Impacts of Low flow Rates on Recreational Rafting Traffic on the Colorado River in Grand Canyon National Park

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Abstract

This project entailed collecting and analyzing data from recreational rafting users on the Colorado River within the Grand Canyon National Park (GRCA). During the previous three river rafting seasons, commercial river guides and private permit holders have recorded their camping and attraction site visits, including the time-in and time-out for each stop, in over 600 diaries called Trip Reports. We examine behavioral changes in recreational rafting in GRCA as reflected in the data. Trip Reports were collected during two different flow regimes from Glen Canyon Dam; a representative typical flow regime (fluctuating flows averaging 19,000 cubic feet per second) and a low flow regime (steady flows at 8,000 cfs). Comparisons of the data illustrate how, for example, the amount of time boats spend on-river, campsite selection, and both selection of and time spent at attraction sites are affected by changes in the base flow rate of the Colorado River. The most significant finding was that trips, on average, spent 50% less time off-river engaged in activities during the low steady summer flow period. Moreover, the selections of camp sites varied under the two flow regimes.

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Introduction

The Bureau of Reclamation and the Glen Canyon Monitoring and Research Center (GCMRC) executed a Science Plan for testing low steady summer flows (LSSF) during the year 2000. The study resulted in Glen Canyon dam water releases of 17,000-19,000 cubic feet per second (cfs) in April and May with 4 days of 31,000 cfs releases in early May. Steady 8,000 cfs releases occurred from June – Sept with another 4 days of 31,000 cfs releases in September.

This project involved the collection and analysis of data to gain insight on the impacts of the summer 2000 low steady flow releases from Glen Canyon Dam on recreational rafting traffic on the Colorado River in the Grand Canyon National Park (GRCA). To read the proposal to conduct this study, see Appendix A. Through an existing cooperative agreement between Northern Arizona University (NAU) and GRCA (CA#8210-99-002), this research comprised the following:

• soliciting participation in the data collection from the recreational users. This includes the commercial users , the private users and the river guides.

• printing and distributing Trip Reports. These are comprehensive diaries that list camp and activity sites along the river corridor within GRCA. Participants complete the report by marking time in and time out for every stop. (see Appendix A)

• entering the trip report information into a database. This database already includes trip report data gathered during the 1998, 1999 and 2000 normal-to-high ("typical") flow regime seasons.

• analyzing and comparing the data sets. This analysis contrasts the recreational use patterns exhibited during typical flow regimes with those of the low flow regimes.

Methods

Soliciting participation in the data collection, as well as the printing and distribution of the Trip Reports, was a shared effort between the authors of this study and the National Park Service (NPS), represented by Linda Jalbert from the Science Center at the Grand Canyon National Park.

Trip Reports have been distributed at Lees Ferry and to private permit holders and to commercial river rafting companies since July 1, 1998 as part of another project (see reports in Bieri, J. A. & C. A. Roberts (2000) and Roberts, C. A. Roberts & H. R. Gimblett (2001)).

For this LSSF project, identical Trip Reports (see Appendix B) were distributed along with a cover sheet (see Appendix C) that explained the reasoning for the LSSF and for this study. We contacted the leadership of the Grand Canyon River Outfitters Association (GCROA), the Grand Canyon Private Boaters Association (GCPBA) and the Grand Canyon River Guides (GCRG) by phone, email and letter (see Appendices D and E). Trip Reports were distributed to the owners of the commercial outfitting companies. They were also mailed directly to private permit holders by the NPS with a letter encouraging participation in the study. In addition, the National

Park Service Lees Ferry ranger station distributed copies of the Trip Report as part of the check-out process at the day of launch.

Completed Trip Reports were typically mailed to the GRCA and forwarded onto the authors of this study. The authors also contacted the individual commercial outfitters to solicit completed Trip Reports.

Trip Reports from 1998 has already been entered into a database developed by Susan Cherry at the University of Arizona. Completed Trip Reports from 1999 and 2000 were entered into an Access 2000 database at Northern Arizona University during the Fall 2000 semester. This work was conducted by an experienced river guide (Rob Noonan) with assistance from an undergraduate student (Stephanie Potter). Rob Noonan was trained by Susan Cherry at Northern Arizona University during the summer of 2000 on the correct way to interpret and enter information into the database. The database was extensively error-checked by running several consistency queries to ensure accuracy in the way data was entered into the system.

We chose to have people experienced with the river enter the data so that they could wisely interpret any anomalies. Problematic Trip Reports were ones that contained incomplete information. In some cases, we could infer what was intended by the person who completed the Trip Report using our expert judgement. For example, if a record indicated a lunch stop with no duration, Rob's familiarity with the river and our other data could suggest a reasonable time to insert for the duration of the lunch stop. As long as a start or end time was included, we felt confident estimating the duration of the lunch stop. In other cases, such as when the time-in and time-out for stops were completely omitted, it was necessary to discard the Trip Report from our data set. The final judgement of Rob Noonan on whether or not a Trip Report was completed well enough for inclusion in this study was respected by the authors of this study.

The Access database was consequently analyzed by the authors of this study. Note that there are two separate databases – one includes Trip Report data collected during the 1998, 1999 and 2000 typical flow regimes and the second contains the Trip Report data collected during the 2000 low flow regimes. The low flow regime consisted of a steady 8,000 cubic feet per second (cfs) that started June 1, 2000 and ended on September 30, 2000. There was a spike flow September 4, 2000 at 9 pm at a rate of +4,000 cfs/hr up to 30,000 cfs. On September 8, the flow was reduced beginning at 3pm by -1,500 cfs/hour. As a result of this spike flow, Trip Report data between September 5 and September 8 are not included in low flow data set.

The analysis of the database was conducted during the Spring 2001 semester at Northern Arizona University by Catherine A. Roberts, a professor of mathematics and by Joanna Bieri, an undergraduate student. Their related involvement with the Grand Canyon River Trip Simulator (GCRTSim) project provided them with the expertise to work on the current project. This computer model of rafting traffic on the Colorado River within GRCA has been the primary focus of the cooperative agreement referenced above. It consists of an extensive database of Trip Reports completed during 1998 and 1999, as well as an integrated statistical and artificial intelligence-based computer simulation that models complex human-environment interactions on the Colorado River through GRCA. The goal of GCRTSim is to simulate a realistic river environment that can be used to test new launch scenarios. The computer model contributes to

the understanding of the effects of launch schedule modifications by reporting resultant changes in congestion, resource impact and encounter levels.

It is worthy of note that this collection of Trip Reports during the low flows of the 2000 season positions GCRTSim to be extended to have the capacity to run simulated launch scenarios on two distinct flow-regimes. The data collected from this report serves the dual purpose of contributing to these efforts.

Deliverables

In addition to this report, a presentation was made at the GCMRC biannual science symposium in Flagstaff on April 26, 2001 (see PowerPoint presentation in Appendix F). The symposium focussed on the results of studies conducted for GCMRC during the low steady summer flows (LSSF) in 2000.

References are provided in this report to other work conducted by the authors of this study. While not directly connected to the LSSF, these publications discuss the use of Trip Reports from the typical flow regimes of 1998-1999-2000 for the Grand Canyon River Trip Simulator project.

The Data Set

Information is presented in multiple formats in this report. As a basic guide, keep in mind that there are two distinct sets of data that are being contrasted – typical flow regime Trip Report data and low flow regime Trip Report data. Moreover, we also provide information broken down among four different trip types (see Figure 1).

Short motor trips	6 – 8 days
Long motor trips	9 or more days
Short oar trips	14 or fewer days
Long oar trips	15 or more days

Figure 1: Trip types based on days between Lees Ferry and Diamond Creek.

These four distinct trip types refer to the days on the river between launch at Lees Ferry (river mile zero) and either take-out or passing Diamond Creek (river mile 225.7). There are a number of ways that Trip Reports can be grouped for analysis – motor/oar, commercial/private, by group size, by trip length, etc. Analysis conducted on the 1998 Trip Report data (see reports in Bieri, J. A. & C. A. Roberts (2000) and Roberts, C. A. & H. R. Gimblett (2001)) concluded that the trip types listed in Fig. 1 appropriately capture the similar behavior among trips of similar length with the same propulsion (motor/oar). It is noted that these categories do not distinguish between private and commercial trips, it was determined that most private trips are long oar trips

and that the occasional long oar trip run by a commercial company tends to behave with enough similarity that grouping them together is appropriate.

The basic statistics on the Trip Reports collected and utilized for this analysis are provided here. In Figure 2, the breakdown of the 487 collected (and useable) Trip Reports from the typical flow regimes are presented. Figure 3 shows the same breakdown for the 120 Trip Reports collected (and useable) from the LSSF period of June 1, 2000 through September 30, 2000. As mentioned earlier, data from the short spike flow that occurred between September 4 – September 8 are not included in the data set since we seek to understand the behavior of trips during the steady, low flow of 8,000 cfs.

Trip type	Private	Commercial	Total	Return rate
Short motor	7	222	229	22%
Long motor	9	18	27	32%
Short oar	24	64	88	26%
Long oar	125	18	143	22%
Totals	165	322	487	29%

Figure 2: Trip Report statistics from typical flow regime collected during 1998, 1999 and 2000 seasons.

Trip type	Private	Commercial	Total	Return rate
Short motor	0	61	61	18%
Long motor	3	3	6	21%
Short oar	2	23	25	22%
Long oar	18	10	28	25%
Totals	23	97	120	20%

Figure 3: Trip Report statistics from low steady flow regime collected between June 1, 2000 and September 30, 2000.

In order to understand how well the data represents the total activity on the river, it is worthwhile to consider the return rate for the Trip Reports. Examining Figures 2 and 3, one can observe that the return rate for long motor trips was dramatically reduced during the low flow period, as compared to the typical flow period. Even though the trip reports for long motor trips represents 21% return rate during the low flow period, one should use caution when drawing conclusions as only six trip reports were collected. In the other trip categories, the return rates were fairly consistent between the typical flow period and the low flow period.

Inaccuracies and incomplete information are, naturally, something that we had to confront in this study. By having river experts enter the data, their judgement was used on occasion to clarify items entered onto the trip report. For example, if a lunch stop was recorded with a time-in but no time-out, we would use the overall average time spent on lunch stops to extrapolate a reasonable time-out for the data item. Trip reports were sometimes sent to us with the locations of camps and activities, but no stopping times. We still entered this data into our database for

use in computing the popularity of the camp and attraction sites, although those trips could not be used when computing the average time spent at the sites. When possible, follow-up phone calls were made to the commercial companies or to the private permit holders to clarify items on some trip reports.

Given that completion of trip reports was difficult and required the participant to record each and every stop, we are pleased with our return rate. We appreciate the involvement of the commercial outfitters in encouraging their river guides to participate in this study. Moreover, we are gratified that so many private trip permit holders were willing to participate in this scientific study. While it would, naturally, be ideal if we had 100% return rate and a 100% accuracy rate, it is worth pointing out that this database of trip reports is the most comprehensive set of recreational use pattern data ever collected for the Colorado River within the Grand Canyon National Park. The database is included here on a CD-ROM as Appendix K.

Boat Speed

Graphs for the average boat speeds were computed from the Trip Report database. Boat speed is the sum of the speed of the Colorado River (which is based on the instantaneous water flow rate) and the speed of the boat (propulsion by motor or oar). Using the standard mathematical equation that boat speed equals the distance traveled divided by the elapsed time, the database of trip reports was queried to determine the boat speed for each time segment that the trip spent on the river in between successive stops.

It is worth noting that some human-powered trips are of a hybrid nature, with several kinds of boats travelling different speeds (oar, paddle, kayak, dory). In this model, the entire trip was viewed as one unit since the trip report simply lists the time-in and time-out from stops that the entire trip made. This is also consistent with the policy of the Grand Canyon National Park that multi-boat trips travel together. Therefore, the oar speeds in the graphs represent an average speed for all human-powered trips of that trip type (short oar or long oar).

Once the average speeds for each and every river segment of an individual trip were computed, the overall speeds were estimated. Over each ten mile stretch of river, computed individual trip speeds from that stretch were averaged together, grouped by trip type (short/long, motor/oar). Thus, each ten mile segment of the river had associated with it an average speed for each of the four trip types. These points were plotted on a set of axes and a smooth polynomial fit was used to create the graphs shown here.

In each of the boat speed graphs, the horizontal axis shows the river mile, where river mile 0 (zero) corresponds to Lees Ferry and river mile 225.7 corresponds to Diamond Creek. The vertical axis shows the average speed in miles per hour. In some reaches of the Colorado River, the trips go faster as a result of the narrowing of the canyon and subsequent speeding up of the river water. There are also sociological influences on the boat speed. For example, in reaches of the river with outstanding views and multiple attraction sites, the overall speed could slow down as the trip leader chooses to shift down the pace of the trip. At the end of the trip, either to make

up lost miles or because there are fewer attraction sites, one can see that trips tend to go faster downstream.

Please note that our data often becomes sketchy and incomplete after Diamond Creek, therefore it is best to view these graphs as carrying the most accuracy prior to mile number 225.7. What may strike the observer as unusual behavior at the far end of the river is most likely due to incomplete data for that stretch of the river. There is also less data after Diamond Creek, as many river trips end there.

Figure 4 shows the overall average boat speed, comparing the normal and low flow regimes. Recall that the normal, or typical, flow regime is based on an average 19,000 cfs water release from Glen Canyon Dam, whereas the low flow was a steady 8,000 cfs. It is expected, therefore, that the water speed itself slows down and affects the overall speed of the boats down river.

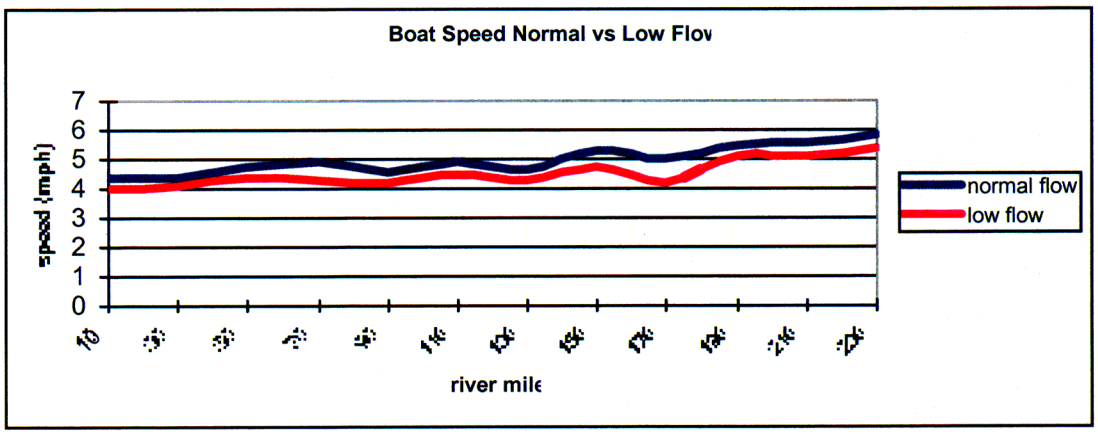

Figure 4: Average boat speed (typical vs. low flow).

More insight can be gained by viewing this data by trip type. Since oar trips are human-powered, their speed is influenced to a greater degree by the base water speed of the Colorado River. Therefore, we expect to see a greater slow down during the low flow regime for oar trips. One might suspect that while motor trips will still slow down, the existence of the motor-power provides these trip types with greater flexibility in making up miles by engaging in a longer time period of higher boat speeds.

In Figure 5, the same information is provided only for the long oar trip type. Recall a long oar trip is of a minimum duration of 15 days between Lees Ferry and Diamond Creek.

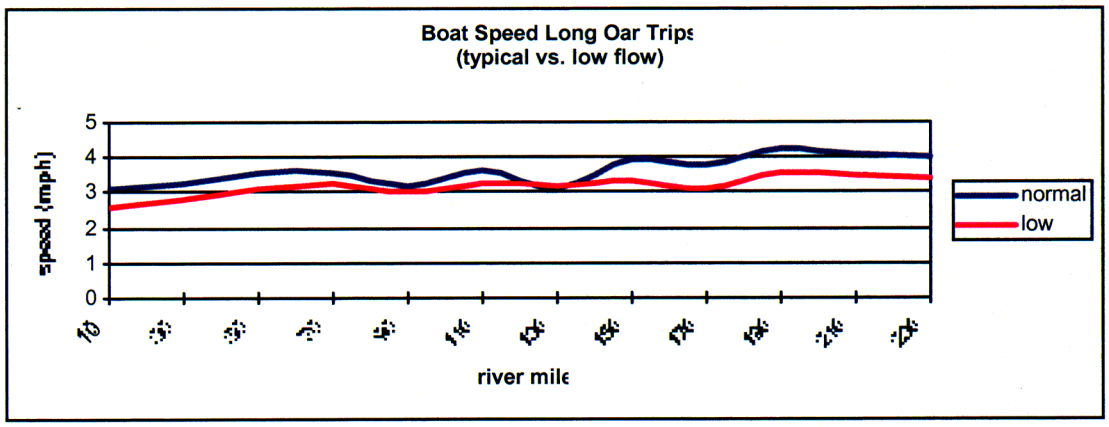

Figure 5: Average speed for long oar trips (typical vs. low flow).

Figure 6 shows the same information for short oar trips, where the influence of the lower base river speed can be seen on the overall boat speed. The differences between the two graphs stays relatively constant throughout the river corridor, although it does tighten in the critical reach that includes key attraction sites such as Deer Creek (mile 136.2).

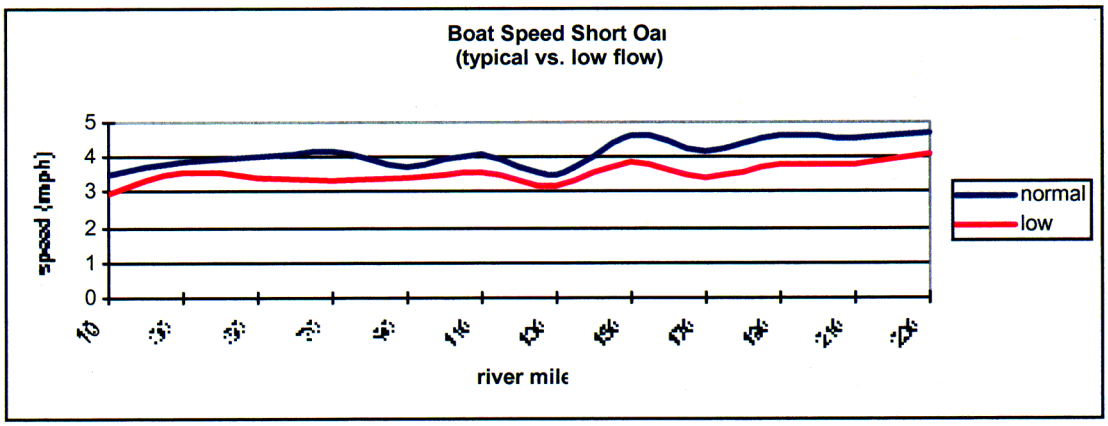

Figure 6: Average speed for short oar trips (typical vs. low flow).

Figure 7 and Figure 8 show the boat speed for motor boats that are long (9 days or longer) and short (6 to 8 days), respectively. Although it might seem as though motor boats would use their mechanized power to make up for time lost to the slower river speed, one can see that this was not less true for long motor trips than it was for short motor trips. The motor boats still went down the Colorado River more slowly during the low flow period than they did, on average, during the normal flow seasons.

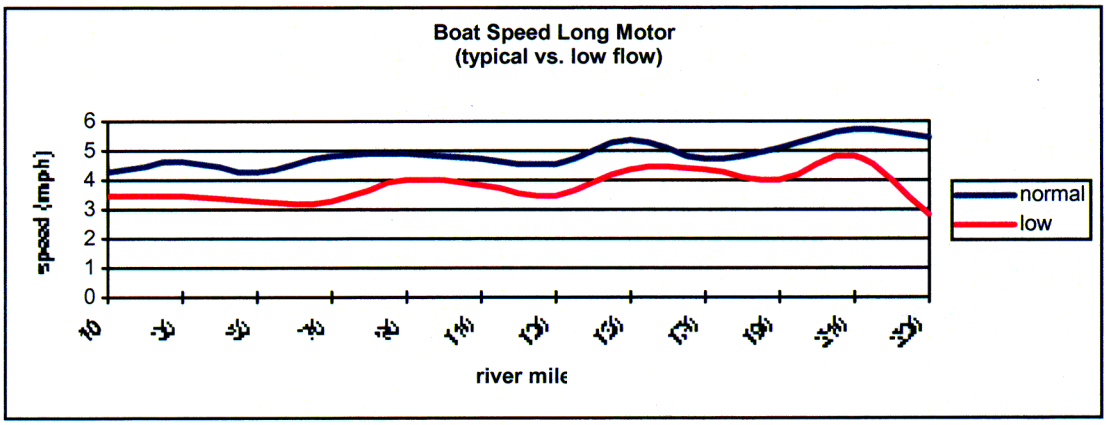

Figure 7: Average speed for long motor trips (typical vs. low flow).

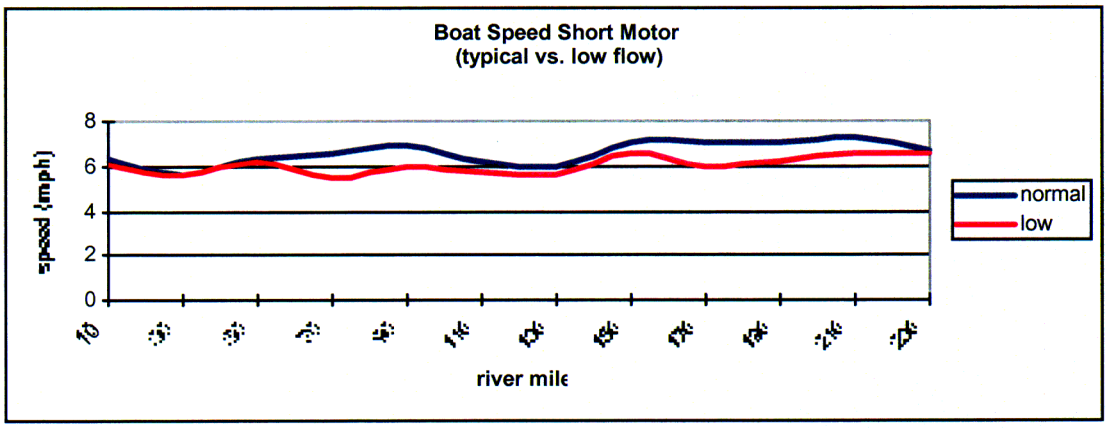

Figure 8: Average speed for short motor trips (typical vs. low flow).

In regard to boat speed, to conclude, it is clear that the reduction in the base water speed of the Colorado River during the low flow regime consequently slowed down the progress of all of the recreational rafting trips to some extent.

Time Spent off River

The strongest measure of the impact of the low steady summer flows on recreation traffic is the reduction in the amount of time available to spend off river, engaged in activities and camping. While time spent on the water and running the rapids is a key component to the recreational experience, so too is time spent off the water hiking, swimming, enjoying waterfalls and side canyons and camping.

The speed of the Colorado River water was reduced during the low flow regime and the boats responded with slower rates of travel downstream. Given the fact that the trip lengths remained

constant during the two flow regimes, the only way that the trips could travel the same number of miles in the same number of days *at slower on river speeds* is to spend more time on the water and less time engaged in activities along the river's edge.

Informal conversations with commercial river runners suggested that spending less time at camp (arriving later in the day and departing earlier in the morning) would be one way to bank extra time to spend traveling downstream. For this report, we were unable to utilize the trip report data to quantify this phenomenon. Camp stops are sometimes affiliated with activities (such as a hike at the camp location). The manner in which data was entered onto the trip report indicated when a camp stop was also an activity stop, but the time that was attributable to the activity was not separated from the total time spent at the site.

Another option available to trips to make up time would be for trips to reduce or eliminate layovers. A layover refers to a trip spending more than one successive night at the same camp. Layovers are often taken to engage in a significant off-river activity, such as a substantial hike. Figure 9 shows the frequency with which river trips engaged in layovers. It can be seen that there were fewer layovers during the low flow regime, which is to be expected. This figure takes the total number of layovers that were reported and divides by the total number of trips, to get a "percentage of layovers per trip" measurement. Note that some long oar trips engage in more than one layover will weight these numbers – so the fact that during normal flow there is a 47% layover per trip measurement does not imply that 47% of the trips reported doing a layover (trips doing more than one layover increase this figure). It is best to compare the fact that this measurement dropped from 47% during the typical flow to 16% during the low flow.

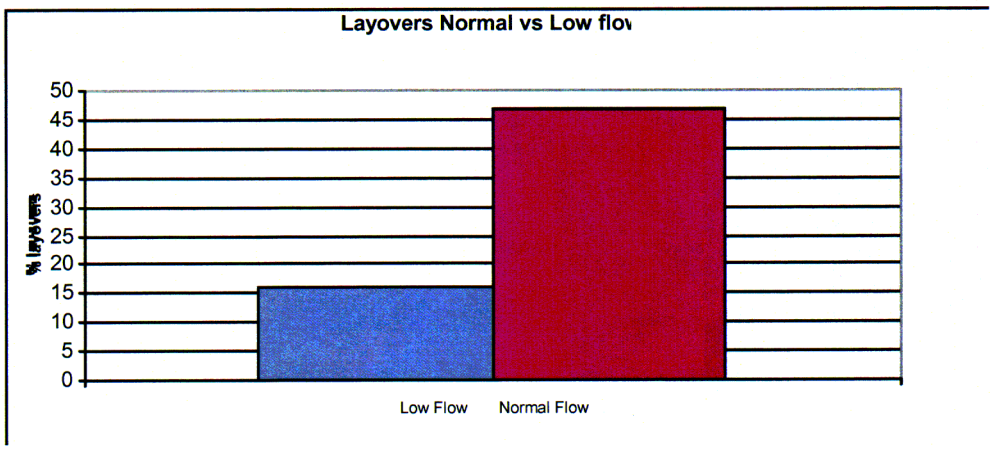

Figure 9: Layover frequency

Long oar trips traditionally engage in layovers with the highest frequency. A breakdown of layover frequency is provided in Figure 10.

