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U.S. Department of the Interior

Grand Canyon National Park

Final Environmental Impact Statement Colorado River Management Plan

Volume Two

Grand Canyon National Park **November 2005**

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"House Rock Rapids"

NPS
U. S. Department of the Interior

Grand Canyon National Park
Arizona

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Final Environmental Impact Statement

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Volume II

UNITED STATES DEPARTMENT OF THE INTERIOR
NPS

FINAL ENVIRONMENTAL IMPACT STATEMENT
COLORADO RIVER MANAGEMENT PLAN
GRAND CANYON NATIONAL PARK

Coconino County, Arizona

Volume II

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4.1 INTRODUCTION

4.1.1 OVERALL GUIDANCE FOR ANALYZING ENVIRONMENTAL IMPACTS

4.1.1.1 ISSUES RELATED TO THE COLORADO RIVER MANAGEMENT PLAN

Issues related to the *Colorado River Management Plan* were identified through public scoping, internal scoping and tribal consultations. These issues are summarized in Chapter 1 and Appendix B. Resource-specific issues are discussed under each impact topic in the following sections of this chapter.

4.1.1.2 GUIDING REGULATIONS AND POLICIES

Overarching environmental protection laws and policies that have guided the development of this revision of the *Colorado River Management Plan* include the National Park Service (NPS) Organic Act (as amended), the National Environmental Policy Act of 1969 (including its amendments and implementing regulations), and the National Parks Omnibus Management Act of 1998. As discussed in Chapter 1, the NPS Organic Act authorizes rules and regulations for the use and administration of national park system areas, whose purpose is "to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

The National Environmental Policy Act (NEPA) of 1969 as amended (42 USC 4321, and 4331–4335) requires federal agencies to prepare fully analyze the impacts to the environment when a major federal action is planned that could affect the quality of the human environment. The Council on Environmental Quality (CEQ) has established regulations that implement the act (40 CFR Parts 1500–1508), and the NPS has adopted procedures to comply with both the act and the CEQ regulations. These procedures are detailed in *Director's Order #12: Conservation Planning, Environmental Impact Analysis, and Decision-making* and its accompanying handbook.

The National Parks Omnibus Management Act of 1998 (Public Law 105-391) requires the Secretary of the Interior to continually improve the NPS's ability to provide state-of-the-art management, protection, and interpretation of and research on resources under its jurisdiction. Thus, park management decisions must be based on full and proper utilization of the results of scientific study. Additionally, this act states that in each case where an NPS action may cause a significant adverse effect on a park resource, the administrative record shall reflect the manner in which resource studies have been considered.

Resource-specific regulations and policies are discussed for each impact topic in the following sections of this chapter.

4.1.1.3 MANAGEMENT OBJECTIVES FOR THE COLORADO RIVER MANAGEMENT PLAN

Management objectives for the of recreational use of the Colorado River as it runs through Grand Canyon National Park are discussed in Chapter 1. Management objectives for each impact topic were used to guide analysis of environmental consequences and are discussed per impact topic in the following sections of this chapter.

4.1.2 METHODOLOGY FOR ANALYZING IMPACTS

4.1.2.1 GENERAL ANALYSIS METHOD

For each impact topic described in Chapter 3 (e.g., air quality, biological resources), the following impact assessment methodology was followed:

- *Define issues of concern*—This step is based on public scoping, internal scoping, and tribal consultation, for each resource topic.
- *Identify the area of potential effect*—The resources, values, and visitor experiences within an area that could be affected are identified.
- *Identify the effects of each alternative*—This was accomplished in two ways: (1) by considering the anticipated impacts of the alternatives on the baseline or existing conditions as described for the no-action alternatives (Alternatives A and 1), and (2) by comparing the anticipated impacts of the alternatives to a condition reasonably affected only by natural processes because in many cases the no-action alternatives are causing significant impacts on the canyon environment. This does not imply comparisons to some sort of idealized "pristine" condition that might have existed if humans had never affected the area at all. Rather, it is a condition that might have existed if humans had little effect on the environment in the area, or if the impacts of the no-action alternatives were reduced to negligible for all impact topics. Effects were characterized based on the following factors:
  - Both direct and indirect effects were considered. A direct effect is caused by an action and occurs in the same time and place. An indirect effect is caused by an action but is later in time or farther away, but is still reasonably foreseeable.
  - Whether the effects on the impact topics would be beneficial or adverse ***was considered.*** A beneficial effect is a positive change in the condition or appearance of a resource or a change that moves the resource toward a desired condition (consistent with park purpose and management objectives). An adverse effect is a change that moves the resource away from a desired condition or detracts from its condition or appearance.
  - The intensity or magnitude of the impact ***was considered***. Four impact thresholds of intensity—negligible, minor, moderate, and major—are defined for each impact topic. Threshold values for these four intensity categories were developed based on federal and state standards, consultation with regulators from applicable agencies, management objectives for the revised *Colorado River Management Plan,* public scoping, tribal consultations, and discussions with subject matter experts.

