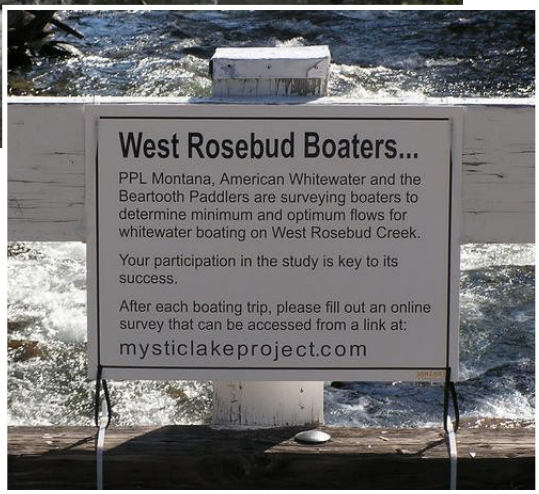
West Rosebud Creek Whitewater Flow Study 2004-05 Report

Triple Tongue Rapid



September 26, 2005

Prepared for:

PPL Montana

By:

American Lands Co. and REC Resources

Summary

Spillway Rapid, about 360 cfs

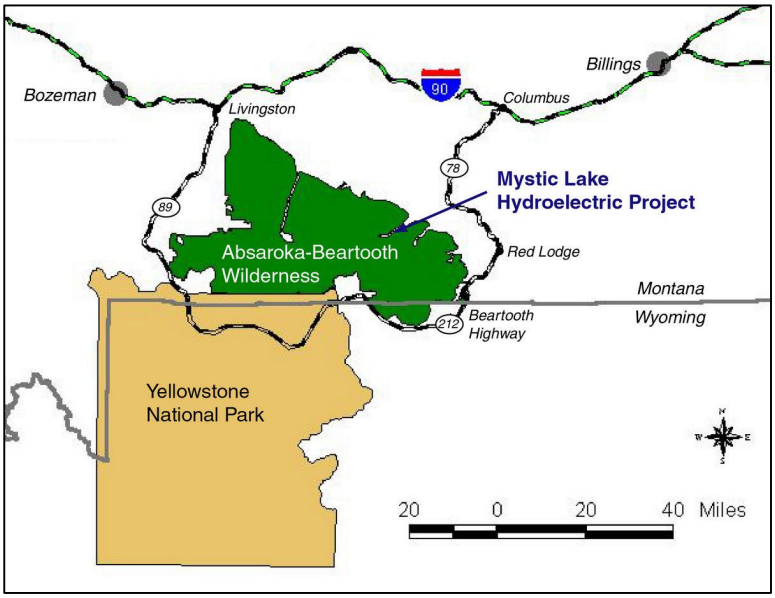
- PPL Montana conducted a whitewater flow study of West Rosebud Creek in 2004-05, with the assistance of the Beartooth Paddlers and American Whitewater.
- Fifty-five paddlers reported characteristics of 128 trips on the creek, through a survey questionnaire and focus group. Boaters experienced a variety of creek flows, ranging from about 50 to 460 cfs.
- Paddlers rated flows on the creek as Class IV and Class V whitewater.
- The creek's scenery, boatability, and challenge scored high. Eighty-six percent of trips were given an overall rating of "somewhat or highly acceptable."
- Eighty-one percent of boaters would "probably or definitely return" for the same flow boated. Satisfaction was highest for flows of 351 to 500 cfs.
- Preference for a flow higher than what was boated decreased significantly for trips above 451 cfs.
- Flow become acceptable at about 300 cfs and is highly acceptable in the 400 to 500 cfs range for most paddlers. Acceptability begins to diminish above 550 cfs
- The minimum acceptable flow for whitewater boating was 300 cfs (median response). A flow of 350 cfs would satisfy the minimum requirements of 87 percent of paddlers. Lower flow is more acceptable later in the season when other area boating opportunities are scarce.
- The optimum flow for whitewater boating was 450 cfs (median response). Eighty-three percent of boaters view optimum flow as 500 cfs or less.
- A flow of 400 cfs is best for a "standard trip" on the West Rosebud, while a flow of 550 cfs is best for a "high challenge" trip.
- If only one flow were available for boating on the West Rosebud, the median preferred flow was 450 cfs. Eighty-seven percent of boaters chose a flow in the 300 to 500 cfs range.
- Sixty-eight percent of boaters rated the creek as "excellent or among the very best" compared to other rivers within a one-hour drive. Fifty-nine percent rated it as "excellent or among the very best" compared to other rivers in Montana.

Contents

Background

West Rosebud Creek flows northeasterly from the Beartooth Mountains in southcentral Montana. It originates on lands managed by the Custer National Forest, passes onto private lands and joins the Stillwater River near Absarokee, Montana.

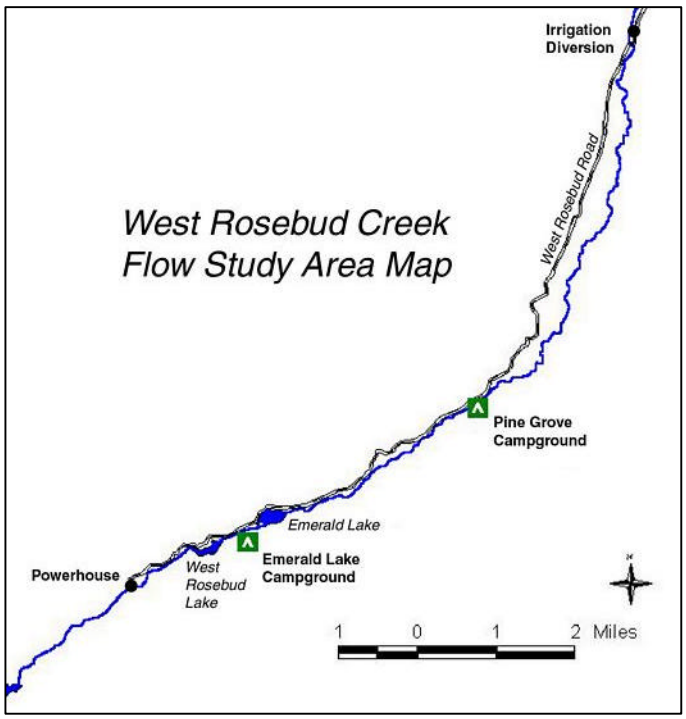
PPL Montana operates the Mystic Lake Hydroelectric Project within the West Rosebud watershed on Forest Service land.



Whitewater paddlers view West Rosebud Creek as a valuable boating resource. Because of Project operations, peak creek flows are typically delayed until mid July, when flows in other nearby creeks are usually diminishing. This makes the West Rosebud an attractive summer paddling destination.

Boaters divide the West Rosebud into two runs. The upper 2.5-mile run begins at the outlet of Emerald Lake and ends at Pine Grove Campground. The lower run continues from Pine Grove Campground to a take-out near an irrigation diversion, 10 miles farther downstream.

In preparation for the Project's FERC relicensing application, PPL Montana worked with American Whitewater and the Beartooth Paddlers Club to study minimum acceptable and optimum flows for whitewater boating on West Rosebud Creek, below PPL Montana's reregulation dam at West Rosebud Lake.



