BR Stream Reach Summary

Study Reach: BR, Blue River - County Line approximately 3 miles below Green Mountain Reservoir to downstream the confluence with the Colorado River.

Reach Description: Approximate channel length: 12.5 miles, average channel slope 0.3% subdivided as follows:

- Confluence of Colorado River to Blue Valley Ranch: Approximate channel length: 3.5 miles, approximate channel slope 0.1%.
- Blue Valley Ranch to County line: Approximate channel length: 9 miles, approximate channel slope 0.4%.

The Blue River study reach extends from its confluence with the Colorado River to the County line. Green Mountain Reservoir is upstream of the County line by an additional 3 miles. The river generally flows through agricultural lands, held in private ownership with the exception of several short segments of BLM property. Approximately 8 miles of the Blue River is located within the Blue Valley Ranch, which has implemented a large-scale restoration effort including the installation of grade control structures, bank protection and off-channel wetlands. Much of the analysis for the Blue River was performed through a cooperative effort between the Blue Valley Ranch (BVR) and Grand County.

With the exception of the confluence area, the river plan form is generally moderately steep, with a confined and well-armored channel. There are two distinct land forms above the channel banks, the first being a relatively flat and wide floodplain bound by the second land form of steep and high banks. The lower portion of the Blue River is unconfined, sinuous and relatively flat as it is affected by backwater conditions from the Colorado River. On the far upstream end of the study reach, closer to Green Mountain Reservoir, the Blue River and associated floodplain valley becomes steeper and narrower, and the channel bed takes on a pool-and-drop planform with large boulder material.

Blue River immediately upstream of the Colorado River confluence, looking south

Blue River below Trough Road at the old railroad crossing, looking upstream
This is the location of the 2008 PHABSIM "spawning site"

Blue River from overlook on Blue Valley Ranch, looking southeast

Blue River on middle PHABSIM site (2009) on Blue Valley Ranch

Flow Recommendations:

***Environmental Flow Methodology*:** There are five PHABSIM study sites for this reach. These sites are described below. See Appendix A for methodologies and Appendix E for PHABSIM survey information.

1. One site was established downstream of County Road 10 in 2007. This site is within the upstream reaches of the Blue River Ranch property.
2. One site was established in 2008 downstream of Trough Road at the old highway bridge. The site is located on BLM property and is referred to in this report as the 'spawning site'.
3. Three additional sites were established in 2009, all within the Blue Valley Ranch property and are referred to as the upper, middle and lower sites.

Water Users:

- Irrigators, municipalities and industry flow-related issues: Jim Yusts operates the Lobeck ditch, which is a headgate diversion. This is controlled by gates, which are hard to install and remove, especially in high flow conditions. Mr. Yusts reports that gate operations are especially difficult when flows are increased rapidly out of Green Mountain Reservoir. Not only are the gates difficult to install and/or remove but often there is insufficient time for him to respond to changing flow conditions.

- Recreation: the upstream reaches of the Blue River, immediately downstream of Green Mountain Reservoir, are popular for kayaking when sufficient flows are present. Most kayakers take out at County Road 10, immediately upstream of Grand County, although there is some interest in continuing downstream (especially now with the recent installation of drop structures along the Blue Valley Ranch). There is no commercial rafting in this reach due to public access issues and the drop structures, although private rafting and canoeing occurs often. Angling is also very popular in this reach for both private and commercial fishing.

Summary of Flows:

<u>Environmental, recommended flow ranges (</u>Appendix A for methodology)

- 200 to 300 cfs, April 1 through September 30
- 200 to 300 cfs, October 1 through March 31
- Flushing flow - at least 1150 cfs for a 3-day duration with a frequency of 1 in 2 years during the late May to late June period.

These target flow recommendations have been refined since the 2008 draft report, and reflect the combined results of all five PHABSIM sites including the use of mean WUA-flow plots for trout spawning and adult habitat. Based upon this analysis, we recommend a revised target flow range for the Blue River of 200 to 300 cfs for both time periods.

<u>CWCB flows</u>

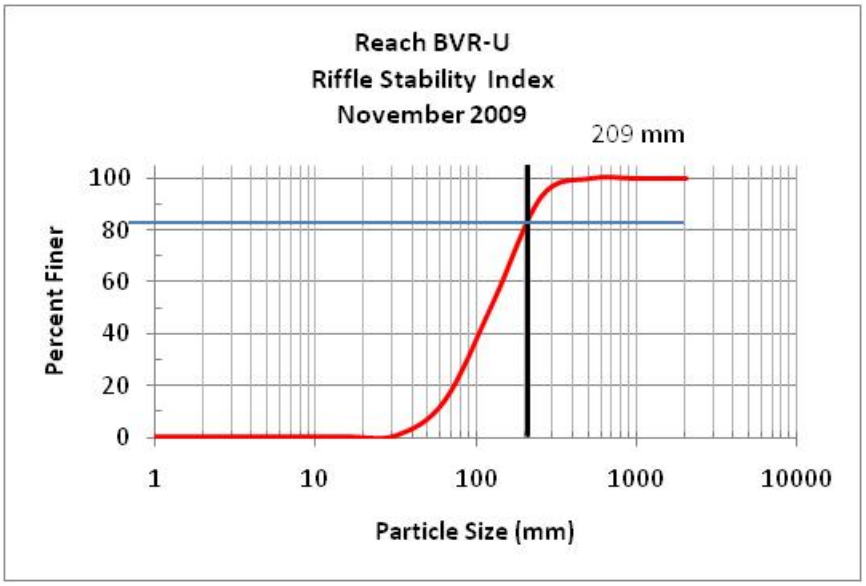
- 85 cfs summer (05/1 – 07/15)
- 60 cfs winter (07/16 – 04/30)

<u>Water Users</u>

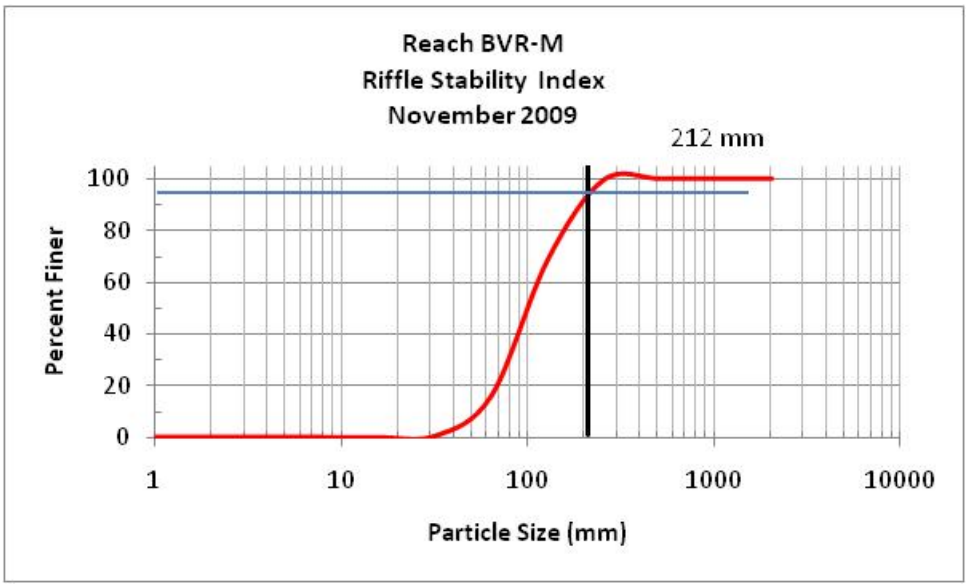
- Irrigators, municipalities and industry: The local diversions in this reach could potentially divert up to approximately 90 cfs. Most of the diversions are made in the summer for irrigation and will likely have some return flows.
- Recreation:
  - Kayaking: 400-1000 cfs
  - Rafting: 550-1400 cfs
  - Angling: 100-1200 cfs

Stream Assessments: In November 2009 Tetra Tech conducted three assessments at three locations within the Blue Valley Ranch property and in August 2008 Tetra Tech conducted three assessments at one location downstream of Trough Road at the spawning site. These included Stream Reach Inventory/Channel Stability Evaluation (SRI/CSE), EPA Habitat Quality Assessment (HQA) and a Riffle Stability Index (RSI) evaluation. The SRI/CSE evaluation scored in the 'good category' at the upper site and 'fair category' at the other three, the EPA HQA evaluation scored in the 'optimal or high suboptimal category' at all four sites and the RSI results indicates this reach tends to have moderate to high bed instability. At the spawning site, conditions tend to be depositional due to reduced channel gradient and occasional backwater conditions caused by the Colorado River. Overall, the stream assessments did not reveal any issues of significant concern. The relatively high degree of riffle bed instability denoted by the RSI scores is likely the result of the magnitude of the 2009 spring peak flow of about 3000 cfs, a flow approaching the 25 year flood event. Results of the assessments are summarized in the following tables and plots. Details and methodology are presented in Appendix A.

