Middle Yuba River
Oregon Creek Reach
Moonshine Creek Site
Draft Hydraulic Calibration Results

Model Used

The hydraulic model for the Moonshine Creek Site PHABSIM study was calibrated by HDR using RHABSIM 3.0 (Riverine Habitat Simulation), a commercial software program written by Thomas R. Payne and Associates of Arcata, California. RHABSIM is a commercial version of the PHABSIM computer model (Milhous et al. 1984).

Model Files

The following RHABSIM file is associated with the Moonshine Creek site:

MYMSALT.RHB

Modeling Methods

Water Surface Elevations (WSE)

For WSEs, these procedures included: the development of stage/discharge rating curves using log-log regression (IFG4); and/or Manning's formula (MANSQ); direct comparison of results; and selection of the most appropriate and accurate method. Log-log and MANSQ were run for each transect, with MANSQ set as the default modeling method. If individual transects did not calibrate sufficiently well using MANSQ, based on general guidelines of maximum Beta (5.0), and/or professional judgment, then log/log was selected. Data file construction, calibration, and simulation followed standard procedures and guidelines outlined in the PHABSIM Reference Manual Version II, Instream Flow Information Paper No.26 (Milhous, R.T., M.A. Updike, and D.M. Schneider 1989).

Modeling Guidelines

PHABSIM modeling guidelines considered for the Moonshine Creek Site were as follows:

1. The beta value (a measure of the change in channel roughness with changes in streamflow) must be between 2.0 and 4.5;
2. The mean error in calculated versus given discharges must be less than 10 percent;
3. There must be no more than a 25 percent difference for any calculated versus given discharge;
4. There must be no more than a 0.1-foot difference between measured and simulated WSEs; and

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5. To determine whether the MANSQ model accurately predicts measured values, the second through fourth of the above criteria must be met, and the beta value parameter used by MANSQ must be within the range of -5.0 to 5.0. The first IFG4 criterion is not applicable to MANSQ.

Habitat Summary for Moonshine Creek Site

A hydraulic model was developed for the 14 instream flow transects on the Moonshine Creek Site on the Middle Yuba River above Englebright Reservoir. Meso-habitats represented in the Oregon Creek Reach are presented in Table 1. Moonshine was one of the two sites within the Oregon Creek Reach. Final transect locations in the Moonshine Creek site are presented in Figure 1.

Table 1. Habitat frequency based on video-mapped data and target transects for the Oregon Creek Reach of the Middle Yuba River.

PHABSIM Habitat	Number	Number Frequency	Adjusted Number Frequency	Potential # Target Transects
High gradient riffles	26	15%	16%	3
Low gradient riffles	23	13%	14%	2
Runs/Step-Runs	26	15%	16%	3
Glides	4	2%	0%	0
Pocket Water	13	8%	8%	2
Pools	79	46%	47%	8
Total	**171**	**100%**	**100%**	**18**[1]

[1] There are more potential transects listed in this table than there are transects at this site because the habitat frequency analysis was for the entire Oregon Creek Reach, which includes both the Moonshine Creek Site and the Yellowjacket Creek Site.

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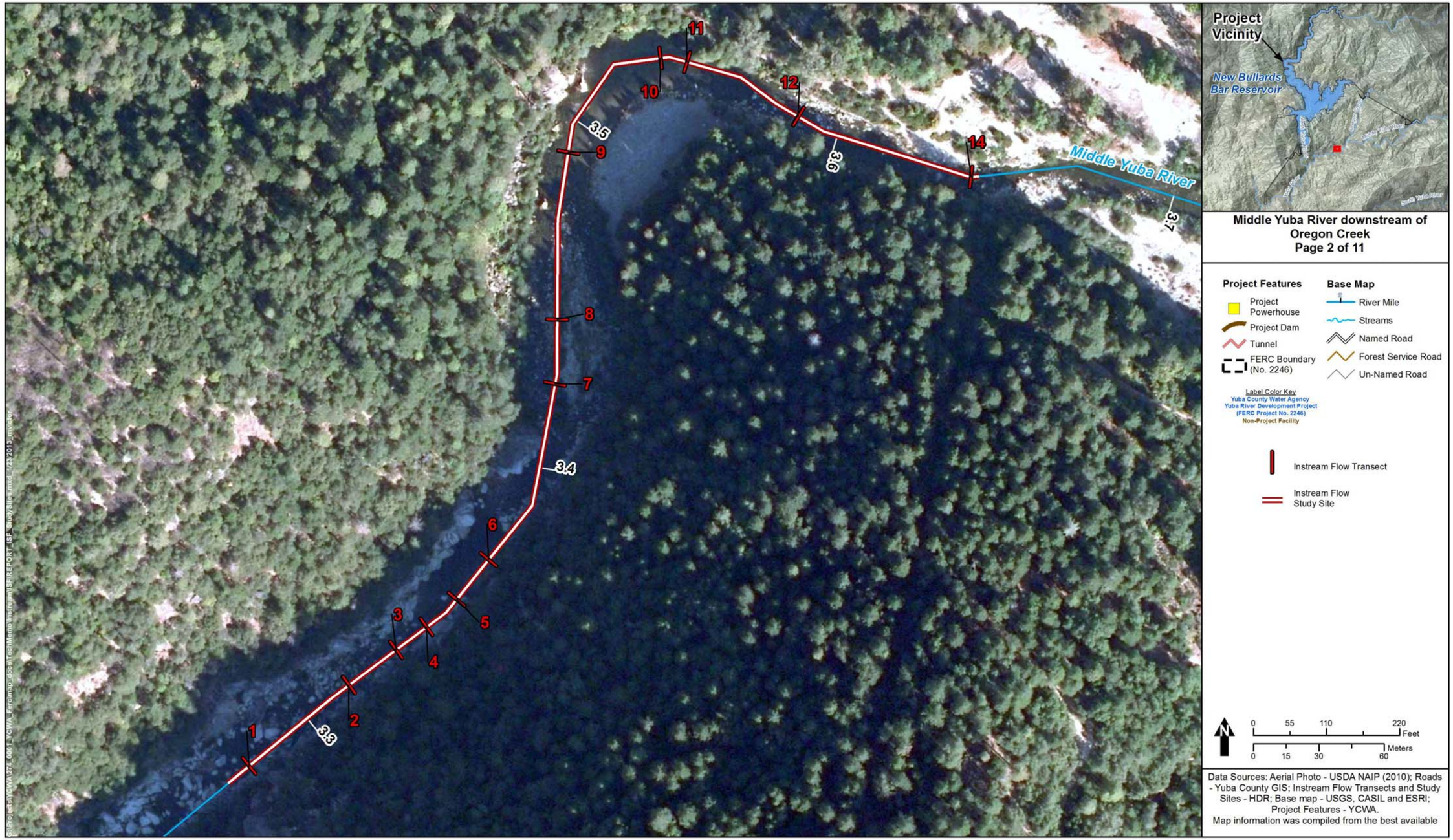

Figure 1. PHABSIM transects in the Moonshine Creek Site of the Oregon Creek Reach on the Middle Yuba River.

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Calibration Summary for Moonshine Creek Site

The Moonshine model was associated with four stage discharge pairs, and primary velocity calibration set at full channel flow of 327 cubic feet per second (cfs). When velocities couldn't be measured safely at 327 cfs, they were measured at 178 cfs. Each transect in the site had one velocity set measured, which is consistent with the "one-velocity" method.

Stage/discharge regressions for Transect 2 (T-02) through T-14 were developed using the four calibration discharges: 327 cfs, 178 cfs, 112 cfs and 34 cfs. Low-Low Flow (LLF) on T-01 was collected a few months after the other three measurements and the hydraulic control appears to have changed in that time. For this reason, the transect was split into two stage/discharge equations: T-01LF, using LLF (34 cfs) and Low Flow (LF) (112 cfs) calibration points; and T-01HF, using LF (112 cfs), Mid Flow (MF) (178 cfs), and High Flow (HF) (327 cfs). Log-Log was not used for T-01LF as a regression with only two points will result in no regression error while MANSQ incorporates the measured channel geometry. T-01LF was only calibrated in MANSQ.

Table 2 summarizes modeling statistics for each transect and modeling method, while Table B-1 and Table B-2, in Appendix B, summarize the given calibration stage and the modeled stages for each flow, at each transect, using all modeling methods used on a given transect.

Cross Sections

Cross sectional profile graphs, with measured WSEs, have been included in Appendix A, in addition to transect photos.

Calibration Details for Moonshine Creek Site

Stage/Discharge Calibration

- All transects in the study site were calibrated using both Log/Log and MANSQ.
- For model calibration, WSEs were selected within the range of field collected data only.
- Cross-sectional geometry and a realistic rating curve fit were considered when choosing the primary modeling method.
- MANSQ was selected as the primary calibration method on T-02 to T-05, T-08, T-09, and T-11 to T-13, based on the modeling guidelines outlined above.
- All Log/Log betas were between 2.0 and 4.5 except 2: T-02, T-08 and T-09.
- All transects had MANSQ betas inside the range of -5.0 to 5.0.
- All MANSQ mean errors were less than 10 percent.
- Both MANSQ and Log/Log mean errors can be seen in Table 2.

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- Refer to Table B-1 and B-2 in the Appendix for a comparison of measured versus modeled WSEs.
- 13 of the 14 calculated discharges were within 20 percent of given discharges.
  - T-02 was outside that range due to an incomplete velocity set.

Table 2. Percent Mean Error for Stage/Discharge Relationships.

	T-14	T-13	T-12	T-11	T-10	T-9	T-8	T-07
Log/Log	0.3252	0.363	0.2114	2.6264	3.2437	1.569	0.1336	2.2475
MANSQ	2.2485	0.6521	0.4736	2.7151	3.4321	0.7701	0.1846	3.5892
MANSQ BETA	0.1342	0.4766	0.3928	0.5706	0.7377	0.5458	0.3927	0.0119
	T-06	**T-05**	**T-04**	**T-03**	**T-02**	**T-01HF**	**T-01LF**	
Log/Log	2.6361	1.7216	2.1575	0.1264	0.1891	0.0899	N/A	
MANSQ	2.4132	1.9401	2.9144	0.4865	0.2382	1.7778	0.628	
MANSQ BETA	0.6488	0.4147	0.2624	0.3526	0.4587	0.365	0.1065	

Velocity Calibration

All transect velocity measurements were collected at the highest target flow possible for that transect. Limiting physical parameters included deep swift water to deep to safely wade or deep water with entrained air which limited ADCP data collection.