The study was conducted over a range of creek flows during the 2004 and 2005 boating seasons, allowing boaters to experience and report on a diversity of whitewater conditions. Although 2004 was a drought year in Montana, flows in 2005 were more typical of a "normal" year.

Two study methods were used to acquire information from paddlers about their perceptions of West Rosebud Creek flows.

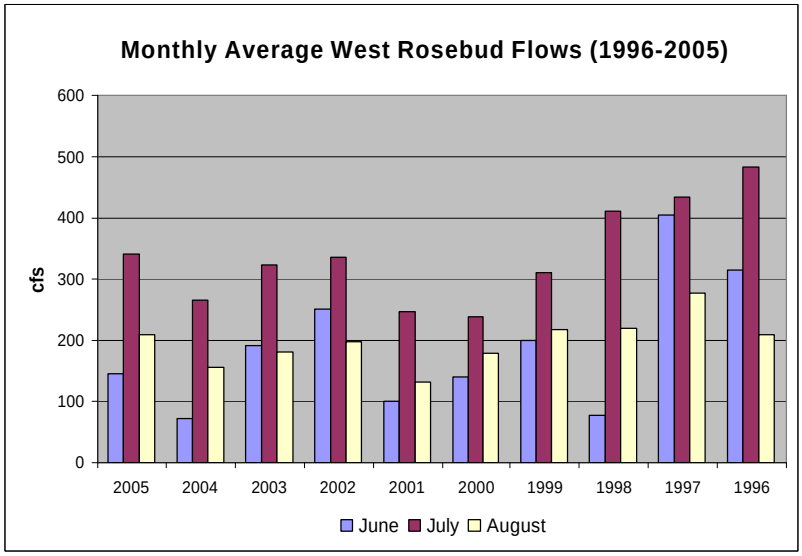
One method consisted of a survey questionnaire (Appendix A) that boaters completed on the Internet or on site after each trip. The first part of the questionnaire gathered trip information and asked paddlers to evaluate the boating experience and their flow preference relative to the flow they boated. Data from this first section were

included in the analysis for every trip each boater made. The second part of the questionnaire asked boaters to evaluate the acceptability of various flows and identify minimum acceptable and optimum flows. Although paddlers completed this second section after each trip, only their most recent responses (from their last completed survey) were used during analysis, because it was expected that their feedback would improve with more West Rosebud experience. This also reduced the effect of repeat survey participants overly-influencing study results.

Emerald Lake put-in

The other study method was a focus group exercise conducted on site in early July 2005 (Appendix B). The focus group was composed of 15 experienced paddlers from Montana that were invited to participate in the study. The group assessed flows ranging from approximately 360 to 460 cfs over a two-day period, discussing advantages and disadvantages, special attributes, safety, and thoughts on higher and lower flows. Focus group participants also completed a survey questionnaire after each run.

Together, the two study methods provide a comprehensive assessment of whitewater boating on West Rosebud Creek. Results from the two methods are interspersed in the following sections of this report. Because of the importance of flow as an independent variable, many of the results are cross tabulated with the West Rosebud flow measured by PPL Montana at the West Rosebud Lake reregulation dam during the boating activity.



Overall, 55 paddlers participated in the whitewater study, reporting experiences from 128 boating trips during the two-season study period.

PPL Montana greatly appreciates the contribution of these many whitewater boaters, as well as the Beartooth Paddlers Club and American Whitewater. This study would not have been possible without their cooperation and support.

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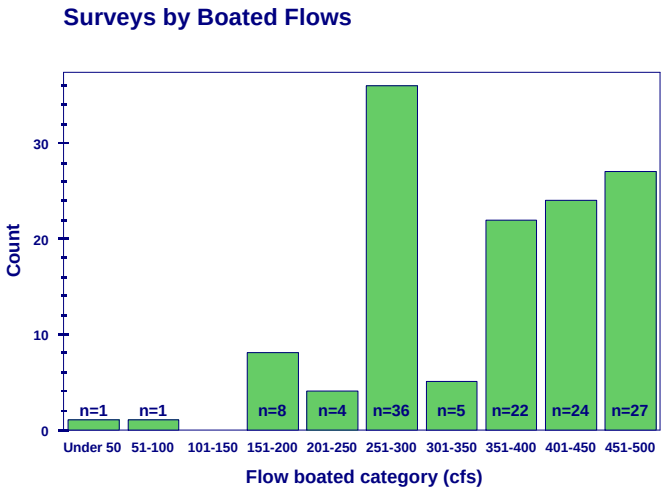
Boating Activity

Flows Boated

In total, 128 surveys were completed for West Rosebud boating trips that occurred from June 2004 through July 2005. Most boating activity occurred when flows peaked in July of both years.

Sixty-one percent of the boating occurred at flows between 301 and 500 cfs, the flow range anticipated to be desirable for whitewater activity.

The highest flow boated was approximately 460 cfs on July 9, 2005 and the lowest was about 45 cfs on August 15, 2004 (when the hydro plant was temporarily offline). A relatively large number of boaters experienced flows of 251-300 cfs because this was the season high in 2004 and many boaters turned out to participate in the study.



Run Boated and Whitewater Classification

Most of the whitewater use was on the upper 2.5-mile run (between Emerald Lake and Pine Grove Campground), with 85 percent of the trips on that run only. Another nine percent of trips included the upper run and the lower 10-mile run (between Pine Grove Campground and the irrigation diversion). Six percent of trips were on the lower run only. All boaters used hard shell kayaks on their trips.

Run boated

	Frequency	Percent
Upper only	109	85.2
Lower only	8	6.3
Upper and lower	11	8.6
Total	128	100.0

When asked to rate the whitewater classification, the upper run was rated Class IV whitewater on 87 percent of the trips and Class V on nine percent. The lower run was rated as Class IV whitewater on 67 percent of trips and Class V on 22 percent. The survey format didn't allow for gradation between classifications and when ratings were discussed in the focus group, it was felt that flows were Class IV+ or Class V- because of significant consequences associated with both runs.