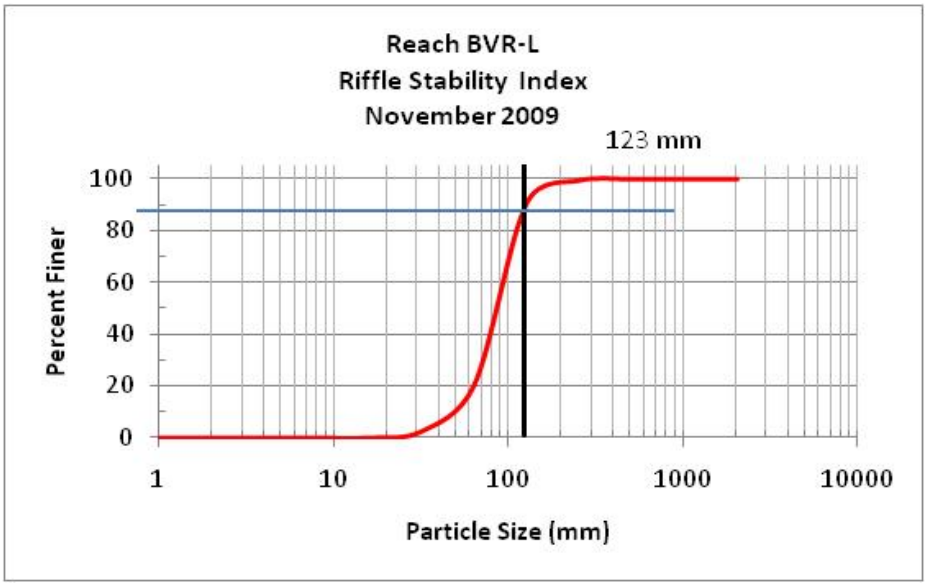
Reach BVR-U Stream Assessments					
Stream Reach Inventory/Channel Stability Evaluation			**EPA Habitat Quality Assessment**		
Attribute			**Attribute**		**Score**
Upper Banks			**Channel**		
1	Landform Slope	2	1	Aquatic Habitat Barriers/ Diversion	18
2	Mass wasting hazard	3	2	Aquatic Structure as Cover	15
3	Debris Jam Potential	6	3	Velocity/ Depth Regimes	17
4	Vegetation Cover	6	4	Channel Flow Status	15
	Upper Bank Score:	**17**	5	Channel Alteration	19
Lower Banks			6	Frequency of Riffles	19
5	Channel Capacity	3	7	Channel Sinuosity	7
6	Bank Rock Content	4		**Channel Score**	**110**
7	Flow obstructors & Deflectors	3	**Banks**		
8	Cutting	5	8	Bank Stability	18
9	Deposition	4	9	Riparian Vegetation Cover and Disturbance	16
	Lower Bank Score:	**19**	10	Riparian Vegetation zone width	14
Channel Bottom				**Bank Score**	48
10	Rock Angularity	3		**Total Score**	**158**
11	Brightness	2	**Notes**		
12	Consolidation/Particle Packing	2			
13	Bottom size distribution	8			
14	Bed Scour and Deposition	8			
15	Clinging Aquatic Veg	4			
	Channel Bottom Score:	**27**			
	Total Score:	**63**			



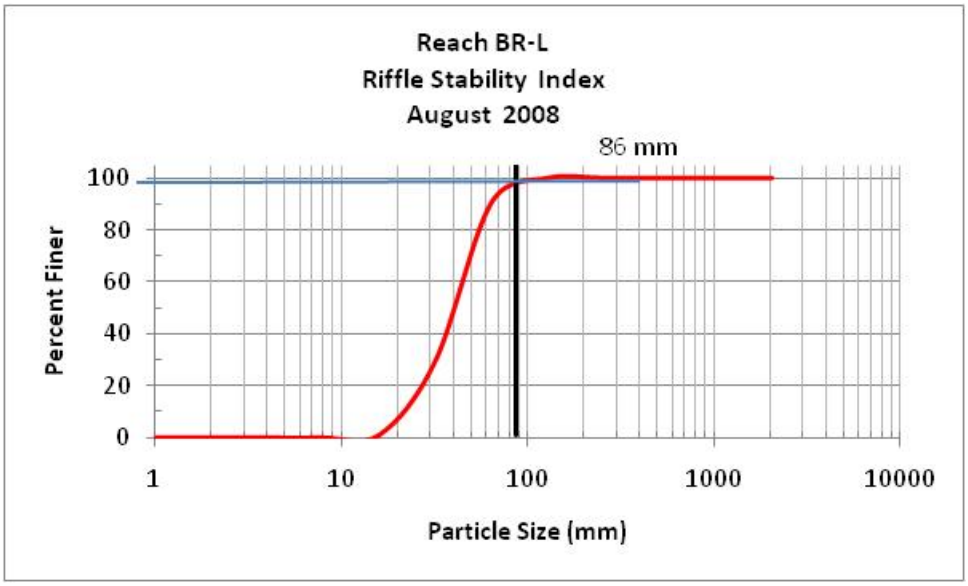
Reach BVR-M Stream Assessments					
Stream Reach Inventory/Channel Stability Evaluation			**EPA Habitat Quality Assessment**		
Attribute			**Attribute**		**Score**
Upper Banks			**Channel**		
1	Landform Slope	2	1	Aquatic Habitat Barriers/ Diversion	18
2	Mass wasting hazard	10	2	Aquatic Structure as Cover	13
3	Debris Jam Potential	6	3	Velocity/ Depth Regimes	18
4	Vegetation Cover	3	4	Channel Flow Status	13
	Upper Bank Score:	**21**	5	Channel Alteration	17
Lower Banks			6	Frequency of Riffles	18
5	Channel Capacity	3	7	Channel Sinuosity	8
6	Bank Rock Content	6		**Channel Score**	**105**
7	Flow obstructors & Deflectors	4	**Banks**		
8	Cutting	6	8	Bank Stability	16
9	Deposition	8	9	Riparian Vegetation Cover and Disturbance	20
	Lower Bank Score:	**27**	10	Riparian Vegetation zone width	18
Channel Bottom				**Bank Score**	54
10	Rock Angularity	3		**Total Score**	**159**
11	Brightness	2	**Notes**		
12	Consolidation/Particle Packing	5			
13	Bottom size distribution	12			
14	Bed Scour and Deposition	8			
15	Clinging Aquatic Veg	4			
	Channel Bottom Score:	**34**			
	Total Score:	**82**			



Reach BVR-L Stream Assessments					
Stream Reach Inventory/Channel Stability Evaluation			**EPA Habitat Quality Assessment**		
Attribute			**Attribute**		**Score**
Upper Banks			**Channel**		
1	Landform Slope	2	1	Aquatic Habitat Barriers/ Diversion	11
2	Mass wasting hazard	9	2	Aquatic Structure as Cover	11
3	Debris Jam Potential	4	3	Velocity/ Depth Regimes	18
4	Vegetation Cover	6	4	Channel Flow Status	13
	Upper Bank Score:	**21**	5	Channel Alteration	15
Lower Banks			6	Frequency of Riffles	15
5	Channel Capacity	3	7	Channel Sinuosity	9
6	Bank Rock Content	6		**Channel Score**	**92**
7	Flow obstructors & Deflectors	3	**Banks**		
8	Cutting	8	8	Bank Stability	14
9	Deposition	5	9	Riparian Vegetation Cover and Disturbance	16
	Lower Bank Score:	**25**	10	Riparian Vegetation zone width	17
Channel Bottom				**Bank Score**	47
10	Rock Angularity	3		**Total Score**	**139**
11	Brightness	2	**Notes**		
12	Consolidation/Particle Packing	5			
13	Bottom size distribution	8			
14	Bed Scour and Deposition	9			
15	Clinging Aquatic Veg	4			
	Channel Bottom Score:	**31**			
	Total Score:	**77**			



Reach BR-L Stream Assessments					
Stream Reach Inventory/Channel Stability Evaluation			**EPA Habitat Quality Assessment**		
Attribute			**Attribute**		**Score**
Upper Banks			**Channel**		
1	Landform Slope	2	1	Aquatic Habitat Barriers/ Diversion	13
2	Mass wasting hazard	6	2	Aquatic Structure as Cover	10
3	Debris Jam Potential	4	3	Velocity/ Depth Regimes	18
4	Vegetation Cover	9	4	Channel Flow Status	18
	Upper Bank Score:	**21**	5	Channel Alteration	13
Lower Banks			6	Frequency of Riffles	16
5	Channel Capacity	3	7	Channel Sinuosity	10
6	Bank Rock Content	7		**Channel Score**	**98**
7	Flow obstructors & Deflectors	6	**Banks**		
8	Cutting	10	8	Bank Stability	10
9	Deposition	8	9	Riparian Vegetation Cover and Disturbance	12
	Lower Bank Score:	**34**	10	Riparian Vegetation zone width	12
Channel Bottom				**Bank Score**	34
10	Rock Angularity	3		**Total Score**	**132**
11	Brightness	2	**Notes**		
12	Consolidation/Particle Packing	6	TetraTech 2007 Spawning PHabsim Site		
13	Bottom size distribution	12			
14	Bed Scour and Deposition	12			
15	Clinging Aquatic Veg	3			
	Channel Bottom Score:	**38**			
	Total Score:	**93**			



Spawning Observations: Several likely rainbow trout redds were observed during a float trip through the reach on 29 April 2008. Observations of additional spawning activities, at that time, were hampered by rising water levels and increasing turbidity. On October 30 and 31, 2008, eight likely brown trout redds were observed at the "spawning site" below Trough Road, while later on October 31, several adult brown trout were observed actively spawning during a float trip through the Blue Valley Ranch. Due to fluctuating conditions over these two days, physical habitat measurements at each redd site could not be made.

