#N/A	#N/A				Pool Squirrel Creek
50	#N/A	#N/A	#N/A	50	#N/A				Run Riffle
									Glide Kerber Creek

More Cross Sections

1) For more cross sections copy this entire sheet by right clicking on the Dimension Tab.
2) Note that the new sheet will not have automatic links back to other sheets so you'll have to enter average, max and min values on the summary page.

Cross Sectional Dimension

This Worksheet:

1) Start by entering the sections "Reference ID" used on the profile sheet.

2) Entering surveyed values for "Distance" and "FS" in the worksheets to the right.

3) The "BS" column can be ignored unless the instrument was moved in the midst of surveying a cross section, in which case a turning point FS and BS are

4) The spreadsheet provides values inferred from the data entered however these should be checked. Values entered take precedence.

Reach:

	value	min	max
slope (%)	---		
discharge rate			
width flood prone area		---	---
low bank height		---	---

Riffle - Run:

	value	min	max
x-area bankfull		---	---
width bankfull		---	---
mean depth	---	---	---
max depth		---	---
hydraulic radius			
width depth ratio	---		

Pool:

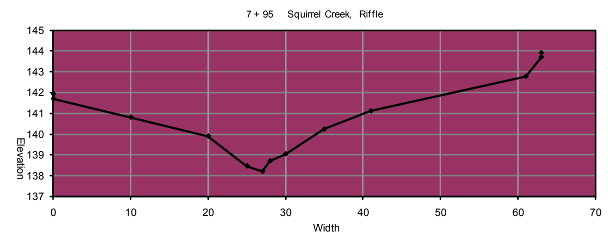
	value	min	max
x-area pool			
width pool			
max depth pool			
hydraulic radius			

Reference Reach (hints)

Stream:	Squirrel Creek
Watershed:	Kerber Creek
Location:	Above Bonanza
Latitude:	38.2947
Longitude:	106.1417
County:	Saguache
Date:	October 24, 2009
Observers:	Jim Fogg Zach Fogg Sam Fogg
Channel type:	Rosgen A
Drainage area (sq.km)	---

Dimension		bankfull channel typical	min	max
floodplain:	width flood prone area (ft)	---	---	---
	low bank height (ft)	---	---	---
riffle - run	x-area bankfull (sq.ft)	---	---	---
	width bankfull (ft)	---	---	---
	mean depth (ft)	---	---	---
	max depth (ft)	---	---	---
	hydraulic radius (ft)	---		
pool:	x-area pool (sq.ft)	---	---	---
	width pool (ft)	---	---	---
	max depth pool (ft)	---	---	---
	hydraulic radius (ft)	---		
dimensionless ratios:		typical	min	max
	width depth ratio	---	---	---
	entrenchment ratio	---	---	---
	bank height ratio	---	---	---
	riffle max depth ratio	---	---	---
	pool area ratio	---	---	---
	pool width ratio	---	---	---
	pool max depth ratio	---	---	---
hydraulics:		bankfull channel		
	discharge rate (cfs)		---	
	channel slope (%)	---		
		riffle-run & (range)		pool
	velocity (ft/s)	---	---	---
	Froude number	---	---	---
	shear stress (lbs/sq.ft)	---	---	---
	shear velocity (ft/s)	---	---	---
	stream power (lb/s)	---	(-------)	
	unit stream power (lb/s/ft)	---	---	
	relative roughness	---	(-------)	
	friction factor u/u*	---	---	
	threshold grain size (t*=0.06) (mm)	---	---	
	Shield's parameter	---		

Cross Section 8



Bankfull Dimensions		Flood Dimensions		Materials	
0.0	x-section area (ft.sq.)	---	W flood prone area (ft)	44	D50 Bed (mm)
0.0	width (ft)	---	entrenchment ratio	83	D84 Bed (mm)
0.0	mean depth (ft)	---	low bank height (ft)	---	threshold grain size (mm):
0.0	max depth (ft)	---	low bank height ratio		
0.0	wetted parimeter (ft)				
0.0	hyd radi (ft)				
0.0	width-depth ratio				