Upper run rating

	Frequency	Percent
3	4	3.4
4	103	87.3
5	11	9.3
Total	118	100.0

Lower run rating

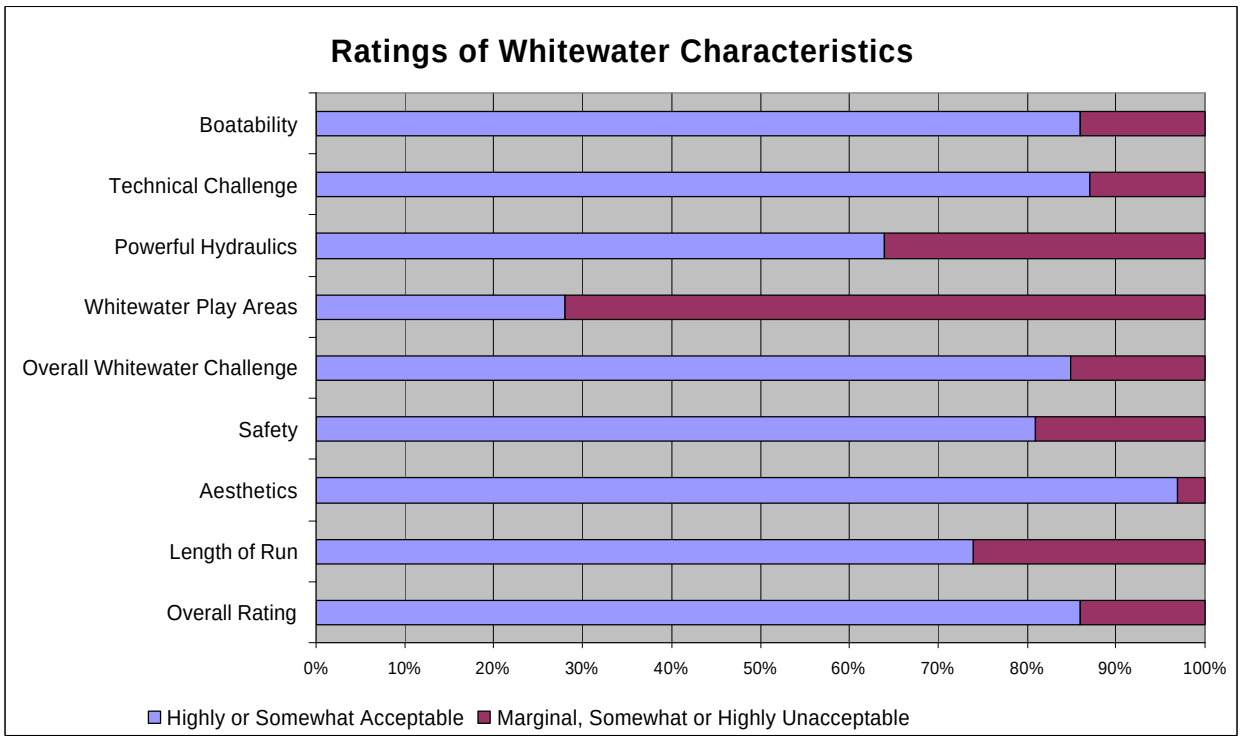
	Frequency	Percent
3	2	11.1
4	12	66.7
5	4	22.2
Total	18	100.0

Boating Characteristics

The experience of whitewater boating on West Rosebud Creek can be described by several key characteristics, such as the nature of the creek's boatability, challenge, hydraulics, safety and other factors. These whitewater characteristics vary with creek flows, as do the boating experiences they create.

Based on their desired experience, each boater evaluated the acceptability of nine whitewater characteristics provided by the flow they boated.

Considering that 39 percent of boated flows were less then 300 cfs, the West Rosebud got high marks. Eighty-six percent of trips were given an overall rating of "somewhat or highly acceptable." Scenery, boatability, and challenge scored highest while the availability of whitewater play areas scored lowest.



To better understand the relationship between various flows and whitewater characteristics, evaluations of the nine characteristics were cross tabulated with creek flows measured by PPL Montana at the West Rosebud Lake reregulation dam (see flow measurement discussion, page 15).

Boatability

Eighty-six percent of boaters rated the creek's ***boatability*** as "somewhat or highly acceptable" at the flow they paddled. Most paddlers found that boatability became acceptable in the 251-300 cfs range.

Boatability * Flow boated category (cfs) Crosstabulation

		Flow boated category (cfs)									
		Under 50	51-100	151-200	201-250	251-300	301-350	351-400	401-450	451-500	Total
Highly acceptable	Count	1		1	1	17	1	16	18	25	80
	% within Flow boated category	100.0%		12.5%	25.0%	48.6%	20.0%	72.7%	75.0%	92.6%	63.0%
Somewhat acceptable	Count		1	2	1	11	1	6	5	2	29
	% within Flow boated category		100.0%	25.0%	25.0%	31.4%	20.0%	27.3%	20.8%	7.4%	22.8%
Marginal	Count			4	1	3	2				10
	% within Flow boated category			50.0%	25.0%	8.6%	40.0%				7.9%
Somewhat unacceptable	Count			1	1	2	1		1		6
	% within Flow boated category			12.5%	25.0%	5.7%	20.0%		4.2%		4.7%
Highly unacceptable	Count					2					2
	% within Flow boated category					5.7%					1.6%
Total	Count	1	1	8	4	35	5	22	24	27	127
	% within Flow boated category	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Technical Challenge

Eighty-seven percent of boaters rated the ***availability of challenging technical boating*** as "somewhat or highly acceptable" and this was relatively high at all boated flows.

Availability of challenging technical boating * Flow boated category (cfs) Crosstabulation

		Flow boated category (cfs)									
		Under 50	51-100	151-200	201-250	251-300	301-350	351-400	401-450	451-500	Total
Highly acceptable	Count				1	17	1	16	20	24	79
	% within Flow boated category				25.0%	50.0%	20.0%	72.7%	83.3%	88.9%	62.7%
Somewhat acceptable	Count	1	1	5	2	10	1	5	3	3	31
	% within Flow boated category	100.0%	100.0%	62.5%	50.0%	29.4%	20.0%	22.7%	12.5%	11.1%	24.6%
Marginal	Count			2		4	2	1			9
	% within Flow boated category			25.0%		11.8%	40.0%	4.5%			7.1%
Somewhat unacceptable	Count			1	1	2	1		1		6
	% within Flow boated category			12.5%	25.0%	5.9%	20.0%		4.2%		4.8%
Highly unacceptable	Count					1					1
	% within Flow boated category					2.9%					.8%
Total	Count	1	1	8	4	34	5	22	24	27	126
	% within Flow boated category	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Powerful Hydraulics

Sixty-six percent of boaters rated the ***availability of powerful hydraulics*** as "somewhat or highly acceptable." Of all the whitewater characteristics, satisfaction was second lowest for hydraulics, which became more acceptable when flow rose above 351 cfs.

Availability of powerful hydraulics * Flow boated category (cfs) Crosstabulation

		Flow boated category (cfs)									
		Under 50	51-100	151-200	201-250	251-300	301-350	351-400	401-450	451-500	Total
Highly acceptable	Count					8		6	13	20	47
	% within Flow boated category					22.9%		28.6%	56.5%	76.9%	38.2%
Somewhat acceptable	Count	1			1	10	2	8	5	5	32
	% within Flow boated category	100.0%			25.0%	28.6%	40.0%	38.1%	21.7%	19.2%	26.0%
Marginal	Count		1	4	2	10	1	7	5	1	31
	% within Flow boated category		100.0%	57.1%	50.0%	28.6%	20.0%	33.3%	21.7%	3.8%	25.2%
Somewhat unacceptable	Count			3		4	1				8
	% within Flow boated category			42.9%		11.4%	20.0%				6.5%
Highly unacceptable	Count				1	3	1				5
	% within Flow boated category				25.0%	8.6%	20.0%				4.1%
Total	Count	1	1	7	4	35	5	21	23	26	123
	% within Flow boated category	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Whitewater Play Areas

Only 28 percent of boaters rated the ***availability of whitewater play areas*** as "somewhat or highly acceptable." This was the least satisfying characteristic and reflects the lack of these opportunities on the creek, which often drops quickly along a relatively narrow channel.