Hydrologic Records: USGS Gage Station 09057500 (BR below Green Mountain Reservoir) has been in operation since 1938, with flows regulated by the reservoir since 1943. In 1985 reservoir operations changed to meet the demands of historical agricultural and domestic water users on the Western Slope (historic user pool), generally resulting in increased releases out of Green Mountain Reservoir. The IHA and exceedence plots address this operation change. Daily streamflow exceedence plots and IHA analysis indicates the recommended flow ranges are commonly present, and often exceeded, within the reach.

Water Temperature: BR is a Tier I stream reach as designated by CDPHE with a chronic temperature standard of 17^{o}C MWAT and an acute temperature standard of 21.2^{o}C DM. No continuous temperature data is available for the Blue River. Based upon available instantaneous temperature records, this reach is likely supportive of a cold-water fishery.

Water Quality: The Blue River near Kremmling has shown exceedences in pH values in the early 2000's. No other water quality concerns were noted from the available data.

Water Supply Issues (UPCO): No water supply issues are reported for this reach.

Results and Remarks:

1. The recommended flow ranges are commonly present, and often exceeded, within the BR reach. Rapid flow changes are identified as a potential issue for spawning habitat (see discussion below).
2. No significant concerns were identified from the stream assessments.
3. Temperatures and water quality appear supportive of a cold-water fishery.
4. Water user concerns are associated with high flows and rapid fluctuations lending to unsafe conditions and conditions that are challenging for operating headgates.
5. Flows for recreation are generally adequate, with the exception of safety concerns noted above.
6. Trout habitat availability varied widely between the 2009 study sites, species, life stages and streamflows, although some similar trends were observed. In general, juvenile trout habitat was more abundant than adult habitat, while for adult brown trout habitat consistently exceeded rainbow trout habitat. Adult and juvenile habitat tended to be more abundant at the upper site, while spawning habitat varied widely between sites, being about 10 times more abundant at the lower site than at the upper.
7. Available trout habitat at the three 2009 BVR sites compared quite favorably with other Grand County streams where PHABSIM sites were established. When the mean maximum WUA for the three 2009 BVR sites was compared with the maximum WUA for the eight largest stream sites in the SMP, available habitat at the BVR sites ranked 2nd for trout spawning, 4th for adult rainbow trout habitat, 5th for both brown and rainbow trout juvenile habitat, and 6th for adult brown trout habitat. These results, when combined with those from the 2008 "spawning site" below Trough Road, suggest the importance of the lower Blue River for trout reproduction in the upper Colorado River basin. Adult trout habitat availability at the BVR would undoubtedly have ranked higher had the PHABSIM sites been located within sections of the ranch where extensive habitat improvement has been implemented.

8. This reach falls within the Lower Blue River Cooperative Management Plan (Plan), released for public review in January 2008. The purpose of the Plan is to provide a framework for future management of the lower Blue. This report investigates land ownership, management policies and land use, and proposes a framework for development of river management.
9. CDOW 2006 electrofishing data indicate that brown trout dominate the cold-water fishery (estimate of 1676 fish/mile > 150 mm) with lesser numbers of rainbow trout (estimate of 138 fish/mile > 150 mm) (Jon Ewert, 2008). Quality trout (> 356 mm) are abundant, the estimate being 549/mile.
10. Rapid changes in streamflow (ramping) have been identified as a possible issue for the Blue River below Green Mountain Reservoir. Such fluctuations could adversely affect aquatic life, including fish, and pose a human safety risk for recreationists and others along the river corridor. Rapidly rising streamflows could potentially re-locate fish and other aquatic life downstream into less favorable habitats, while rapidly declining flows can strand fish and other aquatic life in temporary habitats ultimately leading to desiccation and death (Reiser et al 2008). Also, flow reductions during important life cycle events such as spawning can lead to drying of incubating eggs in redds and immobile fry attempting to emerge from the inter-gravel environment. We have observed this latter problem on the Blue River through the BVR and downstream below the Trough Road. While we do not know the magnitude of the effects of rapid streamflow fluctuations on the Blue River trout population and other aquatic life, we recommend additional study, evaluation and discussion of this potential issue. To the extent possible, flows should be maintained at a fairly constant rate within the recommended target flow range during the trout spawning and incubation period to lessen or prevent the loss of developing trout embryos. This includes the late summer and early fall seasons of September through October during which flows from Green Mountain Reservoir have often been used to supplement downstream water requirements.

Restoration Opportunities:

- ✓ Further analysis and monitoring should be conducted to evaluate ramping rates for flow releases from Green Mountain Reservoir.

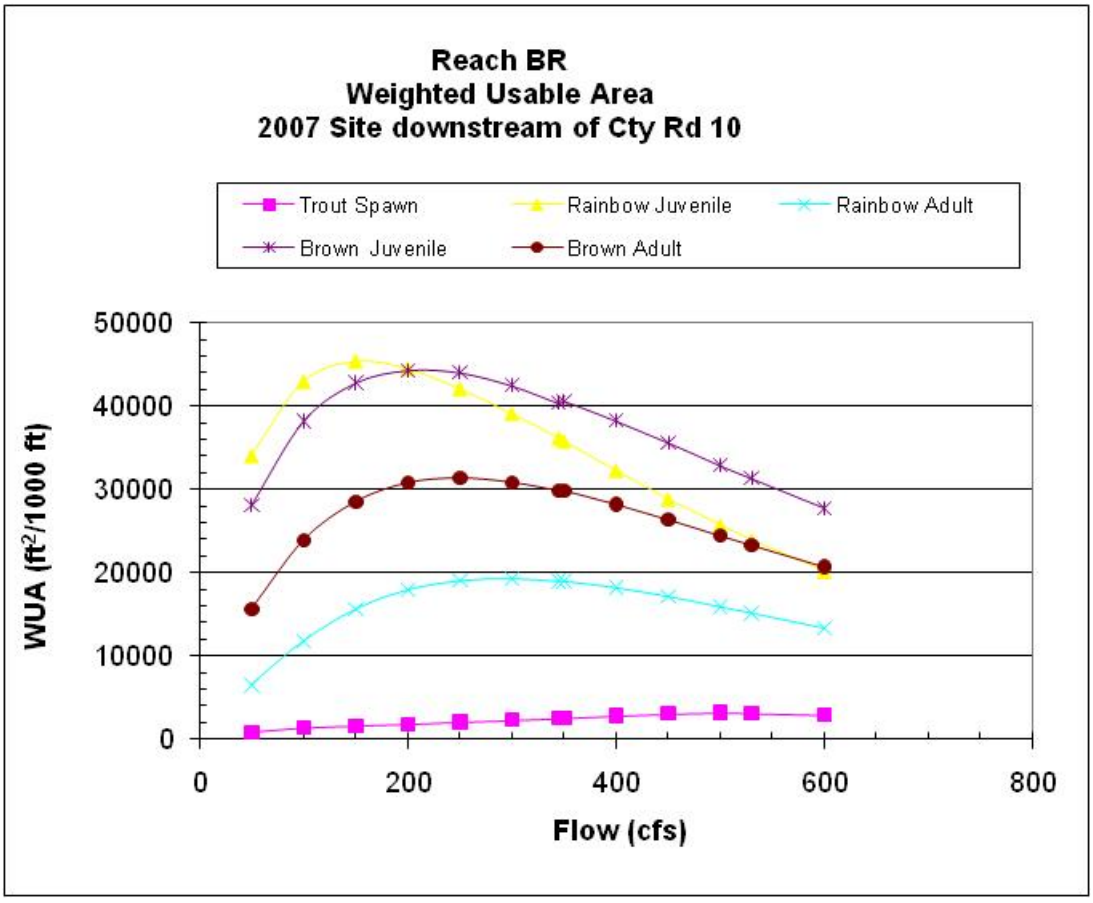
- ✓ Consider bank restoration along Trough Road at old bridge crossing.