  - The context of the impact, primarily whether impacts would be regional or localized, but also whether they would occur in a location that is sensitive or nonsensitive to such impacts. Generally, regional impacts are associated with a management zone, in this case Zone 1, 2, or 3. Localized impacts are those associated with campsites, lunch stops, and attraction sites. If definitions vary from these, they are discussed in the appropriate impact topic section.
  - Whether the duration of the effect is short-term or long-term. Definitions of these terms vary by impact topic and are addressed in each of the following sections.
  - If timing of an action contributes to impacts. The exact time when an impact would occur can often be important, including sensitive time periods, time of day, how often the impact would occur, and seasonality.
- *Identify reasonable mitigations*—Mitigating measures were considered for each impact topic to reduce, avoid, or minimize impacts under each alternative. During the alternatives development process, many mitigating measures***, such as reductions in trip length or group size,*** were incorporated into the alternatives, or included as part of carrying capacity standards, or elements common to all alternatives (see Chapter 2). ***In these cases, mitigations became components of the alternatives and were no longer considered mitigations. Therefore, the mitigations identified in the alternative analysis for each impact topic would be actions or measures outside of the management actions in each alternative.*** In all cases the most important mitigation measure is a commitment to a monitoring and implementation plan and program, as discussed in Chapter 2. During the impact analysis, additional mitigating measures were identified that would likely reduce impacts to each impact topic. A determination was made for each impact topic whether these additional measures could reduce the impacts to a minor intensity or less. Reasonable mitigations are those that could be implemented under conceivably foreseeable operating conditions and would not cause substantial adverse effects to other resources (cultural or natural resources or visitor experience).
- *Determine whether an impact constitutes impairment*—The NPS is prohibited from impairing park resources and values by the NPS Organic Act. The determination of impairment is closely tied to the outcome of the resource impact analysis and consideration of the park's legislative mandates (purpose and significance), and resource management objectives as defined in the *General Management Plan* or other relevant plans. The impact analysis includes any findings of impairment to park resources and values for each of the management alternatives. Impairment is further discussed on page ***249.***
- *Determine cumulative effects*—Cumulative effects were determined by evaluating the incremental effect of the alternative when combined with other past, present, or reasonably foreseeable future actions within and outside of the area of potential effect. ***Analysis also identified to what extent each alternative would contribute to the combined effect of the alternative and other past, present, or reasonably foreseeable future actions.*** (See the discussion on page ***249)***.

4.1.2.2 TOOLS USED TO ANALYZE ENVIRONMENTAL CONSEQUENCES

In addition to the methodology discussed above, several other tools were used to help predict impacts to the physical and social environment. Some of these tools are presented below; others that were uses for specific impact topics are discussed in the following sections of this chapter.

Each alternative represents a set of management variables (group size, launches per day, etc.) that creates a corresponding set of indicators (trips at one time, user discretionary time, etc.). These are discussed in depth in Chapter 2. The analysis is based on how the variables and indicators that make up each alternative would interact with each other; the variables for each alternative are presented in the following tables. Table 4- 1 summarizes key variables and indicators of use for each of the Lees Ferry to Diamond Creek alternatives. Table 4- 2 ranks the alternatives by the estimated totals for user-days, passengers, and user discretionary time, based on the yearly totals presented in Table 4- 1.