Flow rates	# of layovers	total trips	% layovers per trip
Low flow	19	120	15.83
Normal flow	227	487	46.61
long oar normal flow	206	143	144.06
long oar low flow	15	28	53.57
short oar normal flow	11	88	12.5
short oar low flow	0	25	0
long motor normal flow	9	27	33.33
long motor low flow	4	6	66.67
short motor normal flow	0	229	0
short motor low flow	0	61	0

Figure 10: Table for layover frequency by trip type.

Perhaps the most effective manner in which to manage a river trip in order to increase the time available for traveling on river is either to reduce the number of activities altogether and/or to reduce the time spent engaged in activities. The time spent off river engaged in activities was computed from the trip report database. Note that when a camp stop has an associated activity at the same site, the trip report did not distinguish the amount of time to be associated with the camp and the activity. Therefore, only stand-alone activity records were used in these calculations.

In Figure 11, the average number of activities per day is presented for the various trip types. Clearly, the choice of the river trip leaders was not to reduce the number of daily activities.

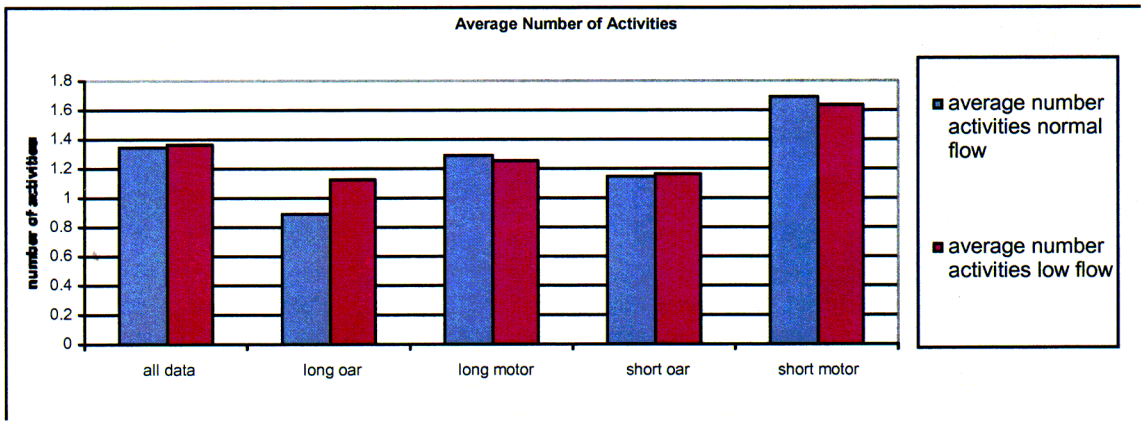

Figure 11: Number of daily off-river activities.

In Figure 12 the average number of hours spent off-river engaged in activities is presented overall. During the normal flow regime of 19,000 cfs, river trips overall spend approximately seven hours engaged in activities such as hiking, swimming and visiting archeological sites. During the low flow regime of 8,000 cfs, river trips spent approximately three and a half hours

engaged in activities. This implies that during the LSSF period, recreational rafters spent only half as much time doing activities than they do during the typical flow regimes. The extra time – approximately three and a half hours per day – was spent on river to make up for time lost to the slower base water speed of the Colorado River.

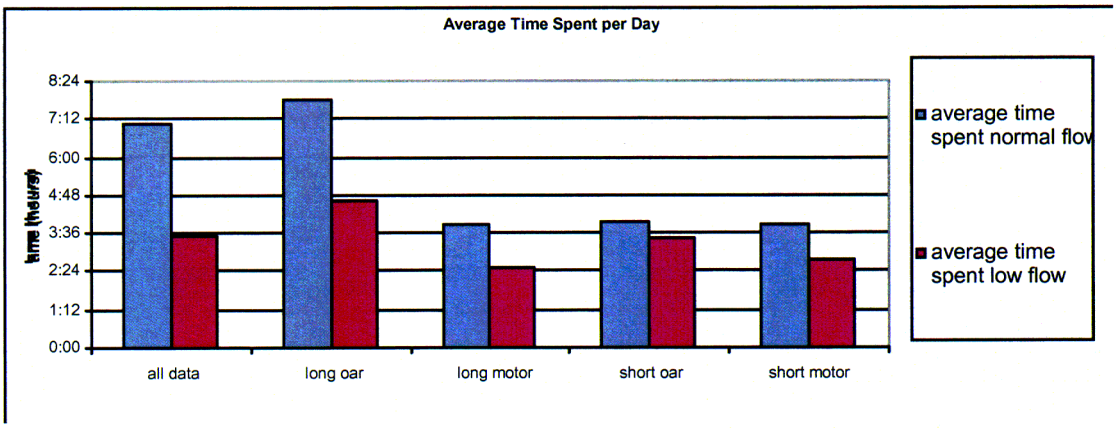

Figure 12: Average time spent on activities.

Figure 13 provides the data used to construct Figure 11. When drawing conclusions, keep in mind that the data for long motor trips was low (only six trip reports). It is interesting to note that the time for short motor boats essentially remained constant over the two flow regimes.

Trip Type	**Average time spent per day**
All	
Typical flow	7:02
Low flow	3:34
Long oar	
Typical flow	7:50
Low flow	4:36
Short oar	
Typical flow	3:58
Low flow	3:28
Long motor	
Typical flow	3:53
Low flow	2:31
Short motor	
Typical flow	2:31
Low flow	2:48

Figure 13: Table for average time spent on activities.

Attraction Site Selection

It is of interest to examine the data to see if significant changes in behavior resulted from the low summer steady flows. The choices that river trips made in regards to attraction sites and camp sites reflect how the flows of the Colorado River impact the nature of a recreational rafting trip.

While time spent at attraction sites and the number of stops at attraction sites have been discussed, it is also interesting to observe if the choices of attraction sites were affected during the low flow regime. Comprehensive lists of data are given in two appendices to this report.

Appendix G lists the visitations at attraction sites during the normal flow regime, broken out by commercial and private use. In addition to the river mile and common site name, the number of trips that reported stopping at the site and the frequency of visitation are provided. Given our small sample size, this data is not broken down by trip type here (although it is available on the CD-ROM provided in Appendix K). Appendix H lists the same attraction visitation data from the low flow regime. Note that in each case they are listed from the most popular attraction site to the least popular attraction sites.

Figure 14 lists the most popular attraction sites, not taking into consideration the standard "stops" at Lees Ferry, Diamond Creek and the Whitmore Helipad. The sites listed in the table were in the top fifteen for at least one of the two flow regimes. In addition to listing the rank (1 = most popular, 2 = second most popular, etc.), the table provides the frequency of visitation (0.91 = 91% of the trips during that flow regime reported stopping for an activity at that site).

River Mile	Site Name	Rank (normal)	Freq. (normal)	Rank (low)	Freq. (low)
136.20	DEER CREEK	1	0.91	1	0.93
156.80	HAVASU	2	0.88	2	0.93
32.80	REDWALL	3	0.82	3	0.85
116.50	ELVES CHASM	4	0.77	5	0.73
61.40	LITTLE COLORADO	5	0.66	4	0.85
87.80	PHANTOM	6	0.61	6	0.59
108.70	SHINUMO	7	0.56	7	0.55
147.90	MATKATAMIBA	8	0.48	9	0.38
132.00	STONE CK	9	0.41	8	0.41
47.20	UPR SADDLE	10	0.34	12	0.27
31.60	SOUTH CANYON	11	0.31	19	0.18
53.00	NANKOWEAP	12	0.3	22	0.16
84.00	CLEAR CK	13	0.28	18	0.2
34.80	NAUTILOID	14	0.26	17	0.2
133.80	TAPEATS	15	0.25	16	0.21
229.00	TRAVERTINE CYN	46	0.05	10	0.33
212.90	PUMPKIN SPRINGS	16	0.25	11	0.3
47.20	LWR BLACKTAIL	19	0.2	13	0.23
120.10	UPR NORTH CYN	17	0.25	14	0.22
20.40	HANCE	32	0.11	15	0.22

Figure 14: Most popular attraction sites.

For the most part, the most popular attraction sites remained constant. This is to be expected, since the desirability of the most popular attraction sites is not a function of the flow release rates from Glen Canyon Dam. More stops were recorded at Hance (mile 20.4), perhaps due to the fact that the nature of the Hance rapid changed and required more scouting by river parties than normal. It is also worth noting that Travertine Canyon (mile 229) was more popular during the low flow regime.

Camp Site Selection

With the same format as the appendices for the frequency of visitation at attraction sites, two appendices are provided in this report that list comprehensively the popularity of the camp sites. Appendix I lists the camp site frequencies during the typical flow period, whereas Appendix J lists the same information from the low flow period. It is worthwhile examining this information to see how camp site selection varied under the different flow regime. For example, along with the low flows came some larger beaches that could accommodate larger group sizes. Moreover, the lack of fluctuation in the water levels made some camps more or less desirable.

Figure 15 provides an abbreviated list of the most popular camp sites. This table does not distinguish between trip types, although this information is available on the CD-ROM provided in Appendix K. The sites listed were in the top fifteen for at least one of the two flow regimes. In addition to listing the rank (1 = most popular, 2 = second most popular, etc.), the table provides the frequency of visitation (0.2 = 20% of the trips during that flow regime reported camping at the site).

River Mile	Site Name	Rank Normal	Freq Normal	Rank Low	Freq Low
108.20	LWR BASS	1	0.2	9	0.16
151.50	LEDGES	2	0.18	23	0.11
136.80	PONCHO'S KITCHEN	3	0.18	14	0.15
29.30	SHINUMO WASH	4	0.17	1	0.2
64.70	CARBON	5	0.17	2	0.17
93.40	GRANITE	6	0.16	10	0.16
219.80	UPPER 220-MILE	7	0.16	8	0.16
133.80	TAPEATS	8	0.15	18	0.12
137.00	BACKEDDY	9	0.15	13	0.15
91.60	TRINITY CK	10	0.15	16	0.13
53.00	NANKOWEAP	11	0.15	48	0.08
16.40	HOT NA NA	12	0.15	7	0.16
109.40	110 MILE	13	0.14	27	0.11
81.30	GRAPEVINE	14	0.14	39	0.09
31.60	SOUTH CANYON	15	0.13	33	0.09
75.60	NEVILLS	17	0.12	19	0.13
61.70	BELOW LCR	174	0.01	3	0.17
136.90	FOOTBALL FIELD	124	0.03	4	0.16
132.00	STONE CK	41	0.08	5	0.16
30.40	FENCE FAULT	24	0.11	6	0.16
198.50	PARASHANT	20	0.12	11	0.15
185.50	No common name	34	0.09	12	0.15
166.5	Upper National	16	0.13	15	0.13

Figure 15: Most popular camp sites.

Some camp sites were popular during both flow regimes. Camps that were in the "top ten" under both flow regimes (by rank, not by percentage of visitation) were Shinumo Wash (mile 29.3), Carbon (mile 64.7), Granite (mile 93.4), Lower Bass (mile 108.2), and Upper 220 (mile 219.8). Shinumo Wash was a larger, better camp at high water which might explain it's elevation to top campsite under the low flow regime. Carbon is a sure favorite due to early shade during the hot summer months. Lower Bass may have dropped in rank popularity in part because trips wanted to get farther down river in light of the low-water dangers associated with some of the rapids in this reach of the river. Moreover, Lower Bass is a popular layover site, where groups enjoy spending an extra day engaged in a long hike. Given the fact that time for layovers decreased, the popularity of Lower Bass also reduced somewhat. During low water, other camps became available. Ross Wheeler (mile 107.8) was a more spacious camp with better shade than Lower Bass.

Some camp sites were popular during the normal flow regime, but lost popularity during the low flow regime. Even though these camps are nice at both low and high water, because more camps become available in low water, people tend to spread out more to new, alternative sites. Camps that were in the "top ten" (by rank) under the normal flow but were not in the low flow were Trinity Creek (mile 91.6), Tapeats (mile 133.8), Poncho's Kitchen (136.8), Ledges (mile 151.5), and Backeddy (mile 137). Of these camps, only Ledges saw a significant drop in both rank popularity and percentage of trips that reported camping there. Trinity Creek is rockier at lower water levels and may lose some of its appeal. Given the fact that time for layovers decreased, the popularity of Tapeats also reduced. There are three camps at Tapeats. The middle camp is inaccessible at low water and the camp in the mouth is more difficult for boats during low water. A nearby camp, Stone Creek (mile 132), increased in popularity over Tapeats during the low flow and was the probable choice for many who would otherwise have chosen Tapeats. Poncho's Kitchen gets very steep sand ledges when the water levels are low and it can be difficult to secure boats and navigate from the boats to the beach. Moreover, this camp, as well as Backeddy (mile 137) are very close to Football Field (mile 136.9), a camp that dramatically increased in popularity during the low flow. The increased popularity of Football Field siphoned off some parties who would normally have camped at Poncho's Kitchen or Backeddy. Ledges is a popular site for groups that want to stage for Havasu, but it is also difficult to access (especially in low water). During the low flow, oar powered trips camping at Ledges would be over two hours from Havasu – perhaps trips wanting to stage for Havasu chose to camp further down river to decrease the travel time to get there. Under the low flow, additional campsites were available for this purpose which drew some of the use away from Ledges. Nankoweap also lost popularity during the low flow regime, perhaps due to the fact that so many alternate camps became available. The data here is just for the main Nankoweap camp – while the others would have been okay during low water, the main camp's location is far from the boats at low water so perhaps accessibility became an issue. Sandbars and a bit of a backeddy behind the sandbar in the Nankoweap area made accessibility an issue. 110 Mile camp probably lost popularity during the low flow regime because it became rocky and not very boat friendly, particularly for motor boats. South Canyon has a poor mooring that probably became more of an issue at low water. Grapevine (mile 81.3) is a camp that people use to set up for a Phantom exchange. It could have lost popularity because other camps closer to Phantom Ranch (mile 87.8) became available and

preferable. This was true, for example, of Zoroaster (mile 84.4), which provided a nice alternative camp site for trips staging for Phantom Ranch.

Some camp sites gained popularity during the low flow regime. Camps that were in the "top ten" (by rank) during the low flow but that were not in the normal flow were Hot Na Na (mile 16.4), Fence Fault (mile 30.4), Below LCR (mile 61.7), Stone Creek (mile 132) and Football Field (mile 136.9). Of these camps, Hot Na Na had the smallest change in popularity frequency. Hot Na Na is a great low water camp and is well positioned for a first night's camp for an oar powered trip. Fence Fault is a hilly camp that is a better choice at low water when more sand is available; it is not a good camp at fluctuating flows and is a nice alternative option from the popular South Canyon camp. The beaches at Below LCR are much bigger during low water, with calm eddies and deep water – note the significant increase in both rank and frequency popularity for this location. Moreover, this camp provides a new alternative in a stretch of the river where there is a relative lack of camps. It may have served as an additional alternative to Crash Canyon (mile 62.6) or Carbon (mile 64.7).. At low water, Stone Creek becomes an attractive campsite because sand becomes available (it is otherwise rocky). This is not a good camp under fluctuating flows, as was the case during 1998 and 1999. This is where people are camping instead of Tapeats that decreased in popularity. Football Field is a tough high water camp, but is large during low water and has a gentler beach so there isn't as much climbing up from the boats to the kitchen and camping areas. Football Field enjoyed a significant increase in both rank and frequency popularity. Parachant (mile 198.5) has gained popularity as a hiking location recently; moreover, during low flows there is more room for mooring boats. The camp at mile 185.5 (no common name) became attractive during the low flows because the beach increased in size and offered excellent boat moorings. This is a good camp for setting up a trip for a Whitmore exchange.

Acknowledgements

Funding for this project in 1998 and 1999 came from a cooperative agreement between Northern Arizona University and the Grand Canyon National Park as part of the Grand Canyon River Trip Simulator Project (CA#8210-99-002). For the 2000 low steady summer flows, funding came from the Grand Canyon Monitoring and Research Center and the Bureau of Reclamation (IA#00-AA-40-4330).

This project wouldn't have been possible without the substantial participation and involvement from many, many people who work and recreate on the Colorado River. I'd like to thank, especially, Linda Jalbert for guiding all of this research. In addition, the leadership of the Grand Canyon Private Boaters Association, the Grand Canyon River Guides and the Grand Canyon River Outfitters Association have provided information and assistance throughout this work.

Special thanks to Tom Martin, Richard Martin, Cameron Stavely, Garrett Schniewind, David Yeamans, Linda Jalbert, Earl Perry and others who offered insight into the changes in the popularity of some of the campsites over the two flow regimes.

References

The citations listed below are not referenced directly in the text of this report. They are provided, however, for the interested reader who would like access to publications from related work conducted by the authors of this study.

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Appendix A: Proposal to Grand Canyon Monitoring and Research Center to conduct this study

Impacts of Low-Flow Rates on Recreational Rafting Traffic on the Colorado River in Grand Canyon National Park

Catherine A. Roberts, Ph.D.
Northern Arizona University
April 26, 2000

This project involves the collection and analysis of data to gain insight on the impacts of the summer 2000 low steady flow releases from Glen Canyon Dam on recreational rafting traffic on the Colorado River in the Grand Canyon National Park (GRCA).

Through an existing cooperative agreement between Northern Arizona University (NAU) and GRCA (CA#8210-99-002), this research would involve the following:

• soliciting participation in the data collection from the recreational users. This includes the commercial users (GCROA), the private users (GCPBA) and the river guides (GCRG).

• printing and distributing trip reports. A trip report is a comprehensive diary that lists camp and activity sites along the river corridor within GRCA. Trip leaders complete the report by marking time in and time out for every stop.

• entering the trip report information into a database. This database already includes trip report data gathered during 1998 and 1999 (approximately 500 records).

• analyzing and comparing the data sets. This analysis will provide insight into recreational use patterns by contrasting the 1998/1999 flow regimes with the 2000 flow regime. This will result in a report (see Deliverables) to GCMRC and GRCA.

An additional benefit of this research is related to the Grand Canyon River Trip Simulator (GCRTSim). This computer model of rafting traffic on the Colorado River within GRCA has been the primary focus of the cooperative agreement referenced above. It consists of an extensive database of trip reports completed during 1998 and 1999, as well as an integrated statistical and artificial intelligence-based computer simulation that models complex human-environment interactions on the Colorado River through GRCA.

The goal of GCRTSim is to simulate a realistic river environment that can be used to test new launch scenarios. The computer model contributes to the understanding of the effects of launch schedule modifications by reporting resultant changes in congestion, resource impact and encounter levels. By using computer simulation to test management options before they are put in to use, GRCA will be on the cutting edge of recreational use management.

The real test of GCRTSim will be in the use of the simulator to examine the outcomes of various alternative launch schedules. The insight that can be provided by GCRTSim is expected to be a valuable contribution to a complex situation, that of managing rafting traffic in GRCA in an optimal way for both the river rafters and the natural resource itself.

Collecting trip reports during the low flows of the 2000 season positions GCRTSim to be extended to have the capacity to run simulated launch scenarios on two distinct flow-regimes. The data collected from this report can serve the dual purpose of contributing to these efforts.

Deliverables

Prior to May 31, 2001 the database consisting of the trip report data collected during summer 2000 will be available in Access format. In addition, a report analyzing the database will be delivered. This report will disclose behavioral changes in recreational rafting in GRCA as reflected in the data. Comparison between the 1998 and 1999 trip reports (considered to be typical flow regime) and 2000 (low-flow regime) will illustrate how, for example, the amount of time boats spend on-river has changed, how campsite selection has changed, and how both selection of and time spent at attraction sites has changed.

References

For updated information about this and other modeling projects, visit the Web site for the Modeling & Simulation Lab at NAU at http://odin.math.nau.edu/msl.

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Appendix B: Trip Report

RIVER TRIP REPORT:

Codes: **C** = Camp, **L** = Lunch, **A** = Activity, **X** = Change of Plans (Please note reason in margin.)

MILE		NAME	Type: CLAX	Time Arrived	Time Left	NOTES: INTENTIONS: Why did you change your plans? (e.g. occupied, weather...)
5.8	R	6 Mile				
8.0	R	Badger				
8.0	L	Jackass				
8.5	L	Below Jackass *				
11.0	R	Soap Creek				
11.8	L	Brown's Inscription				
12.8	R	13 Mile*				
16.4	L	Hot Na Na				
17.0	R	House Rock				
18.1	L	18 Mile Ledges				
19.0	R					
19.1	L					
19.9	L	20 Mile				
20.4	R	Upr North Cyn				
20.5	R	Lwr North Cyn				
21.5	L	*				
21.9	R	*				
23.0	L	Indian Dick				
23.7	L	Lone Cedar				
24.5	L	24.5 Mile				
26.3	L	Above Tiger Wash*				
29.3	L	Shinumo Wash				
30.4	R	Fence Fault				
31.6	R	South Canyon				
31.7	R	Stanton's Cave				
31.8	R	Vasey's Paradise				
32.8	L	Redwall Cavern	**			
33.6	L	Below Redwall				
34.0	L	Little Redwall				
34.8	L	Nautiloid				
37.7	L	Tatahatso				
38.3	L	Marthas				
39.0	R	Redbud Alcove*				
40.9	R	Upr Buckfarm				
41.0	R	Lwr BuckFarm				
43.2	L	Anasazi Bridge				
43.3	L	Lwr Anasazi				
43.8	L	Pres. Harding				
44.2	L	Eminence				
44.6	L					
44.8	L	Willie Taylor				
46.9	L	Duck n Quack				
47.2	R	Upr Saddle				
47.3	R	Lwr Saddle				
50.0	R	Dinosaur				

*Low Water Camp ** Activity Site, No camping

RIVER TRIP REPORT:

Codes: **C** = Camp, **L** = Lunch, **A** = Activity, **X** = Change of Plans (Please note reason in margin.)

MILE		NAME	Type: CLAX	Time Arrived	Time Left	NOTES: INTENTIONS: Why did you change your plans? (e.g. occupied, weather...)
51.2	L					
51.4	L					
51.8	R	Little Nankoweap				
52.6	R	Upper Nankoweap				
53.0	R	Main Nankoweap				
53.2	R	Lower Nankoweap				
56.2	R	Kwagunt				
56.7	R					
57.5	R	Malagosa				
57.5	L	Opp. Malagosa				
58.2	R	Awatubi				
58.6	L	Below Awatubi Left				
59.0	R	Below Awatubi Rt.				
59.8	R	60 Mile*				
60.8	R					
61.0	L	61 Mile				
61.2	R	Above LCR				
61.4	L	LCR	**			Muddy?
61.7	R	Below LCR*				
62.6	R	Crash Cyn				
64.7	R	Carbon				
65.5	R	Lava Cyn				
65.7	L	Palisades Creek				
66.3	L	Above Espejo				
66.8	L	Espejo				
68.3	R	Upper Tanner				
68.4	R	Tanner				
69.8	R	Lower Basalt				
71.0	L	Cardenas				
71.9	R	Upr Unkar				
72.3	L	Unkar				
73.6	R	Below Granary				
74.1	R	Upr Rattlesnake				
74.3	R	Lwr Rattlesnake				
75.6	L	Nevills				
75.8	R	Papago				
76.6	L	Hance				
78.9	L	Below Sock				
81.3	L	Grapevine				
84.0	R	Clear Creek*				
84.4	L	Above Zoroaster*				
87.1	L	Upr Cremation				
87.2	L	Lwr Cremation				
87.8	R	Phantom	**			
89.0	L	Pipe Creek	**			

*Low Water Camp ** Activity Site, No camping

EXAMPLE
RIVER TRIP REPORT:

Codes: **C** = Camp, **L** = Lunch, **A** = Activity, **X** = Change of Plans (Please note reason in margin.)

MILE		NAME	Type: CLAX	Time Arrived	Time Left	NOTES: INTENTIONS: Why did you change your plans? (e.g. occupied, weather...)
120.0	L	Opp. Blacktail	C	4:00	9:30	
120.0	R	Upr Blacktail				
120.1	R	Lwr Blacktail				
120.2	L	*				
120.9	L					
122.2	R	122 Mile				
122.7	L	Upr Forster				
124.3	L	Above Fossil				
124.9	L	Fossil				
125.4	L	Below Fossil				
126.5	R	Randy's Rock	L	11:30	12:30	@127R
131.1	R	Below Bedrock				
131.8	R	Galloway	X			Priv. C
132.0	R	Stone Creek	CCA	4:30	9:00	
133.0	L	Talking Heads				
133.5	R	Racetrack				

We appreciate your assistance in helping guide the future of river recreation modeling. Please ensure that this **River Trip Report is returned to Grand Canyon Science Center, Attn: Linda Jalbert, Grand Canyon National Park, P.O. Box 129, Grand Canyon, AZ. 86023**.

Please take the time to make sure that you have filled in the front page and double check that all camps are documented for each night you were on the river.

Please make any comments below:

ACKNOWLEDGEMENTS:
Identification of campsites was taken from River Campsites in Grand Canyon National Park (1993) and Effects of a Beach/Habitat-Building Flow on Campsites in the Grand Canyon (1997), by Lisa Kearsley et.al. Appreciation is extended to the Grand Canyon Outfitters Association, the Grand Canyon Private Boaters Association, and the Grand Canyon River Guides for their participation in reviewing this River Trip Report.

COLORADO RIVER TRIP REPORT

TYPE TRIP (circle:): Private, Commercial, NPS, Research

OUTFITTER: _____ Trip Leader: _____

Number of boats:
MOTORS: ____ OARS: ____ DORIES: ____ KAYAKS: ____ OTHER: _____

LOCATION	DATE mo/day/yr	TIME	#Commercial Passengers, Privates		#Commercial Crew, Researchers, NPS	
			# IN	#OUT	# IN	#OUT
Lees Ferry Departure						
Phantom Exchange						
Other:						
Whitmore Exchange						
Diamond Takeout						
Lake Mead Takeout						

Thank you for taking the time to fill out this Trip Report for your Colorado River trip. Grand Canyon National Park is gathering information to improve management of the river and protect your recreation experience.