Monitoring: Implement ramping guidelines and perform follow-up spawning surveys.

Support Data

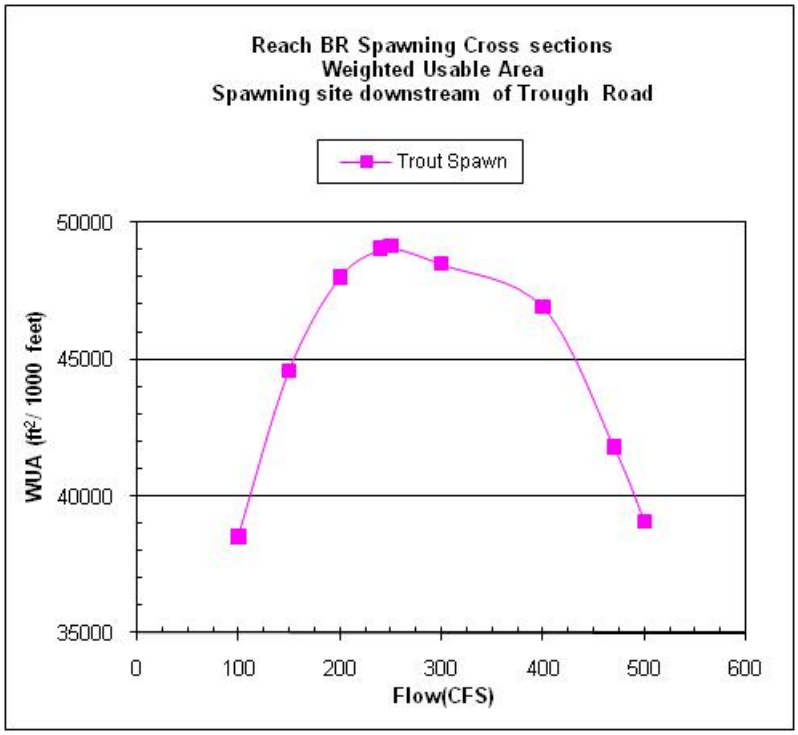
Weighted Useable Area Plots and Tables

Reach BR, 2007 Site downstream of Cty Rd 10						
Discharge	Total Area	Trout Spawn	Rainbow Juvenile	Rainbow Adult	Brown Juvenile	Brown Adult
(cfs)	($ft^{2)}$	Weighted Usable Area (ft^2/1000 ft stream length)				
50	78127.6	845.8	34052.6	6521.2	28078.3	15633.1
100	89204.0	1378.5	42940.4	11774.5	38195.9	23926.0
150	96240.0	1612.1	45363.1	15616.3	42814.4	28551.4
200	99850.2	1831.6	44512.2	17926.2	44339.1	30836.8
250	102839.9	2070.8	42082.2	19039.4	44051.7	31398.7
300	104474.8	2293.0	39086.3	19267.8	42489.5	30878.0
345	105636.2	2510.1	36179.2	18969.5	40405.0	29866.8
350	105717.4	2556.9	35787.5	18975.4	40636.1	29862.4
400	106451.0	2824.0	32280.5	18201.4	38261.7	28210.9
450	107080.3	3064.9	28857.1	17130.3	35662.9	26370.1
500	108358.6	3203.3	25744.1	15893.2	32891.5	24445.1
530	108683.2	3148.9	23932.6	15131.7	31351.6	23307.7
600	109942.7	2932.1	20175.0	13310.6	27796.5	20690.8

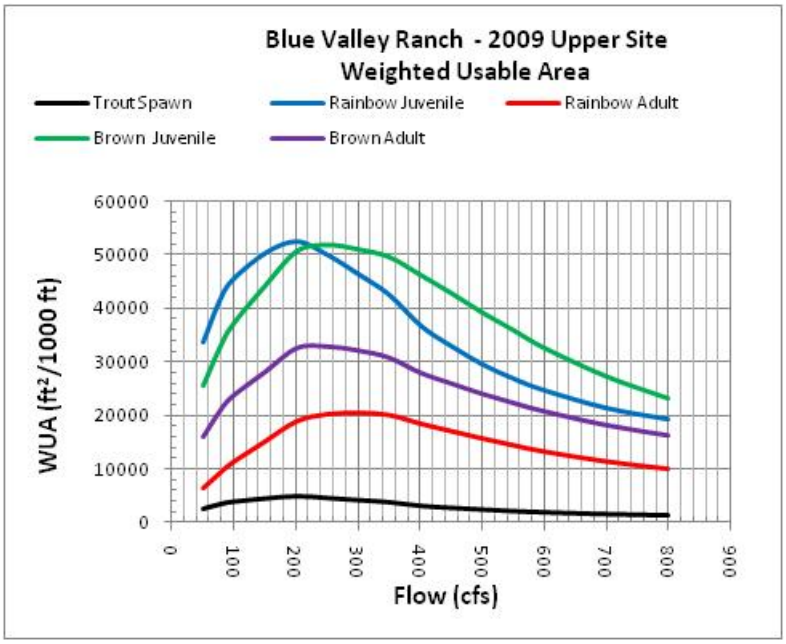


Habitat-flow relations for the 2008 spawning transects downstream of Trough Road.

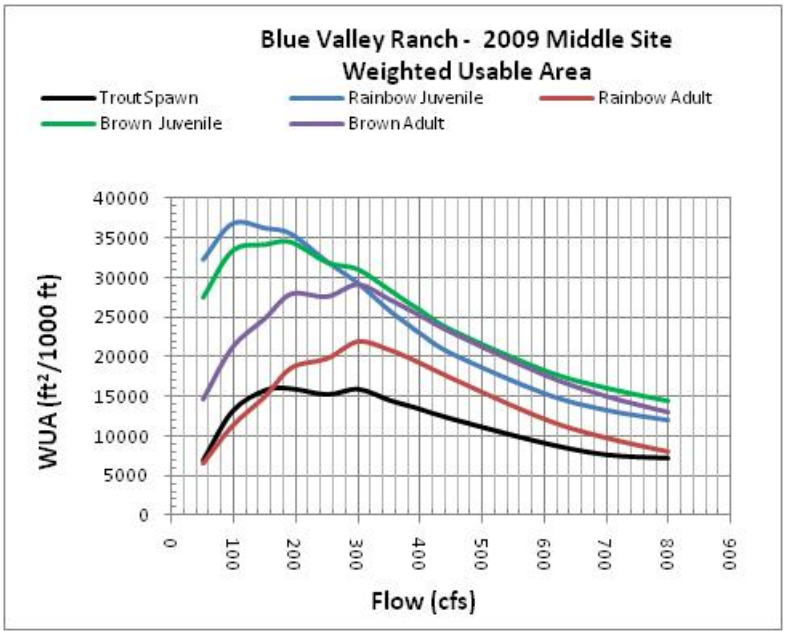
Reach BR		
Discharge	Total Area	Trout Spawn
(cfs)	(ft^2)	Weighted Usable Area (ft^2/1000 ft stream length)
100.00	84488.0	38506.9
150.00	99744.1	44559.1
200.00	112705.6	47988.0
240.00	113301.1	49040.0
250.00	113439.5	49117.9
300.00	114081.8	48484.5
400.00	114902.1	46920.3
470.00	115508.2	41784.2
500.00	115733.4	39080.0



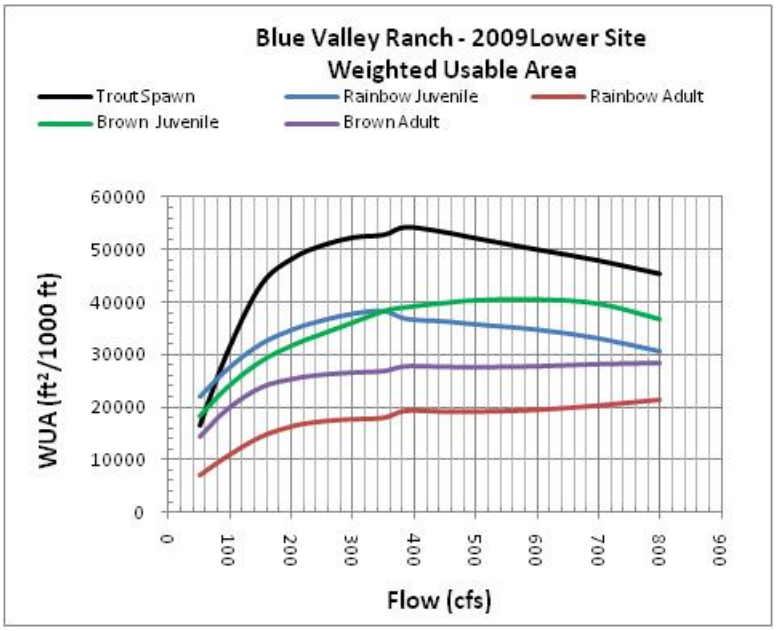
Reach BR 2009 Upper Site						
Discharge	Total Area	Trout Spawn	Rainbow Juvenile	Rainbow Adult	Brown Juvenile	Brown Adult
(cfs)	(ft^2)	Weighted Usable Area (ft^2/1000 ft stream length)				
50	90162	2524	33683	6432	25661	16095
75	92523	3317	41059	9064	32302	20589
96	93974	3802	45140	11108	36767	23524
150	97116	4439	50332	15186	44303	28207
201	99407	4856	52519	18973	50731	32651
250	101151	4526	50040	20282	51904	32943
300	102822	4131	46448	20525	51094	32204
350	104198	3744	42561	20119	49656	30848
402	105199	3058	36663	18474	46220	27967
450	106131	2706	32974	17132	42946	26070
500	106862	2383	29550	15760	39320	24120
550	107535	2087	26872	14471	36050	22423
600	108164	1865	24679	13299	32719	20866
700	109334	1524	21347	11437	27415	18289
800	110437	1299	19245	10051	23294	16370