To analyze the effect of each alternative, resource maps of known natural and cultural resources and visitor stopping points (camp, lunch, and attraction sites), including data on use intensity and known levels of impacts, were created to assist in identifying areas where sensitive resources overlapped with visitor use areas. The maps were used in conjunction with data from the Grand Canyon River trip simulator, as well as data from the Biophysical Impact Monitoring Program (see Chapter 2) to predict changes in use patterns in resource-rich areas. Consequently, analysts determined to what extent each alternative would have a direct effect on the vulnerability of certain sensitive areas.

TABLE 4- 1: SUMMARY OF ALTERNATIVES: LEES FERRY TO DIAMOND CREEK

	Alternatives							
	A	**B**	**C**	**D**	**E**	**F**	**G**	**Modified H**
Number of Motor / No-Motor Months	9/3	0/12	0/12	8/4	6/6	6/6	8/4	***5.5/6.5***
Months with No Motors	Sept 16–Dec 15	All	All	Mar, Apr, Sept, Oct	Oct–Mar	Jul–Dec	Sept–Dec	***Sept 16–March 30***
Maximum Number of Launches per Day								
Summer	9	4	4	5	6	6	6	6
Shoulder	7	2	3	3	3	4	5	***4 (April 16-30), 6 (Sept 1-15), 3 (Remainder)***
Winter	1	1	2	1	2	2	2	1
Maximum Group Size (including guides)								
Commercial Motor	43	N/A	N/A	25	30	30	40	***32 (May-Aug)/24 (Remainder)***
Commercial Oar	39	25	30	25	25	30	30	***32 (May-Aug)/24 (Remainder)***
Noncommercial Standard	16	16	16	16	16	16	16	16
Noncommercial Small	N/A	8	N/A	8	8	8	8	8
Maximum Trip Length to Diamond Creek (in number of days)								
Summer (May–August)								
Commercial Motor	18	N/A	N/A	10	8	10	8	10
Commercial Oar	18	16	16	16	14	16	14	16
Noncommercial Motor	***18***	***N/A***	***N/A***	***16***	***16***	***16***	***14***	***12***
Noncommercial ***Nonmotor***	18	16	16	16	16	16	14	16
Shoulder Seasons (March–April/September–October)								
Commercial Motor	18	N/A	N/A	10	8	10	8	***12***
Commercial Oar	21	18	18	18	16	18	16	18
Noncommercial Motor	***21***	***N/A***	***N/A***	***18***	***18***	***18***	***16***	***12***
Noncommercial ***Nonmotor***	21	18	18	18	18	18	16	***18(Sept 1-15), 21 (Remainder)***
Winter (November–February)								
Commercial Motor	30	N/A	N/A	18	N/A	18	N/A	N/A
Commercial Oar	30	N/A	21	21	N/A	21	N/A	***N/A***
Noncommercial Motor	30	N/A	N/A	18	N/A	18	18	N/A
Noncommercial Oar	30	18	21	30	21	21	21	25
Whitmore Exchanges (months allowed)								
Helicopter Exchanges**	All	None	None	None	Apr–Sept	Jan–Jun	Jan–Aug	***April-Sept***
Hiking Exchanges**	All	None	All	All	All	All	All	***April-Sept***
Estimated Total User-Days								
Commercial	113,083	97,694	166,814	137,368	115,500	128,689	115,500	115,500
Noncommercial	58,048	74,523	115,783	85,946	121,683	106,457	134,410	***113,486***
Total	**171,131**	**172,218**	**282,598**	**223,314**	**237,183**	**235,146**	**249,910**	***228,986***
Estimated Total Yearly Passengers								
Commercial	18,891	7,914	17,686	14,979	16,120	18,671	19,688	***17,606***
Noncommercial	3,571	4,980	7,543	5,449	7,693	6,745	8,992	***7,051***
Total	**22,461**	**12,894**	**25,228**	**20,427**	**23,812**	**25,415**	**28,680**	***24,657***
Opportunity for Winter Commercial Trips?	Motor or oar	No	Oar	Motor or oar	No	Motor or oar	No	***No***
User Discretionary Time (total yearly hours)	355,081	576,754	752,496	710,079	569,603	518,889	421,073	***567,238***
Maximum Number of Trips at One Time	70	60*	60*	58	60*	54	53	60*
Maximum Number of Passengers at One Time	1,095	877	900	890	972	972	***895***	***985***

** NPS would monitor and adaptively manage to ensure that actual TAOT remain at 60 or lower.*
***In cooperation with the Hualapai Tribe.*
NOTE: These are nearest whole numbers. Totals reflect cumulative fractional differences.