- Velocity measurements were modeled at the highest flow possible for each transects.
  - High Flow: T-03 through T-06, T-08 through T-10, T-12, and T-14.
  - Mid Flow: T-01, T-02, T-07, T-11, and T-13.

Table 3 and Table 4 provide the velocity adjustment factor (VAF) for each calibration flow on each transect. VAF is the index of the difference between the requested simulation discharge and computed discharge derived from the velocity simulations (Waddle 2001). Graphical representations of the VAFs can be found in Figure 2 and Figure 3. These velocity adjustments are used to prevent the model from over or under estimating the discharge at flows other than the velocity calibration discharge.

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Table 3. Velocity adjustment factors (VAF).

Transect	1[1]			Transect	2			Transect	3		
WSL	**Calibration Flow**	**Calculated Flow**	**VAF**	**WSL**	**Calibration Flow**	**Calculated Flow**	**VAF**	**WSL**	**Calibration Flow**	**Calculated Flow**	**VAF**
94.08	13.6	54.82	0.2481	91.7	13.6	45.17	0.3011	90.12	13.6	48.87	0.2783
94.72	34	87.66	0.3879	92.23	34	72.48	0.4691	90.6	34	83.08	0.4092
95.89	112	164.31	0.6816	93.09	112	137.27	0.8159	91.45	112	167.28	0.6695
96.49	178	210.59	0.8453	93.49	178	178.41	0.9977	91.88	178	222.64	0.7995
97.41	327	292.59	1.1176	94.07	327	251.63	1.2995	92.52	327	328.91	0.9942
99.21	817.5	486.87	1.6791	95.14	817.5	421.36	1.9401	93.74	817.5	577.58	1.4154
Transect	**4**			**Transect**	**5**			**Transect**	**6**		
WSL	**Calibration Flow**	**Calculated Flow**	**VAF**	**WSL**	**Calibration Flow**	**Calculated Flow**	**VAF**	**WSL**	**Calibration Flow**	**Calculated Flow**	**VAF**
90.2	13.6	31.46	0.4323	90.15	13.6	62.99	0.2159	90.16	13.6	249.3	0.0546
90.7	34	62.6	0.5432	90.71	34	99.32	0.3423	90.69	34	267.97	0.1269
91.66	112	153.31	0.7306	91.71	112	183.9	0.609	91.68	112	304.11	0.3683
92.17	178	217.66	0.8178	92.22	178	235.54	0.7557	92.18	178	323.59	0.5501
92.96	327	348.67	0.9379	93	327	328.41	0.9957	92.97	327	355.08	0.9209
94.42	817.5	724.67	1.1281	94.5	817.5	547.32	1.4937	94.52	817.5	418.63	1.9528
Transect	**7**			**Transect**	**8**			**Transect**	**9**		
WSL	**Calibration Flow**	**Calculated Flow**	**VAF**	**WSL**	**Calibration Flow**	**Calculated Flow**	**VAF**	**WSL**	**Calibration Flow**	**Calculated Flow**	**VAF**
88.28	13.6	8.32	1.634	95.04	13.6	47.06	0.289	94.34	13.6	89.32	0.1523
88.75	34	29.91	1.1366	95.29	34	83.28	0.4082	94.65	34	128.7	0.2642
89.59	112	125.92	0.8895	95.69	112	174.69	0.6411	95.15	112	207.54	0.5396
90.01	178	199.46	0.8924	95.87	178	236.84	0.7516	95.38	178	250.02	0.712
90.65	327	343.04	0.9532	96.13	327	349.59	0.9354	95.73	327	319.03	1.025
91.88	817.5	704.86	1.1598	96.61	817.5	624.36	1.3093	96.35	817.5	460.63	1.7747

[1] VAF for T-01 based solely on T-01HF because collected velocity set was during mid flow, which was not included in T-10LF.

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Table 4. Velocity adjustment factors (cont.)

Transect	**10**			**Transect**	**11**			**Transect**	**12**		
WSL	**Calibration Flow**	**Calculated Flow**	**VAF**	**WSL**	**Calibration Flow**	**Calculated Flow**	**VAF**	**WSL**	**Calibration Flow**	**Calculated Flow**	**VAF**
94.7	13.6	198.88	0.0684	94.65	13.6	94.72	0.1436	93.83	13.6	45.56	0.2985
94.99	34	213.03	0.1596	95	34	121.25	0.2804	94.16	34	80.51	0.4223
95.51	112	238.66	0.4693	95.55	112	169.28	0.6616	94.73	112	165.39	0.6772
95.77	178	251.59	0.7075	95.81	178	193.46	0.9201	95.01	178	217.81	0.8172
96.15	327	271.84	1.2029	96.18	327	231.39	1.4132	95.42	327	316.22	1.0341
96.87	817.5	311.35	2.6257	96.84	817.5	306.65	2.6659	96.18	817.5	562.86	1.4524
Transect	**817.5**	**311.35**	**2.6257**	**96.84**	**14**						
WSL	**817.5**	**311.35**	**2.6257**	**96.84**	**Calibration Flow**	**Calculated Flow**	**VAF**				
90.13	13			Transect	13.6	16.25	0.8368				
90.55	Calibration Flow	Calculated Flow	VAF	WSL	34	40.5	0.8395				
91.28	13.6	53.21	0.2556	89.27	112	124.49	0.8997				
91.64	34	80.25	0.4237	89.58	178	183.8	0.9685				
92.18	327	230.5	1.4187	90.83	327	294.1	1.1119				
93.19	817.5	355.8	2.2976	91.63	817.5	558.96	1.4625				

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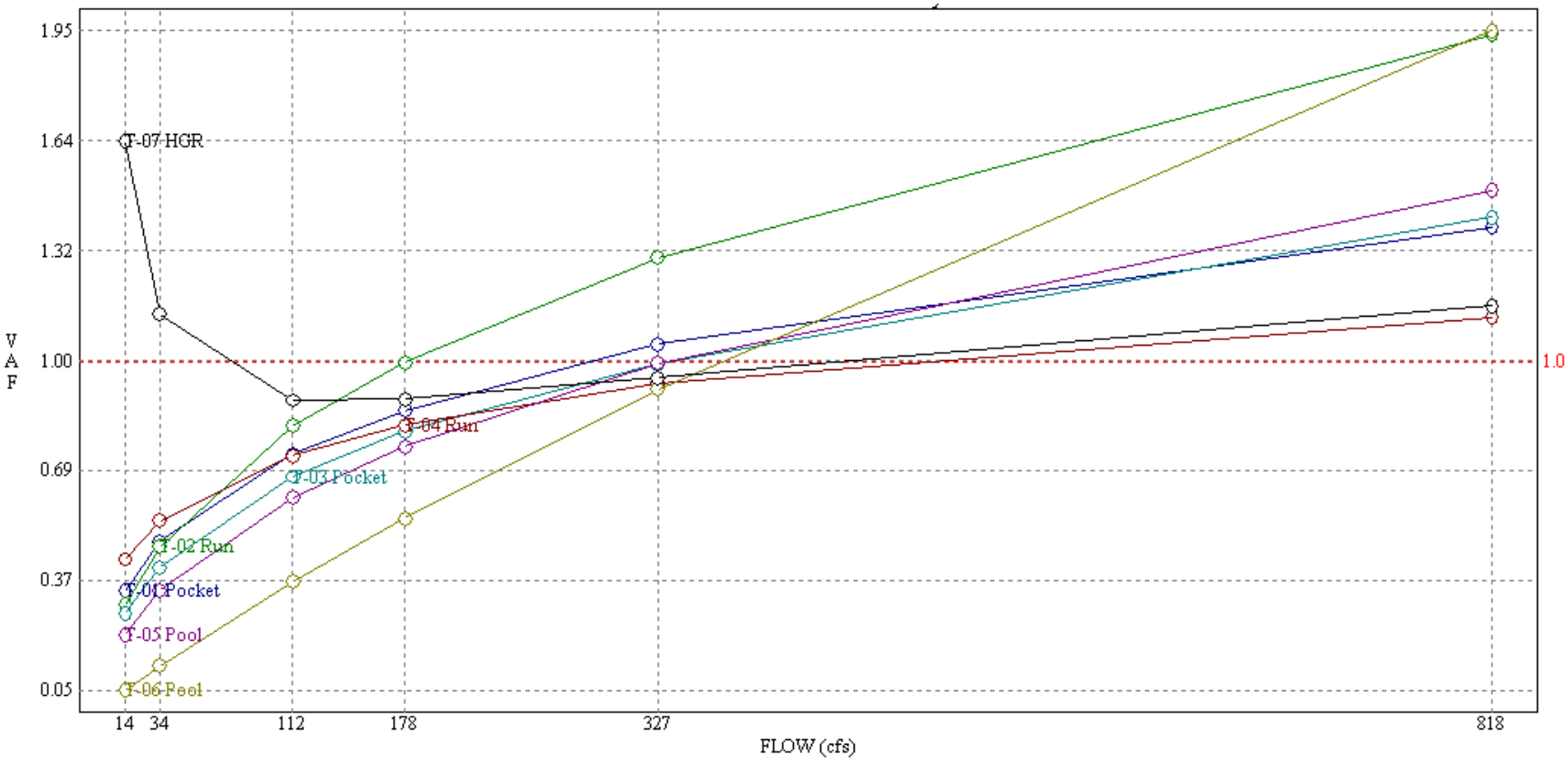

Figure 2. VAF by flow (T-01 to T-07).