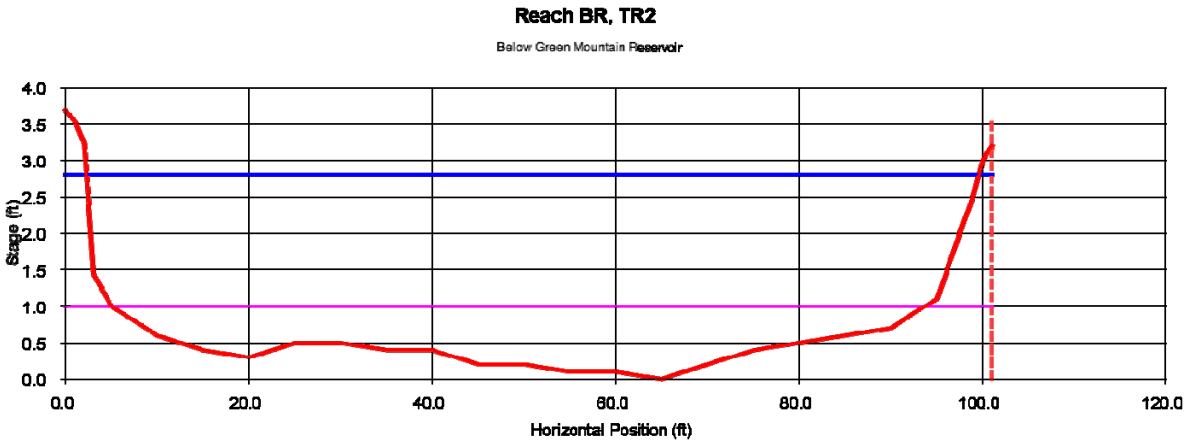
Reach BR 2009 Middle Site						
Discharge	Total Area	Trout Spawn	Rainbow Juvenile	Rainbow Adult	Brown Juvenile	Brown Adult
(cfs)	(ft^2)	Weighted Usable Area (ft^2/1000 ft stream length)				
50	72068	6962	32213	6632	27451	14688
97	77031	13089	36707	11347	33294	21174
150	80274	15723	36142	15073	34096	24848
192	82277	15928	35407	18662	34384	27897
250	84475	15197	31936	19833	31850	27569
300	86157	15859	29210	21965	30963	29081
350	87659	14499	25850	20928	28408	27234
380	88453	13817	24077	19978	26825	26004
400	89136	13354	22947	19258	25861	25173
450	90185	12163	20446	17384	23378	23080
600	93269	9120	15434	12225	18284	17737
700	93969	7649	13334	9845	16064	15053
800	94595	7216	12068	8108	14434	13042



Reach BR 2009 Lower Site						
Discharge	Total Area	Trout Spawn	Rainbow Juvenile	Rainbow Adult	Brown Juvenile	Brown Adult
(cfs)	(ft^2)	Weighted Usable Area (ft^2/1000 ft stream length)				
50	85376	16452	21845	7093	18315	14405
94	93968	30179	27043	10621	23705	19570
150	100101	43224	32040	14361	28764	23775
204	103133	48382	34896	16422	31949	25420
250	105793	50681	36548	17266	34019	26173
300	107995	52189	37852	17683	36165	26578
350	109897	52679	38366	17922	38318	26856
386	110997	54138	36865	19250	39069	27748
450	112449	53171	36336	19085	39886	27654
500	114671	52030	35777	19092	40380	27616
600	116757	49896	34747	19418	40553	27756
700	118821	47806	33094	20261	39737	28179
800	120031	45285	30588	21322	36810	28394