We are gathering information regarding intentions as well as the actual activities of rive parties. This Trip Report is a check list as much as possible; however, we are asking for written notes as well. We developed a shorthand of sorts to accommodate the space restriction. You will find the meaning for the codes to use above each page.

Please attempt to find your camps and attraction sites among those listed. Mark the appropriate code (C,L,A,X). Other stops may be added into the chart itself in the appropriate river mile section. For layovers and multiple purpose stops, enter the appropriate multiple codes (CC for layovers; AL for Activity and Lunch). For intendec stops that are missed, mark an X and note the reason. Any notes on communication or interactions with others about camps and scheduling would be appreciated.

Thank you again for your participation.

RIVER TRIP REPORT:

Codes: **C** = Camp, **L** = Lunch, **A** = Activity, **X** = Change of Plans (Please note reason in margin.)

MILE		NAME	Type: CLAX	Time Arrived	Time Left	NOTES: INTENTIONS: Why did you change your plans? (e.g. occupied, weather…)
89.3	R	Below Pipe Creek				
91.1	R	91 Mile Creek				
91.6	R	Trinity Creek				
92.3	L	Above Salt Creek				
93.4	L	Granite				
94.3	R					
94.9	L	Hermit				
96.0	R	Upr Schist				
96.1	L	Schist				
96.7	L	Boucher				
98.0	R	Upr Crystal				
98.2	R	Lwr Crystal				
99.0	L	Tuna				
102.8	R	New Shady Grove				
103.8	R	Emerald				
107.8	L	Ross Wheeler				
108.0	R	Parkins Inscription*				
108.2	R	Lwr Bass				
108.7	R	Shinumo	**			
109.4	R	110 Mile				
114.3	R	Upr Garnet				
114.5	R	Lower Garnet				
116.5	L	Elves Chasm	**			
118.1	R					
118.5	L					
119.0	R	Big Dune				
119.2	R					
119.5	L	Shady Grove				
119.8	L	120 Mile				
120.0	L	Opp. Blacktail				
120.0	R	Upr Blacktail				
120.1	R	Lwr Blacktail				
120.2	L	*				
120.9	L					
122.2	R	122 Mile				
122.7	L	Upr Forster				
124.3	L	Above Fossil				
124.9	L	Fossil				
125.4	L	Below Fossil				
126.5	R	Randy's Rock				
131.1	R	Below Bedrock				
131.8	R	Galloway				
132.0	R	Stone Creek				
133.0	L	Talking Heads				
133.5	R	Racetrack				
133.8	R	Tapeats				
		Thunder River		N/A	N/A	
		Surprise Valley		N/A	N/A	

*Low Water Camp **Activity Site, No camping

RIVER TRIP REPORT:

Codes: **C** = Camp, **L** = Lunch, **A** = Activity, **X** = Change of Plans (Please note reason in margin.)

MILE		NAME	Type: CLAX	Time Arrived	Time Left	NOTES: INTENTIONS: Why did you change your plans? (e.g. occupied, weather…)
133.9	R	Below Tapeats				
134.2	L					
134.6	L	Owl Eyes				
136.0	L	Junebug				
136.2	R	Deer Creek (Falls)	**			
		Patio		N/A	N/A	
		Dutton/Deer Spgs.		N/A	N/A	
		Surprise Valley		N/A	N/A	
136.2	L	Across Deer Creek				
136.3	L	OC's				
136.8	L	Poncho's Kitchen				
136.9	L	Football Field				
137.0	L	Backeddy				
137.9	L	Doris				
138.2	L					
138.4	L					
139.0	R	Fishtail				
139.8	L	Keyhole				
143.3	L	Above Kanab				
143.5	R	Mouth of Kanab*				
144.2	R	Below Kanab*				
145.1	L	Above Olo				
145.6	L	Olo*				
147.9	R	Opp. Matkat				
147.9	L	Matkatamiba	**			
148.4	L	Matkat Hotel				
148.5	L	Below Matkat*				
150.3	L	Upset Hotel				
151.3	R	Upper Ledges*				
151.5	R	Ledges				
155.7	R	Last Chance				
156.8	L	Havasu	**			
		Big Kids Pool		N/A	N/A	
		Beaver Falls		N/A	N/A	
		Mooney Falls		N/A	N/A	
157.7	R	First Chance				
158.2	R	158 Mile				
158.5	R	Second Chance				
160.0	L	160 Mile				
160.7	R	*				
164.5	R	Tuckup				
164.8	L	Below Tuckup				
166.5	L	Upr National				

*Low Water Camp **Activity Site, No camping

RIVER TRIP REPORT:

Codes: **C** = Camp, **L** = Lunch, **A** = Activity, **X** = Change of Plans (Please note reason in margin.)

MILE	NAME	Type: CLAX	Time Arrived	Time Left	NOTES: INTENTIONS: Why did you change your plans? (e.g. occupied, weather...)
166.6 L	Lwr National				
167.0 L	Below National				
167.2 L					
168.0 R	Fern Glen				
171.0 R	Stairway Cyn				
171.6 L	Mohawk				
172.1 L	172 Mile				
173.0 R					
174.3 R	Upr Cove				
174.4 R	Lwr Cove				
176.0 L	Below Red Slide				
177.1 L	Honga Spring				
177.7 L	Above Anvil				
178.0 R	Vulcan's Anvil				
179.0 L	Above Lava				
179.2 L	Just Above Lava				
179.7 R	Below Lwr Lava				
181.8 R	182 Mile				
182.5 L	Hell's Hollow				
182.5 R	Upr Chevron				
182.6 R	Lwr Chevron				
182.8 R	Below Chevron				
182.8 L					
183.0 L	Below Old Helipad				
184.5 L					
185.3 R	*				
185.5 R					
186.0 L					
186.2 L					
187.0 L	Whitmore Helipad				
188.0 R	Whitmore Wash				
188.2 R	Lwr Whitmore				
189.0 L					
189.5 L					
189.7 L					
190.3 L					
191.0 R	Upper Fat City*				
191.8 L	Fat City				
192.2 R					
192.8 L					
194.1 L	Hualapai Acres				
194.4 L	194 Mile				
196.4 L	Froggy Fault				
196.5 L	Below Froggy				
198.5 R	Parashant				
200.5 L					
201.2 R	201 Mile				

*Low Water Camp **Activity Site, No camping

RIVER TRIP REPORT:

Codes: **C** = Camp, **L** = Lunch, **A** = Activity, **X** = Change of Plans (Please note reason in margin.)

MILE	NAME	Type: CLAX	Time Arrived	Time Left	NOTES: INTENTIONS: Why did you change your plans? (e.g. occupied, weather...)
202.0 R	202 Mile				
202.5 R					
204.5 R	Below Spring Cyn				
206.6 R	Indian Cyn				
208.8 L	Granite Park				
209.5 R					
210.0 R	210 Mile				
210.7 R	Big Cedar				
211.2 L					
211.5 R	Upper Fall Cyn				
211.7 R	Lower Fall Cyn				
212.9 L	Pumpkin Springs				
213.5 L	Below Pumpkin*				
215.6 L	Three Springs				
215.6 R	Opp. Three Spgs.*				
216.4 R					
219.8 R	Upper 220 Mile				
219.9 R	Middle 220 Mile				
220.0 R	Lower 220 Mile				
221.2 R	221 Mile				
222.0 L	222 Mile				
223.0 R	223 Mile				
223.4 L	224 Mile				
224.5 L					
225.7 L	Diamond Creek				
226.0 R					
229.0 L	Travertine Cyn				
230.5 L	Travertine Falls				
235.0 L	Bridge Cyn				
236.0 R	Gneiss Cyn				
238.5 L					
239.6 R	Separation Cyn				
241.5 R	241 Mile				
241.5 L					
242.0 R	242 Mile				
243.1 R	243 Mile				
246.0 L	Spencer Cyn				
246.3 R	Lava Cliffs				
248.2 R	Surprise Cyn				
249.6 R					
252.2 L	Reference Point				
257.0 R	257 Bar				
259.5 R	Burnt Springs				
260.1 L	Quartermaster				
262.0 R					
274.5 L	Columbine Falls				
278.6	Scorpion Island				

*Low Water Camp **Activity Site, No camping

EXAMPLE
RIVER TRIP REPORT:

Codes: **C** = Camp, **L** = Lunch, **A** = Activity, **X** = Change of Plans (Please note reason in margin.)

MILE		NAME	Type: CLAX	Time Arrived	Time Left	NOTES: INTENTIONS: Why did you change your plans? (e.g. occupied, weather...)
120.0	L	Opp. Blacktail	C	4:00	9:30	
120.0	R	Upr Blacktail				
120.1	R	Lwr Blacktail				
120.2	L	*				
120.9	L					
122.2	R	122 Mile				
122.7	L	Upr Forster				
124.3	L	Above Fossil				
124.9	L	Fossil				
125.4	L	Below Fossil				
126.5	R	Randy's Rock	L	11:30	12:30	@127R
131.1	R	Below Bedrock				
131.8	R	Galloway	X			Priv. C
132.0	R	Stone Creek	CCA	4:30	9:00	
133.0	L	Talking Heads				
133.5	R	Racetrack				

We appreciate your assistance in helping guide the future of river recreation modeling. Please ensure that this **River Trip Report is returned to Grand Canyon Science Center, Attn: Linda Jalbert, Grand Canyon National Park, P.O. Box 129, Grand Canyon, AZ. 86023.**

Please take the time to make sure that you have filled in the front page and double check that all camps are documented for each night you were on the river.

Please make any comments below:

ACKNOWLEDGEMENTS:
Identification of campsites was taken from River Campsites in Grand Canyon National Park (1993) and Effects of a Beach/Habitat-Building Flow on Campsites in the Grand Canyon (1997), by Lisa Kearsley et.al. Appreciation is extended to the Grand Canyon Outfitters Association, the Grand Canyon Private Boaters Association, and the Grand Canyon River Guides for their participation in reviewing this River Trip Report.

COLORADO RIVER TRIP REPORT

TYPE TRIP (circle:): Private, Commercial, NPS, Research

OUTFITTER: _____ Trip Leader: _____

Number of boats:
MOTORS: ____ OARS: ____ DORIES: ____ KAYAKS: ____ OTHER: ____

LOCATION	DATE mo/day/yr	TIME	#Commercial Passengers, Privates		#Commercial Crew, Researchers, NPS	
			# IN	#OUT	# IN	#OUT
Lees Ferry Departure						
Phantom Exchange						
Other:						
Whitmore Exchange						
Diamond Takeout						
Lake Mead Takeout						

Thank you for taking the time to fill out this Trip Report for your Colorado River trip Grand Canyon National Park is gathering information to improve management of the river and protect your recreation experience.

We are gathering information regarding intentions as well as the actual activities of ri parties. This Trip Report is a check list as much as possible; however, we are asking t written notes as well. We developed a shorthand of sorts to accommodate the space restriction. You will find the meaning for the codes to use above each page.

Please attempt to find your camps and attraction sites among those listed. Mark the appropriate code (C,L,A,X). Other stops may be added into the chart itself in the appropriate river mile section. For layovers and multiple purpose stops, enter the appropriate multiple codes (CC for layovers; AL for Activity and Lunch). For intend stops that are missed, mark an X and note the reason. Any notes on communication o interactions with others about camps and scheduling would be appreciated.

Thank you again for your participation.

RIVER TRIP REPORT:

Codes: **C** = Camp, **L** = Lunch, **A** = Activity, **X** = Change of Plans (Please note reason in margin.)

MILE		NAME	Type: CLAX	Time Arrived	Time Left	NOTES: INTENTIONS: Why did you change your plans? (e.g. occupied, weather...)
5.8	R	6 Mile				
8.0	R	Badger				
8.0	L	Jackass				
8.5	L	Below Jackass *				
11.0	R	Soap Creek				
11.8	L	Brown's Inscription				
12.8	R	13 Mile*				
16.4	L	Hot Na Na				
17.0	R	House Rock				
18.1	L	18 Mile Ledges				
19.0	R					
19.1	L					
19.9	L	20 Mile				
20.4	R	Upr North Cyn				
20.5	R	Lwr North Cyn				
21.5	L	*				
21.9	R	*				
23.0	L	Indian Dick				
23.7	L	Lone Cedar				
24.5	L	24.5 Mile				
26.3	L	Above Tiger Wash*				
29.3	L	Shinumo Wash				
30.4	R	Fence Fault				
31.6	R	South Canyon				
31.7	R	Stanton's Cave				
31.8	R	Vasey's Paradise				
32.8	L	Redwall Cavern	**			
33.6	L	Below Redwall				
34.0	L	Little Redwall				
34.8	L	Nautiloid				
37.7	L	Tatahatso				
38.3	L	Marthas				
39.0	R	Redbud Alcove*				
40.9	R	Upr Buckfarm				
41.0	R	Lwr BuckFarm				
43.2	L	Anasazi Bridge				
43.3	L	Lwr Anasazi				
43.8	L	Pres. Harding				
44.2	L	Eminence				
44.6	L					
44.8	L	Willie Taylor				
46.9	L	Duck n Quack				
47.2	R	Upr Saddle				
47.3	R	Lwr Saddle				
50.0	R	Dinosaur				

*Low Water Camp ** Activity Site, No camping

RIVER TRIP REPORT:

Codes: **C** = Camp, **L** = Lunch, **A** = Activity, **X** = Change of Plans (Please note reason in margin.)

MILE		NAME	Type: CLAX	Time Arrived	Time Left	NOTES: INTENTIONS: Why did you change your plans? (e.g. occupied, weather...)
51.2	L					
51.4	L					
51.8	R	Little Nankoweap				
52.6	R	Upper Nankoweap				
53.0	R	Main Nankoweap				
53.2	R	Lower Nankoweap				
56.2	R	Kwagunt				
56.7	R					
57.5	R	Malagosa				
57.5	L	Opp. Malagosa				
58.2	R	Awatubi				
58.6	L	Below Awatubi Left				
59.0	R	Below Awatubi Rt.				
59.8	R	60 Mile*				
60.8	R					
61.0	L	61 Mile				
61.2	R	Above LCR				
61.4	L	LCR	**			Muddy?
61.7	R	Below LCR*				
62.6	R	Crash Cyn				
64.7	R	Carbon				
65.5	R	Lava Cyn				
65.7	L	Palisades Creek				
66.3	L	Above Espejo				
66.8	L	Espejo				
68.3	R	Upper Tanner				
68.4	R	Tanner				
69.8	R	Lower Basalt				
71.0	L	Cardenas				
71.9	R	Upr Unkar				
72.3	L	Unkar				
73.6	R	Below Granary				
74.1	R	Upr Rattlesnake				
74.3	R	Lwr Rattlesnake				
75.6	L	Nevills				
75.8	R	Papago				
76.6	L	Hance				
78.9	L	Below Sock				
81.3	L	Grapevine				
84.0	R	Clear Creek*				
84.4	L	Above Zoroaster*				
87.1	L	Upr Cremation				
87.2	L	Lwr Cremation				
87.8	R	Phantom	**			
89.0	L	Pipe Creek	**			

*Low Water Camp ** Activity Site, No camping

RIVER TRIP REPORT:

Codes: **C** = Camp, **L** = Lunch, **A** = Activity, **X** = Change of Plans (Please note reason in margin.)

MILE		NAME	Type: CLAX	Time Arrived	Time Left	NOTES: INTENTIONS: Why did you change your plans? (e.g. occupied, weather...)
89.3	R	Below Pipe Creek				
91.1	R	91 Mile Creek				
91.6	R	Trinity Creek				
92.3	L	Above Salt Creek				
93.4	L	Granite				
94.3	R					
94.9	L	Hermit				
96.0	R	Upr Schist				
96.1	L	Schist				
96.7	L	Boucher				
98.0	R	Upr Crystal				
98.2	R	Lwr Crystal				
99.0	L	Tuna				
102.8	R	New Shady Grove				
103.8	R	Emerald				
107.8	L	Ross Wheeler				
108.0	R	Parkins Inscription*				
108.2	R	Lwr Bass				
108.7	R	Shinumo	**			
109.4	R	110 Mile				
114.3	R	Upr Garnet				
114.5	R	Lower Garnet				
116.5	L	Elves Chasm	**			
118.1	R					
118.5	L					
119.0	R	Big Dune				
119.2	R					
119.5	L	Shady Grove				
119.8	L	120 Mile				
120.0	L	Opp. Blacktail				
120.0	R	Upr Blacktail				
120.1	R	Lwr Blacktail				
120.2	L	*				
120.9	L					
122.2	R	122 Mile				
122.7	L	Upr Forster				
124.3	L	Above Fossil				
124.9	L	Fossil				
125.4	L	Below Fossil				
126.5	R	Randy's Rock				
131.1	R	Below Bedrock				
131.8	R	Galloway				
132.0	R	Stone Creek				
133.0	L	Talking Heads				
133.5	R	Racetrack				
133.8	R	Tapeats				
		Thunder River		N/A	N/A	
		Surprise Valley		N/A	N/A	

*Low Water Camp **Activity Site, No camping

RIVER TRIP REPORT:

Codes: **C** = Camp, **L** = Lunch, **A** = Activity, **X** = Change of Plans (Please note reason in margin.)

MILE		NAME	Type: CLAX	Time Arrived	Time Left	NOTES: INTENTIONS: Why did you change your plans? (e.g. occupied, weather...)
133.9	R	Below Tapeats				
134.2	L					
134.6	L	Owl Eyes				
136.0	L	Junebug				
136.2	R	Deer Creek (Falls)	**			
		Patio		N/A	N/A	
		Dutton/Deer Spgs.		N/A	N/A	
		Surprise Valley		N/A	N/A	
136.2	L	Across Deer Creek				
136.3	L	OC's				
136.8	L	Poncho's Kitchen				
136.9	L	Football Field				
137.0	L	Backeddy				
137.9	L	Doris				
138.2	L					
138.4	L					
139.0	R	Fishtail				
139.8	L	Keyhole				
143.3	L	Above Kanab				
143.5	R	Mouth of Kanab*				
144.2	R	Below Kanab*				
145.1	L	Above Olo				
145.6	L	Olo*				
147.9	R	Opp. Matkat				
147.9	L	Matkatamiba	**			
148.4	L	Matkat Hotel				
148.5	L	Below Matkat*				
150.3	L	Upset Hotel				
151.3	R	Upper Ledges*				
151.5	R	Ledges				
155.7	R	Last Chance				
156.8	L	Havasu	**			
		Big Kids Pool		N/A	N/A	
		Beaver Falls		N/A	N/A	
		Mooney Falls		N/A	N/A	
157.7	R	First Chance				
158.2	R	158 Mile				
158.5	R	Second Chance				
160.0	L	160 Mile				
160.7	R	*				
164.5	R	Tuckup				
164.8	L	Below Tuckup				
166.5	L	Upr National				

*Low Water Camp **Activity Site, No camping

RIVER TRIP REPORT:

Codes: **C** = Camp, **L** = Lunch, **A** = Activity, **X** = Change of Plans (Please note reason in margin.)

MILE	NAME	Type: CLAX	Time Arrived	Time Left	NOTES: INTENTIONS: Why did you change your plans? (e.g. occupied, weather...)
166.6 L	Lwr National				
167.0 L	Below National				
167.2 L					
168.0 R	Fern Glen				
171.0 R	Stairway Cyn				
171.6 L	Mohawk				
172.1 L	172 Mile				
173.0 R					
174.3 R	Upr Cove				
174.4 R	Lwr Cove				
176.0 L	Below Red Slide				
177.1 L	Honga Spring				
177.7 L	Above Anvil				
178.0 R	Vulcan's Anvil				
179.0 L	Above Lava				
179.2 L	Just Above Lava				
179.7 R	Below Lwr Lava				
181.8 R	182 Mile				
182.5 L	Hell's Hollow				
182.5 R	Upr Chevron				
182.6 R	Lwr Chevron				
182.8 R	Below Chevron				
182.8 L					
183.0 L	Below Old Helipad				
184.5 L					
185.3 R	*				
185.5 R					
186.0 L					
186.2 L					
187.0 L	Whitmore Helipad				
188.0 R	Whitmore Wash				
188.2 R	Lwr Whitmore				
189.0 L					
189.5 L					
189.7 L					
190.3 L					
191.0 R	Upper Fat City*				
191.8 L	Fat City				
192.2 R					
192.8 L					
194.1 L	Hualapai Acres				
194.4 L	194 Mile				
196.4 L	Froggy Fault				
196.5 L	Below Froggy				
198.5 R	Parashant				
200.5 L					
201.2 R	201 Mile				

*Low Water Camp **Activity Site, No camping

RIVER TRIP REPORT:

Codes: **C** = Camp, **L** = Lunch, **A** = Activity, **X** = Change of Plans (Please note reason in margin.)

MILE	NAME	Type: CLAX	Time Arrived	Time Left	NOTES: INTENTIONS: Why did you change your plans? (e.g. occupied, weather...)
202.0 R	202 Mile				
202.5 R					
204.5 R	Below Spring Cyn				
206.6 R	Indian Cyn				
208.8 L	Granite Park				
209.5 R					
210.0 R	210 Mile				
210.7 R	Big Cedar				
211.2 L					
211.5 R	Upper Fall Cyn				
211.7 R	Lower Fall Cyn				
212.9 L	Pumpkin Springs				
213.5 L	Below Pumpkin*				
215.6 L	Three Springs				
215.6 R	Opp. Three Spgs.*				
216.4 R					
219.8 R	Upper 220 Mile				
219.9 R	Middle 220 Mile				
220.0 R	Lower 220 Mile				
221.2 R	221 Mile				
222.0 L	222 Mile				
223.0 R	223 Mile				
223.4 L	224 Mile				
224.5 L					
225.7 L	Diamond Creek				
226.0 R					
229.0 L	Travertine Cyn				
230.5 L	Travertine Falls				
235.0 L	Bridge Cyn				
236.0 R	Gneiss Cyn				
238.5 L					
239.6 R	Separation Cyn				
241.5 R	241 Mile				
241.5 L					
242.0 R	242 Mile				
243.1 R	243 Mile				
246.0 L	Spencer Cyn				
246.3 R	Lava Cliffs				
248.2 R	Surprise Cyn				
249.6 R					
252.2 L	Reference Point				
257.0 R	257 Bar				
259.5 R	Burnt Springs				
260.1 L	Quartermaster				
262.0 R					
274.5 L	Columbine Falls				
278.6	Scorpion Island				

*Low Water Camp **Activity Site, No camping

Appendix C: Cover Sheet for Trip Report

WHY ARE GRAND CANYON/COLORADO RIVER FLOWS SO LOW?

As part of the 1995 Glen Canyon Dam Environmental Impact Statement, the U.S. Fish and Wildlife Service issued a Biological Opinion regarding potentially affected threatened and endangered species and ways to mitigate impacts resulting from the operation of the dam. The opinion included mandatory measures designed to avoid jeopardizing the existence of the federally endangered fish known as the humpback chub (Gila cypha) in the Grand Canyon. The humpback chub is a native fish that is present in the warm water sidestreams of the Colorado River. Sustained flows in the warmer months may be vital to the humpback chub spawning periods as well as to young fish survivorship.

The Bureau of Reclamation and the Glen Canyon Monitoring and Research Center (GCMRC) have designed a Science Plan for testing LSSF for the year 2000. The study calls for releases of 17,000-19,000 cubic feet per second (cfs) in April and May with 4 days of 31,000 cfs releases in early May. Steady 8,000 cfs releases occur from June – Sept with another 4 days of 31,000 cfs releases in Sept.

The GCMRC met with stakeholders to discuss concerns they might have during the LSSF period. In response, the GCMRC in conjunction with the National Park Service, Northern Arizona University, and others, will conduct studies to evaluate the impacts on the whitewater rafting community.

The objective of one such study is to collect detailed information on river trip patterns and characteristics during the LSSF. Information is recorded on a Trip Report that is a comprehensive diary listing camp and activity sites along the river. Trip leaders complete the report by recording the time in and out for every stop. The LSSF trip report data will be compared to data from previous "normal" summer flow years.

Another study will examine the potential safety risks to boaters running the Colorado River at lower than normal flows. Observers will be stationed at six rapids to record actions taken to avoid accidents.

Please help researchers collect valuable data regarding whitewater rafting in the Canyon! A good representation of raft trip data is essential to the success of the studies! Your participation is really important, and very much appreciated. Thank you and have a great trip!

Appendix D: Contact letter sent to commercial outfitters to solicit participation in the study.

June 12, 2000

Dear XXX,

One of the studies to evaluate the impacts of the low steady flow release from Glen Canyon Dam this season is being conducted by the Modeling and Simulation Lab at Northern Arizona University. The objective is to collect detailed information on river trip patterns and characteristics during the 2000 season. This study is being paid for by the GCMRC and GRCA.

We are hoping to collect at least 200 Trip Reports during the low-flow season -- it would be best if we could get about a 50% return rate from your company. Starting June 1st, Trip Reports have been distributed at Lees Ferry. To help increase participation, I'm enclosing additional blank Trip Report forms. It is my hope that you'll distribute these to your trip leaders and encourage them to collect this valuable data. A good representation of raft trip data is essential to the success of the studies.

The collected information will be entered into a database this fall. Analysis will be conducted during the winter. The data will be compared to the Trip Report data collected during 1998 and 1999. The end result will be a report to GCMRC and GRCA. This report will quantify the additional time that trips have spent on the water. It will report on the average travel speeds for motor and oar boats in the various reaches of the river. It will compare the choices of activities and the duration of those activities with the data from previous years. The intent is to document the impact of the low flow on how trips are managed as they travel down the Colorado River.

An additional benefit to collecting this data is that this project will enable the Grand Canyon River Trip Simulator (a.k.a. "the computer model") to be enhanced to include a low-flow feature.

The final report will be available during the spring of 2001 on our website at http://odin.math.nau.edu/msl. Please feel free to contact me with any questions or concerns at Catherine.Roberts@nau.edu or (520) 523-6884. If you need more Trip Reports, let me know.