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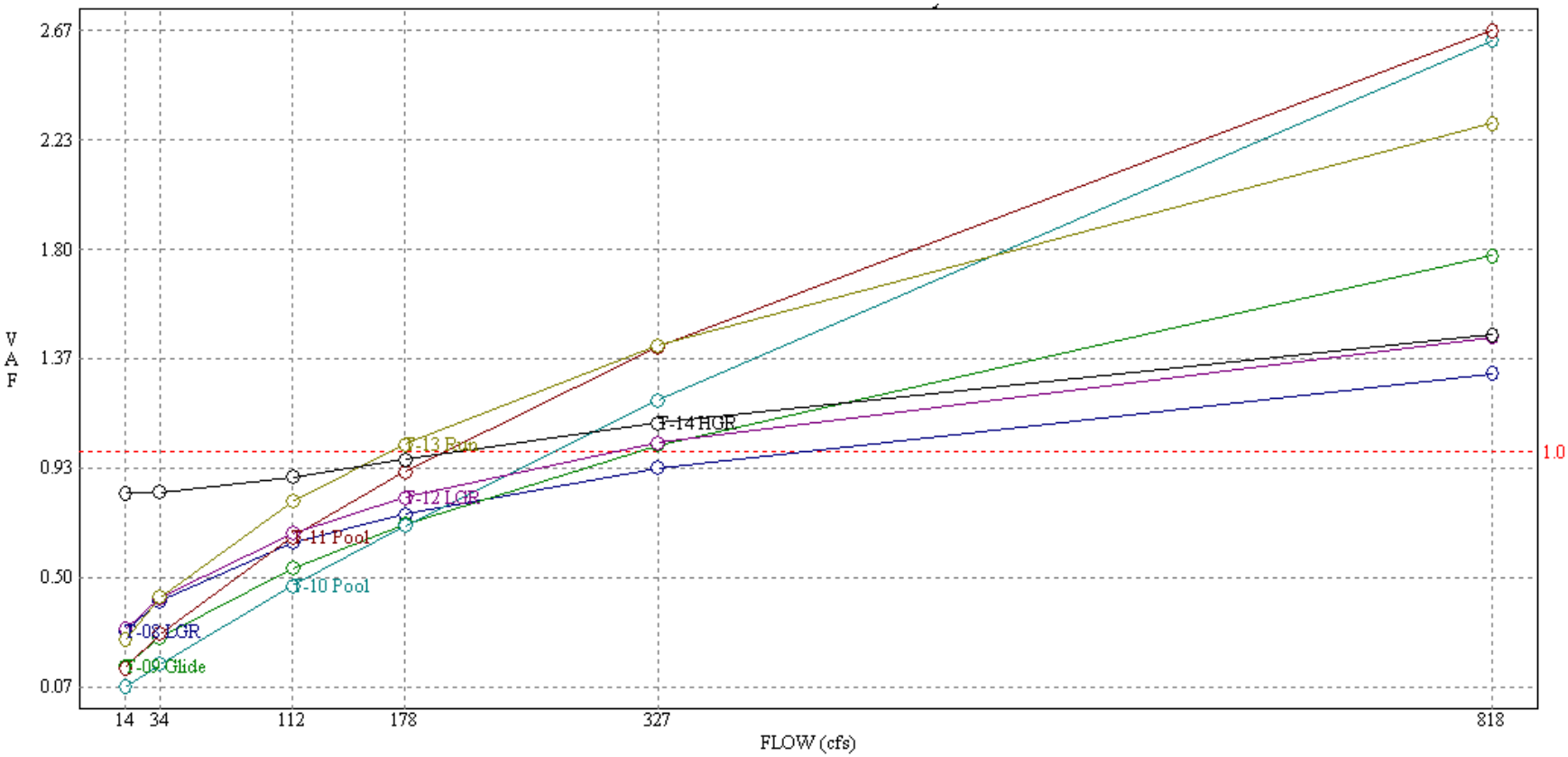

Figure 3. VAF by flow (T-08 to T-14).

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Target Discharge and Field Discharge

Discharge, like WSE, is used to calibrate stage/discharge relationships in the PHABSIM hydraulic models. The best estimate of discharge used in the model was calculated based on averaging numerous measurements from each site. Discharge selections were within the range of flows observed during data collection if the average discharge for the day was not used. Average daily discharge calculated from all field measurements are summarized below in Table 5.

Table 5. Target and measured flows for the Moonshine Creek Site.

Transect	Type	Discharge							
		Low-Low Flow - Target 50 cfs		Low - Target 50 cfs		Mid - Target 115 cfs		High - Target 300 cfs	
		Measured (cfs)	Method	Measured (cfs)	Method	Measured (cfs)	Method	Measured (cfs)	Method
1	Pocket-water	--	--	--	--	207	ADCP/ Swoffer	--	--
2	Run	--	--	--	--	N/A		--	--
3	Pocket-water	--	--	--	--	--	--	333	ADCP/ Swoffer
4	Run	--	--	--	--	169	Swoffer	341	ADCP/ Swoffer
5	Pool	--	--	--	--	--	--	331	ADCP/ Swoffer
6	Pool	--	--	--	--	--	--	385	ADCP/ Swoffer
7	High gradient riffle	--	--	--	--	168	Swoffer	--	--
8	Low gradient riffle	--	--	--	--	--	--	352	ADCP/ Swoffer
9	Glide	33	Swoffer	--	--	--	--	320	Swoffer
		34	Swoffer	--	--	--	--		
10	Pool	--	--	--	--	--	--	267	ADCP/ Swoffer
11	Pool	--	--	--	--	187	ADCP/ Swoffer	--	--
12	Low gradient riffle	--	--	--	--	--	--	323	Swoffer
13	Run	--	--	--	--	188	ADCP/ Swoffer	--	--
14	High gradient riffle	--	--	--	--	--	--	288	Swoffer
Q1	Near T-09	--	--	112	Swoffer	--	--	--	--
Q2	Near T-09	--	--	109	Swoffer	--	--	--	--
Q3	Near T-09	--	--	110	Swoffer	--	--	--	--
Given Flow Averages using best transects		**34**	T-09x2	**110**	(Q1, Q2, Q3)	**178**	(T-04, T-07, T-11, T-13)	**327**	(T-03, T-04, T-05, T-06, T-08, T-09, T-10, T-12, T-14)

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References

Milhous, R. T., D. L. Wegner, and T. Waddle. 1984. User's Guide to the Physical Habitat Simulation System (PHABSIM). Instream Flow Information Paper No. 11. U.S. Fish and Wildlife Service. FWS/OBS-81/43.

Milhous, R. T., M. A. Updike, and D. M. Schneider. 1989. PHABSIM Reference Manual Version II, Instream Flow Information Paper No. 26. U.S. Fish and Wildlife Service Biological Report 89(16).

Waddle, T. J. (ed.) 2001. PHABSIM for Windows: User's Manual and Exercises. U.S. Geological Survey Open-File Report 2001-340.

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Appendix A
Moonshine Creek Site Cross Sectional Profiles and Photos

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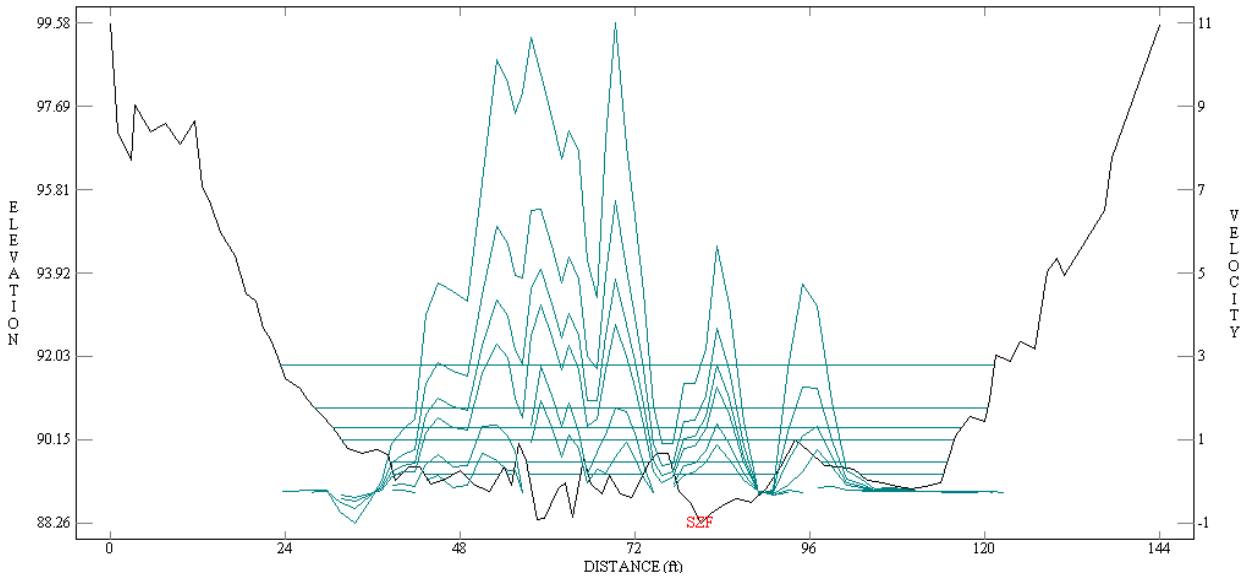

Figure A-1. Cross section for Transect 14 (High Gradient Riffle).

Figure A-2. Transect 14-Looking from left bank to right bank at mid flow.