Cross-section and Bedload Threshold Plots and Tables

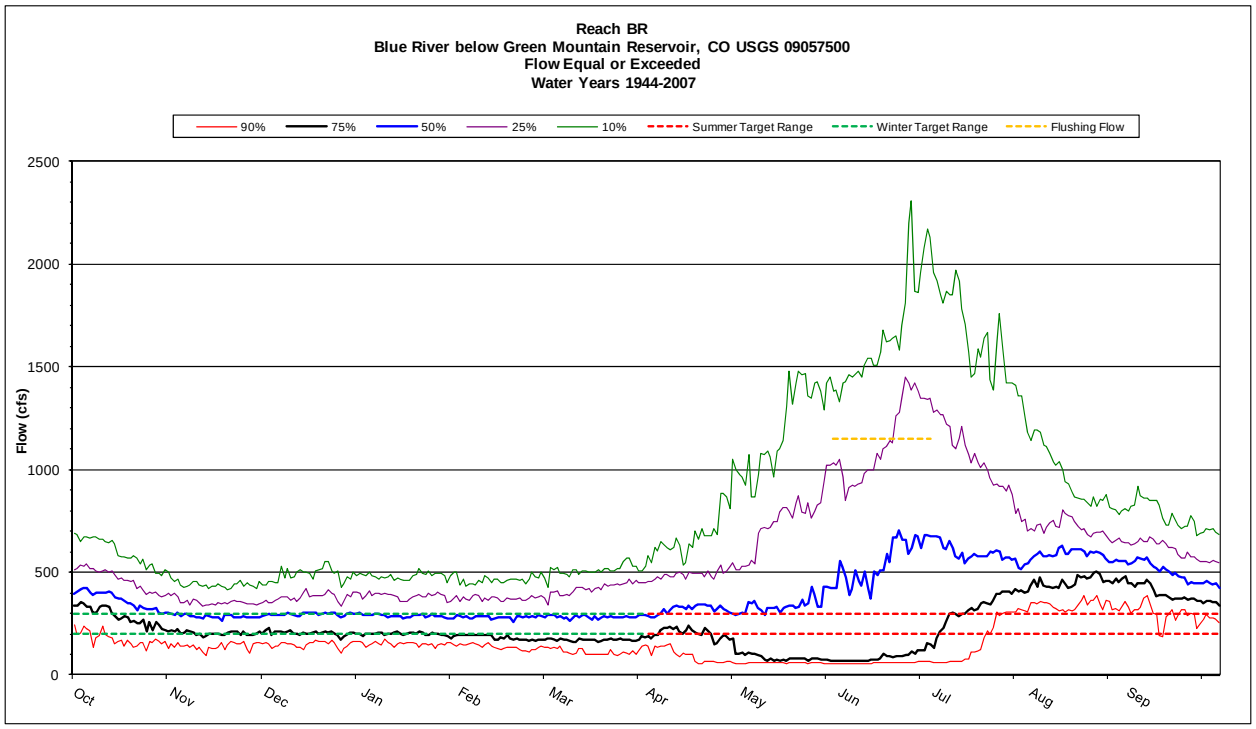


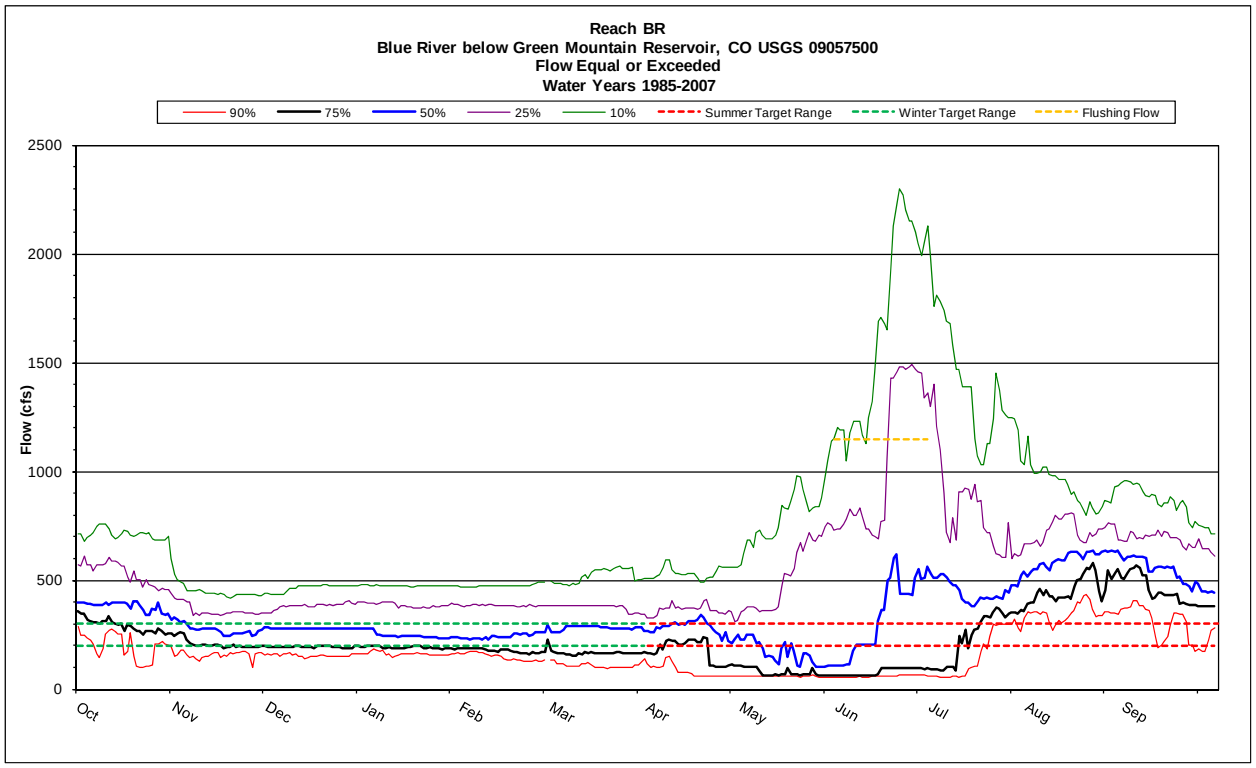
Reach BR, TR2
TT2008 site

Resistance Method: Manning's n
Low Stage n 0.030
High Stage n 0.010

STAGE (ft)	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)	SLOPE (ft/ft)	n	VAVG (ft/s)	Q (cfs)	SHEAR (psf)
1.00	51.81	83.80	83.75	0.620	0.620	0.003	0.030	1.97	102.29	0.12
1.10	60.27	85.530	85.460	0.70	0.71	0.003	0.030	2.23	134.21	0.14
1.20	68.86	86.300	86.200	0.80	0.80	0.003	0.029	2.50	172.10	0.16
1.30	77.51	87.070	86.940	0.89	0.89	0.003	0.029	2.78	215.26	0.19
1.40	86.24	87.830	87.680	0.98	0.98	0.003	0.028	3.06	263.99	0.21
1.50	95.04	88.370	88.160	1.08	1.08	0.004	0.028	3.36	319.09	0.24
1.60	103.87	88.780	88.500	1.17	1.17	0.004	0.027	3.66	380.69	0.27
1.70	112.74	89.200	88.830	1.26	1.27	0.004	0.027	3.98	448.87	0.30
1.80	121.64	89.610	89.170	1.36	1.36	0.004	0.026	4.31	523.98	0.33
1.90	130.57	90.020	89.500	1.45	1.46	0.004	0.026	4.64	606.40	0.36
2.00	139.54	90.430	89.840	1.54	1.55	0.004	0.026	4.99	696.55	0.40
2.10	148.54	90.850	90.180	1.64	1.65	0.004	0.025	5.35	794.86	0.43
2.20	157.57	91.260	90.510	1.73	1.74	0.004	0.025	5.72	901.80	0.47
2.30	166.64	91.670	90.850	1.82	1.83	0.004	0.024	6.11	1017.88	0.50
2.40	175.74	92.080	91.190	1.91	1.93	0.005	0.024	6.51	1143.66	0.54
2.50	184.88	92.500	91.520	2.00	2.02	0.005	0.023	6.92	1279.70	0.58
2.60	194.05	92.860	91.800	2.09	2.11	0.005	0.023	7.35	1427.14	0.62
2.70	203.24	93.200	92.070	2.18	2.21	0.005	0.022	7.81	1586.37	0.67
2.80	212.46	93.550	92.330	2.27	2.30	0.005	0.022	8.27	1757.97	0.71

Hydrographs and Exceedence Plots and Tables





Return Period T (year)	**Probability P (percent)**	**Flood Discharge Q (ft^3/sec)**
1.05	95.2	778
1.11	90.1	901
1.25	80	1079
2	50	1530
5	20	2184
10	10	2638
25	4	3232

Flood frequency analysis for USGS 09057500 Blue River below Green Mountain Reservoir CO, for 59 years of record (Water years 1948-2006; regulated).

IHA Results

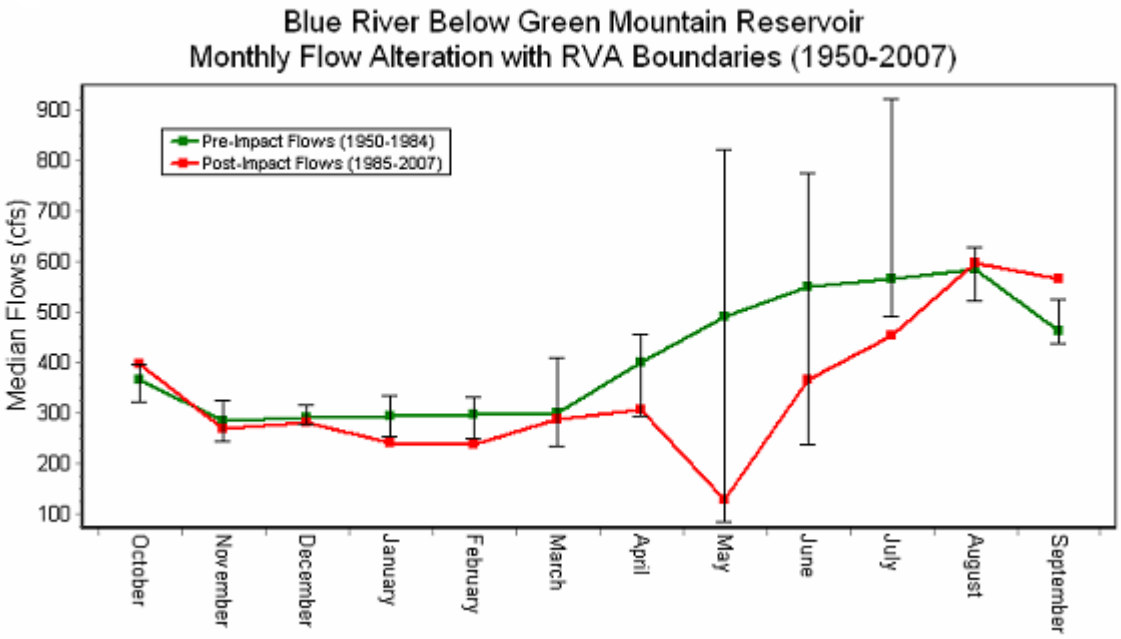
Reach BR
Non-Parametric IHA Scorecard
Blue River below Green Mountain Reservoir, USGS 09057500
Blue River 1950-84 vs 1985-2007

	Pre-impact period: 1950-1984 (35 years)	Post-impact period: 1985-2007 (23 years)
Mean annual flow	459.2	406.2
Mean flow/area	459.2	406.2
Annual C. V.	0.82	0.82
Flow predictability	0.54	0.53
Constancy/predictability	0.72	0.74
% of floods in 60d period	0.29	0.27
Flood-free season	10	47