TABLE 4- 2: RANKINGS BY ALTERNATIVE AND SEASON BASED ON PROJECTED USER-DAYS, PASSENGERS, AND USER DISCRETIONARY TIME—LEES FERRY TO DIAMOND CREEK

Alternative	Winter	Rank	Shoulder Seasons	Rank	Summer	Rank
Total User-Days						
A	6,159	8	43,103	8	121,869	***3***
B	14,459	7	50,339	7	107,419	6
C	82,959	1	89,519	1	110,120	5
D	39,759	5	60,815	***6***	122,739	***2***
E	47,466	4	67,879	***5***	121,836	4
F	54,093	3	78,762	3	102,291	7
G	62,323	2	85,603	2	101,984	8
Modified H	***34,087***	6	***70,583***	***4***	***124,316***	1
Total Passengers						
A	318	8	4,016	7	18,128	***1***
B	927	7	3,475	8	8,492	8
C	5,027	1	8,950	2	11,252	7
D	2,242	5	4,421	6	13,765	6
E	2,782	4	5,801	5	15,230	3
F	3,094	3	8,368	3	13,954	5
G	3,710	2	10,031	1	14,939	4
Modified H	1,855	6	***6,147***	4	***16,655***	***2***
Total User Discretionary Time (in hours)						
A	6,855	8	53,721	8	294,506	6
B	20,229	7	125,081	4	431,444	2
C	228,981	1	188,426	1	335,089	5
D	114,409	2	134,029	3	461,641	1
E	80,727	5	115,114	5	373,761	4
F	113,619	3	135,764	2	269,507	7
G	102,907	4	88,208	***7***	229,958	8
Modified H	***65,789***	6	***107,936***	***6***	***393,513***	3

Highest ranking = 1, lowest ranking = 8

Numbers based on estimated yearly use (see Chapter 2)

TABLE 4- 3: ALLOWABLE USE TYPES AND LEVELS—DIAMOND CREEK TO LAKE MEAD ALTERNATIVES

	Alternatives				
	1	2	3	Modified 4	5
Diamond Creek Launches (maximum group size, including guides)					
Noncommercial	Maximum of two launches per day (16 people each).	Same as alternative 1.	Same as alternative 1.	Same as alternative 1.	Same as alternative 1.
HRR Day Trips	Average of one launch per day (up to 100 people).	Peak season: two launches per day (30 people). Non-peak season: one launch per day (30 people).	Peak season: three launches per day (30 people). Non-peak season: two launches per day (30 people).	Peak season: variable (40 people). Non-peak season: two launches per day (35 people).	Same as ***Modified*** Alternative 4.
HRR Overnight Trips	Average of one trip per week (34 people).	One trip per day (30 people).	Two trips per day (30 people).	Peak season: three trips per day (20 people). Non-peak season: one trip per day (20 people).	Same as ***Modified*** Alternative 4.
Campsites					
Available Campsites	15	15+1	15+2	15+3	15+3
Modification of New Campsites*	N/A	Low	Medium	Low	Low
Trip Length Limits for All Users (Diamond-Separation, Separation – RM 260, RM 260 – Boundary)					
Peak (# of nights)	*No limit*	*1, 1, 2*	*1, 2, 2*	*1, 1, 1*	*1, 1, 1*
Nonpeak (# of nights)	*No limit*	*1, 2, 2*	*2, 3, 3*	*1, 2, 2*	*1, 2, 2*
Quartermaster Area Dock					
Type of Dock	Two small floating docks (deteriorated).	None.	One small floating dock at RM 262.5. No other docking facilities.	***One floating dock, sized to safely accommodate HRR and pontoon use.***	One large floating dock at RM 262.5.
Pontoon Operations					
Maximum Daily Passengers**	Peak season: 188 Non-peak season: ***130***	0	400	***480 (600 based on favorable review of operations and resource monitoring data).***	960
Upriver Travel from Lake Mead					
Allowable Destination	Unlimited below Separation Canyon	Below RM 262	Below Separation Canyon	Below Separation Canyon	Below RM 273
Allowable Use (***exceptions may be granted by NPS when Diamond Creek floods)***	Unrestricted commercial pick-ups, tow-outs, and non-commercial jetboats.	Commercial pick-ups: peak season—two per day; non-peak season—none. Tow-outs allowed below RM 262.	Four commercial pick-ups per day, year-round.*** Two jetboat tours per day in the peak season. Tow-outs allowed below Separation Canyon.	Commercial pick-ups: peak season—four per day; non-peak season—one per day. Tow-outs below ***RM 240***.	No jetboats allowed. Tow-outs ***below RM 273.***