We really appreciate your willingness to participate in this data collection project. Please note that we only need the time-in and time-out for every stop -- it is not necessary to note encounters, changes of plans or any other information.

Thank you,

Catherine A. Roberts, Ph.D.

Appendix E: Contact letter to private permit holders to solicit participation in the study

United States Department of the Interior
NATIONAL PARK SERVICE
Grand Canyon National Park
P.O. Box 129
Grand Canyon, Arizona 86023-0129
N1623 (GRCA 8213)

July 13, 2000

Dear XXX;

You may be aware that your river trip will occur during an experimental flow from Glen Canyon Dam. The Record of Decision for the Glen Canyon Dam Environmental Impact Statement shows that balancing river conditions for a wide range of economic, recreational, natural and cultural resource types, remains a real challenge. This year's test for the low steady summer flow (LSSF) is consistent with the U.S. Fish and Wildlife Biological Opinion which calls for experimental flow regimes in low volume years. One of the primary purposes of the LSSF is to address the flow conditions intended to benefit native fish. The LSSF consists of a constant 8,000 cfs flow from June 1 through September 30. In addition, a four-day spike flow of 31,000 cfs is scheduled for September 5 through September 8, after which time it drops back to the constant 8,000 cfs flow.

The LSSF study plan includes several projects categorized at ecosystem studies, integrated monitoring of sand storage and budget studies, and socio-economic studies. The socio-economic category includes individual studies that are of great importance to recreational users. The study of "Whitewater Boating Safety" examines the relative risk involved in running rapids at low flows. Another study, "Effects on Recreational River Trip Characteristics," compares river trip characteristics such as travel time and off-river activities to "normal" flow regimes. Other studies look at economic impacts to recreational users (whitewater boating and angling) as well as power customers, and changes in campable beach areas.

Your cooperation and participation in these studies is very important. Two studies are under the direction of Park staff. We will be coordinating the whitewater safety and river trip characteristic studies.

The whitewater safety study follows the methodology established in the Glen Canyon Environmental Studies (1985-1992 and 1996), and includes making observations at key "major" rapids, and analyzing NPS incident reports. You may encounter observers at Hance, Horn Creek, Crystal, and Dubendorff, Lava and 232 Mile. These rapids are included based on previous studies and public input. Observers will be recording the characteristics or your runs at rapids. You may be asked a few questions by the observers regarding your trip experience. Observers will be in the field intermittently, and will not be able to document all trips during the experiment. In order to obtain a more complete data set, we ask that you complete the enclosed form. The data is not intended to judge your skills, but to determine the rate and type of

incidents associated with various flow regimes. This data will be compared to data collected at medium and higher flows.

The study also includes analysis of reported data. There are two primary sources of data that are examined: the NPS Emergency Services files, and River Incident Reports. The EMS files include information on helicopter evacuations and medical assistance from Park staff. The River Incident Report is included in the noncommercial operating requirements. River trip permitees are required to file these reports when incidents resulting in evacuation, personal injury requiring more than first aid, and property damage greater than $500 occurs. It is important that these are filed even if you did not require assistance from the Park staff.

The "river trip characteristics" study is being conducted as part of the cooperative agreement with Northern Arizona University to develop and test the Grand Canyon River Trip Simulator (GCRTSim). During the primary seasons in 1998 and 1999, river users completed river trip reports that were used in the development of the GCRTSim, a computerized model used to store visitor use and resource data needed to "simulate" river traffic. While the river planning effort was halted, the Park has committed to completion of this tool to examine river use capacities and launch scenarios under the current management plan. The LSSF has presented an opportunity to collect additional information to compare with trips during "normal" daily flows. Catherine Roberts, the Principal Investigator and NAU team leader for the development of the GCRTSim will be collecting and evaluating river trip data. Your participation in this data collection effort is vital to the success of this particular study.

A river trip report and a data sheet for recording your experience at major rapids is enclosed. You will also find a stamped, addressed, return envelope. Please return this at your earliest convenience following your trip.

If you have any questions about the recreation studies described above, please don't hesitate to contact me at 520-638-7909.

Again, thank you for your cooperation and participation in the recreation studies associated with the LSSF experiment. Have a wonderful trip.

Sincerely,

Linda Jalbert
Recreation Planner
Enclosures (3)

Appendix F: Power Point Presentation to GCMRC April 26, 2001

Impact of Low-Flow Rates on Recreational Rafting Traffic on the Colorado River in Grand Canyon National Park

Catherine A. Roberts

Joanna A. Bieri

Basic Information

- Bureau of Reclamation
  Grand Canyon Monitoring &
  Research Center
  (IA # 00-AA-40-4330)

- Cooperative agreement between
  Grand Canyon National Park &
  Northern Arizona University
  (CA#8210-99-002)

Contact Information

- Catherine A. Roberts
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  Worcester, MA 01610
  croberts@mathcs.holycross.edu

- Joanna A. Bieri
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  Flagstaff, AZ 86011-5717
  jab34@dana.ucc.nau.edu

Low Summer Steady Flow (LSSF)

Glen Canyon dam releases during summer 2000

- 17,000 - 19,000 cfs in April and May
- Four days of 31,000 cfs in early May
- Steady 8,000 cfs June - September
- Four days of 31,000 cfs in early September

Objective of Study

To examine the impact of LSSF on recreational rafting traffic on the Colorado River within the Grand Canyon National Park.

Outline of the Study

- Collect Trip Reports during LSSF.
- Place information into database.
- Compare “low flow” data to “typical flow” data collected during 1998/1999.

Trip Report

RIVER TRIP REPORT:

Codes: **C** = Camp, **L** = Lunch, **A** = Activity, **X** = Change of Plans (Please note reason in margin.)

MILE		NAME	Type: CLAX	Time Arrived	Time Left	NOTES: INTENTIONS: Why did you change your plans? (e.g. occupied, weather...)
51.2	L					
51.4	L					
51.8	R	Little Nankoweap				
52.6	R	Upper Nankoweap	C/A	4:15	9:15	
53.0	R	Main Nankoweap				
53.2	R	Lower Nankoweap				- passed private group still camping
56.2	R	Kwagunt				
56.7	R					
57.5	R	Malagosa				
57.5	L	Opp. Malagosa				
58.2	R	Awatubi				
58.6	L	Below Awatubi Left				
59.0	R	Below Awatubi Rt.				
59.8	R	60 Mile* 10:50				
60.8	R					
61.0	L	61 Mile				
61.2	R	Above LCR				
61.4	L	LCR	**A	11:15	12:45	Muddy? YES!
61.7	R	Below LCR*	L	1:15	2:15	
62.6	R	Crash Cyn				
64.7	R	Carbon	A	3:35	3:45	- passed by 1 motor
65.5	R	Lava Cyn	C	4:20	8 AM	- passed by 3 motor, encounter
65.7	L	Palisades Creek				
[illegible]	L	Above Espejo				

Trip & Flow Classifications

- Commercial = C
  Private = P

- Trip Length = days between Lees Ferry and Diamond Creek

- Low Flow = LSSF (8,000 cfs)
  Typical Flow = 1998/1999 (19,000 cfs)

Four Trip Types

- Motor
  - Short 8 or fewer days
  - Long 9 or more days

- Oar
  - Short 14 or fewer days
  - Long 15 or more days

Low Flow Trip Reports

- Short Motor 61 C, 0 P
- Long Motor 3 C, 3 P
- Short Oar 23 C, 2 P
- Long Oar 10 C, 18 P

TOTAL = 120 Trip Reports

599 launches = 20% return rate

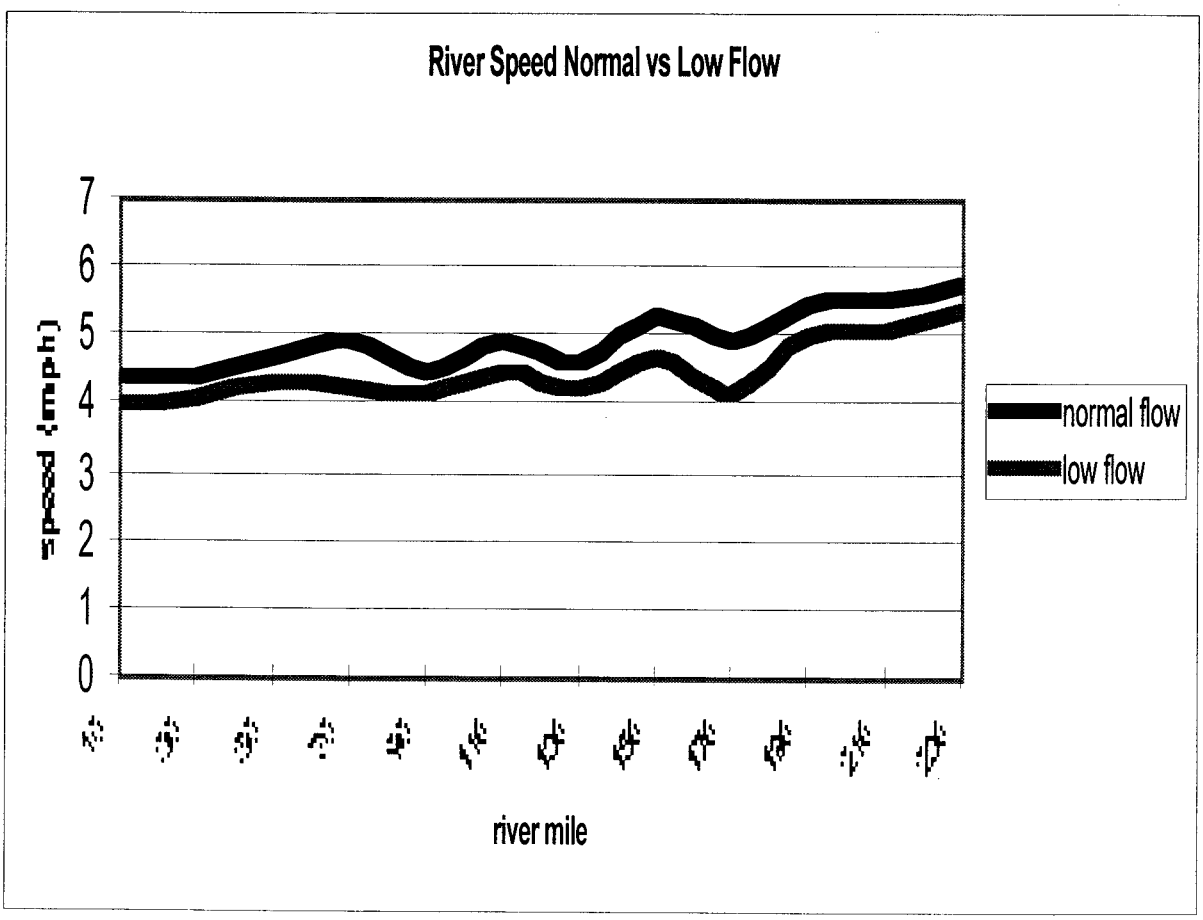
Typical Flow Trip Reports

- Short Motor 222 C, 7 P
- Long Motor 18 C, 9 P
- Short Oar 64 C, 24 P
- Long Oar 18 C, 125 P