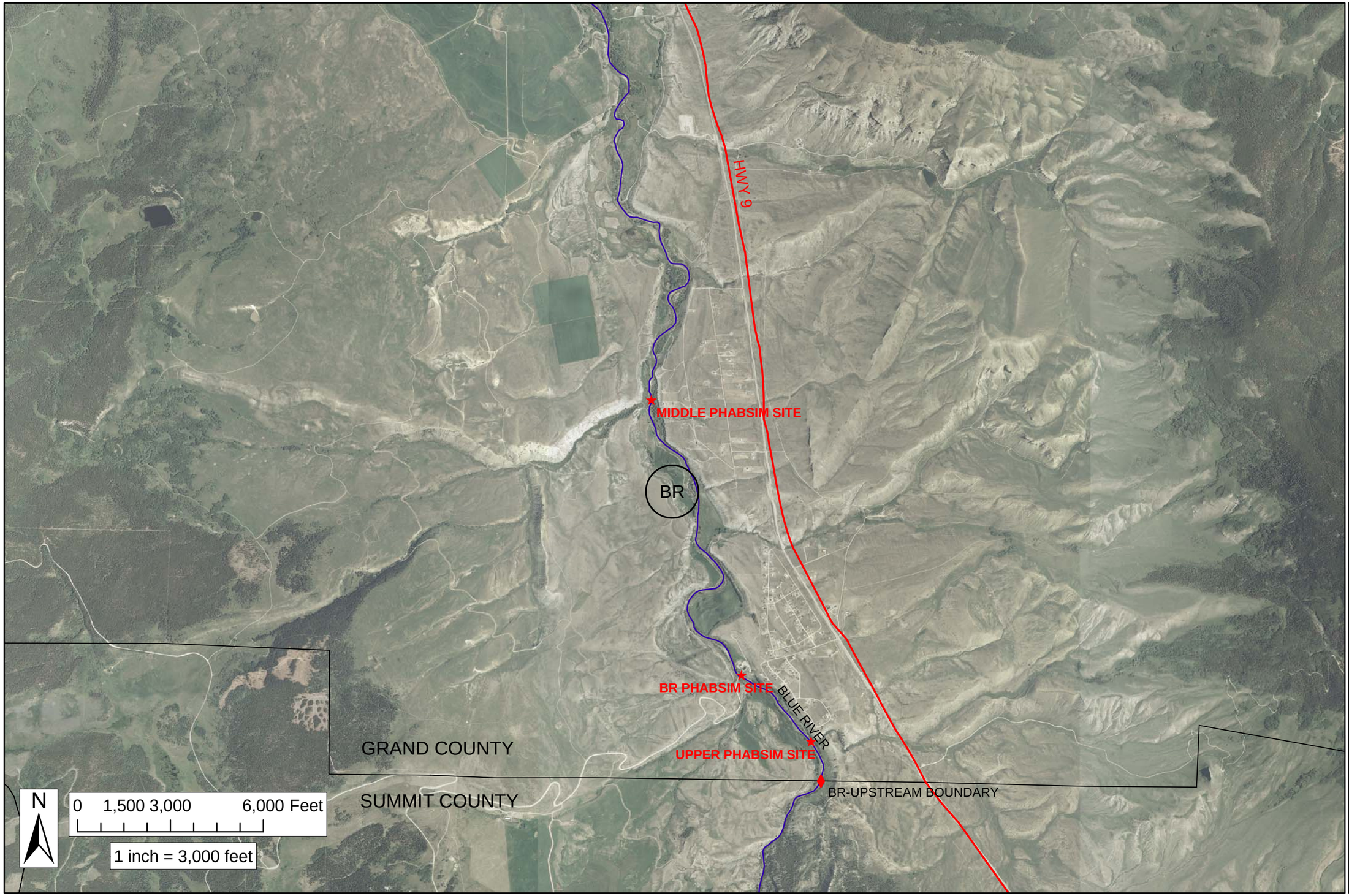
	MEDIANS		COEFF. of DISP.		DEVIATION FACTOR		SIGNIFICANCE COUNT	
	Pre	Post	Pre	Post	Medians	C.D.	Medians	C.D.
Parameter Group #1								
October (cfs)	365	398	0.3753	0.6332	0.09041	0.6869	0.2082	0.05405
November (cfs)	284	267.5	0.4155	0.5271	0.0581	0.2686	0.4915	0.3373
December (cfs)	292	280	0.2466	0.6714	0.0411	1.723	0.5055	0.001001
January (cfs)	295	242	0.4746	0.7727	0.1797	0.6282	0.08408	0.07307
February (cfs)	298	236.5	0.4128	0.8753	0.2064	1.121	0.0971	0.01101
March (cfs)	300	287	0.8367	0.7561	0.04333	0.0963	0.5686	0.6436
April (cfs)	399	307	0.6729	0.4039	0.2306	0.3998	0.1191	0.1331
May (cfs)	490	128	1.688	3.594	0.7388	1.129	0.2753	0.1542
June (cfs)	551.5	365.5	1.84	2.389	0.3373	0.2978	0.5085	0.4665
July (cfs)	565	453	1.019	1.219	0.1982	0.1953	0.1572	0.4665
August (cfs)	585	598	0.3658	0.2809	0.02222	0.232	0.6607	0.5876
September (cfs)	464	566	0.3502	0.4744	0.2198	0.3545	0.02503	0.2112
Parameter Group #2								
1-day minimum (cfs)	55	59	3.182	0.7797	0.07273	0.755	0.4695	0.3944
3-day minimum (cfs)	74.67	69.33	2.768	0.6538	0.07143	0.7638	0.9139	0.3103
7-day minimum (cfs)	80.86	82	2.873	0.6481	0.01413	0.7744	0.977	0.07608
30-day minimum (cfs)	157.2	112.8	1.452	1.246	0.2824	0.1419	0.5125	0.6747
90-day minimum (cfs)	237.5	170.3	0.7157	0.9172	0.2829	0.2815	0.1572	0.2903
1-day maximum (cfs)	1480	1260	0.5412	0.6841	0.1486	0.2641	0.2713	0.3183
3-day maximum (cfs)	1460	1143	0.545	0.6921	0.2169	0.27	0.2012	0.3203
7-day maximum (cfs)	1396	990.6	0.5629	0.6996	0.2903	0.2427	0.1672	0.3894
30-day maximum (cfs)	1071	805.1	0.6854	0.6937	0.2482	0.01212	0.2222	0.971
90-day maximum (cfs)	754.1	623.4	0.6655	0.7647	0.1733	0.1491	0.2012	0.5786
Number of zero days (count)	0	0	0	0				
Base flow index (7day minimun in cfs/median in cfs)	0.2229	0.2086	1.354	0.8031	0.06441	0.4067	0.7698	0.2012
Parameter Group #3								
Date of minimum (Julian day)	296	154	0.4617	0.1639	0.776	0.645	0.1171	0.02002
Date of maximum (Julian day)	178	185	0.1366	0.194	0.03825	0.42	0.2843	0.5195
Parameter Group #4								
Low pulse count (#)	4	4	2.5	0.75	0	0.7	0.5035	0.1081
Low pulse duration (days)	5.25	6	4.905	2.917	0.1429	0.4053	0.6326	0.5636
High pulse count (#)	5	3	1.4	1	0.4	0.2857	0.1872	0.5836
High pulse duration (days)	7.5	14	2.8	1.714	0.8667	0.3878	0.0991	0.2753
The low pulse threshold is (cfs)	253							
The high pulse threshold is (cfs)	538							
Parameter Group #5								
Rise rate (cfs difference between consecutive days)	4	4	4.25	0.5	0	0.8824	0.6987	0.1171
Fall rate (cfs difference between consecutive days)	-4	-4	-4	-0.5	0	0.875	0.2272	0.2352
Number of reversals	163	126	0.2209	0.1905	0.227	0.1376	0.00	0.5395

Reach BR
IHA Percentile Data
Blue River below Green Mountain Reservoir, USGS 09057500
Blue River 1950-84 vs 1985-2007