* Low—vegetation removal only; medium—vegetation removal and limited supply storage.

** Passenger access occurs via helicopter.

*** Commercial pickups would be allowed to shuttle kayak trips up to RM 273.

4.1.2.3 INCOMPLETE OR UNAVAILABLE INFORMATION

The DO #12 Handbook offers guidance on how to address data gaps in an environmental impact statement (NPS 2001a). If "such information cannot be obtained due to excessive cost or technical impossibility, the proposed alternative for decision will be modified to eliminate the action causing the unknown or uncertain impact or other alternatives will be selected" (sec. 4). In the case where alternatives cannot be modified to eliminate unknown or uncertain potential impacts, the handbook states in Section 4.5 that the NPS is required to address the following (in accordance with 42 CFR 1502.22):

- The relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment
- A summary of existing credible scientific adverse impacts, which is relevant to evaluating the reasonably foreseeable significant adverse impacts
- An evaluation of such impacts based upon theoretical approaches or research methods generally accepted in the scientific community

Data that are incomplete or unavailable are addressed per impact topic in the following sections of this chapter.

4.1.2.4 ASSUMPTIONS

Several assumptions were made in evaluating the effects of recreational use alternatives for the river corridor at Grand Canyon National Park. These assumptions were applied to all of the impact topics unless otherwise noted.

- *Analysis Period*—The analysis period addresses potential short- and long-term effects from the selected alternative for the *Colorado River Management Plan,* which has a 10-year planning horizon.
- *Analysis Area*—The analysis area includes the Colorado River corridor from Lees Ferry through Grand Canyon National Park and adjacent tribal lands to Lake Mead. The analysis area includes areas commonly visited by river runners hiking off the river. Except for cumulative impacts analyses or as specifically stated in the text, the analysis area does not include areas upstream from Lees Ferry (including Glen Canyon Dam), Lees Ferry itself (which is part of Glen Canyon National Recreation Area), or areas in Lake Mead National Recreation Area (including Pearce Ferry and South Cove).
- *Beaches*—The diminished sediment load in the river below Glen Canyon Dam has resulted in, and will continue to result in, an overall reduction in the total number of beaches and individual beach sizes (see Section 3.2.1 Soils in Chapter 3).
- ***Campsites—Campsites are defined as having a common kitchen/group area, clear areas large enough for tents, an area suitable for toilet set-up, and reasonable access to the river. The common area is generally located near the water (in the new high-water zone) to minimize both the carrying of gear and the impacts to vegetation.***
- *Flows*—The analysis assumes flows will be consistent with the annual operations plan for Glen Canyon Dam, prepared by the Bureau of Reclamation annually. The flow regime is consistent with the record of decision on Glen Canyon Dam operations, and it assumes minimum releases to meet the requirements of the 1922 Colorado River Compact. Flows will remain in the range of 5,000–25,000 cfs, with the possibility of short-term experimental releases of up to 45,000 cfs.