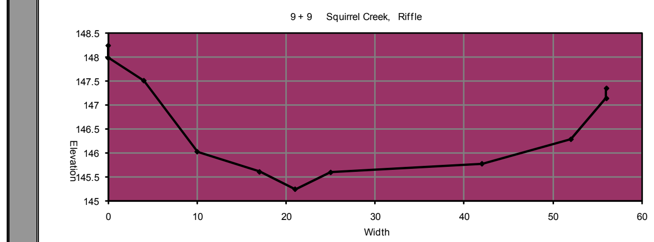
Bankfull Flow		Flow Resistance		Forces & Power	
---	velocity (ft/s)	---	Manning's roughness	---	channel slope (%)
---	discharge rate (cfs)	---	D'Arcy-Weisbach fric.	---	shear stress (lb/sq.ft.)
---	Froude number	---	resistance factor u/u*	---	shear velocity (ft/s)
		---	relative roughness	---	unit strm power (lb/ft/s)

Cross Section: Riffle
reference ID: 8
instrument height: 148.11
longitudinal station: 795

Bankfull Stage FS ---, elevation
Low Bank Height FS ---, elevation
Flood Prone Area width fpa ---
Channel Slope percent slope ---
Flow Resistance Manning's "n" ---, D'Arcy - Weisbach "f" ---
Note:

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
		148.11	6.18	141.93		top LHP#8
0		148.11	6.41	141.7		GR at pin
10		148.11	7.3	140.81		
20		148.11	8.21	139.9		
25		148.11	9.64	138.47		LEW
27		148.11	9.91	138.2		thalweg
28		148.11	9.4	138.71		REW
30		148.11	9.06	139.05		
35		148.11	7.87	140.24		
41		148.11	7	141.11		
61		148.11	5.34	142.77		
63		148.11	4.4	143.71		GR at pin
63		148.11	4.2	143.91		top RHP#8

Cross Section 9



Bankfull Dimensions		Flood Dimensions		Materials	
0.0	x-section area (ft.sq.)	---	W flood prone area (ft)	44	D50 Bed (mm)
0.0	width (ft)	---	entrenchment ratio	83	D84 Bed (mm)
0.0	mean depth (ft)	---	low bank height (ft)	---	threshold grain size (mm):
0.0	max depth (ft)	---	low bank height ratio		
0.0	wetted parimeter (ft)				
0.0	hyd radi (ft)				
0.0	width-depth ratio				

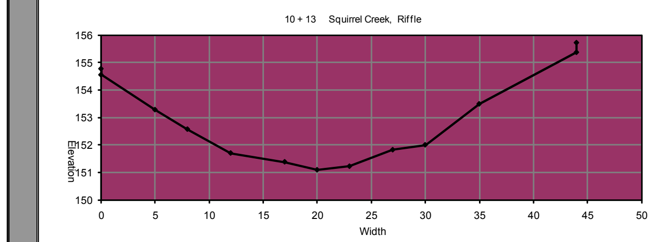
Bankfull Flow		Flow Resistance		Forces & Power	
---	velocity (ft/s)	---	Manning's roughness	---	channel slope (%)
---	discharge rate (cfs)	---	D'Arcy-Weisbach fric.	---	shear stress (lb/sq.ft.)
---	Froude number	---	resistance factor u/u*	---	shear velocity (ft/s)
		---	relative roughness	---	unit strm power (lb/ft/s)

Cross Section: Riffle
reference ID: 9
instrument height: 154.51
longitudinal station: 909

Bankfull Stage FS ---, elevation
Low Bank Height FS ---, elevation
Flood Prone Area width fpa ---
Channel Slope percent slope ---
Flow Resistance Manning's "n" ---, D'Arcy - Weisbach "f" ---
Note:

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
		154.51	6.27	148.24		top LHP#9
0		154.51	6.53	147.98		GR at pin
4		154.51	7	147.51		
10		154.51	8.48	146.03		
17		154.51	8.9	145.61		LEW
21		154.51	9.26	145.25		thalweg
25		154.51	8.91	145.6		REW
42		154.51	8.73	145.78		
52		154.51	8.22	146.29		
56		154.51	7.37	147.14		GR at pin
56		154.51	7.16	147.35		top RHP#9

Cross Section 10



Bankfull Dimensions		Flood Dimensions		Materials	
0.0	x-section area (ft.sq.)	---	W flood prone area (ft)	44	D50 Bed (mm)
0.0	width (ft)	---	entrenchment ratio	83	D84 Bed (mm)
0.0	mean depth (ft)	---	low bank height (ft)	---	threshold grain size (mm):
0.0	max depth (ft)	---	low bank height ratio		
0.0	wetted parimeter (ft)				
0.0	hyd radi (ft)				
0.0	width-depth ratio				

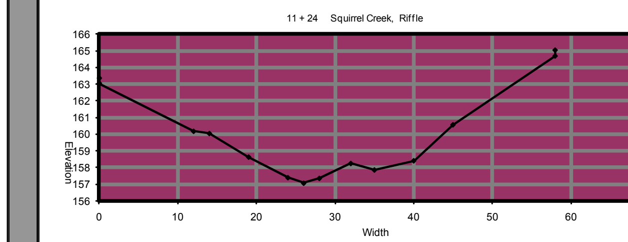
Bankfull Flow		Flow Resistance		Forces & Power	
---	velocity (ft/s)	---	Manning's roughness	---	channel slope (%)
---	discharge rate (cfs)	---	D'Arcy-Weisbach fric.	---	shear stress (lb/sq.ft.)
---	Froude number	---	resistance factor u/u*	---	shear velocity (ft/s)
		---	relative roughness	---	unit strm power (lb/ft/s)

Cross Section: Riffle
reference ID: 10
instrument height: 161.28
longitudinal station: 1013

Bankfull Stage FS ---, elevation
Low Bank Height FS ---, elevation
Flood Prone Area width fpa ---
Channel Slope percent slope ---
Flow Resistance Manning's "n" ---, D'Arcy - Weisbach "f" ---
Note:

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
		161.28	6.51	154.77		top LHP#10
0		161.28	6.73	154.55		GR at pin
5		161.28	8	153.28		
8		161.28	8.71	152.57		
12		161.28	9.58	151.7		
17		161.28	9.9	151.38		LEW
20		161.28	10.19	151.09		thalweg
23		161.28	10.06	151.22		REW
27		161.28	9.46	151.82		
30		161.28	9.28	152		
35		161.28	7.79	153.49		
44		161.28	5.91	155.37		GR at pin
44		161.28	5.56	155.72		top RHP#10

Cross Section 11



Bankfull Dimensions		Flood Dimensions		Materials	
0.0	x-section area (ft.sq.)	---	W flood prone area (ft)	44	D50 Bed (mm)
0.0	width (ft)	---	entrenchment ratio	83	D84 Bed (mm)
0.0	mean depth (ft)	---	low bank height (ft)	---	threshold grain size (mm):
0.0	max depth (ft)	---	low bank height ratio		
0.0	wetted parimeter (ft)				
0.0	hyd radi (ft)				
0.0	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
---	velocity (ft/s)	---	Manning's roughness	---	channel slope (%)
---	discharge rate (cfs)	---	D'Arcy-Weisbach fric.	---	shear stress (lb/sq.ft.)
---	Froude number	---	resistance factor u/u*	---	shear velocity (ft/s)
		---	relative roughness	---	unit strm power (lb/ft/s)