Availability of whitewater play areas * Flow boated category (cfs) Crosstabulation

		Flow boated category (cfs)									
		Under 50	51-100	151-200	201-250	251-300	301-350	351-400	401-450	451-500	Total
Highly acceptable	Count				1	2	1	1	1	3	9
	% within Flow boated category				25.0%	5.7%	20.0%	4.5%	4.5%	11.1%	7.2%
Somewhat acceptable	Count		1	2		7		5	6	5	26
	% within Flow boated category		100.0%	25.0%		20.0%		22.7%	27.3%	18.5%	20.8%
Marginal	Count	1				13	2	7	5	9	37
	% within Flow boated category	100.0%				37.1%	40.0%	31.8%	22.7%	33.3%	29.6%
Somewhat unacceptable	Count			4	1	8	1	7	4	5	30
	% within Flow boated category			50.0%	25.0%	22.9%	20.0%	31.8%	18.2%	18.5%	24.0%
Highly unacceptable	Count			2	2	5	1	2	6	5	23
	% within Flow boated category			25.0%	50.0%	14.3%	20.0%	9.1%	27.3%	18.5%	18.4%
Total	Count	1	1	8	4	35	5	22	22	27	125
	% within Flow boated category	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Overall Whitewater Challenge

Eighty-five percent of boaters rated the ***overall whitewater challenge*** as "somewhat or highly acceptable." Acceptability became relatively high at flows above 351 cfs.

Overall whitewater challenge * Flow boated category (cfs) Crosstabulation

		Flow boated category (cfs)									
		Under 50	51-100	151-200	201-250	251-300	301-350	351-400	401-450	451-500	Total
Highly acceptable	Count		1			17	1	13	17	21	70
	% within Flow boated category		100.0%			48.6%	20.0%	59.1%	70.8%	77.8%	55.1%
Somewhat acceptable	Count	1		2	2	10	2	8	7	6	38
	% within Flow boated category	100.0%		25.0%	50.0%	28.6%	40.0%	36.4%	29.2%	22.2%	29.9%
Marginal	Count			5	1	5	1	1			13
	% within Flow boated category			62.5%	25.0%	14.3%	20.0%	4.5%			10.2%
Somewhat unacceptable	Count			1	1	3	1				6
	% within Flow boated category			12.5%	25.0%	8.6%	20.0%				4.7%
Total	Count	1	1	8	4	35	5	22	24	27	127
	% within Flow boated category	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Safety

Eighty-one percent of boaters rated the ***safety*** as "somewhat or highly acceptable." Safety concerns were frequently mentioned in the focus group because of the consequences that could occur if a paddler gets in trouble. At higher flows on the upper run, eddies are few and assistance is difficult to offer, making reliance on self rescue important. On the lower run it was noted that wire fences spanning the creek pose serious risks to paddlers and interfere with the creek's boatability.

Safety * Flow boated category (cfs) Crosstabulation

		Flow boated category (cfs)									
		Under 50	51-100	151-200	201-250	251-300	301-350	351-400	401-450	451-500	Total
Highly acceptable	Count			2	1	11	2	12	11	7	46
	% within Flow boated category			28.6%	25.0%	31.4%	40.0%	57.1%	45.8%	25.9%	36.8%
Somewhat acceptable	Count	1		4	1	13	1	7	12	16	55
	% within Flow boated category	100.0%		57.1%	25.0%	37.1%	20.0%	33.3%	50.0%	59.3%	44.0%
Marginal	Count		1	1	1	7		2	1	1	14
	% within Flow boated category		100.0%	14.3%	25.0%	20.0%		9.5%	4.2%	3.7%	11.2%
Somewhat unacceptable	Count					1	1			2	4
	% within Flow boated category					2.9%	20.0%			7.4%	3.2%
Highly unacceptable	Count				1	3	1			1	6
	% within Flow boated category				25.0%	8.6%	20.0%			3.7%	4.8%
Total	Count	1	1	7	4	35	5	21	24	27	125
	% within Flow boated category	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Aesthetics

As could be expected in the West Rosebud's setting and with no relation to flow, 97 percent of boaters rated the ***aesthetics*** as "somewhat or highly acceptable."

Aesthetics * Flow boated category (cfs) Crosstabulation

		Flow boated category (cfs)								
		Under 50	151-200	201-250	251-300	301-350	351-400	401-450	451-500	Total
Highly acceptable	Count	1	6	2	28	4	20	22	26	109
	% within Flow boated category	100.0%	75.0%	50.0%	82.4%	80.0%	90.9%	95.7%	96.3%	87.9%
Somewhat acceptable	Count		1	1	5		2	1	1	11
	% within Flow boated category		12.5%	25.0%	14.7%		9.1%	4.3%	3.7%	8.9%
Marginal	Count		1	1						2
	% within Flow boated category		12.5%	25.0%						1.6%
Highly unacceptable	Count				1	1				2
	% within Flow boated category				2.9%	20.0%				1.6%
Total	Count	1	8	4	34	5	22	23	27	124
	% within Flow boated category	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Length of Run

Seventy-four percent of boaters rated the ***length of run*** as "somewhat or highly acceptable." Most of the boating (85 percent) was on the upper run only, which is particularly fast, with paddlers often covering the 2.5 miles in 30 minutes. Although a short run, the creek access points are conveniently located, making multiple runs easy.

Length of run * Flow boated category (cfs) Crosstabulation

		Flow boated category (cfs)									
		Under 50	51-100	151-200	201-250	251-300	301-350	351-400	401-450	451-500	Total
Highly acceptable	Count			2		11	1	7	8	13	42
	% within Flow boated category			25.0%		31.4%	20.0%	31.8%	36.4%	48.1%	33.6%
Somewhat acceptable	Count	1	1	3	1	13	3	10	10	9	51
	% within Flow boated category	100.0%	100.0%	37.5%	25.0%	37.1%	60.0%	45.5%	45.5%	33.3%	40.8%
Marginal	Count			3		8	1	4	4	5	25
	% within Flow boated category			37.5%		22.9%	20.0%	18.2%	18.2%	18.5%	20.0%
Somewhat unacceptable	Count				3	3		1			7
	% within Flow boated category				75.0%	8.6%		4.5%			5.6%
Total	Count	1	1	8	4	35	5	22	22	27	125
	% within Flow boated category	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Overall Rating

Eighty-six percent of boaters rated the ***run overall*** as "somewhat or highly acceptable." Satisfaction generally increased with flow.

Overall rating * Flow boated category (cfs) Crosstabulation

		Flow boated category (cfs)									
		Under 50	51-100	151-200	201-250	251-300	301-350	351-400	401-450	451-500	Total
Highly acceptable	Count	1	1			20	1	14	16	21	74
	% within Flow boated category	100.0%	100.0%			57.1%	20.0%	63.6%	69.6%	91.3%	60.7%
Somewhat acceptable	Count			3	1	8	2	8	7	2	31
	% within Flow boated category			37.5%	25.0%	22.9%	40.0%	36.4%	30.4%	8.7%	25.4%
Marginal	Count			5	2	5	1				13
	% within Flow boated category			62.5%	50.0%	14.3%	20.0%				10.7%
Somewhat unacceptable	Count				1		1				2
	% within Flow boated category				25.0%		20.0%				1.6%
Highly unacceptable	Count					2					2
	% within Flow boated category					5.7%					1.6%
Total	Count	1	1	8	4	35	5	22	23	23	122
	% within Flow boated category	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Pine Grove take-out

Rapids on Upper Run

1. Spillway
2. Triple Tongue
3. Snake
4. Stump
5. Snag
6. Goat Boy

Flow Preferences

Several parts of the study were designed to define whitewater flow preferences for West Rosebud Creek. Approaching preferences from different aspects yielded a more comprehensive understanding of the effects of flow on whitewater experiences.