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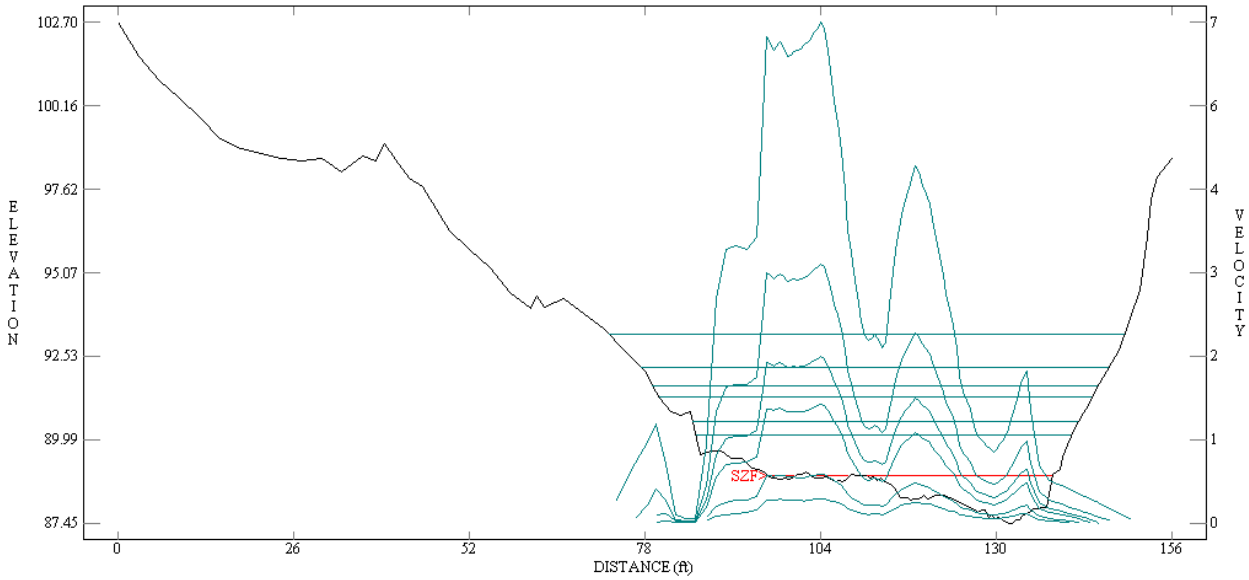

Figure A-3. Cross Section for Transect 13 (Run).

Figure A-4. Transect 13-Looking from right bank to left bank at mid flow.

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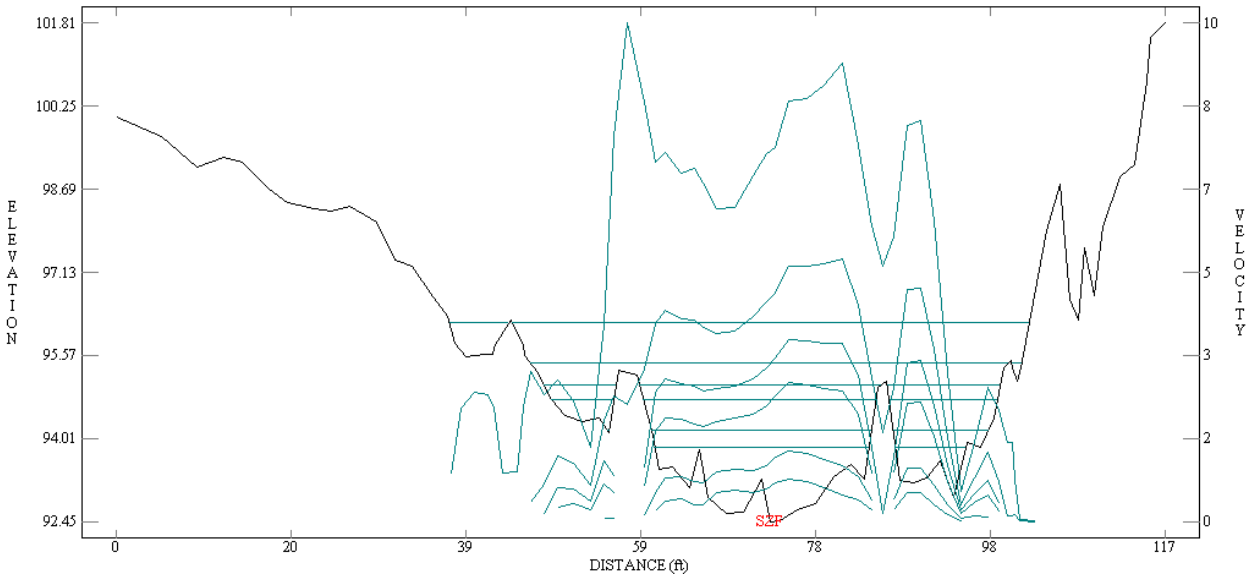

Figure A-5. Cross section for Transect 12 (Run).

Figure A-6. Transect 12-Looking from right bank to left bank at mid flow.

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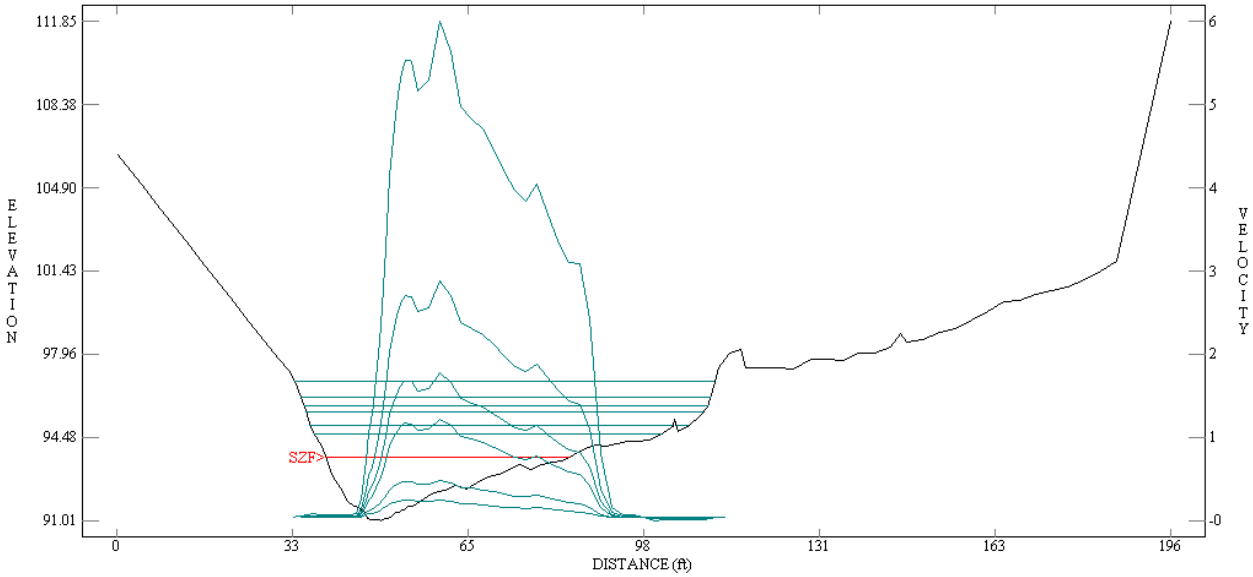

Figure A-7. Cross Section for Transect 11 (Pool Head).

Figure A-8. Transect 11-Looking from left bank to right bank at mid flow.

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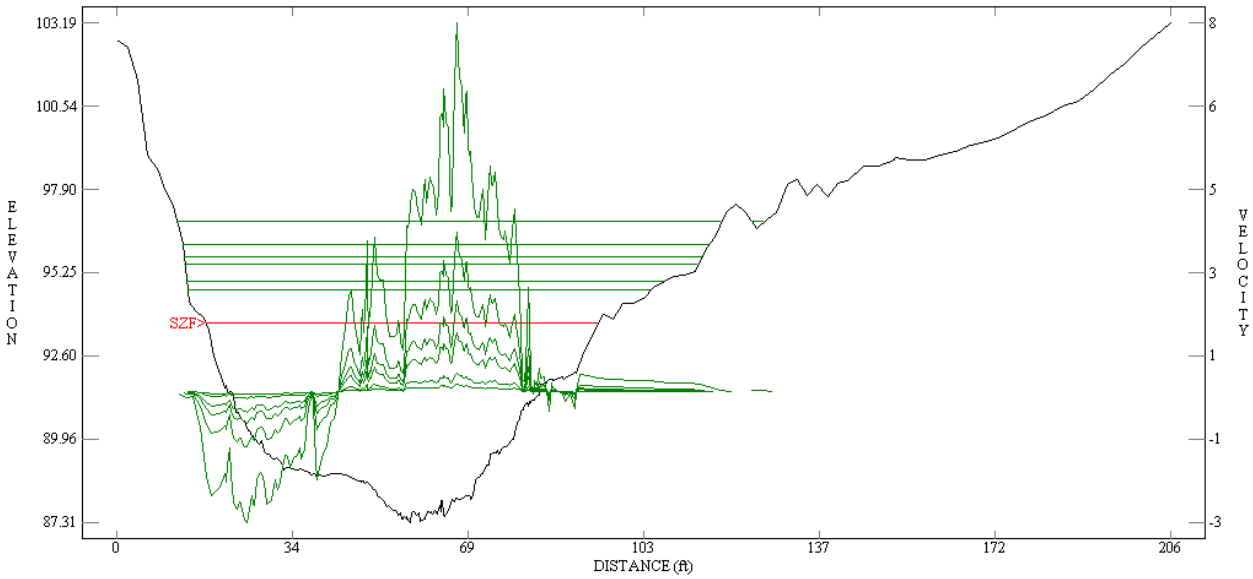

Figure A-9. Cross section for Transect 10 (Pool Belly).

Figure A-10. Transect 10-Looking from right bank to left bank at mid flow.