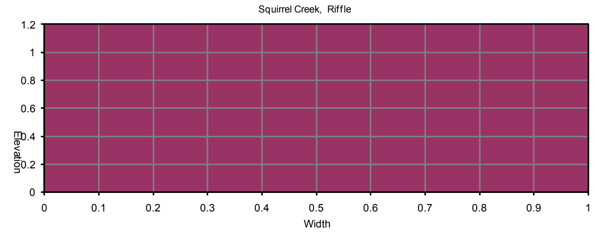
Cross Section: Riffle
reference ID: 11
instrument height: 170.87
longitudinal station: 1124

Bankfull Stage FS ---, elevation
Low Bank Height FS ---, elevation
Flood Prone Area width fpa ---
Channel Slope percent slope ---
Flow Resistance Manning's "n" ---, D'Arcy - Weisbach "f" ---
Note:

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
		170.87	7.51	163.36		top LHP#11
0		170.87	7.82	163.05		GR at pin
12		170.87	10.69	160.18		
14		170.87	10.82	160.05		
19		170.87	12.23	158.64		
24		170.87	13.46	157.41		LEW
26		170.87	13.79	157.08		thalweg
28		170.87	13.5	157.37		REW
32		170.87	12.61	158.26		
35		170.87	13	157.87		
40		170.87	12.45	158.42		
45		170.87	10.3	160.57		
58		170.87	6.19	164.68		GR at pin
58		170.87	5.84	165.03		top RHP#11

Cross Section

Squirrel Creek, Riffle



Bankfull Dimensions

0.0	x-section area (ft.sq.)
0.0	width (ft)
0.0	mean depth (ft)
0.0	max depth (ft)
0.0	wetted parimeter (ft)
0.0	hyd radi (ft)
0.0	width-depth ratio

Flood Dimensions

---	W flood prone area (ft)
---	entrenchment ratio
---	low bank height (ft)
---	low bank height ratio

Materials

44	D50 Bed (mm)
83	D84 Bed (mm)
---	threshold grain size (mm):

Bankfull Flow

---	velocity (ft/s)
---	discharge rate (cfs)
---	Froude number

Flow Resistance

---	Manning's roughness
---	D'Arcy-Weisbach fric.
---	resistance factor u/u*
---	relative roughness

Forces & Power

---	channel slope (%)
---	shear stress (lb/sq.ft.)
---	shear velocity (ft/s)
---	unit strm power (lb/ft/s)

bkht

Cross Section Riffle

reference ID ---
instrument height ---
longitudinal station ---

Bankfull Stage

FS ---
elevation ---

Low Bank Height

FS ---
elevation ---

Flood Prone Area

width fpa ---

Channel Slope

percent slope ---

Flow Resistance

Manning's "n" ---
D'Arcy - Weisbach "f" ---

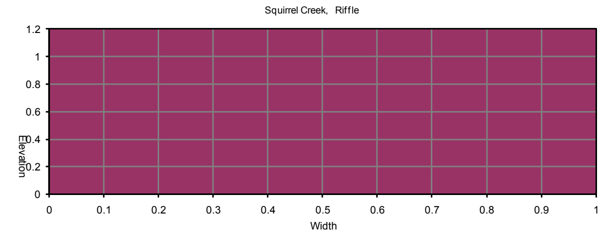
Note:

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
		0				

Riffle	FPA	TRUE	BKHT	TRUE			D MAX	POWER	UNIT	FEATURE Riffle
Pool	#N/A		x lf bk	y lf bk	x rt bk	y rt bk	0	---	1	Pool Squirrel Creek,
Run	0	#N/A	0	#N/A	0	#N/A				Run Riffle
Glide	0	#N/A	#N/A	#N/A	0	#N/A				Glide Kerber Creek