Relative to the flow they boated, paddlers were asked if they would return for the same flow and their preference for flow change.

Boaters were also asked to judge the acceptability of various creek flows based on their West Rosebud experience. Of particular interest to the study were perceptions of minimum acceptable and optimum flows for whitewater boating. Because a paddler's knowledge and opinions about flow improve with more experience, only their most recent responses (from their last survey) were used in analysis for these questions. At the time of their last survey, 69 percent of the 55 paddlers had boated the creek more than once and one-third had boated six or more times.

Times boated run on last survey

	Frequency	Percent	Cumulative Percent
1 time	17	30.9	30.9
2 - 5 times	20	36.4	67.3
6 - 10 times	8	14.5	81.8
11 - 20 times	5	9.1	90.9
21 - 30 times	2	3.6	94.5
More than 30 times	3	5.5	100.0
Total	55	100.0	

Likely to Return for Flow Boated

Eighty-one percent of boaters said they would "probably or definitely return" for the same flow boated. Satisfaction was highest at 351 to 500 cfs.

Likely to return for same flow boated * Flow boated category (cfs) Crosstabulation

		Flow boated category (cfs)									
		Under 50	51-100	151-200	201-250	251-300	301-350	351-400	401-450	451-500	Total
Definately yes	Count	1	1	1	1	18	2	16	20	26	86
	% within Flow boated category	100.0%	100.0%	12.5%	25.0%	50.0%	40.0%	72.7%	83.3%	96.3%	67.2%
Probably	Count			1	1	9		2	4	1	18
	% within Flow boated category			12.5%	25.0%	25.0%		9.1%	16.7%	3.7%	14.1%
Possibly	Count			2	1	8	2	4			17
	% within Flow boated category			25.0%	25.0%	22.2%	40.0%	18.2%			13.3%
Definately no	Count			4	1	1	1				7
	% within Flow boated category			50.0%	25.0%	2.8%	20.0%				5.5%
Total	Count	1	1	8	4	36	5	22	24	27	128
	% within Flow boated category	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Preferred Change to Flow Boated

Relative to the flow they boated, 52 percent of boaters preferred slightly higher flows and 21 percent preferred much higher flows. Preference for higher flows decreased significantly for trips above 451 cfs.

Prefer flows that were * Flow boated category (cfs) Crosstabulation

		Flow boated category (cfs)									
		Under 50	51-100	151-200	201-250	251-300	301-350	351-400	401-450	451-500	Total
Much higher	Count	1		6	3	7	2		1	1	21
	% within Flow boated category	100.0%		75.0%	75.0%	19.4%	40.0%		4.2%	3.7%	16.4%
Slightly higher	Count		1	2	1	23	2	16	18	4	67
	% within Flow boated category		100.0%	25.0%	25.0%	63.9%	40.0%	72.7%	75.0%	14.8%	52.3%
About the same	Count					5	1	6	4	19	35
	% within Flow boated category					13.9%	20.0%	27.3%	16.7%	70.4%	27.3%
Slightly lower	Count								1	3	4
	% within Flow boated category								4.2%	11.1%	3.1%
Much lower	Count					1					1
	% within Flow boated category					2.8%					.8%
Total	Count	1	1	8	4	36	5	22	24	27	128
	% within Flow boated category	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Comparative Flow Evaluation

Based on their previous experience, boaters were asked to evaluate the acceptability of various West Rosebud flows for their craft and skill level. In making their flow evaluations, boaters were asked to consider all the flow-dependent characteristics that contribute to a high quality trip (such as boatability, challenge, hydraulics, safety, and availability of play areas).

Because most of the 55 boaters had not experienced a wide range of flows, the acceptability of many flows was based on hypothetical judgments. Many boaters elected to rate only those flows close to what they had boated while others offered opinions along the entire flow range.

Results indicate that flows become acceptable at about 300 cfs and are highly acceptable in the 400 to 500 cfs range for most paddlers. Acceptability begins to diminish above 550 cfs (this would be especially true for paddlers with lesser boating skills; about one-third of the evaluations were done by focus group participants that had substantial boating experience).

Evaluation		**Flow (cfs)**										
		200	**250**	**300**	**350**	**400**	**450**	**500**	**550**	**600**	**650**	**700**
Highly acceptable	Count		1	7	15	**23**	**31**	**24**	**16**	9	7	7
	% within flow		2.6%	17.5%	34.1%	**57.5%**	**72.1%**	**64.9%**	**50.0%**	29.0%	21.9%	21.9%
Somewhat acceptable	Count		4	**13**	**20**	12	7	8	**11**	**10**	6	3
	% within flow		10.3%	**32.5%**	**45.5%**	30.0%	16.3%	21.6%	**34.4%**	**32.3%**	18.8%	9.4%
Marginal	Count	3	12	**12**	7	4	5	4	3	7	**7**	6
	% within flow	7.9%	21.8%	**30.0%**	15.9%	10.0%	11.6%	10.8%	9.4%	22.6%	**21.9%**	18.8%
Somewhat unacceptable	Count	10	**10**	6	1	1		1		2	7	**6**
	% within flow	26.3%	**25.6%**	15.0%	2.3%	2.5%		2.7%		6.5%	21.9%	**18.8%**
Highly unacceptable	Count	**25**	12	2	1				2	3	5	10
	% within flow	**65.8%**	31.0%	5.0%	2.3%				6.3%	9.7%	15.6%	31.3%
Total	Count	38	39	40	44	40	43	37	32	31	32	32
	% within flow	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Median response within flow category highlighted

Results also show that paddlers with more experience on the West Rosebud find a wider range of flows to be acceptable. When the comparative analysis was performed again using only responses from the ten boaters that had made 11 or more trips, 70 percent of these repeat paddlers gave ratings of "somewhat or highly" acceptable to a 300 cfs flow (compared to 50 percent of all paddlers) and 60 percent of repeat paddlers gave this rating to a 650 cfs flow (compared to 41 percent of all paddlers).

Characteristics of 350 and 450 cfs Flows

Focus group participants paddled the upper run at flows of approximately 360, 430 and 460 cfs and discussed the boating characteristics at those flows. In summary, flow of about 350 cfs was described as a "perfect intermediate" flow suitable for a range of abilities. Flow was readily boatable and offered easy corrections. Moves could be easily achieved and good (but small) eddies were available. On the down side, pin rocks were exposed and the run was a bit "boney." Participants rated the flow as Class IV to IV+ (IV with consequences that are Class V). It was noted that the run is difficult to scout and that woody debris presents hazards.