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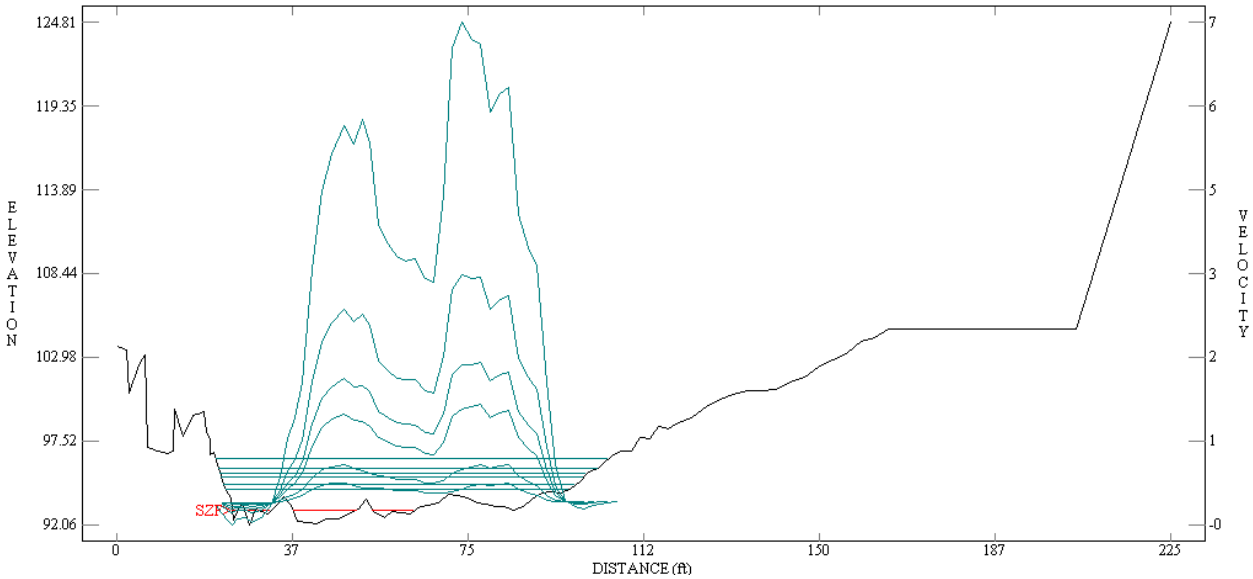

Figure A-11. Cross section for Transect 09 (Glide).

Figure A 12. Transect 09-Looking upstream to whole transect at mid flow.

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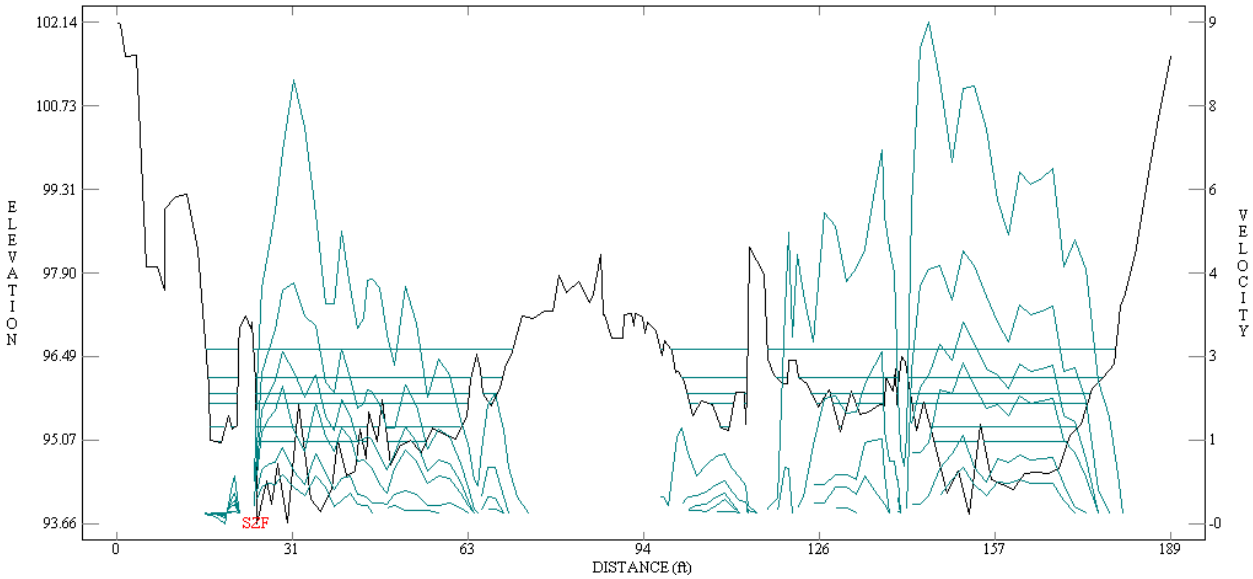

Figure A-13. Cross section for Transect 08 (Low Gradient Riffle).

Figure A-14. Transect 08-Looking upstream at right ascending channel at mid flow.

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Figure A-15. Transect 08-Looking upstream at left ascending channel at mid flow.

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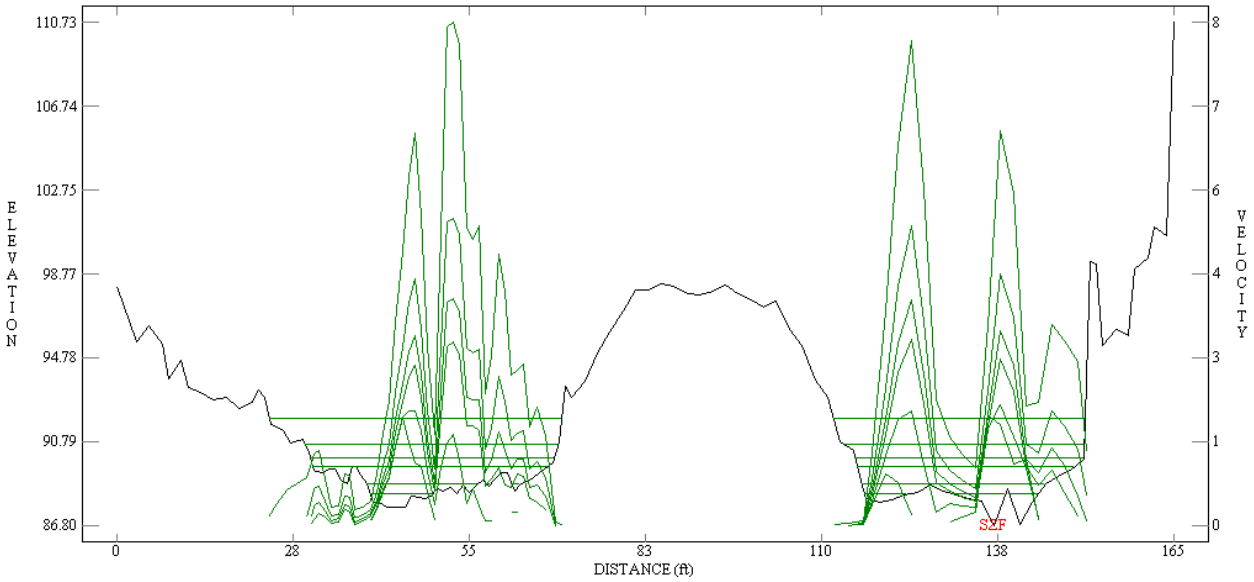

Figure A-16. Cross section for Transect 07 (High Gradient Riffle).

Figure A-17. Transect 07-Looking from left bank to right bank of right ascending channel at low flow.

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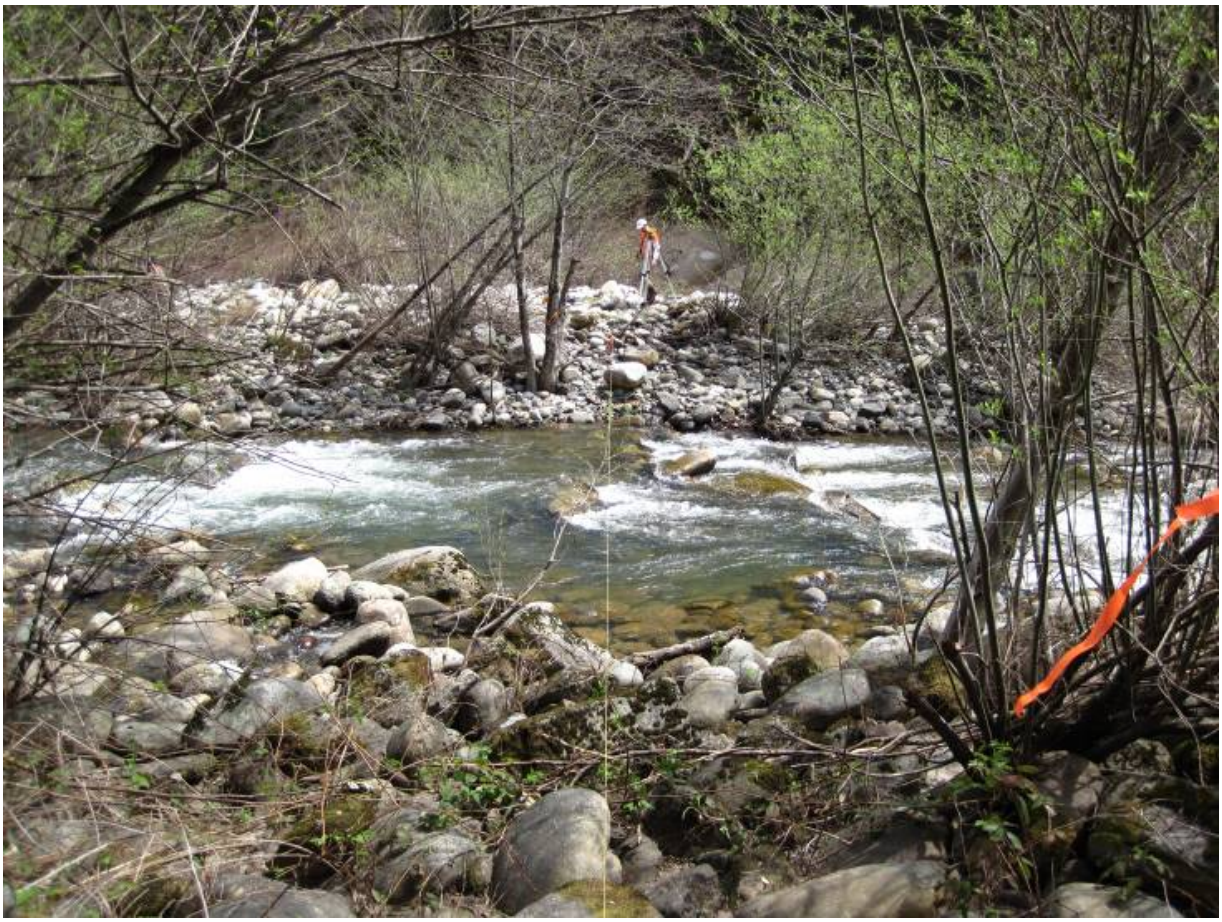

Figure A-18. Transect 07-Looking from left bank to right bank of left ascending channel at low flow.