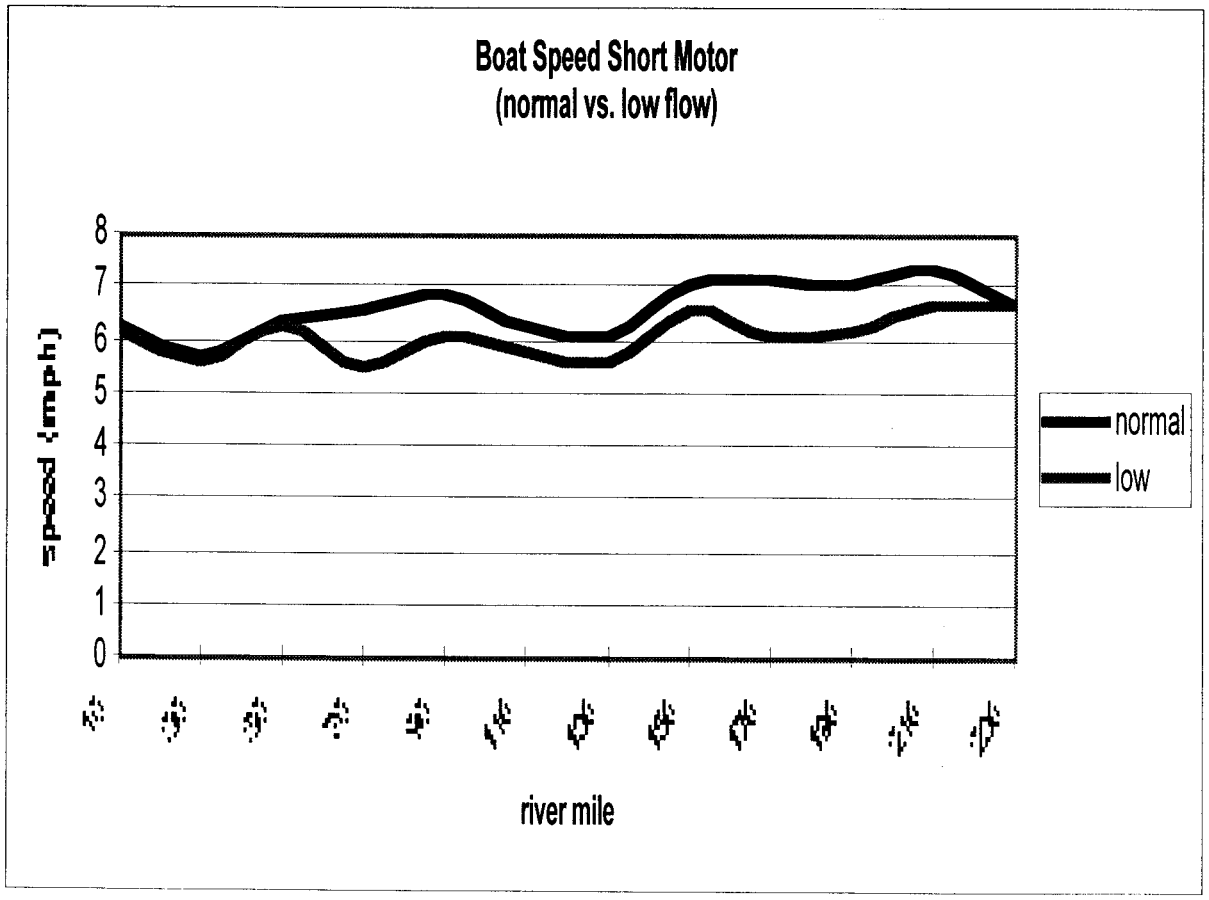
TOTAL = 487 Trip Reports

1,689 launches = 29% return

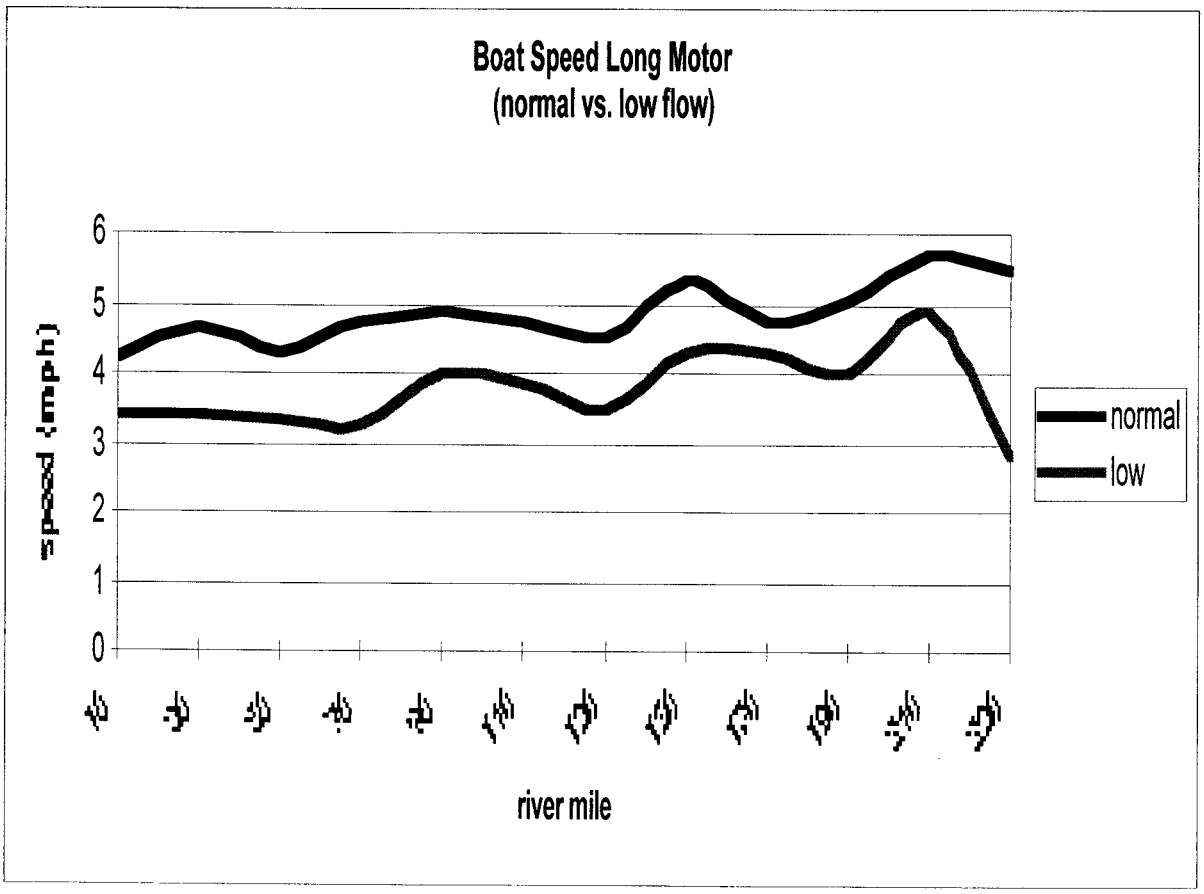
Boat Speed
Low vs. Typical Flow



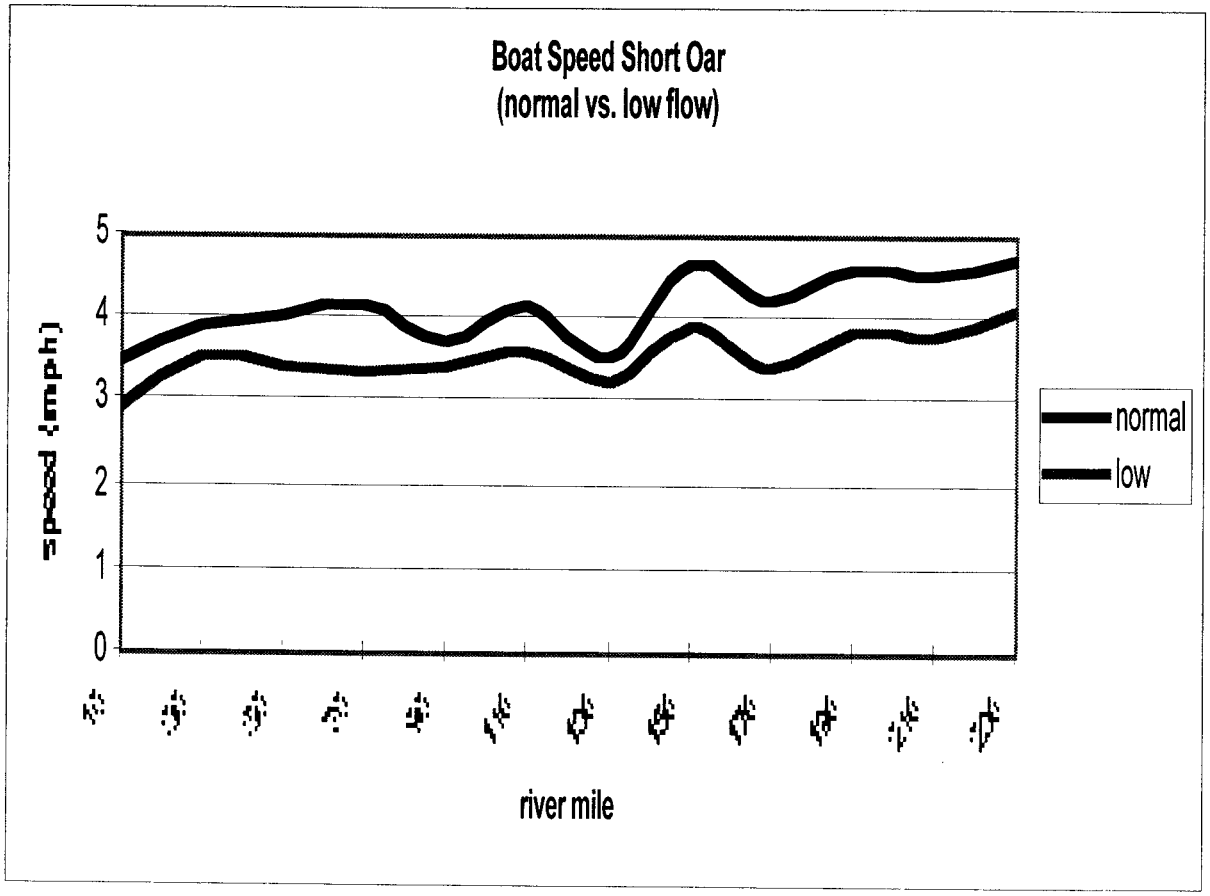
Boat Speed
Short Motor



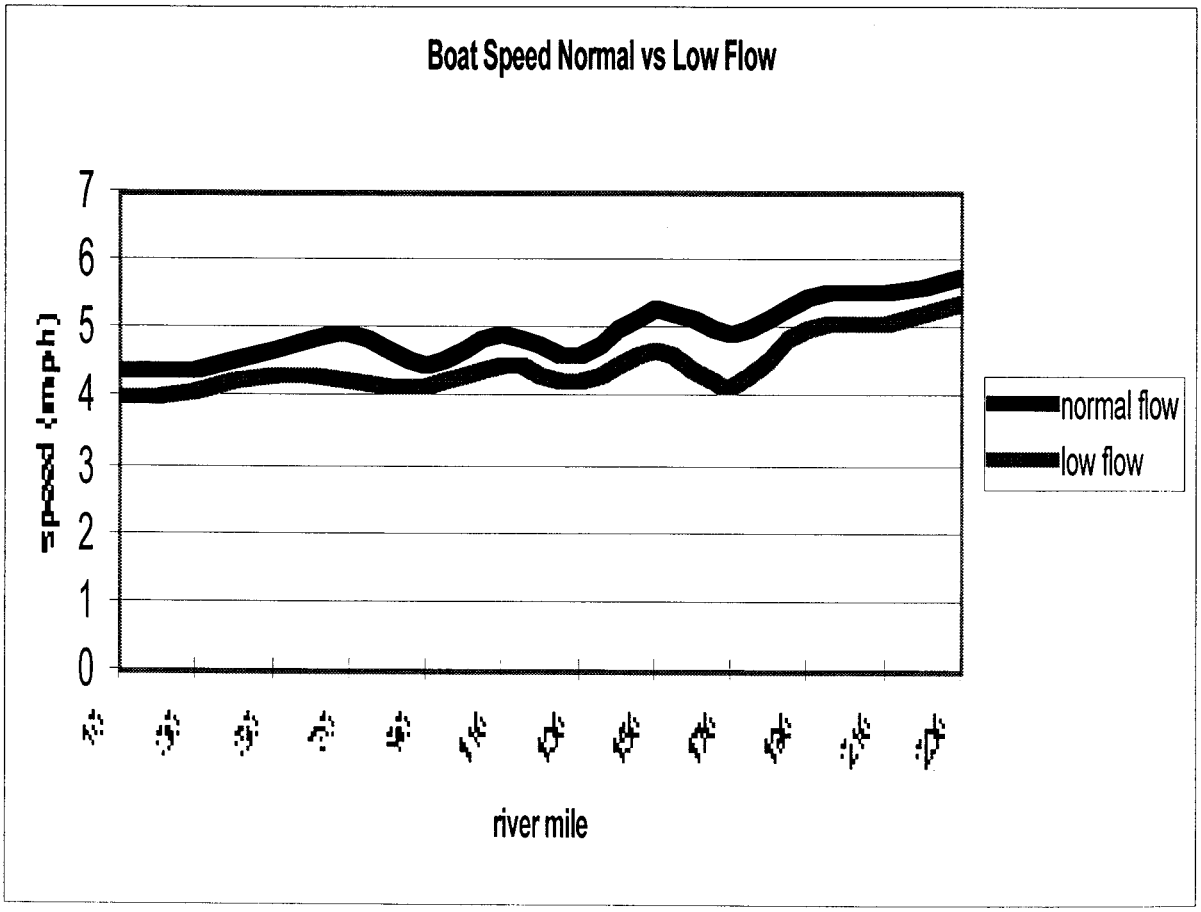
Boat Speed
Long Motor



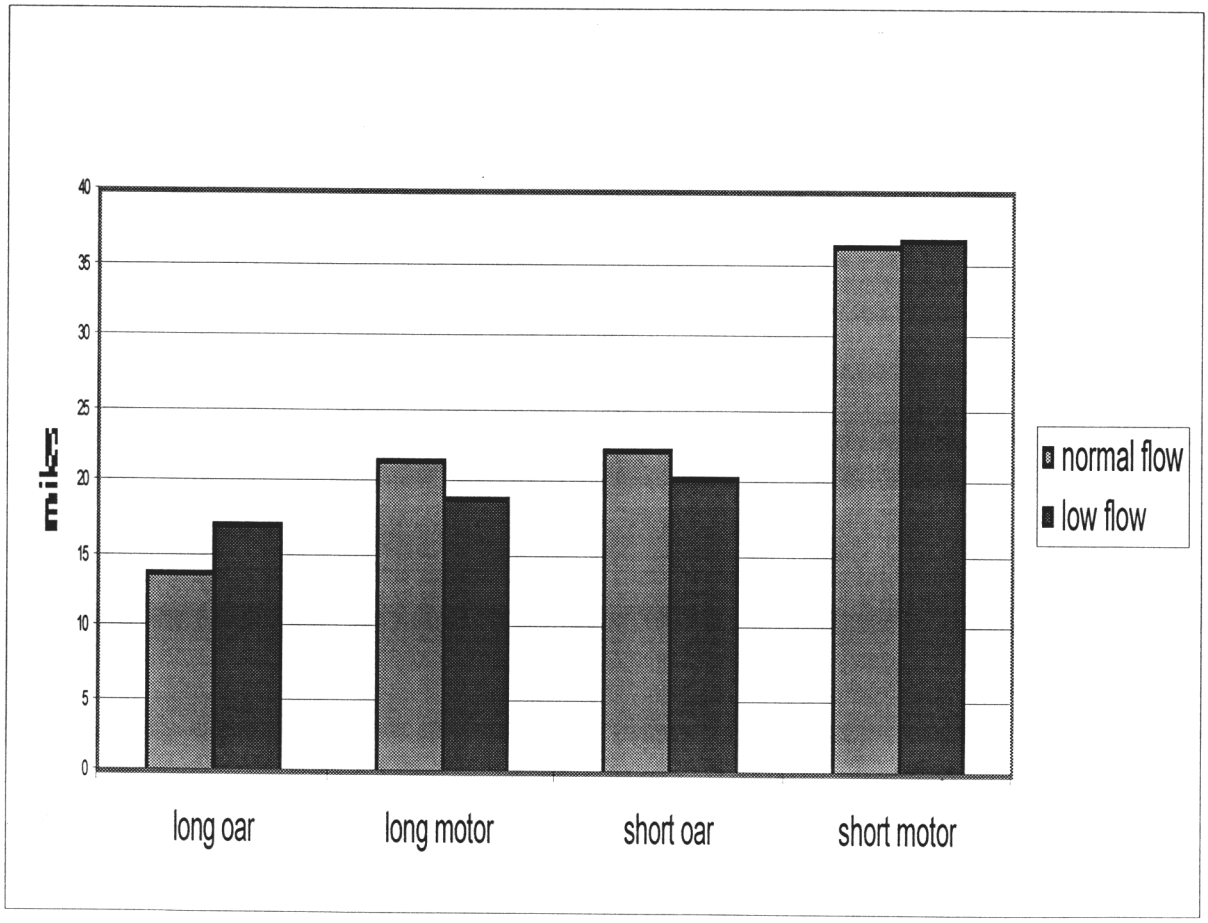
Boat Speed
Short Oar



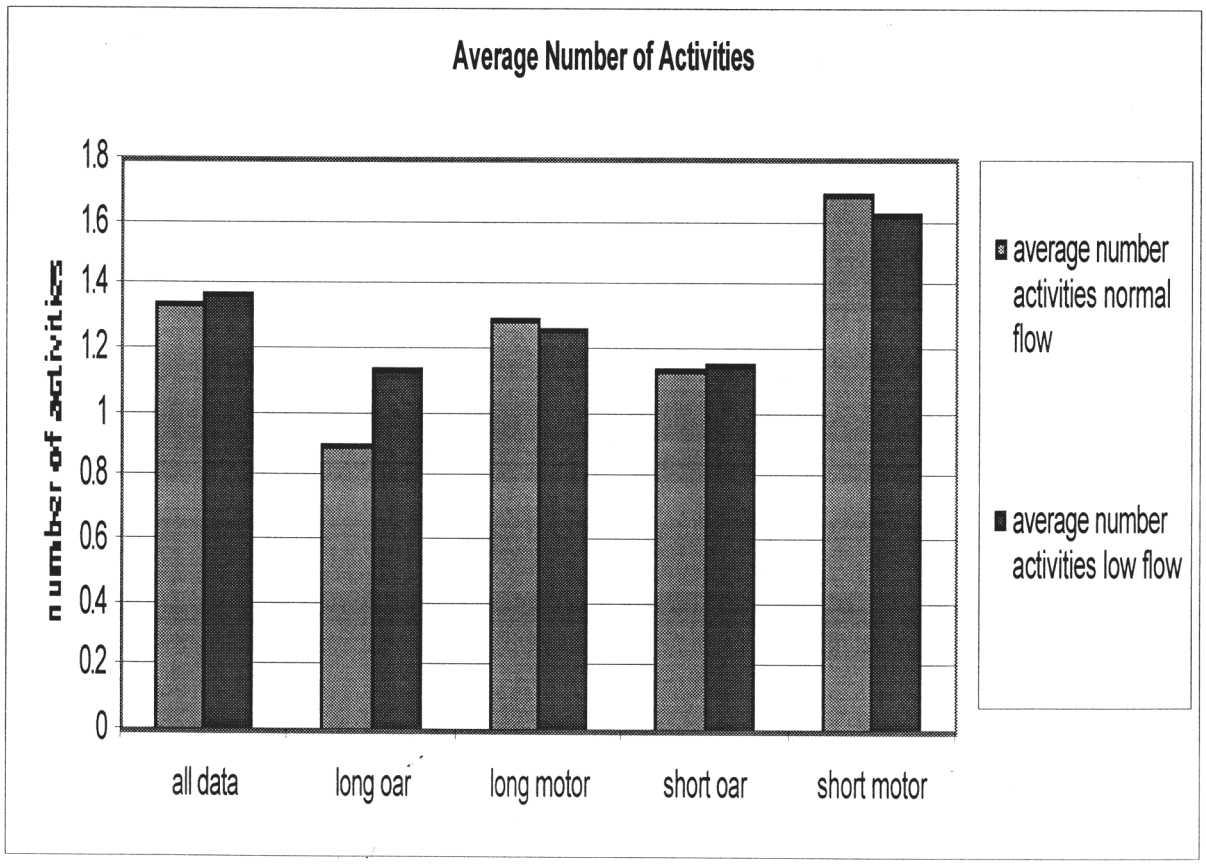
Boat Speed
Long Oar



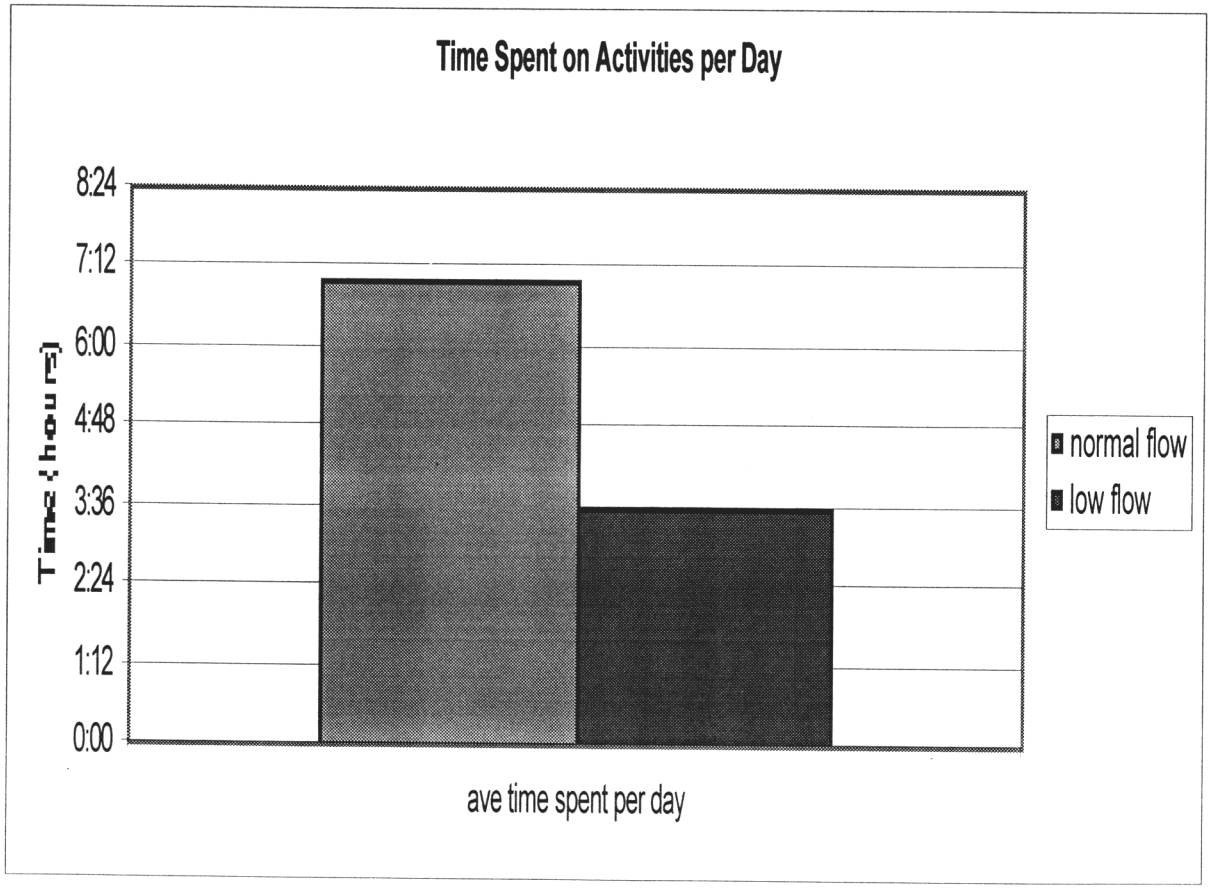
Average Daily Miles



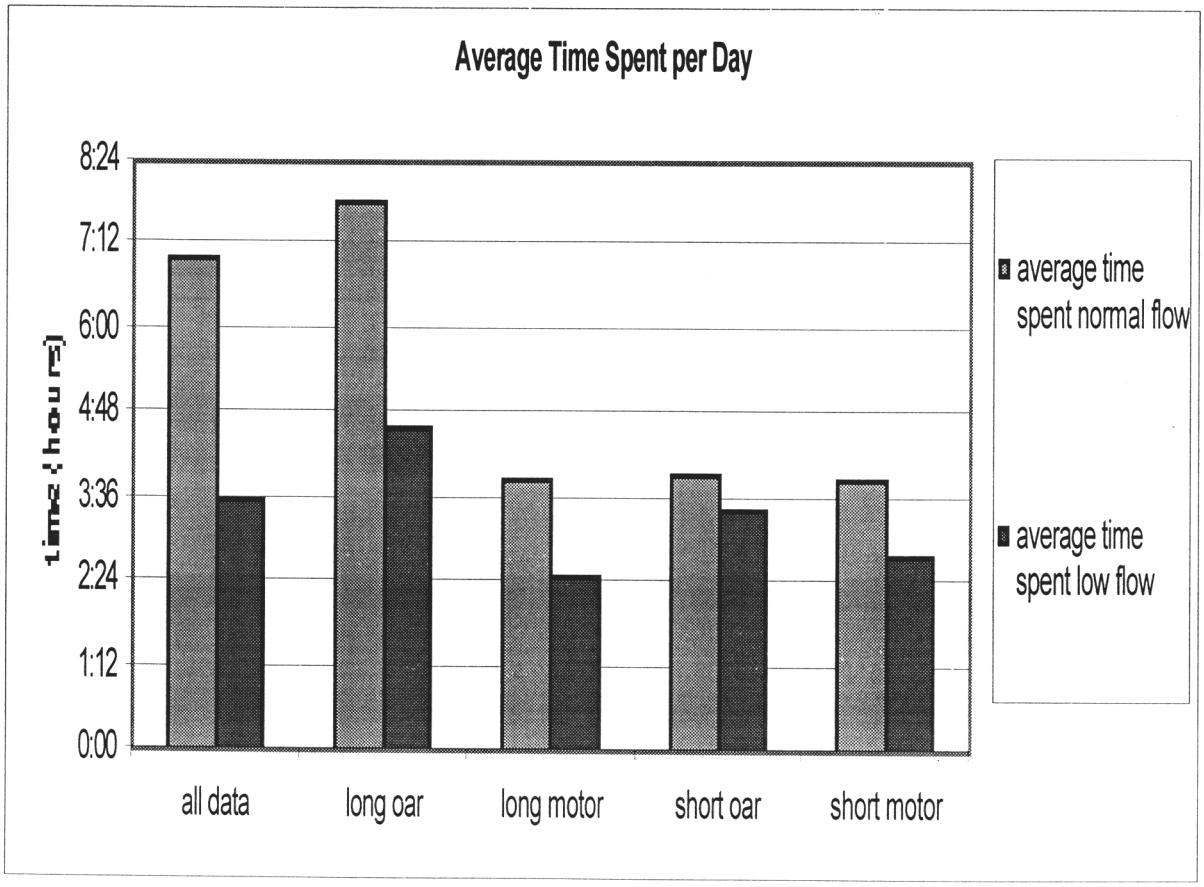
Daily Number of Activities



Daily Time Spent on Activities



Daily Time Spent on Activities



Conclusions

- No change in number of activities/day
- No change in number of miles/day

- Boats spent more time on water
- Boat speeds slower
- 50% reduction in time spent on activities

What's Next?

- Analysis of campsite and activity visitation frequencies for "low" and "typical" flows.
- Final report to GCMRC
- Several graphs posted on our website:

http://odin.math.nau.edu/~msl

Appendix G: Frequency data for attraction sites (typical flow)

Commercial Activity Frequency (typical flow)					Private Activity Frequency (typical flow)			
River Mile	Site Name	# Stops	Frequency		River Mile	Site Name	# Stops	Frequency
0.00	LEES FERRY	324	1		0.00	LEES FERRY	155	1
136.20	DEER CREEK	304	0.9382716		87.80	PHANTOM	136	0.877419355
156.80	HAVASU	287	0.8858025		156.80	HAVASU	134	0.864516129
32.80	REDWALL	278	0.8580247		136.20	DEER CREEK	132	0.851612903
116.50	ELVES CHASM	242	0.7469136		116.50	ELVES CHASM	125	0.806451613
61.40	LITTLE COLORADO	219	0.6759259		225.70	DIAMOND CREEK	124	0.8
279.00	LAKE MEAD TAKEOUT	217	0.6697531		32.80	REDWALL	115	0.741935484
108.70	SHINUMO	199	0.6141975		147.90	MATKATAMIBA	109	0.703225806
87.80	PHANTOM	156	0.4814815		61.40	LITTLE COLORADO	98	0.632258065
132.00	STONE CK	151	0.4660494		133.80	TAPEATS	74	0.477419355
187.00	WHITMORE HELIPAD	142	0.4382716		108.70	SHINUMO	71	0.458064516
147.90	MATKATAMIBA	120	0.3703704		34.80	NAUTILOID	62	0.4
47.20	UPR SADDLE	117	0.3611111		29.30	SHINUMO WASH	57	0.367741935
225.70	DIAMOND CREEK	117	0.3611111		212.90	PUMPKIN SPRINGS	54	0.348387097
31.60	SOUTH CANYON	104	0.3209877		279.00	LAKE MEAD TAKEOUT	46	0.296774194
53.00	NANKOWEAP	104	0.3209877		47.20	UPR SADDLE	45	0.290322581
229.00	TRAVERTINE CYN	98	0.3024691		132.00	STONE CK	45	0.290322581
84.00	CLEAR CK	96	0.2962963		31.60	SOUTH CANYON	44	0.283870968
20.40	UPR NORTH CYN	81	0.25		168.00	FERN GLEN	43	0.277419355
120.10	LWR BLACKTAIL	75	0.2314815		145.60	OLO	41	0.264516129
239.60	SEPARATION CYN	71	0.2191358		20.40	UPR NORTH CYN	40	0.258064516
212.90	PUMPKIN SPRINGS	68	0.2098765		53.00	NANKOWEAP	40	0.258064516
34.80	NAUTILOID	62	0.191358		84.00	CLEAR CK	37	0.238709677
120.00	UPR BLACKTAIL	62	0.191358		188.00	WHITMORE WASH	36	0.232258065
179.20	JUST ABOVE LAVA	60	0.1851852		71.90	UPR UNKAR	35	0.225806452
64.70	CARBON	51	0.1574074		76.60	HANCE	35	0.225806452
133.80	TAPEATS	48	0.1481481		72.30	UNKAR	33	0.212903226
72.30	UNKAR	46	0.1419753		16.40	HOT NA NA	32	0.207792208
166.50	UPR NATIONAL	45	0.1388889		179.20	JUST ABOVE LAVA	32	0.206451613
188.00	WHITMORE WASH	42	0.1296296		94.90	HERMIT	31	0.2
16.40	HOT NA NA	38	0.117284		64.70	CARBON	29	0.187096774
168.00	FERN GLEN	37	0.1141975		93.40	GRANITE	28	0.180645161
71.90	UPR UNKAR	36	0.1111111		98.00	UPR CRYSTAL	28	0.180645161
47.30	LWR SADDLE	34	0.1049383		120.00	UPR BLACKTAIL	28	0.180645161
65.50	LAVA CYN	33	0.1018519		17.00	HOUSE ROCK	27	0.174193548
68.40	TANNER	33	0.1018519		53.20	LWR NANKOWEAP	27	0.174193548
89.00	PIPE CREEK	33	0.1018519		166.50	UPR NATIONAL	27	0.174193548
98.00	UPR CRYSTAL	30	0.0925926		143.50	MOUTH OF KANAB	26	0.167741935
53.20	LWR NANKOWEAP	28	0.0864198		71.00	CARDENAS	23	0.148387097

94.90	HERMIT	27	0.0833333		198.50	PARASHANT	20	0.129032258
41.00	LWR BUCKFARM	25	0.0771605		120.10	LWR BLACKTAIL	19	0.122580645
93.40	GRANITE	25	0.0771605		229.00	TRAVERTINE CYN	19	0.122580645
215.60	OPP THREE SPRING	25	0.0771605		47.30	LWR SADDLE	18	0.116129032
179.00	ABOVE LAVA	24	0.0740741		65.50	LAVA CYN	18	0.116129032
131.80	GALLOWAY	23	0.0709877		41.00	LWR BUCKFARM	17	0.109677419
40.90	UPR BUCKFARM	21	0.0648148		164.50	TUCKUP	17	0.109677419
202.00	202 MILE	21	0.0648148		51.80	LITTLE NANKOWEAP	16	0.103225806
19.10		20	0.0617284		108.20	LWR BASS	16	0.103225806
52.60	UPR NANKOWEAP	20	0.0617284		75.60	NEVILLS	15	0.096774194
75.60	NEVILLS	20	0.0617284		179.70	BELOW LWR LAVA	14	0.090322581
76.60	HANCE	20	0.0617284		208.80	GRANITE PARK	14	0.090322581
91.60	TRINITY CK	20	0.0617284		52.60	UPR NANKOWEAP	13	0.083870968
39.00	REDBUD ALCOVE	19	0.058642		131.10	BELOW BEDROCK	13	0.083870968
186.00		19	0.058642		178.00	VULCAN'S ANVIL	13	0.083870968
206.60	INDIAN CYN	19	0.058642		157.70	FIRST CHANCE	12	0.077922078
243.10	243 MILE	19	0.058642		179.00	ABOVE LAVA	12	0.077419355
29.30	SHINUMO WASH	18	0.0555556		148.50	BELOW MATKAT	11	0.071428571
71.00	CARDENAS	18	0.0555556		56.20	KWAGUNT	11	0.070967742
108.20	LWR BASS	17	0.0524691		68.40	TANNER	11	0.070967742
230.50	TRAVERTINE FALLS	17	0.0524691		89.00	PIPE CREEK	11	0.070967742
11.80	BROWN'S INSCRIPTION	16	0.0493827		107.80	ROSS WHEELER	11	0.070967742
17.00	HOUSE ROCK	16	0.0493827		11.80	BROWN'S INSCRIPTION	10	0.064516129
20.50	LWR NORTH CYN	16	0.0493827		24.50	24.5 MILE	10	0.064516129
92.30	ABOVE SALT CK	16	0.0493827		202.00	202 MILE	10	0.064516129
166.60	LWR NATIONAL	14	0.0432099		219.80	UPPER 220-MILE	10	0.064516129
131.10	BELOW BEDROCK	13	0.0401235		194.10	HUALAPAI ACRES	9	0.058441558
158.20	158 MILE	13	0.0401235		43.80	PRES HARDING	9	0.058064516
183.00	BELOW OLD HELIPAD	13	0.0401235		131.80	GALLOWAY	9	0.058064516
98.20	LWR CRYSTAL	12	0.037037		166.60	LWR NATIONAL	9	0.058064516
143.50	MOUTH OF KANAB	12	0.037037		174.30	UPR COVE	9	0.058064516
44.20	EMINENCE	10	0.0308642		206.60	INDIAN CYN	9	0.058064516
107.80	ROSS WHEELER	10	0.0308642		239.60	SEPARATION CYN	9	0.058064516
241.50	241 MILE	10	0.0308642		204.50	BELOW SPRING CYN	8	0.051612903
56.20	KWAGUNT	9	0.0277778		18.10	18 MILE LEDGES	7	0.045454545
30.40	FENCE FAULT	8	0.0246914		92.30	ABOVE SALT CK	7	0.045454545
179.70	BELOW LWR LAVA	8	0.0246914		119.50	SHADY GROVE	7	0.045454545
19.90	20 MILE	7	0.0216049		158.20	158 MILE	7	0.045454545
58.60	BELOW AWATUBI LEFT	7	0.0216049		186.00		7	0.045454545

119.20		7	0.0216049		224.50		7	0.045454545
145.60	OLO	7	0.0216049		40.90	UPR BUCKFARM	7	0.04516129
178.00	VULCAN'S ANVIL	7	0.0216049		81.30	GRAPEVINE	7	0.04516129
74.10	UPR RATTLESNAKE	6	0.0185185		91.60	TRINITY CK	7	0.04516129
136.20	ACROSS DEER CK	6	0.0185185		98.20	LWR CRYSTAL	7	0.04516129
188.20	LWR WHITMORE	6	0.0185185		122.70	UPR FORSTER	7	0.04516129
194.10	HUALAPAI ACRES	6	0.0185185		230.50	TRAVERTINE FALLS	7	0.04516129
198.50	PARASHANT	6	0.0185185		8.00	BADGER	6	0.038709677
210.70	BIG CEDAR	6	0.0185185		89.30	BELOW PIPE CK	6	0.038709677
219.80	UPPER 220-MILE	6	0.0185185		114.30	UPR GARNET	6	0.038709677
26.30	ABOVE TIGER WASH	5	0.0154321		187.00	WHITMORE HELIPAD	6	0.038709677
56.70		5	0.0154321		119.20		5	0.032467532
74.30	LWR RATTLESNAKE	5	0.0154321		177.70	ABOVE ANVIL	5	0.032467532
81.30	GRAPEVINE	5	0.0154321		191.80	FAT CITY	5	0.032467532
119.50	SHADY GROVE	5	0.0154321		200.50		5	0.032467532
160.00	160 MILE	5	0.0154321		57.50	MALAGOSA	5	0.032258065
18.10	18 MILE LEDGES	4	0.0123457		69.80	LWR BASALT	5	0.032258065
37.70	TATAHATSO	4	0.0123457		114.50	LWR GARNET	5	0.032258065
43.80	PRES HARDING	4	0.0123457		126.50	RANDY'S ROCK	5	0.032258065
44.80	WILLIE TAYLOR	4	0.0123457		171.60	MOHAWK	5	0.032258065
51.80	LITTLE NANKOWEAP	4	0.0123457		44.60		4	0.025974026
109.40	110 MILE	4	0.0123457		182.80	BELOW CHEVRON	4	0.025974026
148.50	BELOW MATKAT	4	0.0123457		11.00	SOAP CREEK	4	0.025806452
208.80	GRANITE PARK	4	0.0123457		44.20	EMINENCE	4	0.025806452
23.00	INDIAN DICK	3	0.0092593		91.10	91 MILE CK	4	0.025806452
23.70	LONE CEDAR	3	0.0092593		122.20	122 MILE	4	0.025806452
24.50	24.5 MILE	3	0.0092593		133.50	RACETRACK	4	0.025806452
43.20	ANASAZI BRIDGE	3	0.0092593		133.90	BELOW TAPEATS	4	0.025806452
120.00	OPP. BLACKTAIL	3	0.0092593		134.60	OWL EYES	4	0.025806452
133.00	TALKING HEADS	3	0.0092593		136.00	JUNEBUG	4	0.025806452
136.80	PONCHO'S KITCHEN	3	0.0092593		136.80	PONCHO'S KITCHEN	4	0.025806452
147.90	OPP MATKAT	3	0.0092593		139.00	FISHTAIL	4	0.025806452
164.50	TUCKUP	3	0.0092593		235.00	BRIDGE CYN	4	0.025806452
174.40	LWR COVE	3	0.0092593		96.00	UPR SCHIST	3	0.019480519
182.50	UPR CHEVRON	3	0.0092593		120.20		3	0.019480519
182.80	BELOW CHEVRON	3	0.0092593		243.10	243 MILE	3	0.019480519
191.00	UPPER FAT CITY	3	0.0092593		257.00	257 BAR	3	0.019480519
191.80	FAT CITY	3	0.0092593		20.50	LWR NORTH CYN	3	0.019354839
192.80		3	0.0092593		23.00	INDIAN DICK	3	0.019354839
204.50	BELOW SPRING CYN	3	0.0092593		23.70	LONE CEDAR	3	0.019354839
223.00	223-MILE	3	0.0092593		43.20	ANASAZI BRIDGE	3	0.019354839
224.50		3	0.0092593		65.70	PALISADE S CREEK	3	0.019354839
235.00	BRIDGE CYN	3	0.0092593		96.10	SCHIST	3	0.019354839
11.00	SOAP CREEK	2	0.0061728		103.80	EMERALD	3	0.019354839
12.80	13 MILE	2	0.0061728		109.40	110 MILE	3	0.019354839