Flows in the range of 450 cfs offered a cleaner and more padded run and were a good step up from the lower flow. Rocks were more covered and pinnings were less. Hydraulics were bigger and offered better play, but paddlers had to work harder for fewer eddies. Although many thought the higher flow was easier to boat, there were more swimmers and bigger "beatings." The flow was rated Class IV+ to V- because of required moves and consequences.

Triple Tongue Rapid, about 360 cfs

Triple Tongue Rapid, about 460 cfs

Minimum Acceptable Flow

The minimum acceptable flow for whitewater boating was 200 or 250 cfs for one-third of boaters and 300 cfs for another one-third. Flow of 350 cfs would satisfy the minimum requirements of 87 percent of paddlers. The average (median) minimum acceptable flow was 300 cfs.

When discussed in the focus group, it was pointed out that "minimum acceptable" was a relative term that changes over the boating season. Boaters are more willing to tolerate lower flows when boating opportunities become scarce. West Rosebud flows of 250 to 300 cfs might not be attractive when other creeks are running high, but become more acceptable when those other creeks become unboatable in mid-summer.

Optimum Flow

A paddler's optimum flow provides the requirements necessary for their desired experience. The median optimum flow was 450 cfs. About one-third of paddlers view flows of 300, 350 or 400 cfs as optimal, while another 51 percent look for 450 or 500 cfs flows. Eighty-three percent of boaters view optimum flow as 500 cfs or less.

Standard and High Challenge Trip Flows

Many boaters are interested in a "standard" whitewater trip at medium flows. Based on this normative definition, a flow of 400 cfs was identified as best for a "standard trip" on the West Rosebud (median response).

Some boaters are interested in taking trips at higher flows for increased whitewater challenge. A flow of 550 cfs was best for a "high challenge trip" on the West Rosebud (median response).

Preferred Flow

When asked for their preference if only one flow were available for boating on the West Rosebud, the median preferred flow was 450 cfs. Eighty-seven percent of boaters chose flows in the 300 to 500 cfs range. When asked in the focus group about a seasonal preference for a preferred flow, it was agreed that later is better (mid-July to mid-August, when flows in other creeks are dropping).

Minimum acceptable flow

	Frequency	Percent	Cumulative Percent
200 cfs	5	9.3	9.3
250 cfs	13	24.1	33.3
300 cfs	19	35.2	68.5
350 cfs	10	18.5	87.0
400 cfs	3	5.6	92.6
450 cfs	3	5.6	98.1
500 cfs	1	1.9	100.0
Total	54	100.0	

Optimum flow

	Frequency	Percent	Cumulative Percent
300 cfs	3	5.7	5.7
350 cfs	8	15.1	20.8
400 cfs	6	11.3	32.1
450 cfs	12	22.6	54.7
500 cfs	15	28.3	83.0
550 cfs	1	1.9	84.9
600 cfs	4	7.5	92.5
650 cfs	3	5.7	98.1
700 cfs	1	1.9	100.0
Total	53	100.0	

Standard trip flow

	Frequency	Percent	Cumulative Percent
250 cfs	2	3.7	3.7
300 cfs	9	16.7	20.4
350 cfs	8	14.8	35.2
400 cfs	14	25.9	61.1
450 cfs	11	20.4	81.5
500 cfs	8	14.8	96.3
550 cfs	2	3.7	100.0
Total	54	100.0	

High challenge trip flow

	Frequency	Percent	Cumulative Percent
400 cfs	6	11.1	11.1
450 cfs	5	9.3	20.4
500 cfs	9	16.7	37.0
550 cfs	9	16.7	53.7
600 cfs	13	24.1	77.8
650 cfs	4	7.4	85.2
700 cfs	8	14.8	100.0
Total	54	100.0	

Preferred flow if only one available

	Frequency	Percent	Cumulative Percent
300 cfs	3	5.6	5.6
350 cfs	10	18.5	24.1
400 cfs	5	9.3	33.3
450 cfs	14	25.9	59.3
500 cfs	15	27.8	87.0
550 cfs	2	3.7	90.7
600 cfs	3	5.6	96.3
700 cfs	2	3.7	100.0
Total	54	100.0	

West Rosebud Comparisons

To gain an understanding of the overall quality of boating on the West Rosebud and the creek's importance as a whitewater resource, boaters were asked to compare it to other rivers in the area, state, region and country.

Sixty-eight percent of boaters rated the creek as "excellent or among the very best" compared to other rivers within a one-hour drive.

Fifty-nine percent of boaters rated the creek as "excellent or among the very best" compared to other rivers in Montana.

Fifty-three percent of boaters rated the creek as excellent or among the very best compared to other rivers in the Rockies.

Forty-six percent of boaters rated the creek as "excellent or among the very best" compared to other rivers in the country.

Above Snake Rapid, about 360 cfs

W. Rosebud compared to others within 1-hour drive

	Frequency	Percent
Average	8	15.1
Better than average	9	17.0
Excellent	21	39.6
Among the very best	15	28.3
Total	53	100.0

W. Rosebud compared to others in Montana

	Frequency	Percent
Average	4	7.5
Better than average	18	34.0
Excellent	20	37.7
Among the very best	11	20.8
Total	53	100.0

W. Rosebud compared to other in the Rockies

	Frequency	Percent
Worse than average	1	2.0
Average	6	11.8
Better than average	17	33.3
Excellent	24	47.1
Among the very best	3	5.9
Total	51	100.0

W. Rosebud compared to others in the country

	Frequency	Percent
Worse than average	2	3.8
Average	10	19.2
Better than average	16	30.8
Excellent	21	40.4
Among the very best	3	5.8
Total	52	100.0

Flow Measurements

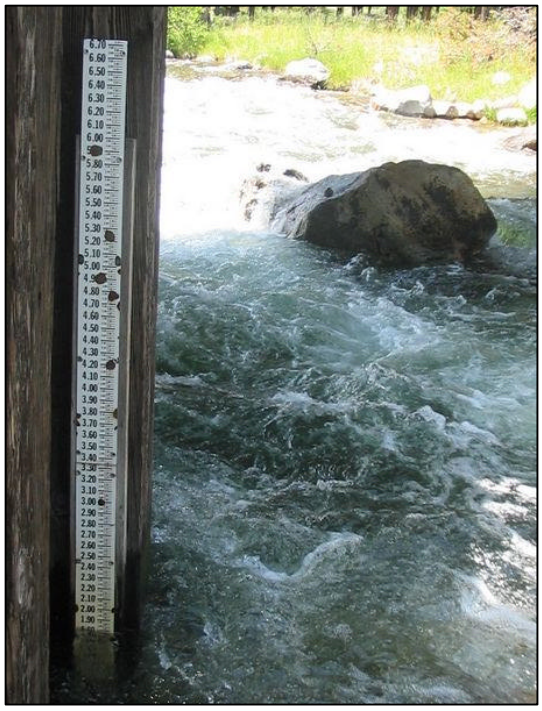
Measuring and communicating West Rosebud Creek flows below PPL Montana's reregulation dam at West Rosebud Lake is important to whitewater boaters. As study results show, whitewater experiences are heavily flow dependent. Knowledge of flow conditions help paddlers plan the timing of their activity to achieve desired outcomes.