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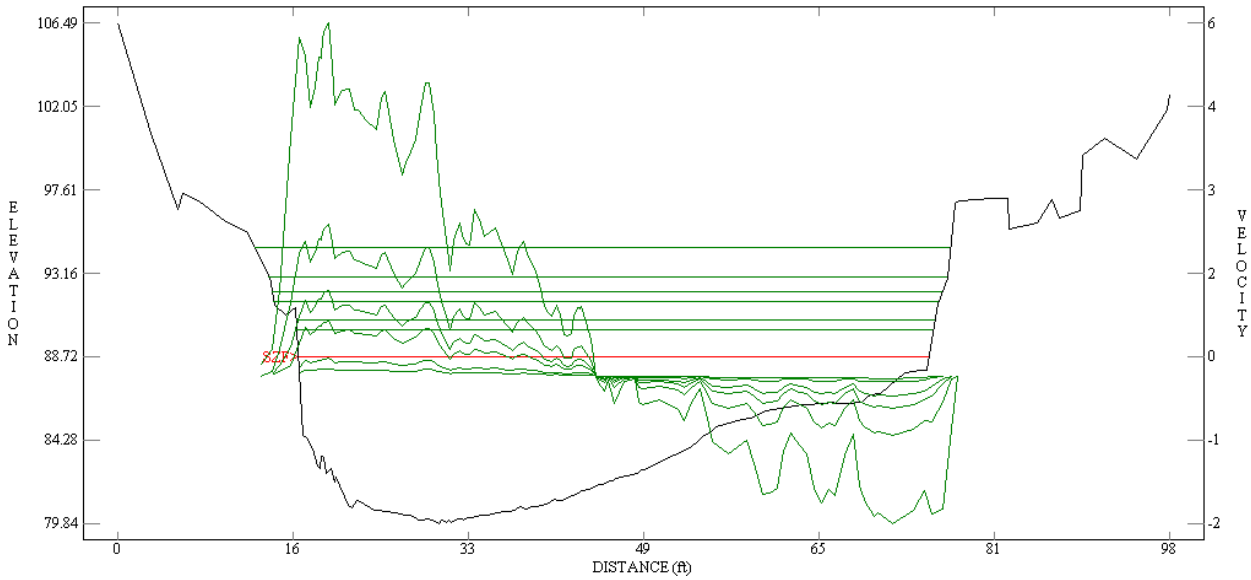

Figure A-19. Cross section for Transect 06 (Pool Belly).

Figure A-20. Transect 06-Looking from left bank to right bank at mid flow.

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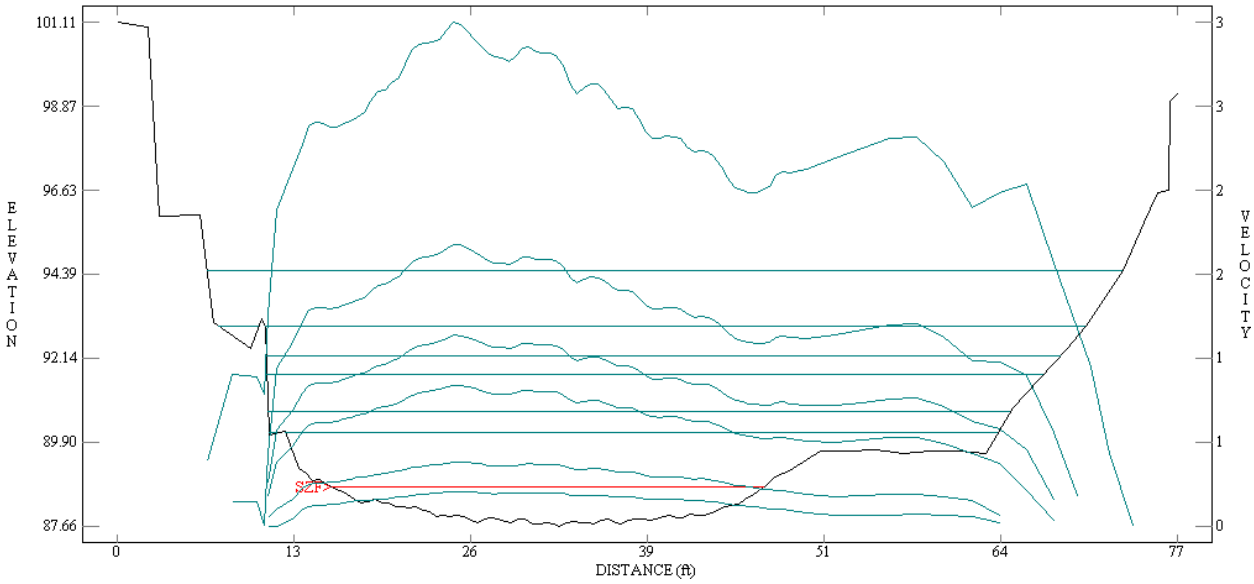

Figure A-21. Cross section for Transect 05 (Pool Tail).

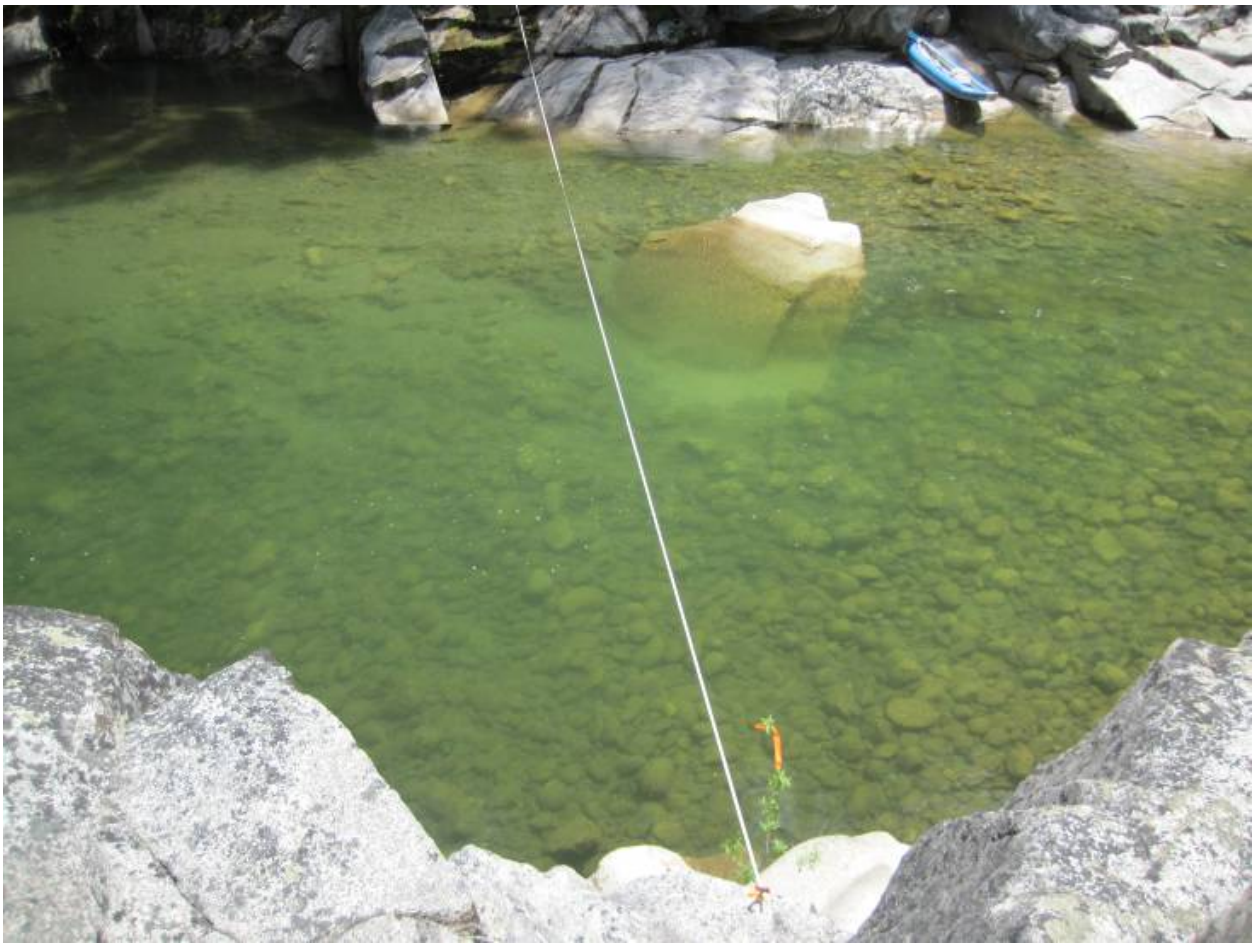

Figure A-22. Transect 05-Looking from right bank to left bank at mid flow.