33.60	BELOW REDWALL	2	0.0061728		124.30	ABOVE FOSSIL	3	0.019354839
44.60		2	0.0061728		124.90	FOSSIL	3	0.019354839
51.20		2	0.0061728		125.40	BELOW FOSSIL	3	0.019354839
84.40	ABOVE ZOROASTER	2	0.0061728		139.80	KEYHOLE	3	0.019354839
87.10	UPR CREMATION	2	0.0061728		150.30	UPSET HOTEL	3	0.019354839
94.30		2	0.0061728		188.20	LWR WHITMORE	3	0.019354839
96.00	UPR SCHIST	2	0.0061728		19.10		2	0.012987013
96.10	SCHIST	2	0.0061728		51.20		2	0.012987013
120.20		2	0.0061728		58.60	BELOW AWATUBI LEFT	2	0.012987013
122.20	122 MILE	2	0.0061728		94.30		2	0.012987013
124.30	ABOVE FOSSIL	2	0.0061728		138.20		2	0.012987013
126.50	RANDY'S ROCK	2	0.0061728		160.00	160 MILE	2	0.012987013
137.00	BACKEDDY	2	0.0061728		183.00	BELOW OLD HELIPAD	2	0.012987013
139.00	FISHTAIL	2	0.0061728		190.30		2	0.012987013
157.70	FIRST CHANCE	2	0.0061728		191.00	UPPER FAT CITY	2	0.012987013
167.20		2	0.0061728		196.50	BELOW FROGGY	2	0.012987013
171.60	MOHAWK	2	0.0061728		241.50	241 MILE	2	0.012987013
184.50		2	0.0061728		248.20	SURPRISE CYN	2	0.012987013
194.40	194 MILE	2	0.0061728		8.00	JACKASS	2	0.012903226
196.40	FROGGY FAULT	2	0.0061728		8.50	BELOW JACKASS	2	0.012903226
216.40		2	0.0061728		19.00		2	0.012903226
219.90	MIDDLE 220-MILE	2	0.0061728		21.50		2	0.012903226
223.40	224-MILE	2	0.0061728		30.40	FENCE FAULT	2	0.012903226
236.00	GNEISS CYN	2	0.0061728		39.00	REDBUD ALCOVE	2	0.012903226
274.50	COLUMBINE FALLS	2	0.0061728		43.30	LWR ANASAZI	2	0.012903226
8.00	BADGER	1	0.0030864		44.80	WILLIE TAYLOR	2	0.012903226
8.00	JACKASS	1	0.0030864		61.20	ABOVE LCR	2	0.012903226
19.00		1	0.0030864		73.60	BELOW GRANARY	2	0.012903226
21.90		1	0.0030864		74.30	LWR RATTLESNA KE	2	0.012903226
34.00	LITTLE REDWALL	1	0.0030864		87.10	UPR CREMATION	2	0.012903226
38.30	MARTHA'S	1	0.0030864		108.00	PARKINS' INSCR	2	0.012903226
50.00	DINOSAUR	1	0.0030864		136.20	ACROSS DEER CK	2	0.012903226
51.40		1	0.0030864		136.90	FOOTBALL FIELD	2	0.012903226
58.20	AWATUBI	1	0.0030864		137.90	DORIS	2	0.012903226
59.00	BELOW AWATUBI RIGHT	1	0.0030864		167.00	BELOW NATIONAL	2	0.012903226
60.80		1	0.0030864		171.00	STAIRWAY CYN	2	0.012903226
62.60	CRASH CYN	1	0.0030864		174.40	LWR COVE	2	0.012903226
69.80	LWR BASALT	1	0.0030864		177.10	HONGA SPRING	2	0.012903226
87.20	LWR CREMATION	1	0.0030864		182.50	HELL'S HOLLOW	2	0.012903226
91.10	91 MILE CK	1	0.0030864		185.50		2	0.012903226

119.80	120 MILE	1	0.0030864		192.80		2	0.012903226
120.90		1	0.0030864		194.40	194 MILE	2	0.012903226
122.70	UPR FORSTER	1	0.0030864		209.50		2	0.012903226
133.50	RACETRACK	1	0.0030864		211.50	UPR FALL CYN	2	0.012903226
136.90	FOOTBALL FIELD	1	0.0030864		216.40		2	0.012903226
137.90	DORIS	1	0.0030864		220.00	LOWER 220-MILE	2	0.012903226
139.80	KEYHOLE	1	0.0030864		242.00	242 MILE	2	0.012903226
143.30	ABOVE KANAB	1	0.0030864		274.50	COLUMBINE FALLS	2	0.012903226
145.10	ABOVE OLO	1	0.0030864		46.90	DUCK N QUACK	1	0.006493506
148.40	MATKAT HOTEL	1	0.0030864		56.70		1	0.006493506
151.50	LEDGES	1	0.0030864		57.50	OPP. MALAGOSA	1	0.006493506
155.70	LAST CHANCE	1	0.0030864		61.00	61 MILE	1	0.006493506
160.70		1	0.0030864		78.90	BELOW SOCK	1	0.006493506
171.00	STAIRWAY CYN	1	0.0030864		160.70		1	0.006493506
173.00		1	0.0030864		172.10	172 MILE	1	0.006493506
174.30	UPR COVE	1	0.0030864		173.00		1	0.006493506
176.00	BELOW RED SLIDE	1	0.0030864		182.50	UPR CHEVRON	1	0.006493506
177.70	ABOVE ANVIL	1	0.0030864		184.50		1	0.006493506
182.80		1	0.0030864		246.30	LAVA CLIFFS	1	0.006493506
186.20		1	0.0030864		5.80	6 MILE	1	0.006451613
189.70		1	0.0030864		12.80	13 MILE	1	0.006451613
190.30		1	0.0030864		19.90	20 MILE	1	0.006451613
192.20		1	0.0030864		26.30	ABOVE TIGER WASH	1	0.006451613
200.50		1	0.0030864		37.70	TATAHATSO	1	0.006451613
202.50		1	0.0030864		50.00	DINOSAUR	1	0.006451613
211.20		1	0.0030864		58.20	AWATUBI	1	0.006451613
211.50	UPR FALL CYN	1	0.0030864		59.80	60 MILE	1	0.006451613
211.70	LWR FALL CYN	1	0.0030864		60.80		1	0.006451613
221.20	221-MILE	1	0.0030864		61.70	BELOW LCR	1	0.006451613
242.00	242 MILE	1	0.0030864		66.80	ESPEJO	1	0.006451613
246.00	SPENCER CYN	1	0.0030864		75.80	PAPAGO	1	0.006451613
260.10	QUARTERMASTER	1	0.0030864		102.80	NEW SHADY GROVE	1	0.006451613
5.80	6 MILE	0	0		118.10		1	0.006451613
8.50	BELOW JACKASS	0	0		118.50		1	0.006451613
21.50		0	0		119.00	BIG DUNE	1	0.006451613
43.30	LWR ANASAZI	0	0		119.80	120 MILE	1	0.006451613
46.90	DUCK N QUACK	0	0		120.00	OPP. BLACKTAIL	1	0.006451613
57.50	MALAGOSA	0	0		134.20		1	0.006451613
57.50	OPP. MALAGOSA	0	0		136.30	OC'S	1	0.006451613
59.80	60 MILE	0	0		138.40		1	0.006451613
61.00	61 MILE	0	0		143.30	ABOVE KANAB	1	0.006451613
61.20	ABOVE LCR	0	0		144.20	BELOW KANAB	1	0.006451613
61.70	BELOW LCR	0	0		145.10	ABOVE OLO	1	0.006451613
65.70	PALISADE S CREEK	0	0		147.90	OPP MATKAT	1	0.006451613
66.80	ESPEJO	0	0		148.40	MATKAT HOTEL	1	0.006451613
73.60	BELOW GRANARY	0	0		151.50	LEDGES	1	0.006451613
75.80	PAPAGO	0	0		155.70	LAST CHANCE	1	0.006451613
78.90	BELOW SOCK	0	0		158.50	SECOND	1	0.006451613

						CHANCE		
89.30	BELOW PIPE CK	0	0		164.80	BELOW TUCKUP	1	0.006451613
102.80	NEW SHADY GROVE	0	0		181.80	182 MILE	1	0.006451613
103.80	EMERALD	0	0		182.60	LWR CHEVRON	1	0.006451613
108.00	PARKINS' INSCR	0	0		186.20		1	0.006451613
114.30	UPR GARNET	0	0		192.20		1	0.006451613
114.50	LWR GARNET	0	0		201.20	201 MILE	1	0.006451613
118.10		0	0		202.50		1	0.006451613
118.50		0	0		210.00	210 MILE	1	0.006451613
119.00	BIG DUNE	0	0		215.60	OPP THREE SPRING	1	0.006451613
124.90	FOSSIL	0	0		219.90	MIDDLE 220-MILE	1	0.006451613
125.40	BELOW FOSSIL	0	0		222.00	222-MILE	1	0.006451613
133.90	BELOW TAPEATS	0	0		223.40	224-MILE	1	0.006451613
134.20		0	0		236.00	GNEISS CYN	1	0.006451613
134.60	OWL EYES	0	0		241.50		1	0.006451613
136.00	JUNEBUG	0	0		249.60		1	0.006451613
136.30	OC'S	0	0		259.50	BURNT SPRINGS	1	0.006451613
138.20		0	0		278.60	SCORPION ISLAND	1	0.006451613
138.40		0	0		21.90		0	0
144.20	BELOW KANAB	0	0		33.60	BELOW REDWALL	0	0
150.30	UPSET HOTEL	0	0		34.00	LITTLE REDWALL	0	0
158.50	SECOND CHANCE	0	0		38.30	MARTHA'S	0	0
164.80	BELOW TUCKUP	0	0		51.40		0	0
167.00	BELOW NATIONAL	0	0		59.00	BELOW AWATUBI RIGHT	0	0
172.10	172 MILE	0	0		62.60	CRASH CYN	0	0
177.10	HONGA SPRING	0	0		74.10	UPR RATTLESNAKE	0	0
181.80	182 MILE	0	0		84.40	ABOVE ZOROASTER	0	0
182.50	HELL'S HOLLOW	0	0		87.20	LWR CREMATION	0	0
182.60	LWR CHEVRON	0	0		120.90		0	0
185.50		0	0		133.00	TALKING HEADS	0	0
196.50	BELOW FROGGY	0	0		137.00	BACKEDDY	0	0
201.20	201 MILE	0	0		167.20		0	0
209.50		0	0		176.00	BELOW RED SLIDE	0	0
210.00	210 MILE	0	0		182.80		0	0
220.00	LOWER 220-MILE	0	0		189.70		0	0
222.00	222-MILE	0	0		196.40	FROGGY FAULT	0	0
241.50		0	0		210.70	BIG CEDAR	0	0
246.30	LAVA CLIFFS	0	0		211.20		0	0
248.20	SURPRISE CYN	0	0		211.70	LWR FALL CYN	0	0
249.60		0	0		221.20	221-MILE	0	0
257.00	257 BAR	0	0		223.00	223-MILE	0	0
259.50	BURNT SPRINGS	0	0		246.00	SPENCER CYN	0	0
278.60	SCORPION ISLAND	0	0		260.10	QUARTERMASTER	0	0
66.30	ABOVE ESPEJO		0		66.30	ABOVE ESPEJO		

189.00			0		189.00			
189.50			0		189.50			

Appendix H: Frequency data for attraction sites (low flow)

Commercial Activity Frequency (low flow)					Private Activity Frequency (low flow)			
River Mile	Site Name	# Stops	Frequency		River Mile	Site Name	# Stops	Frequency
0.00	LEES FERRY	96	1		0.00	LEES FERRY	20	1
136.20	DEER CREEK	93	0.96875		87.80	PHANTOM	18	0.9
156.80	HAVASU	90	0.9375		156.80	HAVASU	18	0.9
32.80	REDWALL	86	0.895833333		116.50	ELVES CHASM	17	0.85
61.40	LITTLE COLORADO	84	0.875		225.70	DIAMOND CREEK	17	0.85
116.50	ELVES CHASM	68	0.708333333		61.40	LITTLE COLORADO	15	0.75
279.00	LAKE MEAD TAKEOUT	65	0.677083333		136.20	DEER CREEK	15	0.75
108.70	SHINUMO	58	0.604166667		32.80	REDWALL	13	0.65
87.80	PHANTOM	50	0.520833333		147.90	MATKATAMI BA	12	0.6
132.00	STONE CK	45	0.46875		212.90	PUMPKIN SPRINGS	9	0.45
187.00	WHITMORE HELIPAD	43	0.447916667		29.30	SHINUMO WASH	7	0.35
229.00	TRAVERTINE CYN	35	0.364583333		34.80	NAUTILOID	7	0.35
147.90	MATKATAMI BA	32	0.333333333		133.80	TAPEATS	7	0.35
225.70	DIAMOND CREEK	31	0.322916667		20.40	UPR NORTH CYN	6	0.3
47.20	UPR SADDLE	27	0.28125		108.70	SHINUMO	6	0.3
212.90	PUMPKIN SPRINGS	26	0.270833333		168.00	FERN GLEN	6	0.3
76.60	HANCE	24	0.25		31.60	SOUTH CANYON	5	0.25
120.10	LWR BLACKTAIL	24	0.25		53.00	NANKOWEA P	5	0.25
20.40	UPR NORTH CYN	20	0.208333333		166.50	UPR NATIONAL	5	0.25
84.00	CLEAR CK	20	0.208333333		17.00	HOUSE ROCK	4	0.2
98.00	UPR CRYSTAL	17	0.177083333		40.90	UPR BUCKFARM	4	0.2
120.00	UPR BLACKTAIL	17	0.177083333		47.20	UPR SADDLE	4	0.2
133.80	TAPEATS	17	0.177083333		65.50	LAVA CYN	4	0.2
31.60	SOUTH CANYON	16	0.166666667		71.90	UPR UNKAR	4	0.2
34.80	NAUTILOID	16	0.166666667		120.00	UPR BLACKTAIL	4	0.2
64.70	CARBON	15	0.15625		145.60	OLO	4	0.2
53.00	NANKOWEA P	14	0.145833333		279.00	LAKE MEAD TAKEOUT	4	0.2
89.00	PIPE CREEK	13	0.135416667		47.30	LWR SADDLE	3	0.15
41.00	LWR BUCKFARM	12	0.125		53.20	LWR NANKOWEA P	3	0.15
179.20	JUST ABOVE LAVA	12	0.125		64.70	CARBON	3	0.15
17.00	HOUSE ROCK	10	0.104166667		72.30	UNKAR	3	0.15
29.30	SHINUMO WASH	10	0.104166667		84.00	CLEAR CK	3	0.15
65.50	LAVA CYN	10	0.104166667		98.00	UPR CRYSTAL	3	0.15
72.30	UNKAR	10	0.104166667		120.10	LWR	3	0.15

						BLACKTAIL		
168.00	FERN GLEN	10	0.104166667		188.00	WHITMORE WASH	3	0.15
179.00	ABOVE LAVA	10	0.104166667		198.50	PARASHANT	3	0.15
47.30	LWR SADDLE	9	0.09375		229.00	TRAVERTINE CYN	3	0.15
75.60	NEVILLS	9	0.09375		11.80	BROWN'S INSCRIPTION	2	0.1
230.50	TRAVERTINE FALLS	9	0.09375		93.40	GRANITE	2	0.1
52.60	UPR NANKOWEA P	7	0.072916667		132.00	STONE CK	2	0.1
166.50	UPR NATIONAL	7	0.072916667		143.50	MOUTH OF KANAB	2	0.1
166.60	LWR NATIONAL	7	0.072916667		219.80	UPPER 220-MILE	2	0.1
239.60	SEPARATION CYN	7	0.072916667		239.60	SEPARATION CYN	2	0.1
44.20	EMINENCE	6	0.0625		11.00	SOAP CREEK	1	0.05
126.50	RANDY'S ROCK	6	0.0625		20.50	LWR NORTH CYN	1	0.05
188.00	WHITMORE WASH	6	0.0625		24.50	24.5 MILE	1	0.05
202.00	202 MILE	6	0.0625		26.30	ABOVE TIGER WASH	1	0.05
11.80	BROWN'S INSCRIPTION	5	0.052083333		41.00	LWR BUCKFARM	1	0.05
68.40	TANNER	5	0.052083333		43.80	PRES HARDING	1	0.05
71.90	UPR UNKAR	5	0.052083333		51.80	LITTLE NANKOWEA P	1	0.05
93.40	GRANITE	5	0.052083333		71.00	CARDENAS	1	0.05
131.10	BELOW BEDROCK	5	0.052083333		75.60	NEVILLS	1	0.05
198.50	PARASHANT	5	0.052083333		76.60	HANCE	1	0.05
206.60	INDIAN CYN	5	0.052083333		81.30	GRAPEVINE	1	0.05
39.00	REDBUD ALCOVE	4	0.041666667		89.00	PIPE CREEK	1	0.05
40.90	UPR BUCKFARM	4	0.041666667		94.90	HERMIT	1	0.05
53.20	LWR NANKOWEA P	4	0.041666667		107.80	ROSS WHEELER	1	0.05
56.20	KWAGUNT	4	0.041666667		108.20	LWR BASS	1	0.05
91.60	TRINITY CK	4	0.041666667		114.30	UPR GARNET	1	0.05
108.20	LWR BASS	4	0.041666667		122.70	UPR FORSTER	1	0.05
145.60	OLO	4	0.041666667		136.20	ACROSS DEER CK	1	0.05
20.50	LWR NORTH CYN	3	0.03125		139.80	KEYHOLE	1	0.05
71.00	CARDENAS	3	0.03125		147.90	OPP MATKAT	1	0.05
131.80	GALLOWAY	3	0.03125		148.50	BELOW MATKAT	1	0.05
148.40	MATKAT HOTEL	3	0.03125		150.30	UPSET HOTEL	1	0.05
30.40	FENCE FAULT	2	0.020833333		164.50	TUCKUP	1	0.05
81.30	GRAPEVINE	2	0.020833333		174.40	LWR COVE	1	0.05
94.90	HERMIT	2	0.020833333		179.20	JUST ABOVE LAVA	1	0.05
98.20	LWR CRYSTAL	2	0.020833333		191.80	FAT CITY	1	0.05

107.80	ROSS WHEELER	2	0.020833333		194.10	HUALAPAI ACRES	1	0.05
122.70	UPR FORSTER	2	0.020833333		194.40	194 MILE	1	0.05
143.50	MOUTH OF KANAB	2	0.020833333		204.50	BELOW SPRING CYN	1	0.05
191.80	FAT CITY	2	0.020833333		206.60	INDIAN CYN	1	0.05
192.80		2	0.020833333		211.50	UPR FALL CYN	1	0.05
204.50	BELOW SPRING CYN	2	0.020833333		215.60	OPP THREE SPRING	1	0.05
8.00	BADGER	1	0.010416667		223.40	224-MILE	1	0.05
23.70	LONE CEDAR	1	0.010416667		230.50	TRAVERTINE FALLS	1	0.05
24.50	24.5 MILE	1	0.010416667		5.80	6 MILE	0	0
33.60	BELOW REDWALL	1	0.010416667		8.00	BADGER	0	0
37.70	TATAHATSO	1	0.010416667		8.00	JACKASS	0	0
43.80	PRES HARDING	1	0.010416667		8.50	BELOW JACKASS	0	0
44.80	WILLIE TAYLOR	1	0.010416667		12.80	13 MILE	0	0
51.80	LITTLE NANKOWEA P	1	0.010416667		16.40	HOT NA NA	0	0
61.20	ABOVE LCR	1	0.010416667		18.10	18 MILE LEDGES	0	0
73.60	BELOW GRANARY	1	0.010416667		19.00		0	0
74.10	UPR RATTLESNA KE	1	0.010416667		19.10		0	0
102.80	NEW SHADY GROVE	1	0.010416667		19.90	20 MILE	0	0
109.40	110 MILE	1	0.010416667		21.50		0	0
120.00	OPP. BLACKTAIL	1	0.010416667		21.90		0	0
124.30	ABOVE FOSSIL	1	0.010416667		23.00	INDIAN DICK	0	0
134.20		1	0.010416667		23.70	LONE CEDAR	0	0
134.60	OWL EYES	1	0.010416667		30.40	FENCE FAULT	0	0
136.20	ACROSS DEER CK	1	0.010416667		33.60	BELOW REDWALL	0	0
137.90	DORIS	1	0.010416667		34.00	LITTLE REDWALL	0	0
139.00	FISHTAIL	1	0.010416667		37.70	TATAHATSO	0	0
143.30	ABOVE KANAB	1	0.010416667		38.30	MARTHA'S	0	0
145.10	ABOVE OLO	1	0.010416667		39.00	REDBUD ALCOVE	0	0
147.90	OPP MATKAT	1	0.010416667		43.20	ANASAZI BRIDGE	0	0
158.20	158 MILE	1	0.010416667		43.30	LWR ANASAZI	0	0
164.50	TUCKUP	1	0.010416667		44.20	EMINENCE	0	0
167.20		1	0.010416667		44.60		0	0
174.40	LWR COVE	1	0.010416667		44.80	WILLIE TAYLOR	0	0
178.00	VULCAN'S ANVIL	1	0.010416667		46.90	DUCK N QUACK	0	0
186.20		1	0.010416667		50.00	DINOSAUR	0	0
189.70		1	0.010416667		51.20		0	0
202.50		1	0.010416667		51.40		0	0
211.70	LWR FALL CYN	1	0.010416667		52.60	UPR NANKOWEA	0	0

						P		
215.60	OPP THREE SPRING	1	0.010416667		56.20	KWAGUNT	0	0
220.00	LOWER 220-MILE	1	0.010416667		56.70		0	0
235.00	BRIDGE CYN	1	0.010416667		57.50	MALAGOSA	0	0
236.00	GNEISS CYN	1	0.010416667		57.50	OPP. MALAGOSA	0	0
241.50	241 MILE	1	0.010416667		58.20	AWATUBI	0	0
246.30	LAVA CLIFFS	1	0.010416667		58.60	BELOW AWATUBI LEFT	0	0
274.50	COLUMBINE FALLS	1	0.010416667		59.00	BELOW AWATUBI RIGHT	0	0
5.80	6 MILE	0	0		59.80	60 MILE	0	0
8.00	JACKASS	0	0		60.80		0	0
8.50	BELOW JACKASS	0	0		61.00	61 MILE	0	0
11.00	SOAP CREEK	0	0		61.20	ABOVE LCR	0	0
12.80	13 MILE	0	0		61.70	BELOW LCR	0	0
16.40	HOT NA NA	0	0		62.60	CRASH CYN	0	0
18.10	18 MILE LEDGES	0	0		65.70	PALISADE S CREEK	0	0
19.00		0	0		66.30	ABOVE ESPEJO	0	0
19.10		0	0		66.80	ESPEJO	0	0
19.90	20 MILE	0	0		68.40	TANNER	0	0
21.50		0	0		69.80	LWR BASALT	0	0
21.90		0	0		73.60	BELOW GRANARY	0	0
23.00	INDIAN DICK	0	0		74.10	UPR RATTLESNAKE	0	0
26.30	ABOVE TIGER WASH	0	0		74.30	LWR RATTLESNAKE	0	0
34.00	LITTLE REDWALL	0	0		75.80	PAPAGO	0	0
38.30	MARTHA'S	0	0		78.90	BELOW SOCK	0	0
43.20	ANASAZI BRIDGE	0	0		84.40	ABOVE ZOROASTER	0	0
43.30	LWR ANASAZI	0	0		87.10	UPR CREMATION	0	0
44.60		0	0		87.20	LWR CREMATION	0	0
46.90	DUCK N QUACK	0	0		89.30	BELOW PIPE CK	0	0
50.00	DINOSAUR	0	0		91.10	91 MILE CK	0	0
51.20		0	0		91.60	TRINITY CK	0	0
51.40		0	0		92.30	ABOVE SALT CK	0	0
56.70		0	0		94.30		0	0
57.50	MALAGOSA	0	0		96.00	UPR SCHIST	0	0
57.50	OPP. MALAGOSA	0	0		96.10	SCHIST	0	0
58.20	AWATUBI	0	0		98.20	LWR CRYSTAL	0	0
58.60	BELOW AWATUBI LEFT	0	0		102.80	NEW SHADY GROVE	0	0
59.00	BELOW AWATUBI RIGHT	0	0		103.80	EMERALD	0	0

59.80	60 MILE	0	0		108.00	PARKINS' INSCR	0	0
60.80		0	0		109.40	110 MILE	0	0
61.00	61 MILE	0	0		114.50	LWR GARNET	0	0
61.70	BELOW LCR	0	0		118.10		0	0
62.60	CRASH CYN	0	0		118.50		0	0
65.70	PALISADE S CREEK	0	0		119.00	BIG DUNE	0	0
66.30	ABOVE ESPEJO	0	0		119.20		0	0
66.80	ESPEJO	0	0		119.50	SHADY GROVE	0	0
69.80	LWR BASALT	0	0		119.80	120 MILE	0	0
74.30	LWR RATTLESNA KE	0	0		120.00	OPP. BLACKTAIL	0	0
75.80	PAPAGO	0	0		120.20		0	0
78.90	BELOW SOCK	0	0		120.90		0	0
84.40	ABOVE ZOROASTER	0	0		122.20	122 MILE	0	0
87.10	UPR CREMATION	0	0		124.30	ABOVE FOSSIL	0	0
87.20	LWR CREMATION	0	0		124.90	FOSSIL	0	0
89.30	BELOW PIPE CK	0	0		125.40	BELOW FOSSIL	0	0
91.10	91 MILE CK	0	0		126.50	RANDY'S ROCK	0	0
92.30	ABOVE SALT CK	0	0		131.10	BELOW BEDROCK	0	0
94.30		0	0		131.80	GALLOWAY	0	0
96.00	UPR SCHIST	0	0		133.00	TALKING HEADS	0	0
96.10	SCHIST	0	0		133.50	RACETRACK	0	0
103.80	EMERALD	0	0		133.90	BELOW TAPEATS	0	0
108.00	PARKINS' INSCR	0	0		134.20		0	0
114.30	UPR GARNET	0	0		134.60	OWL EYES	0	0
114.50	LWR GARNET	0	0		136.00	JUNEBUG	0	0
118.10		0	0		136.30	OC'S	0	0
118.50		0	0		136.80	PONCHO'S KITCHEN	0	0
119.00	BIG DUNE	0	0		136.90	FOOTBALL FIELD	0	0
119.20		0	0		137.00	BACKEDDY	0	0
119.50	SHADY GROVE	0	0		137.90	DORIS	0	0
119.80	120 MILE	0	0		138.20		0	0
120.20		0	0		138.40		0	0
120.90		0	0		139.00	FISHTAIL	0	0
122.20	122 MILE	0	0		143.30	ABOVE KANAB	0	0
124.90	FOSSIL	0	0		144.20	BELOW KANAB	0	0
125.40	BELOW FOSSIL	0	0		145.10	ABOVE OLO	0	0
133.00	TALKING HEADS	0	0		148.40	MATKAT HOTEL	0	0
133.50	RACETRACK	0	0		151.50	LEDGES	0	0
133.90	BELOW TAPEATS	0	0		155.70	LAST CHANCE	0	0