A USGS gage located immediately downstream of the PPL Montana powerhouse has not provided reliable measurements under all flow conditions during this whitewater study. This gage is also upstream of tributaries that add water to the downstream reach used by boaters. Importantly, PPL Montana's reregulation dam between the USGS gage and the boated reach also affects flows and diminishes the value of the USGS gage.

During 2004-05, PPL Montana measured creek flow at its reregulation dam and these estimates were used to determine the "flow boated" values in this study, based on the date and time of each paddler's activity. Because it was important for boaters to understand what flow they boated when they filled out the questionnaire, and because the boating community wanted to monitor flow conditions for trip planning, PPL Montana began reporting its flow estimates on the Internet in 2004. Unfortunately, the remote location and communication links presented problems for real-time reporting and results were sporadic. Reliable results weren't available until the 2005 season, and in mid-July (when flows were diminishing) hardware problems brought the reporting system down again. In the event that another reporting station is established in the future, and if it interprets flows differently than the system used for this study, these study results will be adjusted to fit the new reported flow values.

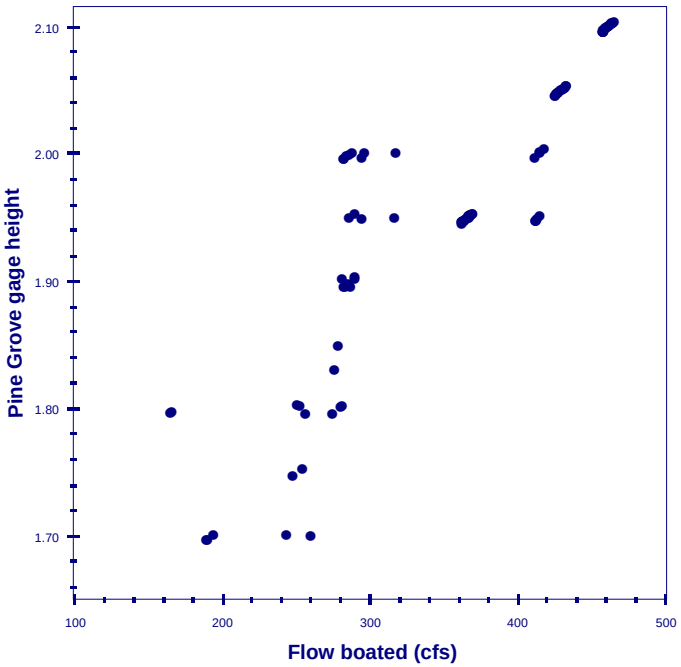
Reregulation dam at West Rosebud Lake

Even with Internet-based reporting, it is important for boaters to be able to estimate flow conditions when they are in the field. Historically, boaters have used the staff gage at the bridge at Pine Grove Campground to estimate West Rosebud Creek flows. Although most of the flows of interest occur over a narrow range on the gage and "bouncing" water levels make reading difficult, the gage provides a rough measure of creek height and flow.



Staff gage at Pine Grove bridge

Boaters were asked to report the staff gage height, if checked at the time of their paddling activity. A total of 104 observations were reported and correlated with creek flows measured at the reregulation dam. For flows ranging between 200-460 cfs, the reported gage height varied about five inches, between 1.7 and 2.1 feet.



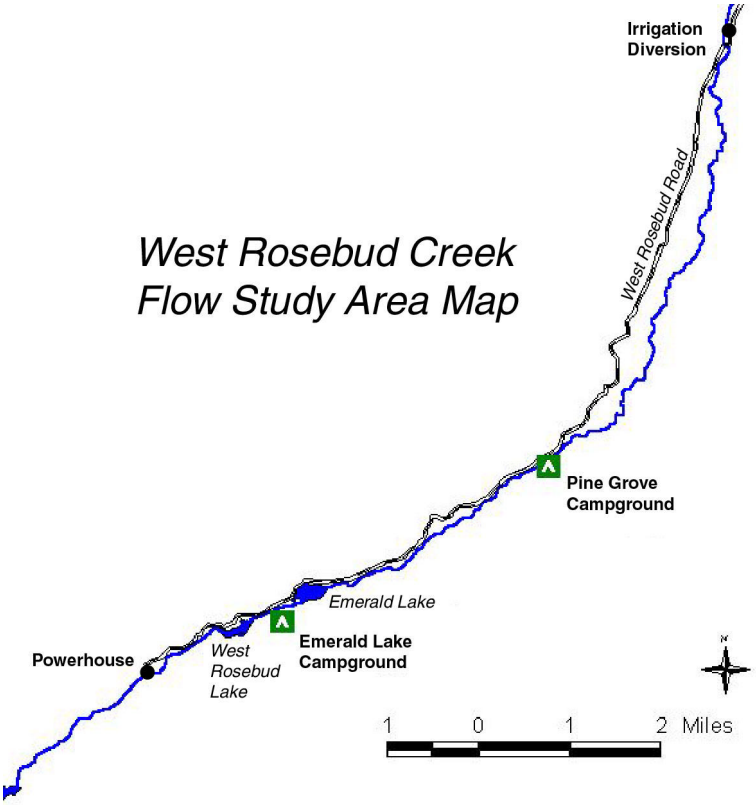
Appendix A – Survey Questionnaire

Introduction

PPL Montana is partnering with American Whitewater and the Beartooth Paddling Club to identify a preferred range of whitewater boating flows on West Rosebud Creek below Emerald Lake. PPL Montana operates the Mystic Lake Hydroelectric Project in the upper West Rosebud drainage. The Project is undergoing relicensing with the Federal Energy Regulatory Commission (FERC) and PPL Montana, American Whitewater, Beartooth Paddlers and other stakeholders are involved in FERC's new Integrated Licensing Process.

The partners have jointly agreed to survey whitewater boaters that paddle any portion of West Rosebud Creek from Emerald Lake to the irrigation diversion ten miles downstream. Information from the survey will help us identify a flow preference curve for whitewater boating, which will identify minimum acceptable and optimum flows. This flow preference curve will be used to evaluate possible effects on whitewater boating from Project operation and help define flow needs.

If you paddle West Rosebud Creek, please complete this questionnaire each time you boat the creek between June 1 and August 31, 2005. Information from repeat paddlers provides valuable comparative information that helps us better understand the boatable flow range.



We are interested in your use of any portion of West Rosebud Creek between Emerald Lake and the irrigation diversion. The creek is commonly delineated into an upper run (between Emerald Lake and Pine Grove Campground) and lower run (from Pine Grove Campground to the irrigation diversion).

In 2005 PPL Montana began reporting real-time flows from a new gage immediately below West Rosebud Lake to help boaters track favorable whitewater conditions. Please reference these flow reports, available from the Mystic Lake Relicensing Coordination website (mysticlakeproject.com), to determine what flow you boated before you complete this survey. The USGS maintains a real-time flow gage upstream of West Rosebud Lake, but because the lake functions as a re-regulation reservoir for the upstream hydropower project, it doesn't accurately reflect downstream flows and shouldn't be used for your survey reference.