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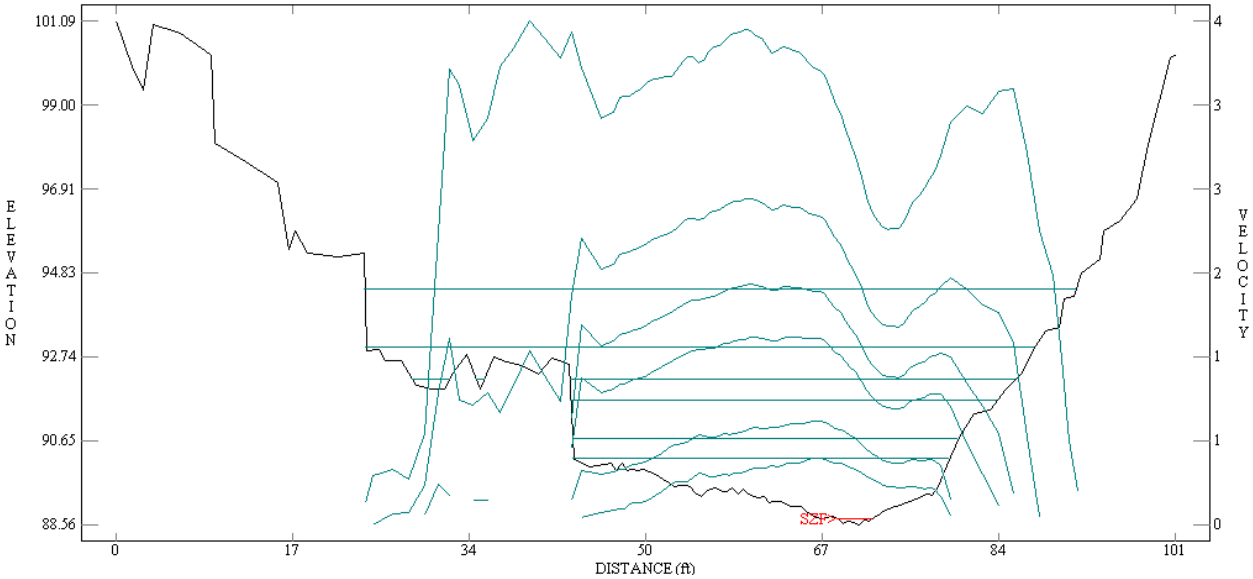

Figure A-23. Cross section for Transect 04 (Run).

Figure A-24. Transect 04-Looking from right bank to left bank at mid flow.

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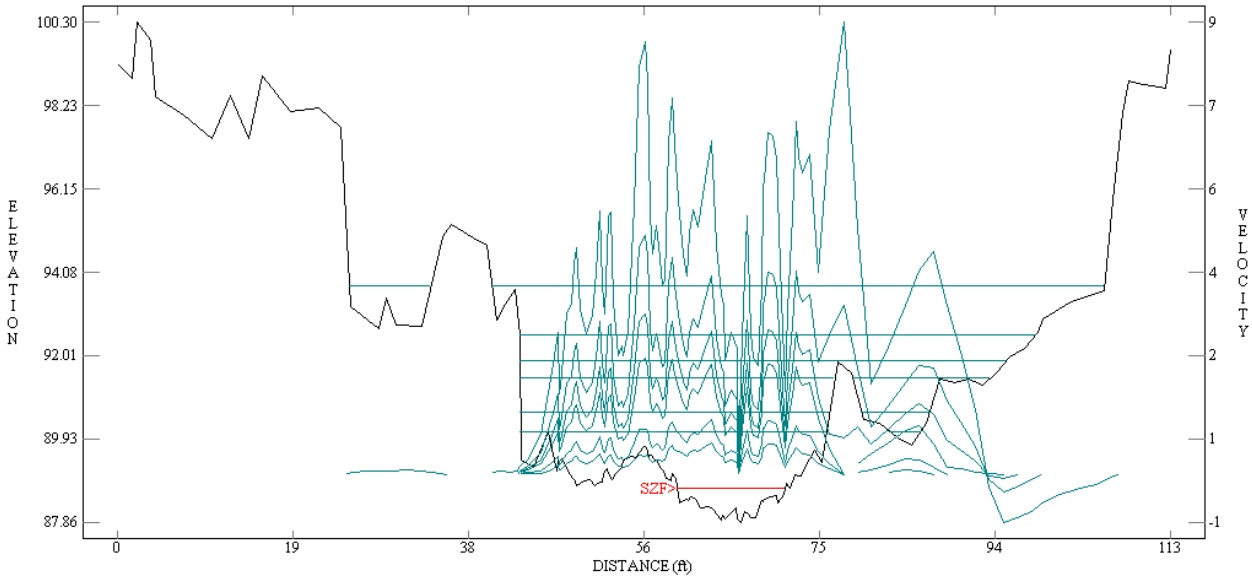

Figure A-25. Cross section for Transect 03 (Pocketwater).

Figure A-26. Transect 03-Looking from right bank to left bank at low flow.

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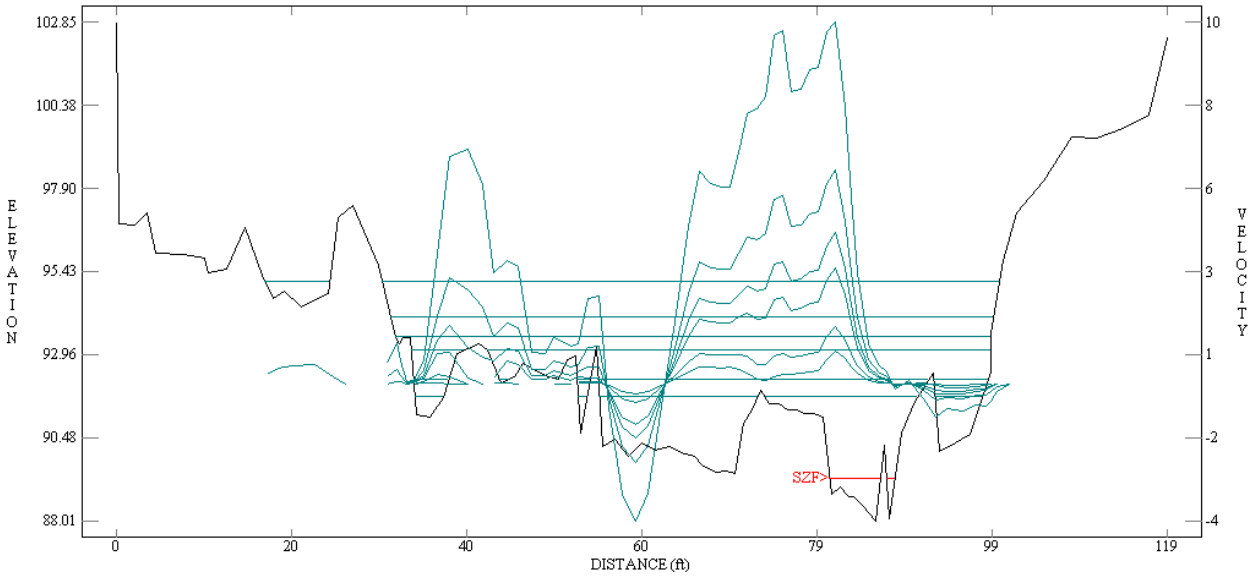

Figure A-27. Cross section for Transect 02 (Run).

Figure A-28. Transect 02-Looking from right bank to left bank at mid flow.

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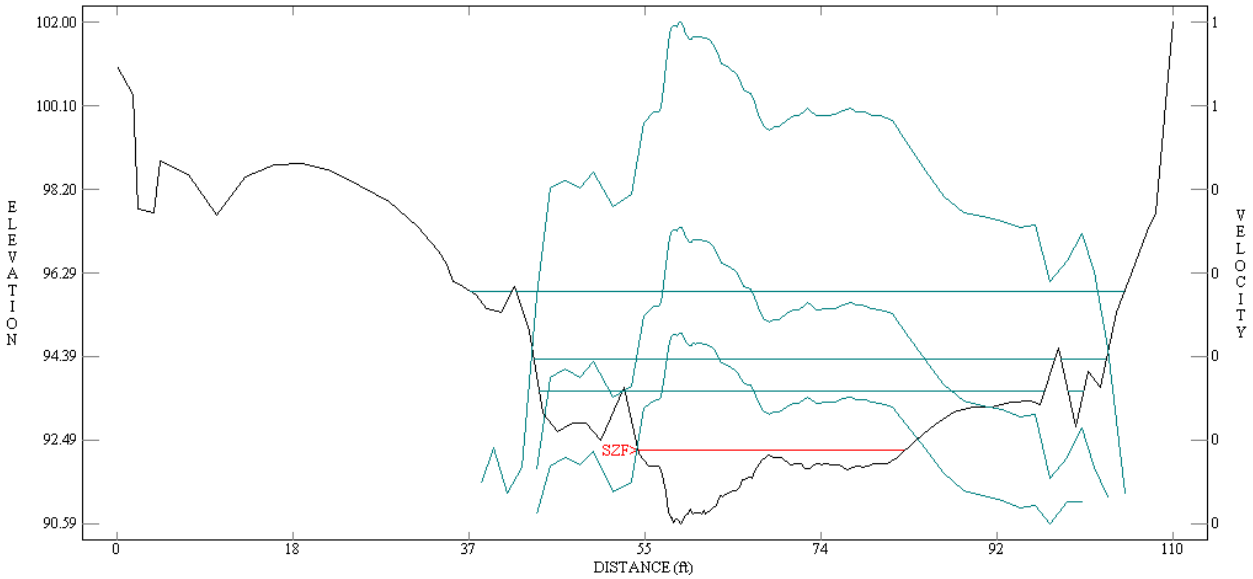

Figure A-29. Cross section for Transect 01LF (Pocketwater).