	Pre-impact period: 1950-1984 (35 years)						Post-impact period: 1985-2007 (23 years)					
			Pre-Impact						Post-Impact			
	10%	25%	50%	75%	90%	(75-25)/50	10%	25%	50%	75%	90%	(75-25)/50
Parameter Group #1												
October (cfs)	178.2	288	365	425	504	0.3753	270.6	314	398	566	703.2	0.6332
November (cfs)	163	216	284	334	370.3	0.4155	185.1	203	267.5	344	427.9	0.5271
December (cfs)	158.4	254	292	326	407.6	0.2466	150.4	194	280	382	476.4	0.6714
January (cfs)	168	246	295	386	460.6	0.4746	164	190	242	377	474.4	0.7727
February (cfs)	145	235	298	358	444.2	0.4128	149.4	177	236.5	384	475.2	0.8753
March (cfs)	154.2	192	300	443	501	0.8367	103.6	166	287	383	542	0.7561
April (cfs)	139.3	232.5	399	501	758.8	0.6729	66	216	307	340	509.3	0.4039
May (cfs)	57.8	69	490	896	1346	1.688	62.8	69	128	529	797.4	3.594
June (cfs)	56.6	80	551.5	1095	1538	1.84	61	91	365.5	964	1519	2.389
July (cfs)	110.2	417	565	993	1596	1.019	110	321	453	873	1156	1.219
August (cfs)	378.2	475	585	689	814.4	0.3658	373.4	506	598	674	889.8	0.2809
September (cfs)	361.6	402	464	564.5	677.2	0.3502	359.2	449	566	717.5	814.5	0.4744
Parameter Group #2												
1-day minimum (cfs)	11.6	34	55	209	300.4	3.182	5.72	53	59	99	194.2	0.7797
3-day minimum (cfs)	26.2	50.67	74.67	257.3	307.8	2.768	44.27	55	69.33	100.3	197.7	0.6538
7-day minimum (cfs)	51	54.43	80.86	286.7	313	2.873	51.66	55.43	82	108.6	201.1	0.6481
30-day minimum (cfs)	55.31	62.47	157.2	290.8	331.6	1.452	55.76	65.53	112.8	206.2	342.5	1.246
90-day minimum (cfs)	93.5	124.3	237.5	294.3	348.8	0.7157	71.6	124	170.3	280.3	393.7	0.9172
1-day maximum (cfs)	780.2	929	1480	1730	2728	0.5412	717.2	878	1260	1740	2858	0.6841
3-day maximum (cfs)	692.5	911	1460	1707	2657	0.545	693.6	872	1143	1663	2825	0.6921
7-day maximum (cfs)	661.6	868.6	1396	1654	2425	0.5629	648.5	858.4	990.6	1551	2745	0.6996
30-day maximum (cfs)	583	685.3	1071	1419	1856	0.6854	570.7	667.5	805.1	1226	1985	0.6937
90-day maximum (cfs)	424	504.4	754.1	1006	1478	0.6655	411	477.2	623.4	953.9	1293	0.7647
Number of zero days (count)	0	0	0	0	0	0	0	0	0	0	0	0
Base flow index (7day minimun in cfs/median in cfs)	0.1187	0.1525	0.2229	0.4543	0.5716	1.354	0.1177	0.1659	0.2086	0.3334	0.4603	0.8031
Parameter Group #3												
Date of minimum (Julian day)	119.2	130	296	327	0.6	0.4617	78.2	123	154	183	332.2	0.1639
Date of maximum (Julian day)	122	150	178	200	240.2	0.1366	156.4	172	185	243	273.2	0.194
Parameter Group #4												
Low pulse count (#)	0	1	4	11	29	2.5	1.4	2	4	5	7	0.75
Low pulse duration (days)	1.95	2	5.25	27.75	44.45	4.905	1	3	6	20.5	58.9	2.917
High pulse count (#)	1	2	5	9	16.4	1.4	1.4	2	3	5	6.2	1
High pulse duration (days)	2	3.75	7.5	24.75	69	2.8	6	8	14	32	56.7	1.714
Parameter Group #5												
Rise rate (cfs difference between consecutive days)	2	2	4	19	40.2	4.25	3	4	4	6	9.3	0.5
Fall rate (cfs difference between consecutive days)	-53	-19	-4	-3	-2	-4	-6	-5	-4	-3	-3	-0.5
Number of reversals	126.6	140	163	176	193.2	0.2209	101.8	115	126	139	146.8	0.1905
EFC Monthly Low Flows												
October Low Flow (cfs)	194	283	326	366.8	436.5	0.2569	237.6	281.5	338	409.5	459.8	0.3787
November Low Flow (cfs)	181.1	233	291	329.5	370.3	0.3316	186	202.5	253	296	404.4	0.3696
December Low Flow (cfs)	158.4	252	288	316	374.6	0.2222	144.1	185	223.5	339.9	417.4	0.693
January Low Flow (cfs)	165.3	229.4	286.5	335.8	412	0.3713	158	188.5	211.5	296.3	395	0.5095
February Low Flow (cfs)	145	233	285	337	413.2	0.3649	149.1	173.6	206.8	328.5	396.6	0.7491
March Low Flow (cfs)	151.8	191	277.5	392	475.4	0.7243	113.6	166	199	315	424.2	0.7487
April Low Flow (cfs)	158.2	206	303.5	432.5	496.2	0.7463	148.6	210	300	327.8	466.2	0.3925
May Low Flow (cfs)	84.3	238.9	318.8	433.8	518.6	0.6114	94.5	108.1	231.5	330	516.4	0.9584
June Low Flow (cfs)	85	235.5	344	425.5	507	0.5523	96.3	105	288.5	362.5	491.1	0.8925
July Low Flow (cfs)	119	249.5	340	481.5	496	0.6824	208	248	322	376	406	0.3975
August Low Flow (cfs)	302	345	425	490	498	0.3412	309.6	349.5	417.3	457.5	489	0.2588
September Low Flow (cfs)	292.4	334	393	420	489.8	0.2188	106.9	315.8	388	437.3	486.3	0.3131
EFC Parameters												
Extreme low peak (cfs)	12.3	26.75	49	55.25	64.05	0.5816	4.5	52	56	64.13	67.75	0.2165
Extreme low duration (days)	1	1	3.5	45.63	55.1	12.75	1	4.25	16.5	28.38	76	1.462
Extreme low timing (Julian date)	29.55	119.5	160	313.6	346.5	0.4696	82.75	112.4	143.8	167.3	257.5	0.1499
Extreme low freq. (#/year)	0	0	1	2	16	2	0	0	1	1	3.6	1
High flow peak (cfs)	489.2	559.8	620	710	960.8	0.2423	584.3	618.5	697.5	947.8	1102	0.472
High flow duration (days)	3	4.25	8.5	25.5	41	2.5	6.45	15.75	24	42.5	68.25	1.115
High flow timing (Julian date)	58.9	115.5	206	239	277.4	0.3374	160.8	200.5	211	241.1	262.5	0.111
High flow frequency (#/year)	1	2	4	12	22	2.5	1	2	3	3	4.6	0.3333
High flow rise rate (cfs differnenc between consecutive days)	25.7	41.43	94.92	143.7	211.3	1.077	12.41	29.25	58.36	81.01	126.8	0.8867
High flow fall rate (cfs difference between consecutive days)	-154.6	-99.9	-43.25	-23.96	-18.92	-1.756	-114.5	-60.7	-39.45	-21.01	-11.34	-1.006
Small Flood peak (cfs)	1480	1518	1595	1850	2252	0.2085	1615	1619	1760	2375	2480	0.4297
Small Flood duration (days)	29.1	44.25	62	93	113.5	0.7863	15	24.75	60.75	81.5	110	0.9342
Small Flood timing (Julian date)	136	145.8	165	186.8	227.9	0.112	163	169	178	185.9	188.5	0.04611
Small Flood freq. (#/year)	0	0	0	1	1	0	0	0	0	1	1	0
Small Flood riserate (cfs difference between consecutive days)	22.13	27.73	48.54	90.08	172.9	1.285	34.76	61.56	79.63	260.1	313	2.493
Small Flood fallrate (cfs difference between consecutive days)	-118.7	-54.17	-46.32	-30.09	-18.37	-0.5197	-111.7	-91.26	-49.23	-34.7	-16.06	-1.149
Large flood peak (cfs)	2980	2980	3040	3370	3370	0.1283	3110	3110	3560	4010	4010	0.2528
Large flood duration (days)	60	60	140	141	141	0.5786	92	92	93	94	94	0.02151
Large flood timing (Julian date)	183	183	190	193	193	0.02732	177	177	185.5	194	194	0.04645
Large flood freq. (#/year)	0	0	0	0	0.4	0	0	0	0	0	0.6	0
Large flood riserate (cfs difference between consecutive days)	32.63	32.63	41.07	391.3	391.3	8.733	40.52	40.52	63.22	85.93	85.93	0.7183
Large flood fallrate (cfs difference between consecutive days)	-54.4	-54.4	-37.95	-33.59	-33.59	-0.5481	-95.41	-95.41	-81.48	-67.54	-67.54	-0.3421


Blue River Below Green Mountain Reservoir
Monthly Flow Alteration with RVA Boundaries (1950-2007)
Pre-Impact Flows (1950-1984)
Post-Impact Flows (1985-2007)
Median Flows (cfs)
900
800
700
600
500
400
300
200
100
October
November
December
January
February
March
April
May
June
July
August
September

GRAND COUNTY STREAM MANAGEMENT PLAN REACHES



Legend

- REACH BOUNDARY
- PHABSIM SITES
- DIVERSIONS

REACH: BR

SHEET # :
1 OF 2

TETRA TECH

GRAND COUNTY STREAM MANAGEMENT PLAN REACHES

TOWN OF KREMMLING

HWY 40

RIVER RANCH VILLAGE PMP1

MCELROY NO 1 DITCH

MARTIN PUMP NO 1 DITCH

MUDDY CREEK

CR7

CR6

MCELROY NO 2 DITCH

MCELROY STATE PUMP NO 1

T A ENGLE DITCH NO 1-651

THOMPSON PUMP NO 1

THOMPSON PUMP NO 2

T A ENGLE DITCH NO 3

T A ENGLE DITCH NO 1-925

T A ENGLE DITCH NO 2

KENNY BARGER DITCH

HOLDCROFT PUMP NO 1

HOLDCROFT PUMP NO 2

HOLDCROFT

Public Fishing Access

CR6/CR7/BR/MC2 BOUNDARY

BR

COLORADO RIVER

BR PHABSIM SITE BLW. TROUGH RD. (SPAWNING SITE)

DRY CREEK DITCH (HDG 2)

CR7

LOWER PHABSIM SITE

LOBACK DITCH

BLUE RIVER

HWY 9

N

0 1,500 3,000 6,000 Feet

1 inch = 3,000 feet

Legend

- REACH BOUNDARY
- PHABSIM SITES
- DIVERSIONS

REACH: BR

SHEET # :
2 OF 2

GRAND COUNTY Colorado · Est 1874

TETRA TECH