Cross Section

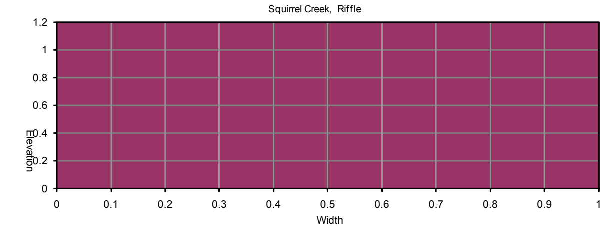
Squirrel Creek, Riffle



Bankfull Dimensions: 0.0 x-section area (ft.sq.); 0.0 width (ft); 0.0 mean depth (ft); 0.0 max depth (ft); 0.0 wetted parimeter (ft); 0.0 hyd radi (ft); 0.0 width-depth ratio
Flood Dimensions: --- W flood prone area (ft); --- entrenchment ratio; --- low bank height (ft); --- low bank height ratio
Materials: 44 D50 Bed (mm); 83 D84 Bed (mm); --- threshold grain size (mm):
Bankfull Flow: --- velocity (ft/s); --- discharge rate (cfs); --- Froude number
Flow Resistance: --- Manning's roughness; --- D'Arcy-Weisbach fric.; --- resistance factor u/u*; --- relative roughness
Forces & Power: --- channel slope (%); --- shear stress (lb/sq.ft.); --- shear velocity (ft/s); --- unit strm power (lb/ft/s)
Cross Section Riffle; reference ID ---; instrument height ---; longitudinal station ---
Bankfull Stage: FS ---; elevation ---
Low Bank Height: FS ---; elevation ---
Flood Prone Area: width fpa ---
Channel Slope: percent slope ---
Flow Resistance: Manning's "n" ---; D'Arcy - Weisbach "f" ---
Note:
Distance (ft) | BS (ft) | HI (ft) 0 | FS (ft) | Elevation (ft) | Omit Bkf | Notes
FPA TRUE BKHT TRUE D MAX POWER UNIT FEATURE Riffle
#N/A x lf bk y lf bk x rt bk y rt bk 0 --- 1 Pool Squirrel Creek,
0 #N/A 0 #N/A 0 #N/A Run Riffle
0 #N/A #N/A #N/A 0 #N/A Glide Kerber Creek

Cross Section

Squirrel Creek, Riffle



Bankfull Dimensions: 0.0 x-section area (ft.sq.); 0.0 width (ft); 0.0 mean depth (ft); 0.0 max depth (ft); 0.0 wetted parimeter (ft); 0.0 hyd radi (ft); 0.0 width-depth ratio
Flood Dimensions: --- W flood prone area (ft); --- entrenchment ratio; --- low bank height (ft); --- low bank height ratio
Materials: 44 D50 Bed (mm); 83 D84 Bed (mm); --- threshold grain size (mm):
Bankfull Flow: --- velocity (ft/s); --- discharge rate (cfs); --- Froude number
Flow Resistance: --- Manning's roughness; --- D'Arcy-Weisbach fric.; --- resistance factor u/u*; --- relative roughness
Forces & Power: --- channel slope (%); --- shear stress (lb/sq.ft.); --- shear velocity (ft/s); --- unit strm power (lb/ft/s)
Cross Section Riffle; reference ID ---; instrument height ---; longitudinal station ---
Bankfull Stage: FS ---; elevation ---
Low Bank Height: FS ---; elevation ---
Flood Prone Area: width fpa ---
Channel Slope: percent slope ---
Flow Resistance: Manning's "n" ---; D'Arcy - Weisbach "f" ---
Note:
Distance (ft) | BS (ft) | HI (ft) 0 | FS (ft) | Elevation (ft) | Omit Bkf | Notes
FPA TRUE BKHT TRUE D MAX POWER UNIT FEATURE Riffle
#N/A x lf bk y lf bk x rt bk y rt bk 0 --- 1 Pool Squirrel Creek,
0 #N/A 0 #N/A 0 #N/A Run Riffle
0 #N/A #N/A #N/A 0 #N/A Glide Kerber Creek

More Cross Sections

1) For more cross sections copy this entire sheet by right clicking on the Dimension Tab.
2) Note that the new sheet will not have automatic links back to other sheets so you'll have to enter average, max and min values on the summary page.