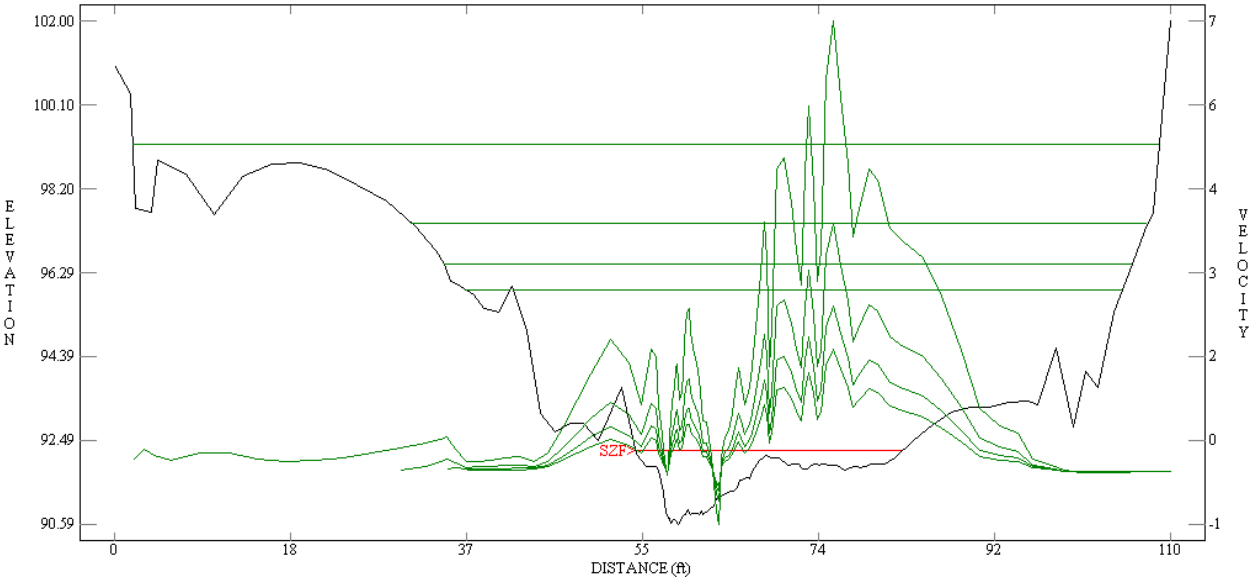

Figure A-30. Cross section for Transect 01HF (Pocketwater).

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Figure A-31. Transect 01-Looking from left bank to right bank at mid flow.

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Appendix B
Moonshine Creek Site Water Surface Elevation Comparison Tables

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Table B-1. Measured and Modeled WSEs (Q in cfs, all other values in ft).

Transect		1LF		Transect		1HF		Transect		2		Transect		3	
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**
34	**94.35**		94.35	**34**				**34**	**92.23**	92.23	92.23	**34**	**90.6**	90.6	90.6
112	**95.89**		95.88	**112**	**95.89**	95.89	95.88	**112**	**93.09**	93.09	93.09	**112**	**91.45**	91.45	91.45
				178	**96.48**	96.49	96.48	**178**	**93.49**	93.49	93.49	**178**	**91.87**	91.87	91.88
				327	**97.41**	97.41	97.41	**327**	**94.07**	94.07	94.07	**327**	**92.53**	92.53	92.52
Transect		**4**		**Transect**		**5**		**Transect**		**6**		**Transect**		**7**	
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**
34	**90.7**	90.71	90.7	**34**	**90.72**	90.73	90.71	**34**	**90.68**	90.69	90.68	**34**	**88.76**	88.75	88.82
112	**91.73**	91.69	91.66	**112**	**91.75**	91.72	91.71	**112**	**91.73**	91.68	91.71	**112**	**89.59**	89.59	89.59
178	**92.18**	92.18	92.17	**178**	**92.19**	92.22	92.22	**178**	**92.15**	92.18	92.2	**178**	**89.97**	90.01	90
327	**92.93**	92.96	92.96	**327**	**93.01**	93.01	93	**327**	**92.96**	92.97	92.95	**327**	**90.69**	90.65	90.72
Transect		**8**		**Transect**		**9**		**Transect**		**10**		**Transect**		**11**	
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**
34	**95.29**	95.29	95.29	**34**	**94.65**	94.65	94.65	**34**	**95**	94.99	95	**34**	**95**	95	95
112	**95.69**	95.69	95.69	**112**	**95.17**	95.16	95.15	**112**	**95.52**	95.51	95.52	**112**	**95.52**	95.52	95.55
178	**95.87**	95.87	95.87	**178**	**95.38**	95.39	95.38	**178**	**95.73**	95.77	95.75	**178**	**95.74**	95.77	95.81
327	**96.13**	96.13	96.13	**327**	**95.73**	95.73	95.73	**327**	**96.18**	96.15	96.07	**327**	**96.18**	96.16	96.18
Transect		**12**		**Transect**		**13**		**Transect**		**14**					
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**				
34	**94.16**	94.16	94.16	**34**	**90.55**	90.55	90.55	**34**	**89.58**	89.58	89.63				
112	**94.74**	94.74	94.73	**112**	**91.28**	91.27	91.28	**112**	**90.14**	90.14	90.14				
178	**95.01**	95.01	95.01	**178**	**91.63**	91.63	91.64	**178**	**90.41**	90.41	90.41				
327	**95.42**	95.42	95.42	**327**	**92.19**	92.19	92.18	**327**	**90.83**	90.83	90.86				

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Table B-2. Differences Between Measured and Modeled WSEs (Q in cfs, all other values in ft).

Transect		1LF		Transect		1HF		Transect		2		Transect		3	
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**
34	**94.35**		0.00	**34**				**34**	**92.23**	0.00	0.00	**34**	**90.6**	0.00	0.00
112	**95.89**		-0.01	**112**	**95.89**		-0.01	**112**	**93.09**	0.00	0.00	**112**	**91.45**	0.00	0.00
				178	**96.48**		0	**178**	**93.49**	0.00	0.00	**178**	**91.87**	0.00	0.01
				327	**97.41**		0	**327**	**94.07**	0.00	0.00	**327**	**92.53**	0.00	-0.01
Transect		**4**		**Transect**		**5**		**Transect**		**6**		**Transect**		**7**	
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**
34	**90.7**	0.01	0.00	**34**	**90.72**	0.01	-0.01	**34**	**90.68**	0.01	0.00	**34**	**88.76**	-0.01	0.06
112	**91.73**	-0.04	-0.07	**112**	**91.75**	-0.03	-0.04	**112**	**91.73**	-0.05	-0.02	**112**	**89.59**	0.00	0.00
178	**92.18**	0.00	-0.01	**178**	**92.19**	0.03	0.03	**178**	**92.15**	0.03	0.05	**178**	**89.97**	0.04	0.03
327	**92.93**	0.03	0.03	**327**	**93.01**	0.00	-0.01	**327**	**92.96**	0.01	-0.01	**327**	**90.69**	-0.04	0.03
Transect		**8**		**Transect**		**9**		**Transect**		**10**		**Transect**		**11**	
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**
34	**95.29**	0.00	0.00	**34**	**94.65**	0.00	0.00	**34**	**95**	-0.01	0.00	**34**	**95**	0.00	0.00
112	**95.69**	0.00	0.00	**112**	**95.17**	-0.01	-0.02	**112**	**95.52**	-0.01	0.00	**112**	**95.52**	0.00	0.03
178	**95.87**	0.00	0.00	**178**	**95.38**	0.01	0.00	**178**	**95.73**	0.04	0.02	**178**	**95.74**	0.03	0.07
327	**96.13**	0.00	0.00	**327**	**95.73**	0.00	0.00	**327**	**96.18**	-0.03	-0.11	**327**	**96.18**	-0.02	0.00
Transect		**12**		**Transect**		**13**		**Transect**		**14**					
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**				
34	**94.16**	0.00	0.00	**34**	**90.55**	0.00	0.00	**34**	**89.58**	0.00	0.05				
112	**94.74**	0.00	-0.01	**112**	**91.28**	-0.01	0.00	**112**	**90.14**	0.00	0.00				
178	**95.01**	0.00	0.00	**178**	**91.63**	0.00	0.01	**178**	**90.41**	0.00	0.00				
327	**95.42**	0.00	0.00	**327**	**92.19**	0.00	-0.01	**327**	**90.83**	0.00	0.03				

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Appendix C
Model Calibration Notes

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T-01

- Modeling was separated into a high flow [HF] regime (HF, MF, and LF) and a low flow [LF] regime (LF and LLF) for calibration purposes due to what appears to be a different hydraulic control at LLF than at the other flows. This practice is consistent with suggestions in Waddle 2001.
- Station 35.10, increased N to decrease flow on left bank. Large upstream rocks will prevent significant flow through area.
- Stations 38.6 and 40.1 – reduced N to release flow during higher simulation flows

T-02

- Incomplete velocity set was collected due to entrained air and deep very fast velocities between stations 69.0 – 83.00. Velocities were modeled using photographs and a mass balance target for the transect discharge.

T-03

- Stations 95.50 to 112.60 – Adjusted N values to lessen negative velocity spike; based on adjacent cell.

T-04

- Stations 33.20 and 35.80 to 43.00 – Adjusted N values to dampen velocity spikes on shallow rock shelf.

T-05

- No changes

T-06

- Stations 17.09, 19.04 and 19.33 – increased N to reduce velocity spike on left bank during upward simulation.

T-07

- Bedshifted bed from station 0 to 79 in order to allow for accurate depths over both channels with only one WSE.
- Stations 51.00 and 52.00 – Adjusted N values to dampen velocity spike; based on adjacent cell.
- Stations 123.00 and 125.00 – Adjusted N values to dampen velocity spike.

T-08

- Bedshifted bed from station 116.5 to 188.5 in order to allow for accurate depths over both channels with only one WSE.
- Log/Log beta is 5.43

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- Station 144.50 – Adjusted N value to dampen velocity spike; based on adjacent cell.

T-09

- Log/Log beta is 4.52
- No velocity changes

T-10

- Stations 21.18, 21.28, 21.78, 22.79, 23.18, 29.31, and 38.23 – Adjusted N values to dampen velocity spikes; based on adjacent cells
- Stations 52.92, 53.97, and 54.33 – Adjusted N values to less a velocity trough.
- Stations 89.82 to 206 – Adjusted N values to release some flow at higher discharges; based on adjacent cell.

T-11

- No changes

T-12

- Station 58.10, 59.80 – Increased N values to decrease velocity spike; based on adjacent values
- Station 85.00 – Adjusted N value to decrease velocity trough; based on adjacent values

T-13

- No changes.

T-14

- Station 67.50 – Adjusted N value to decrease a velocity trough; based on adjacent cell.

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