136.00	JUNEBUG	0	0		157.70	FIRST CHANCE	0	0
136.30	OC'S	0	0		158.20	158 MILE	0	0
136.80	PONCHO'S KITCHEN	0	0		158.50	SECOND CHANCE	0	0
136.90	FOOTBALL FIELD	0	0		160.00	160 MILE	0	0
137.00	BACKEDDY	0	0		160.70		0	0
138.20		0	0		164.80	BELOW TUCKUP	0	0
138.40		0	0		166.60	LWR NATIONAL	0	0
139.80	KEYHOLE	0	0		167.00	BELOW NATIONAL	0	0
144.20	BELOW KANAB	0	0		167.20		0	0
148.50	BELOW MATKAT	0	0		171.00	STAIRWAY CYN	0	0
150.30	UPSET HOTEL	0	0		171.60	MOHAWK	0	0
151.50	LEDGES	0	0		172.10	172 MILE	0	0
155.70	LAST CHANCE	0	0		173.00		0	0
157.70	FIRST CHANCE	0	0		174.30	UPR COVE	0	0
158.50	SECOND CHANCE	0	0		176.00	BELOW RED SLIDE	0	0
160.00	160 MILE	0	0		177.10	HONGA SPRING	0	0
160.70		0	0		177.70	ABOVE ANVIL	0	0
164.80	BELOW TUCKUP	0	0		178.00	VULCAN'S ANVIL	0	0
167.00	BELOW NATIONAL	0	0		179.00	ABOVE LAVA	0	0
171.00	STAIRWAY CYN	0	0		179.70	BELOW LWR LAVA	0	0
171.60	MOHAWK	0	0		181.80	182 MILE	0	0
172.10	172 MILE	0	0		182.50	HELL'S HOLLOW	0	0
173.00		0	0		182.50	UPR CHEVRON	0	0
174.30	UPR COVE	0	0		182.60	LWR CHEVRON	0	0
176.00	BELOW RED SLIDE	0	0		182.80	BELOW CHEVRON	0	0
177.10	HONGA SPRING	0	0		182.80		0	0
177.70	ABOVE ANVIL	0	0		183.00	BELOW OLD HELIPAD	0	0
179.70	BELOW LWR LAVA	0	0		184.50		0	0
181.80	182 MILE	0	0		185.50		0	0
182.50	HELL'S HOLLOW	0	0		186.00		0	0
182.50	UPR CHEVRON	0	0		186.20		0	0
182.60	LWR CHEVRON	0	0		187.00	WHITMORE HELIPAD	0	0
182.80	BELOW CHEVRON	0	0		188.20	LWR WHITMORE	0	0
182.80		0	0		189.00		0	0
183.00	BELOW OLD HELIPAD	0	0		189.50		0	0
184.50		0	0		189.70		0	0
185.50		0	0		190.30		0	0
186.00		0	0		191.00	UPPER FAT	0	0

						CITY		
188.20	LWR WHITMORE	0	0		192.20		0	0
189.00		0	0		192.80		0	0
189.50		0	0		196.40	FROGGY FAULT	0	0
190.30		0	0		196.50	BELOW FROGGY	0	0
191.00	UPPER FAT CITY	0	0		200.50		0	0
192.20		0	0		201.20	201 MILE	0	0
194.10	HUALAPAI ACRES	0	0		202.00	202 MILE	0	0
194.40	194 MILE	0	0		202.50		0	0
196.40	FROGGY FAULT	0	0		208.80	GRANITE PARK	0	0
196.50	BELOW FROGGY	0	0		209.50		0	0
200.50		0	0		210.00	210 MILE	0	0
201.20	201 MILE	0	0		210.70	BIG CEDAR	0	0
208.80	GRANITE PARK	0	0		211.20		0	0
209.50		0	0		211.70	LWR FALL CYN	0	0
210.00	210 MILE	0	0		216.40		0	0
210.70	BIG CEDAR	0	0		219.90	MIDDLE 220-MILE	0	0
211.20		0	0		220.00	LOWER 220-MILE	0	0
211.50	UPR FALL CYN	0	0		221.20	221-MILE	0	0
216.40		0	0		222.00	222-MILE	0	0
219.80	UPPER 220-MILE	0	0		223.00	223-MILE	0	0
219.90	MIDDLE 220-MILE	0	0		224.50		0	0
221.20	221-MILE	0	0		235.00	BRIDGE CYN	0	0
222.00	222-MILE	0	0		236.00	GNEISS CYN	0	0
223.00	223-MILE	0	0		241.50	241 MILE	0	0
223.40	224-MILE	0	0		241.50		0	0
224.50		0	0		242.00	242 MILE	0	0
241.50		0	0		243.10	243 MILE	0	0
242.00	242 MILE	0	0		246.00	SPENCER CYN	0	0
243.10	243 MILE	0	0		246.30	LAVA CLIFFS	0	0
246.00	SPENCER CYN	0	0		248.20	SURPRISE CYN	0	0
248.20	SURPRISE CYN	0	0		249.60		0	0
249.60		0	0		257.00	257 BAR	0	0
257.00	257 BAR	0	0		259.50	BURNT SPRINGS	0	0
259.50	BURNT SPRINGS	0	0		260.10	QUARTERMASTER	0	0
260.10	QUARTERMASTER	0	0		274.50	COLUMBINE FALLS	0	0
278.60	SCORPION ISLAND	0	0		278.60	SCORPION ISLAND	0	0

Appendix I: Frequency data for camp sites (typical flow)

Commercial camp site frequency (typical flow)					Private camp site frequency (typical flow)			
River Mile	Site Name	# Stops	Frequency		River Mile	Site Name	# Stops	Frequency
137.00	BACKEDDY	66	0.203703704		133.80	TAPEATS	67	0.432258065
136.80	PONCHO'S KITCHEN	53	0.163580247		81.30	GRAPEVINE	52	0.335483871
30.40	FENCE FAULT	49	0.151234568		11.00	SOAP CREEK	51	0.329032258
64.70	CARBON	46	0.141975309		108.20	LWR BASS	50	0.322580645
108.20	LWR BASS	46	0.141975309		151.50	LEDGES	49	0.316129032
53.00	NANKOWEAP	44	0.135802469		219.80	UPPER 220-MILE	49	0.316129032
93.40	GRANITE	44	0.135802469		29.30	SHINUMO WASH	39	0.251612903
109.40	110 MILE	44	0.135802469		31.60	SOUTH CANYON	36	0.232258065
29.30	SHINUMO WASH	43	0.132716049		64.70	CARBON	35	0.225806452
23.00	INDIAN DICK	41	0.12654321		93.40	GRANITE	35	0.225806452
91.60	TRINITY CK	40	0.12345679		91.60	TRINITY CK	33	0.212903226
166.50	UPR NATIONAL	39	0.12037037		16.40	HOT NA NA	32	0.206451613
16.40	HOT NA NA	38	0.117283951		136.80	PONCHO'S KITCHEN	32	0.206451613
96.10	SCHIST	37	0.114197531		198.50	PARASHANT	32	0.206451613
151.50	LEDGES	37	0.114197531		208.80	GRANITE PARK	31	0.2
185.50		36	0.111111111		53.00	NANKOWEAP	27	0.174193548
131.80	GALLOWAY	34	0.104938272		75.60	NEVILLS	27	0.174193548
166.60	LWR NATIONAL	34	0.104938272		188.00	WHITMORE WASH	26	0.167741935
53.20	LWR NANKOWEAP	33	0.101851852		202.00	202 MILE	26	0.167741935
75.60	NEVILLS	32	0.098765432		109.40	110 MILE	24	0.15483871
114.30	UPR GARNET	31	0.095679012		120.00	UPR BLACKTAIL	24	0.15483871
168.00	FERN GLEN	31	0.095679012		168.00	FERN GLEN	24	0.15483871
74.10	UPR RATTLESNAKE	29	0.089506173		65.50	LAVA CYN	23	0.148387097
148.40	MATKAT HOTEL	29	0.089506173		166.50	UPR NATIONAL	23	0.148387097
34.80	NAUTILOID	28	0.086419753		47.20	UPR SADDLE	22	0.141935484
137.90	DORIS	28	0.086419753		53.20	LWR NANKOWEAP	22	0.141935484
235.00	BRIDGE CYN	27	0.083333333		56.20	KWAGUNT	22	0.141935484
31.60	SOUTH CANYON	26	0.080246914		87.20	LWR CREMATION	22	0.141935484
87.10	UPR CREMATION	26	0.080246914		107.80	ROSS WHEELER	22	0.141935484
119.80	120 MILE	26	0.080246914		164.50	TUCKUP	22	0.141935484
202.00	202 MILE	26	0.080246914		219.90	MIDDLE 220-MILE	22	0.141935484
219.80	UPPER 220-MILE	26	0.080246914		20.40	UPR NORTH CYN	21	0.135483871
223.00	223-MILE	26	0.080246914		71.00	CARDENAS	21	0.135483871
56.20	KWAGUNT	25	0.077160494		166.60	LWR NATIONAL	21	0.135483871
20.40	UPR NORTH CYN	24	0.074074074		87.10	UPR CREMATION	20	0.129032258
41.00	LWR BUCKFARM	24	0.074074074		143.50	MOUTH OF KANAB	20	0.129032258
47.20	UPR SADDLE	24	0.074074074		174.30	UPR COVE	20	0.129032258
132.00	STONE CK	24	0.074074074		34.80	NAUTILOID	19	0.122580645
174.40	LWR COVE	24	0.074074074		43.80	PRES HARDING	19	0.122580645
198.50	PARASHANT	24	0.074074074		96.10	SCHIST	19	0.122580645
19.90	20 MILE	23	0.070987654		52.60	UPR NANKOWEAP	18	0.116129032
50.00	DINOSAUR	22	0.067901235		71.90	UPR UNKAR	18	0.116129032
47.30	LWR SADDLE	21	0.064814815		222.00	222-MILE	18	0.116129032
74.30	LWR RATTLESNAKE	21	0.064814815		114.50	LWR GARNET	17	0.109677419
119.00	BIG DUNE	21	0.064814815		150.30	UPSET HOTEL	17	0.109677419
19.10		20	0.061728395		41.00	LWR BUCKFARM	16	0.103225806
136.20	ACROSS DEER CK	20	0.061728395		132.00	STONE CK	16	0.103225806
176.00	BELOW RED SLIDE	20	0.061728395		155.70	LAST CHANCE	16	0.103225806
20.50	LWR NORTH CYN	19	0.058641975		148.40	MATKAT HOTEL	15	0.096774194
34.00	LITTLE REDWALL	19	0.058641975		91.10	91 MILE CK	14	0.090322581
61.20	ABOVE LCR	19	0.058641975		98.00	UPR CRYSTAL	14	0.090322581
65.50	LAVA CYN	19	0.058641975		122.20	122 MILE	14	0.090322581

71.00	CARDENAS	19	0.058641975		133.50	RACETRACK	14	0.090322581
136.30	OC'S	19	0.058641975		33.60	BELOW REDWALL	13	0.083870968
150.30	UPSET HOTEL	19	0.058641975		74.30	LWR RATTLESNAKE	13	0.083870968
186.00		19	0.058641975		94.90	HERMIT	13	0.083870968
243.10	243 MILE	19	0.058641975		122.70	UPR FORSTER	13	0.083870968
71.90	UPR UNKAR	18	0.055555556		136.20	ACROSS DEER CK	13	0.083870968
87.20	LWR CREMATION	18	0.055555556		24.50	24.5 MILE	12	0.077419355
131.10	BELOW BEDROCK	18	0.055555556		44.20	EMINENCE	12	0.077419355
134.60	OWL EYES	18	0.055555556		157.70	FIRST CHANCE	12	0.077419355
188.00	WHITMORE WASH	18	0.055555556		158.50	SECOND CHANCE	12	0.077419355
68.40	TANNER	17	0.052469136		174.40	LWR COVE	12	0.077419355
122.20	122 MILE	17	0.052469136		220.00	LOWER 220-MILE	12	0.077419355
44.20	EMINENCE	16	0.049382716		40.90	UPR BUCKFARM	11	0.070967742
92.30	ABOVE SALT CK	16	0.049382716		47.30	LWR SADDLE	11	0.070967742
155.70	LAST CHANCE	16	0.049382716		51.80	LITTLE NANKOWEAP	11	0.070967742
23.70	LONE CEDAR	15	0.046296296		76.60	HANCE	11	0.070967742
164.50	TUCKUP	15	0.046296296		120.10	LWR BLACKTAIL	11	0.070967742
179.70	BELOW LWR LAVA	15	0.046296296		145.60	OLO	11	0.070967742
81.30	GRAPEVINE	14	0.043209877		148.50	BELOW MATKAT	11	0.070967742
187.00	WHITMORE HELIPAD	14	0.043209877		206.60	INDIAN CYN	11	0.070967742
221.20	221-MILE	14	0.043209877		20.50	LWR NORTH CYN	10	0.064516129
242.00	242 MILE	14	0.043209877		68.40	TANNER	10	0.064516129
40.90	UPR BUCKFARM	13	0.040123457		114.30	UPR GARNET	10	0.064516129
158.20	158 MILE	13	0.040123457		125.40	BELOW FOSSIL	10	0.064516129
183.00	BELOW OLD HELIPAD	13	0.040123457		136.30	OC'S	10	0.064516129
222.00	222-MILE	13	0.040123457		11.80	BROWN'S INSCRIPTION	9	0.058064516
114.50	LWR GARNET	12	0.037037037		23.00	INDIAN DICK	9	0.058064516
126.50	RANDY'S ROCK	12	0.037037037		38.30	MARTHA'S	9	0.058064516
143.50	MOUTH OF KANAB	12	0.037037037		74.10	UPR RATTLESNAKE	9	0.058064516
236.00	GNEISS CYN	12	0.037037037		164.80	BELOW TUCKUP	9	0.058064516
43.80	PRES HARDING	11	0.033950617		181.80	182 MILE	9	0.058064516
118.10		11	0.033950617		194.10	HUALAPAI ACRES	9	0.058064516
182.60	LWR CHEVRON	11	0.033950617		212.90	PUMPKIN SPRINGS	9	0.058064516
188.20	LWR WHITMORE	11	0.033950617		235.00	BRIDGE CYN	9	0.058064516
219.90	MIDDLE 220-MILE	11	0.033950617		8.00	BADGER	8	0.051612903
194.40	194 MILE	10	0.030864198		21.50		8	0.051612903
239.60	SEPARATION CYN	10	0.030864198		50.00	DINOSAUR	8	0.051612903
241.50	241 MILE	10	0.030864198		137.00	BACKEDDY	8	0.051612903
98.20	LWR CRYSTAL	9	0.027777778		179.70	BELOW LWR LAVA	8	0.051612903
107.80	ROSS WHEELER	9	0.027777778		18.10	18 MILE LEDGES	7	0.04516129
134.20		9	0.027777778		34.00	LITTLE REDWALL	7	0.04516129
136.90	FOOTBALL FIELD	9	0.027777778		37.70	TATAHATSO	7	0.04516129
147.90	OPP MATKAT	9	0.027777778		65.70	PALISADE S CREEK	7	0.04516129
158.50	SECOND CHANCE	9	0.027777778		84.00	CLEAR CK	7	0.04516129
208.80	GRANITE PARK	9	0.027777778		92.30	ABOVE SALT CK	7	0.04516129
38.30	MARTHA'S	8	0.024691358		103.80	EMERALD	7	0.04516129
52.60	UPR NANKOWEAP	8	0.024691358		119.50	SHADY GROVE	7	0.04516129
75.80	PAPAGO	8	0.024691358		119.80	120 MILE	7	0.04516129
120.00	OPP. BLACKTAIL	8	0.024691358		134.20		7	0.04516129
133.50	RACETRACK	8	0.024691358		158.20	158 MILE	7	0.04516129
164.80	BELOW TUCKUP	8	0.024691358		182.50	HELL'S HOLLOW	7	0.04516129
181.80	182 MILE	8	0.024691358		185.50		7	0.04516129
58.20	AWATUBI	7	0.021604938		186.00		7	0.04516129
58.60	BELOW AWATUBI LEFT	7	0.021604938		194.40	194 MILE	7	0.04516129
59.00	BELOW AWATUBI RIGHT	7	0.021604938		215.60	OPP THREE SPRING	7	0.04516129
62.60	CRASH CYN	7	0.021604938		224.50		7	0.04516129

98.00	UPR CRYSTAL	7	0.021604938		229.00	TRAVERTINE CYN	7	0.04516129
119.20		7	0.021604938		17.00	HOUSE ROCK	6	0.038709677
133.80	TAPEATS	7	0.021604938		119.00	BIG DUNE	6	0.038709677
192.80		7	0.021604938		131.10	BELOW BEDROCK	6	0.038709677
212.90	PUMPKIN SPRINGS	7	0.021604938		131.80	GALLOWAY	6	0.038709677
223.40	224-MILE	7	0.021604938		136.00	JUNEBUG	6	0.038709677
229.00	TRAVERTINE CYN	7	0.021604938		171.00	STAIRWAY CYN	6	0.038709677
11.00	SOAP CREEK	6	0.018518519		171.60	MOHAWK	6	0.038709677
91.10	91 MILE CK	6	0.018518519		176.00	BELOW RED SLIDE	6	0.038709677
120.00	UPR BLACKTAIL	6	0.018518519		204.50	BELOW SPRING CYN	6	0.038709677
125.40	BELOW FOSSIL	6	0.018518519		221.20	221-MILE	6	0.038709677
194.10	HUALAPAI ACRES	6	0.018518519		5.80	6 MILE	5	0.032258065
210.70	BIG CEDAR	6	0.018518519		8.00	JACKASS	5	0.032258065
220.00	LOWER 220-MILE	6	0.018518519		12.80	13 MILE	5	0.032258065
274.50	COLUMBINE FALLS	6	0.018518519		19.90	20 MILE	5	0.032258065
37.70	TATAHATSO	5	0.015432099		23.70	LONE CEDAR	5	0.032258065
56.70		5	0.015432099		26.30	ABOVE TIGER WASH	5	0.032258065
119.50	SHADY GROVE	5	0.015432099		59.00	BELOW AWATUBI RIGHT	5	0.032258065
120.90		5	0.015432099		61.20	ABOVE LCR	5	0.032258065
160.00	160 MILE	5	0.015432099		119.20		5	0.032258065
182.50	HELL'S HOLLOW	5	0.015432099		126.50	RANDY'S ROCK	5	0.032258065
215.60	OPP THREE SPRING	5	0.015432099		133.90	BELOW TAPEATS	5	0.032258065
18.10	18 MILE LEDGES	4	0.012345679		177.70	ABOVE ANVIL	5	0.032258065
19.00		4	0.012345679		179.20	JUST ABOVE LAVA	5	0.032258065
33.60	BELOW REDWALL	4	0.012345679		182.80		5	0.032258065
61.70	BELOW LCR	4	0.012345679		191.80	FAT CITY	5	0.032258065
122.70	UPR FORSTER	4	0.012345679		200.50		5	0.032258065
124.90	FOSSIL	4	0.012345679		230.50	TRAVERTINE FALLS	5	0.032258065
138.40		4	0.012345679		239.60	SEPARATION CYN	5	0.032258065
143.30	ABOVE KANAB	4	0.012345679		278.60	SCORPION ISLAND	5	0.032258065
145.10	ABOVE OLO	4	0.012345679		30.40	FENCE FAULT	4	0.025806452
148.50	BELOW MATKAT	4	0.012345679		44.60		4	0.025806452
171.60	MOHAWK	4	0.012345679		62.60	CRASH CYN	4	0.025806452
186.20		4	0.012345679		69.80	LWR BASALT	4	0.025806452
246.00	SPENCER CYN	4	0.012345679		72.30	UNKAR	4	0.025806452
24.50	24.5 MILE	3	0.009259259		102.80	NEW SHADY GROVE	4	0.025806452
39.00	REDBUD ALCOVE	3	0.009259259		108.00	PARKINS' INSCR	4	0.025806452
43.20	ANASAZI BRIDGE	3	0.009259259		134.60	OWL EYES	4	0.025806452
66.80	ESPEJO	3	0.009259259		137.90	DORIS	4	0.025806452
69.80	LWR BASALT	3	0.009259259		147.90	OPP MATKAT	4	0.025806452
94.90	HERMIT	3	0.009259259		177.10	HONGA SPRING	4	0.025806452
102.80	NEW SHADY GROVE	3	0.009259259		182.80	BELOW CHEVRON	4	0.025806452
108.00	PARKINS' INSCR	3	0.009259259		188.20	LWR WHITMORE	4	0.025806452
120.10	LWR BLACKTAIL	3	0.009259259		225.70	DIAMOND CREEK	4	0.025806452
133.90	BELOW TAPEATS	3	0.009259259		236.00	GNEISS CYN	4	0.025806452
136.00	JUNEBUG	3	0.009259259		249.60		4	0.025806452
139.80	KEYHOLE	3	0.009259259		259.50	BURNT SPRINGS	4	0.025806452
171.00	STAIRWAY CYN	3	0.009259259		8.50	BELOW JACKASS	3	0.019354839
177.10	HONGA SPRING	3	0.009259259		19.00		3	0.019354839
182.50	UPR CHEVRON	3	0.009259259		43.30	LWR ANASAZI	3	0.019354839
182.80	BELOW CHEVRON	3	0.009259259		58.20	AWATUBI	3	0.019354839
191.00	UPPER FAT CITY	3	0.009259259		60.80		3	0.019354839
191.80	FAT CITY	3	0.009259259		73.60	BELOW GRANARY	3	0.019354839
192.20		3	0.009259259		89.30	BELOW PIPE CK	3	0.019354839
206.60	INDIAN CYN	3	0.009259259		96.00	UPR SCHIST	3	0.019354839
210.00	210 MILE	3	0.009259259		118.10		3	0.019354839
211.50	UPR FALL CYN	3	0.009259259		120.20		3	0.019354839

224.50		3	0.009259259		120.90		3	0.019354839
225.70	DIAMOND CREEK	3	0.009259259		136.90	FOOTBALL FIELD	3	0.019354839
12.80	13 MILE	2	0.00617284		139.00	FISHTAIL	3	0.019354839
21.90		2	0.00617284		143.30	ABOVE KANAB	3	0.019354839
44.60		2	0.00617284		179.00	ABOVE LAVA	3	0.019354839
51.20		2	0.00617284		186.20		3	0.019354839
51.80	LITTLE NANKOWEAP	2	0.00617284		196.40	FROGGY FAULT	3	0.019354839
65.70	PALISADE S CREEK	2	0.00617284		223.40	224-MILE	3	0.019354839
84.40	ABOVE ZOROASTER	2	0.00617284		243.10	243 MILE	3	0.019354839
94.30		2	0.00617284		257.00	257 BAR	3	0.019354839
96.00	UPR SCHIST	2	0.00617284		19.10		2	0.012903226
103.80	EMERALD	2	0.00617284		21.90		2	0.012903226
120.20		2	0.00617284		39.00	REDBUD ALCOVE	2	0.012903226
133.00	TALKING HEADS	2	0.00617284		51.20		2	0.012903226
144.20	BELOW KANAB	2	0.00617284		58.60	BELOW AWATUBI LEFT	2	0.012903226
157.70	FIRST CHANCE	2	0.00617284		61.70	BELOW LCR	2	0.012903226
174.30	UPR COVE	2	0.00617284		75.80	PAPAGO	2	0.012903226
182.80		2	0.00617284		94.30		2	0.012903226
184.50		2	0.00617284		116.50	ELVES CHASM	2	0.012903226
196.40	FROGGY FAULT	2	0.00617284		124.90	FOSSIL	2	0.012903226
216.40		2	0.00617284		133.00	TALKING HEADS	2	0.012903226
278.60	SCORPION ISLAND	2	0.00617284		138.20		2	0.012903226
8.00	BADGER	1	0.00308642		144.20	BELOW KANAB	2	0.012903226
17.00	HOUSE ROCK	1	0.00308642		160.00	160 MILE	2	0.012903226
21.50		1	0.00308642		167.20		2	0.012903226
26.30	ABOVE TIGER WASH	1	0.00308642		183.00	BELOW OLD HELIPAD	2	0.012903226
43.30	LWR ANASAZI	1	0.00308642		190.30		2	0.012903226
51.40		1	0.00308642		191.00	UPPER FAT CITY	2	0.012903226
59.80	60 MILE	1	0.00308642		192.80		2	0.012903226
72.30	UNKAR	1	0.00308642		196.50	BELOW FROGGY	2	0.012903226
76.60	HANCE	1	0.00308642		209.50		2	0.012903226
84.00	CLEAR CK	1	0.00308642		241.50	241 MILE	2	0.012903226
108.70	SHINUMO	1	0.00308642		246.00	SPENCER CYN	2	0.012903226
118.50		1	0.00308642		248.20	SURPRISE CYN	2	0.012903226
124.30	ABOVE FOSSIL	1	0.00308642		274.50	COLUMBINE FALLS	2	0.012903226
139.00	FISHTAIL	1	0.00308642		44.80	WILLIE TAYLOR	1	0.006451613
145.60	OLO	1	0.00308642		46.90	DUCK N QUACK	1	0.006451613
160.70		1	0.00308642		56.70		1	0.006451613
167.00	BELOW NATIONAL	1	0.00308642		57.50	MALAGOSA	1	0.006451613
167.20		1	0.00308642		57.50	OPP. MALAGOSA	1	0.006451613
173.00		1	0.00308642		59.80	60 MILE	1	0.006451613
177.70	ABOVE ANVIL	1	0.00308642		61.00	61 MILE	1	0.006451613
179.20	JUST ABOVE LAVA	1	0.00308642		66.80	ESPEJO	1	0.006451613
189.70		1	0.00308642		78.90	BELOW SOCK	1	0.006451613
190.30		1	0.00308642		84.40	ABOVE ZOROASTER	1	0.006451613
200.50		1	0.00308642		87.80	PHANTOM	1	0.006451613
202.50		1	0.00308642		108.70	SHINUMO	1	0.006451613
204.50	BELOW SPRING CYN	1	0.00308642		120.00	OPP. BLACKTAIL	1	0.006451613
209.50		1	0.00308642		136.20	DEER CREEK	1	0.006451613
211.70	LWR FALL CYN	1	0.00308642		139.80	KEYHOLE	1	0.006451613
230.50	TRAVERTINE FALLS	1	0.00308642		145.10	ABOVE OLO	1	0.006451613
241.50		1	0.00308642		147.90	MATKATAMIBA	1	0.006451613
279.00	LAKE MEAD TAKEOUT	1	0.00308642		160.70		1	0.006451613
0.00	LEES FERRY	0	0		167.00	BELOW NATIONAL	1	0.006451613
5.80	6 MILE	0	0		172.10	172 MILE	1	0.006451613
8.00	JACKASS	0	0		173.00		1	0.006451613
8.50	BELOW JACKASS	0	0		178.00	VULCAN'S ANVIL	1	0.006451613