Please pass along the word about this study to fellow boaters. The more responses we get the more useful our results will be. For further information about the study contact: jefrost@rec-res.com.

About Yourself

1. Your name: _____
2. Your email address: _____
3. Have you completed this survey before for another trip on the West Rosebud?

   _____ Yes
   ____ No

Your Recent Boating Trip *– tell us about your most recent trip on the West Rosebud...*

4. Month: _____
5. Day: _____
6. When did you put in? _____
7. When did you take out? _____
8. Where did you put in?

   ____ Emerald Lake ____ Pine Grove Campground Other: _____
9. Where did you take out?

   ____ Pine Grove Campground ____ Bridge below diversion
   ____ Irrigation diversion Other: _____
10. What type of craft did you use?

    ____ Hard shell kayak ____ Open canoe
    ____ Inflatable kayak ____ Cataraft
    ____ Closed deck canoe ____ Wrap-floor raft
    ____ Self-bailing raft Other: _____

Flow Conditions *– tell us about the flow conditions during your recent trip...*

11. If you checked the staff gage at the bridge near Pine Grove Campground, what was the creek height in feet?

    _____ feet

12. Considering the flow conditions during your trip, in general how would you rate the whitewater difficulty of the reach you boated using the International Whitewater Scale? *I*f you are unsure or didn't boat one of the reaches, choose N/A. *(Check one box for each row)*

	Class I	Class II	Class III	Class IV	Class V	Class VI	N/A
Upper Run – 3 miles: Emerald Lake to Pine Grove Campground							
Lower Run – 7 miles: Pine Grove Campground to irrigation diversion							

13. Please evaluate the flow on this run for your craft and skill level for each of the following characteristics. *(Check one box for each row)*

	Highly Unacceptable	Somewhat Unacceptable	Marginal	Somewhat Acceptable	Highly Acceptable
Boatability					
Availability of challenging technical boating					
Availability of powerful hydraulics					
Availability of whitewater "play areas"					
Overall whitewater challenge					
Safety					
Aesthetics					
Length of Run					
OVERALL RATING					

Flow Preferences *– tell us about your preferred flow conditions...*

14. Are you likely to return to boat this flow you just evaluated? *(Choose one)*

    ____ Definitely no
    ____ Possibly
    ____ Probably
    ____ Definitely yes

15. In general, would you prefer a flow that was higher, lower or about the same as this flow? *(Choose one)*

    ____ Much lower flow
    ____ Slightly lower flow
    ____ About the same; this was close to an optimum flow
    ____ Slightly higher flow
    ____ Much higher flow

16. Are you likely to return for future boating at the preferred flow you identified in Question 15?

    ____ Yes
    ____ No

17. Including your recent trip, how many times have you boated this section of West Rosebud Creek?

    ____ 1 time ____ 11-20 times
    ____ 2-5 times ____ 21-30 times
    ____ 6-10 times ____ More than 30 times

Please Note: *If you completed a survey before for a previous West Rosebud trip, your responses to the remaining questions might be different than what you reported earlier, based on new knowledge from your most recent trip. During study analysis, only your most recent responses to the remaining questions will be used. Please update the rest of the survey with your latest opinions.*

Quality of Various West Rosebud Flows

18. For comparative purposes please estimate the quality of the following West Rosebud flows for your craft and skill level. In making your evaluations, please consider all the flow-dependent characteristics that contribute to a high quality trip (e.g., boatability, whitewater challenge, safety, availability of surfing or other play areas, aesthetics, and length of run). If you do not feel comfortable evaluating a flow you have not seen, leave that row blank.

	Highly Unacceptable	Somewhat Unacceptable	Marginal	Somewhat Acceptable	Highly Acceptable
100 cfs					
150 cfs					
200 cfs					
250 cfs					
300 cfs					
350 cfs					
400 cfs					
450 cfs					
500 cfs					
550 cfs					
600 cfs					
650 cfs					
700 cfs					

Minimum and Optimum Flows *– Based on your boating trips on the West Rosebud, please specify the flows that provide the following types of experiences. (Note: you can specify flows that you have not seen, but which you think would provide the type of experience in question.)*

19. From a recreational perspective what is the **minimum acceptable flow** for this run? The minimum acceptable is the lowest flow you would return to boat, not the minimum flow necessary to navigate. *(Choose one)*

100 cfs	150 cfs	200 cfs	250 cfs	300 cfs	350 cfs	400 cfs	450 cfs	500 cfs	550 cfs	600 cfs	650 cfs	700 cfs

20. For you, what is the **optimum flow** for this run? *(Choose one)*

100 cfs	150 cfs	200 cfs	250 cfs	300 cfs	350 cfs	400 cfs	450 cfs	500 cfs	550 cfs	600 cfs	650 cfs	700 cfs

21. Many people are interested in a "standard" whitewater trip at medium flows. Think of this "standard trip" in your craft. What is the best or optimal flow for a **standard** trip? *(Choose one)*

100 cfs	150 cfs	200 cfs	250 cfs	300 cfs	350 cfs	400 cfs	450 cfs	500 cfs	550 cfs	600 cfs	650 cfs	700 cfs

22. Some people are interested in taking trips at higher flows for increased whitewater challenge. Think of this "high challenge trip" in your craft. What is the best or optimal flow for a **high challenge trip**? *(Choose one)*

100 cfs	150 cfs	200 cfs	250 cfs	300 cfs	350 cfs	400 cfs	450 cfs	500 cfs	550 cfs	600 cfs	650 cfs	700 cfs

23. If one flow for boating was released, **what flow would you prefer**? *(Choose one)*

100 cfs	150 cfs	200 cfs	250 cfs	300 cfs	350 cfs	400 cfs	450 cfs	500 cfs	550 cfs	600 cfs	650 cfs	700 cfs

24. At the optimum flows for standard and high challenge trips, would you recommend this section to others?

Standard trip:	**High challenge trip:**
____ Yes	____ Yes
____ No	____ No

Summing Up

25. How would you rate boating opportunities on the West Rosebud compared to: *(Choose one per row)*

	Worse than average	Average	Better than average	Excellent	Among the very best
Other rivers within a one hour drive					
Other rivers in Montana					
Other rivers in the Rockies					
Other rivers in the country					

26. Do you have other comments you'd like to make about flows on the West Rosebud?

THANK YOU FOR YOUR PARTICIPATION!

Appendix B – Focus Group

A focus group was conducted on-site during the weekend of July 9-10, 2005. Fifteen experienced paddlers were invited to participate in the group. Group members boated three flows (approximately 360, 430 and 460 cfs) on the upper run.

After each run, group members completed survey questionnaires and then participated in a structured discussion about the flow's boating characteristics. John Gangemi, former Conservation Director of American Whitewater, facilitated the discussion.

Members of the focus group answered these nine questions:

1. What are the advantages of this flow?
2. What are the disadvantages of this flow?
3. What was the whitewater class of this flow?
4. Any safety concerns at this flow?
5. What are the special attributes at this flow?
6. What are your thoughts on a lower flow?
7. What are your thoughts on a higher flow?
8. What is the commercial potential at this flow?
9. What is your seasonal preference for flow here?

Results of the focus group discussion are interspersed with survey questionnaire results throughout this report.