11.80	BROWN'S INSCRIPTION	0	0		182.50	UPR CHEVRON	1	0.006451613
44.80	WILLIE TAYLOR	0	0		182.60	LWR CHEVRON	1	0.006451613
46.90	DUCK N QUACK	0	0		184.50		1	0.006451613
57.50	MALAGOSA	0	0		187.00	WHITMORE HELIPAD	1	0.006451613
57.50	OPP. MALAGOSA	0	0		192.20		1	0.006451613
60.80		0	0		202.50		1	0.006451613
61.00	61 MILE	0	0		210.00	210 MILE	1	0.006451613
73.60	BELOW GRANARY	0	0		211.50	UPR FALL CYN	1	0.006451613
78.90	BELOW SOCK	0	0		216.40		1	0.006451613
87.80	PHANTOM	0	0		223.00	223-MILE	1	0.006451613
89.30	BELOW PIPE CK	0	0		241.50		1	0.006451613
116.50	ELVES CHASM	0	0		242.00	242 MILE	1	0.006451613
136.20	DEER CREEK	0	0		246.30	LAVA CLIFFS	1	0.006451613
138.20		0	0		260.10	QUARTERMASTER	1	0.006451613
147.90	MATKATAMIBA	0	0		43.20	ANASAZI BRIDGE	0	0
172.10	172 MILE	0	0		51.40		0	0
178.00	VULCAN'S ANVIL	0	0		98.20	LWR CRYSTAL	0	0
179.00	ABOVE LAVA	0	0		118.50		0	0
196.50	BELOW FROGGY	0	0		124.30	ABOVE FOSSIL	0	0
246.30	LAVA CLIFFS	0	0		138.40		0	0
248.20	SURPRISE CYN	0	0		189.70		0	0
249.60		0	0		210.70	BIG CEDAR	0	0
257.00	257 BAR	0	0		211.70	LWR FALL CYN	0	0
259.50	BURNT SPRINGS	0	0		279.00	LAKE MEAD TAKEOUT	0	0
260.10	QUARTERMASTER	0	0		0.00	LEES FERRY		
32.80	REDWALL				32.80	REDWALL		
61.40	LITTLE COLORADO				61.40	LITTLE COLORADO		
66.30	ABOVE ESPEJO				66.30	ABOVE ESPEJO		
89.00	PIPE CREEK				89.00	PIPE CREEK		
156.80	HAVASU				156.80	HAVASU		
189.00					189.00			
189.50					189.50			
201.20	201 MILE				201.20	201 MILE		
211.20					211.20			

Appendix J: Frequency data for camp sites (low flow)

Commercial camp site frequency (low flow)					Private camp site frequency (low flow)			
River Mile	Site Name	# Stops	Frequency		River Mile	Site Name	# Stops	Frequency
29.30	SHINUMO WASH	19	0.197916667		133.80	TAPEATS	12	0.6
136.90	FOOTBALL FIELD	19	0.197916667		219.80	UPPER 220-MILE	8	0.4
61.70	BELOW LCR	18	0.1875		53.20	LWR NANKOWEAP	6	0.3
132.00	STONE CK	18	0.1875		64.70	CARBON	6	0.3
137.00	BACKEDDY	17	0.177083333		108.20	LWR BASS	6	0.3
30.40	FENCE FAULT	16	0.166666667		16.40	HOT NA NA	5	0.25
185.50		16	0.166666667		31.60	SOUTH CANYON	5	0.25
16.40	HOT NA NA	14	0.145833333		71.00	CARDENAS	5	0.25
64.70	CARBON	14	0.145833333		81.30	GRAPEVINE	5	0.25
91.60	TRINITY CK	14	0.145833333		151.50	LEDGES	5	0.25
93.40	GRANITE	14	0.145833333		166.50	UPR NATIONAL	5	0.25
136.80	PONCHO'S KITCHEN	14	0.145833333		168.00	FERN GLEN	5	0.25
198.50	PARASHANT	13	0.135416667		202.00	202 MILE	5	0.25
108.20	LWR BASS	12	0.125		8.00	BADGER	4	0.2
109.40	110 MILE	12	0.125		11.00	SOAP CREEK	4	0.2
236.00	GNEISS CYN	12	0.125		29.30	SHINUMO WASH	4	0.2
47.20	UPR SADDLE	11	0.114583333		34.80	NAUTILOID	4	0.2
166.60	LWR NATIONAL	11	0.114583333		53.00	NANKOWEAP	4	0.2
23.70	LONE CEDAR	10	0.104166667		71.90	UPR UNKAR	4	0.2
71.90	UPR UNKAR	10	0.104166667		75.60	NEVILLS	4	0.2
75.60	NEVILLS	10	0.104166667		87.10	UPR CREMATION	4	0.2
118.10		10	0.104166667		93.40	GRANITE	4	0.2
166.50	UPR NATIONAL	10	0.104166667		114.30	UPR GARNET	4	0.2
219.80	UPPER 220-MILE	10	0.104166667		136.20	ACROSS DEER CK	4	0.2
239.60	SEPARATION CYN	10	0.104166667		155.70	LAST CHANCE	4	0.2
71.00	CARDENAS	9	0.09375		198.50	PARASHANT	4	0.2
107.80	ROSS WHEELER	9	0.09375		11.80	BROWN'S INSCRIPTION	3	0.15
119.00	BIG DUNE	9	0.09375		20.40	UPR NORTH CYN	3	0.15
155.70	LAST CHANCE	9	0.09375		30.40	FENCE FAULT	3	0.15
168.00	FERN GLEN	9	0.09375		40.90	UPR BUCKFARM	3	0.15
20.40	UPR NORTH CYN	8	0.083333333		47.20	UPR SADDLE	3	0.15
23.00	INDIAN DICK	8	0.083333333		92.30	ABOVE SALT CK	3	0.15
34.80	NAUTILOID	8	0.083333333		108.00	PARKINS' INSCR	3	0.15
47.30	LWR SADDLE	8	0.083333333		122.70	UPR FORSTER	3	0.15
65.50	LAVA CYN	8	0.083333333		131.10	BELOW BEDROCK	3	0.15
84.40	ABOVE ZOROASTER	8	0.083333333		136.80	PONCHO'S KITCHEN	3	0.15
87.20	LWR CREMATION	8	0.083333333		150.30	UPSET HOTEL	3	0.15
134.60	OWL EYES	8	0.083333333		188.00	WHITMORE WASH	3	0.15
151.50	LEDGES	8	0.083333333		208.80	GRANITE PARK	3	0.15
188.00	WHITMORE WASH	8	0.083333333		12.80	13 MILE	2	0.1
96.10	SCHIST	7	0.072916667		19.10		2	0.1
148.40	MATKAT HOTEL	7	0.072916667		23.70	LONE CEDAR	2	0.1
164.80	BELOW TUCKUP	7	0.072916667		33.60	BELOW REDWALL	2	0.1
181.80	182 MILE	7	0.072916667		43.80	PRES HARDING	2	0.1
202.00	202 MILE	7	0.072916667		47.30	LWR SADDLE	2	0.1
216.40		7	0.072916667		61.20	ABOVE LCR	2	0.1
12.80	13 MILE	6	0.0625		61.70	BELOW LCR	2	0.1
31.60	SOUTH CANYON	6	0.0625		78.90	BELOW SOCK	2	0.1
44.20	EMINENCE	6	0.0625		91.10	91 MILE CK	2	0.1
56.20	KWAGUNT	6	0.0625		96.10	SCHIST	2	0.1
114.30	UPR GARNET	6	0.0625		103.80	EMERALD	2	0.1

114.50	LWR GARNET	6	0.0625		114.50	LWR GARNET	2	0.1
119.20		6	0.0625		125.40	BELOW FOSSIL	2	0.1
150.30	UPSET HOTEL	6	0.0625		131.80	GALLOWAY	2	0.1
220.00	LOWER 220-MILE	6	0.0625		133.50	RACETRACK	2	0.1
242.00	242 MILE	6	0.0625		133.90	BELOW TAPEATS	2	0.1
19.10		5	0.052083333		143.50	MOUTH OF KANAB	2	0.1
38.30	MARTHA'S	5	0.052083333		147.90	OPP MATKAT	2	0.1
50.00	DINOSAUR	5	0.052083333		158.20	158 MILE	2	0.1
53.00	NANKOWEAP	5	0.052083333		164.50	TUCKUP	2	0.1
74.10	UPR RATTLESNAKE	5	0.052083333		166.60	LWR NATIONAL	2	0.1
81.30	GRAPEVINE	5	0.052083333		171.60	MOHAWK	2	0.1
87.10	UPR CREMATION	5	0.052083333		179.70	BELOW LWR LAVA	2	0.1
103.80	EMERALD	5	0.052083333		181.80	182 MILE	2	0.1
133.00	TALKING HEADS	5	0.052083333		191.00	UPPER FAT CITY	2	0.1
136.20	ACROSS DEER CK	5	0.052083333		191.80	FAT CITY	2	0.1
40.90	UPR BUCKFARM	4	0.041666667		204.50	BELOW SPRING CYN	2	0.1
41.00	LWR BUCKFARM	4	0.041666667		215.60	OPP THREE SPRING	2	0.1
52.60	UPR NANKOWEAP	4	0.041666667		222.00	222-MILE	2	0.1
53.20	LWR NANKOWEAP	4	0.041666667		223.00	223-MILE	2	0.1
131.10	BELOW BEDROCK	4	0.041666667		223.40	224-MILE	2	0.1
137.90	DORIS	4	0.041666667		229.00	TRAVERTINE CYN	2	0.1
145.60	OLO	4	0.041666667		243.10	243 MILE	2	0.1
158.50	SECOND CHANCE	4	0.041666667		18.10	18 MILE LEDGES	1	0.05
164.50	TUCKUP	4	0.041666667		20.50	LWR NORTH CYN	1	0.05
174.40	LWR COVE	4	0.041666667		23.00	INDIAN DICK	1	0.05
182.50	HELL'S HOLLOW	4	0.041666667		24.50	24.5 MILE	1	0.05
186.00		4	0.041666667		34.00	LITTLE REDWALL	1	0.05
200.50		4	0.041666667		38.30	MARTHA'S	1	0.05
212.90	PUMPKIN SPRINGS	4	0.041666667		41.00	LWR BUCKFARM	1	0.05
11.00	SOAP CREEK	3	0.03125		44.20	EMINENCE	1	0.05
20.50	LWR NORTH CYN	3	0.03125		46.90	DUCK N QUACK	1	0.05
37.70	TATAHATSO	3	0.03125		51.80	LITTLE NANKOWEAP	1	0.05
43.20	ANASAZI BRIDGE	3	0.03125		52.60	UPR NANKOWEAP	1	0.05
57.50	MALAGOSA	3	0.03125		56.20	KWAGUNT	1	0.05
62.60	CRASH CYN	3	0.03125		58.20	AWATUBI	1	0.05
98.00	UPR CRYSTAL	3	0.03125		59.00	BELOW AWATUBI RIGHT	1	0.05
118.50		3	0.03125		74.30	LWR RATTLESNAKE	1	0.05
120.10	LWR BLACKTAIL	3	0.03125		76.60	HANCE	1	0.05
131.80	GALLOWAY	3	0.03125		84.00	CLEAR CK	1	0.05
136.30	OC'S	3	0.03125		87.20	LWR CREMATION	1	0.05
176.00	BELOW RED SLIDE	3	0.03125		89.30	BELOW PIPE CK	1	0.05
191.00	UPPER FAT CITY	3	0.03125		91.60	TRINITY CK	1	0.05
194.40	194 MILE	3	0.03125		94.90	HERMIT	1	0.05
230.50	TRAVERTINE FALLS	3	0.03125		98.00	UPR CRYSTAL	1	0.05
17.00	HOUSE ROCK	2	0.020833333		107.80	ROSS WHEELER	1	0.05
26.30	ABOVE TIGER WASH	2	0.020833333		109.40	110 MILE	1	0.05
34.00	LITTLE REDWALL	2	0.020833333		116.50	ELVES CHASM	1	0.05
58.20	AWATUBI	2	0.020833333		118.10		1	0.05
58.60	BELOW AWATUBI LEFT	2	0.020833333		118.50		1	0.05
61.20	ABOVE LCR	2	0.020833333		122.20	122 MILE	1	0.05
66.30	ABOVE ESPEJO	2	0.020833333		124.90	FOSSIL	1	0.05
74.30	LWR RATTLESNAKE	2	0.020833333		126.50	RANDY'S ROCK	1	0.05
92.30	ABOVE SALT CK	2	0.020833333		132.00	STONE CK	1	0.05
126.50	RANDY'S ROCK	2	0.020833333		134.20		1	0.05

133.80	TAPEATS	2	0.020833333		136.30	OC'S	1	0.05
139.80	KEYHOLE	2	0.020833333		143.30	ABOVE KANAB	1	0.05
143.50	MOUTH OF KANAB	2	0.020833333		145.10	ABOVE OLO	1	0.05
144.20	BELOW KANAB	2	0.020833333		145.60	OLO	1	0.05
145.10	ABOVE OLO	2	0.020833333		148.40	MATKAT HOTEL	1	0.05
171.60	MOHAWK	2	0.020833333		148.50	BELOW MATKAT	1	0.05
179.20	JUST ABOVE LAVA	2	0.020833333		157.70	FIRST CHANCE	1	0.05
182.80	BELOW CHEVRON	2	0.020833333		158.50	SECOND CHANCE	1	0.05
188.20	LWR WHITMORE	2	0.020833333		167.20		1	0.05
190.30		2	0.020833333		174.30	UPR COVE	1	0.05
192.80		2	0.020833333		174.40	LWR COVE	1	0.05
194.10	HUALAPAI ACRES	2	0.020833333		177.10	HONGA SPRING	1	0.05
215.60	OPP THREE SPRING	2	0.020833333		177.70	ABOVE ANVIL	1	0.05
221.20	221-MILE	2	0.020833333		179.00	ABOVE LAVA	1	0.05
223.00	223-MILE	2	0.020833333		185.50		1	0.05
229.00	TRAVERTINE CYN	2	0.020833333		190.30		1	0.05
235.00	BRIDGE CYN	2	0.020833333		192.20		1	0.05
243.10	243 MILE	2	0.020833333		192.80		1	0.05
8.00	BADGER	1	0.010416667		194.10	HUALAPAI ACRES	1	0.05
18.10	18 MILE LEDGES	1	0.010416667		194.40	194 MILE	1	0.05
19.00		1	0.010416667		196.40	FROGGY FAULT	1	0.05
19.90	20 MILE	1	0.010416667		201.20	201 MILE	1	0.05
21.50		1	0.010416667		202.50		1	0.05
24.50	24.5 MILE	1	0.010416667		206.60	INDIAN CYN	1	0.05
39.00	REDBUD ALCOVE	1	0.010416667		209.50		1	0.05
43.80	PRES HARDING	1	0.010416667		219.90	MIDDLE 220-MILE	1	0.05
46.90	DUCK N QUACK	1	0.010416667		220.00	LOWER 220-MILE	1	0.05
51.40		1	0.010416667		221.20	221-MILE	1	0.05
59.00	BELOW AWATUBI RIGHT	1	0.010416667		236.00	GNEISS CYN	1	0.05
66.80	ESPEJO	1	0.010416667		259.50	BURNT SPRINGS	1	0.05
73.60	BELOW GRANARY	1	0.010416667		0.00	LEES FERRY	0	0
75.80	PAPAGO	1	0.010416667		5.80	6 MILE	0	0
84.00	CLEAR CK	1	0.010416667		8.00	JACKASS	0	0
94.90	HERMIT	1	0.010416667		8.50	BELOW JACKASS	0	0
96.00	UPR SCHIST	1	0.010416667		17.00	HOUSE ROCK	0	0
102.80	NEW SHADY GROVE	1	0.010416667		19.00		0	0
108.00	PARKINS' INSCR	1	0.010416667		19.90	20 MILE	0	0
119.50	SHADY GROVE	1	0.010416667		21.50		0	0
120.00	OPP. BLACKTAIL	1	0.010416667		21.90		0	0
120.00	UPR BLACKTAIL	1	0.010416667		26.30	ABOVE TIGER WASH	0	0
122.20	122 MILE	1	0.010416667		32.80	REDWALL	0	0
122.70	UPR FORSTER	1	0.010416667		37.70	TATAHATSO	0	0
124.30	ABOVE FOSSIL	1	0.010416667		39.00	REDBUD ALCOVE	0	0
125.40	BELOW FOSSIL	1	0.010416667		43.20	ANASAZI BRIDGE	0	0
133.50	RACETRACK	1	0.010416667		43.30	LWR ANASAZI	0	0
138.40		1	0.010416667		44.60		0	0
143.30	ABOVE KANAB	1	0.010416667		44.80	WILLIE TAYLOR	0	0
157.70	FIRST CHANCE	1	0.010416667		50.00	DINOSAUR	0	0
160.00	160 MILE	1	0.010416667		51.20		0	0
160.70		1	0.010416667		51.40		0	0
167.00	BELOW NATIONAL	1	0.010416667		56.70		0	0
167.20		1	0.010416667		57.50	MALAGOSA	0	0
173.00		1	0.010416667		57.50	OPP. MALAGOSA	0	0
174.30	UPR COVE	1	0.010416667		58.60	BELOW AWATUBI LEFT	0	0
179.70	BELOW LWR LAVA	1	0.010416667		59.80	60 MILE	0	0
182.50	UPR CHEVRON	1	0.010416667		60.80		0	0

184.50		1	0.010416667		61.00	61 MILE	0	0
186.20		1	0.010416667		61.40	LITTLE COLORADO	0	0
187.00	WHITMORE HELIPAD	1	0.010416667		62.60	CRASH CYN	0	0
189.00		1	0.010416667		65.50	LAVA CYN	0	0
191.80	FAT CITY	1	0.010416667		65.70	PALISADE S CREEK	0	0
206.60	INDIAN CYN	1	0.010416667		66.30	ABOVE ESPEJO	0	0
208.80	GRANITE PARK	1	0.010416667		66.80	ESPEJO	0	0
211.70	LWR FALL CYN	1	0.010416667		68.40	TANNER	0	0
224.50		1	0.010416667		69.80	LWR BASALT	0	0
241.50	241 MILE	1	0.010416667		72.30	UNKAR	0	0
278.60	SCORPION ISLAND	1	0.010416667		73.60	BELOW GRANARY	0	0
0.00	LEES FERRY	0	0		74.10	UPR RATTLESNAKE	0	0
5.80	6 MILE	0	0		75.80	PAPAGO	0	0
8.00	JACKASS	0	0		84.40	ABOVE ZOROASTER	0	0
8.50	BELOW JACKASS	0	0		87.80	PHANTOM	0	0
11.80	BROWN'S INSCRIPTION	0	0		89.00	PIPE CREEK	0	0
21.90		0	0		94.30		0	0
32.80	REDWALL	0	0		96.00	UPR SCHIST	0	0
33.60	BELOW REDWALL	0	0		98.20	LWR CRYSTAL	0	0
43.30	LWR ANASAZI	0	0		102.80	NEW SHADY GROVE	0	0
44.60		0	0		108.70	SHINUMO	0	0
44.80	WILLIE TAYLOR	0	0		119.00	BIG DUNE	0	0
51.20		0	0		119.20		0	0
51.80	LITTLE NANKOWEAP	0	0		119.50	SHADY GROVE	0	0
56.70		0	0		119.80	120 MILE	0	0
57.50	OPP. MALAGOSA	0	0		120.00	OPP. BLACKTAIL	0	0
59.80	60 MILE	0	0		120.00	UPR BLACKTAIL	0	0
60.80		0	0		120.10	LWR BLACKTAIL	0	0
61.00	61 MILE	0	0		120.20		0	0
61.40	LITTLE COLORADO	0	0		120.90		0	0
65.70	PALISADE S CREEK	0	0		124.30	ABOVE FOSSIL	0	0
68.40	TANNER	0	0		133.00	TALKING HEADS	0	0
69.80	LWR BASALT	0	0		134.60	OWL EYES	0	0
72.30	UNKAR	0	0		136.00	JUNEBUG	0	0
76.60	HANCE	0	0		136.20	DEER CREEK	0	0
78.90	BELOW SOCK	0	0		136.90	FOOTBALL FIELD	0	0
87.80	PHANTOM	0	0		137.00	BACKEDDY	0	0
89.00	PIPE CREEK	0	0		137.90	DORIS	0	0
89.30	BELOW PIPE CK	0	0		138.20		0	0
91.10	91 MILE CK	0	0		138.40		0	0
94.30		0	0		139.00	FISHTAIL	0	0
98.20	LWR CRYSTAL	0	0		139.80	KEYHOLE	0	0
108.70	SHINUMO	0	0		144.20	BELOW KANAB	0	0
116.50	ELVES CHASM	0	0		147.90	MATKATAMIBA	0	0
119.80	120 MILE	0	0		156.80	HAVASU	0	0
120.20		0	0		160.00	160 MILE	0	0
120.90		0	0		160.70		0	0
124.90	FOSSIL	0	0		164.80	BELOW TUCKUP	0	0
133.90	BELOW TAPEATS	0	0		167.00	BELOW NATIONAL	0	0
134.20		0	0		171.00	STAIRWAY CYN	0	0
136.00	JUNEBUG	0	0		172.10	172 MILE	0	0
136.20	DEER CREEK	0	0		173.00		0	0
138.20		0	0		176.00	BELOW RED SLIDE	0	0

139.00	FISHTAIL	0	0		178.00	VULCAN'S ANVIL	0	0
147.90	OPP MATKAT	0	0		179.20	JUST ABOVE LAVA	0	0
147.90	MATKATAMIBA	0	0		182.50	HELL'S HOLLOW	0	0
148.50	BELOW MATKAT	0	0		182.50	UPR CHEVRON	0	0
156.80	HAVASU	0	0		182.60	LWR CHEVRON	0	0
158.20	158 MILE	0	0		182.80	BELOW CHEVRON	0	0
171.00	STAIRWAY CYN	0	0		182.80		0	0
172.10	172 MILE	0	0		183.00	BELOW OLD HELIPAD	0	0
177.10	HONGA SPRING	0	0		184.50		0	0
177.70	ABOVE ANVIL	0	0		186.00		0	0
178.00	VULCAN'S ANVIL	0	0		186.20		0	0
179.00	ABOVE LAVA	0	0		187.00	WHITMORE HELIPAD	0	0
182.60	LWR CHEVRON	0	0		188.20	LWR WHITMORE	0	0
182.80		0	0		189.00		0	0
183.00	BELOW OLD HELIPAD	0	0		189.50		0	0
189.50		0	0		189.70		0	0
189.70		0	0		196.50	BELOW FROGGY	0	0
192.20		0	0		200.50		0	0
196.40	FROGGY FAULT	0	0		210.00	210 MILE	0	0
196.50	BELOW FROGGY	0	0		210.70	BIG CEDAR	0	0
201.20	201 MILE	0	0		211.20		0	0
202.50		0	0		211.50	UPR FALL CYN	0	0
204.50	BELOW SPRING CYN	0	0		211.70	LWR FALL CYN	0	0
209.50		0	0		212.90	PUMPKIN SPRINGS	0	0
210.00	210 MILE	0	0		216.40		0	0
210.70	BIG CEDAR	0	0		224.50		0	0
211.20		0	0		225.70	DIAMOND CREEK	0	0
211.50	UPR FALL CYN	0	0		230.50	TRAVERTINE FALLS	0	0
219.90	MIDDLE 220-MILE	0	0		235.00	BRIDGE CYN	0	0
222.00	222-MILE	0	0		239.60	SEPARATION CYN	0	0
223.40	224-MILE	0	0		241.50	241 MILE	0	0
225.70	DIAMOND CREEK	0	0		241.50		0	0
241.50		0	0		242.00	242 MILE	0	0
246.00	SPENCER CYN	0	0		246.00	SPENCER CYN	0	0
246.30	LAVA CLIFFS	0	0		246.30	LAVA CLIFFS	0	0
248.20	SURPRISE CYN	0	0		248.20	SURPRISE CYN	0	0
249.60		0	0		249.60		0	0
257.00	257 BAR	0	0		257.00	257 BAR	0	0
259.50	BURNT SPRINGS	0	0		260.10	QUARTERMASTER	0	0
260.10	QUARTERMASTER	0	0		274.50	COLUMBINE FALLS	0	0
274.50	COLUMBINE FALLS	0	0		278.60	SCORPION ISLAND	0	0
279.00	LAKE MEAD TAKEOUT	0	0		279.00	LAKE MEAD TAKEOUT	0	0