- *Group Size*—Larger groups use more space. While large campsites can accommodate larger numbers, those campsites are diminishing both in size and number, and they are not distributed evenly throughout the canyon. Thus, larger groups are known to spread up into the old high-water zone, causing impacts to natural and cultural resources that otherwise would be relatively undisturbed. Additionally, larger groups are more likely to exceed the carrying capacity of attraction sites. This affects not only the physical resource, but also the social environment, since crowding is known to adversely impact visitor experience.
- *Variety of Opportunities*—An important aspect of analyzing impacts is the determination of the range of opportunities for various trip types. The analysis of public scoping comments clearly indicated that there is no one definition of the ideal Grand Canyon river trip. For example, while some people may prefer a trip without motors of any kind, some may prefer a motorized trip that ends with a helicopter ride. Still others may prefer motorized trips, but find the prospect of encountering a helicopter shuttle unacceptable. Some visitors want a social experience while others prefer to vacation with a small group that is unlikely to encounter other groups. Some want short trips, others want long trips. Preferences also vary on desired seasons and whether trips are commercial or self-guided. All of these variables, and the degree to which each is offered, are considered in any analysis that incorporates the range of trip types or variety of trip opportunities.
- *Commercial Operations*—Commercial companies currently seek to optimize use of their allocations (see “Socioeconomic Conditions” in Chapter 3). Averages for trip types and seasons assume that group size and trip length tendencies from the past will continue for trips that meet the specific alternative’s limits, and other trips would adjust to the new limit thresholds.
- ***Variances—The NPS recognizes that emergencies and extenuating circumstances, such as flooding at Diamond Creek or medical emergencies, may arise. In these cases, the NPS may decide to grant variances for the components of use presented in the CRMP.***
- *Demand*—Overall, demand for recreational trips (both commercial and noncommercial) will continue to exceed supply.
- *Winter Use*—Analysis assumed a solid demand for winter use, based on winter test results (see Chapter 1).
- *User Discretionary Time (UDT)*—User discretionary time is a calculation of the cumulative amount of time people have to experience and explore the river corridor during their river trip. The type of trip, the length, and the time of year (seasonal availability of daylight) all affect the amount of time that visitors have to experience the Grand Canyon and interact with the environment. While this interaction carries a potential for resource impacts, that potential is weighed against other factors such as group size and the number of trips at one time. Further, user discretionary time is also an indicator of whether visitors are allowed enough time to experience the resources and values of the Grand Canyon. ***While human behavior cannot be precisely predicted, the data assumptions used in developing the UDT model have yielded a useful tool that refines and contributes to the analysis. It is but one of the tools used in analysis and is useful as a relative indicator of the amount of time that visitors will have to interact with the environment.***

- *Interconnectivity of Variables*—Analysis focused on the interaction of the variables and indicators associated with each alternative (see Chapter 2). For example, the maximum number of daily launches and allowable trip lengths can work to mitigate or exacerbate impacts caused by larger groups. Therefore, the analysis focused on considering the interaction of the suite of variables and indicators that made up each alternative.
- ***Exchanges at Whitmore—The NPS has the authority to regulate passenger exchanges but it has no control over how visitors exit the canyon once they have left the Park. For alternatives that present separate caps for hiking and helicopter exchanges, it is assumed that the NPS and the Hualapai Tribe would cooperatively establish a means to regulate the numbers and types of exchanges at Whitmore. The NPS has no authority over helicopter flights on Hualapai Land.***
- *Grand Canyon West Operations*—Grand Canyon West is a 9,000-acre, tour-related facility operating on the Hualapai Reservation under the Grand Canyon Resort Corporation, which is wholly owned by the Hualapai Tribe. Current operations of Grand Canyon Resort Corporation include Hualapai River Runner (HRR) trips, pontoon tours (with helicopter access), helicopter rim-to-river tours, van tours to Diamond Creek and Grand Canyon West, hotel and ranch accommodations, and excursions to resort facilities and overlooks. Of these operations, only the HRR and pontoon trips, which access the Colorado River as it passes through Grand Canyon National Park, are included within the scope of the Colorado River Management Plan. All other Grand Canyon Resort Corporation operations are conducted on sovereign Hualapai tribal lands and are not under the purview of this plan. However, all aircraft operations are under the authority of the Federal Aviation Administration and are subject to their rules and regulations.
- *Helicopter Use in the Quartermaster Area*—The NPS has no authority over helicopter flights on Hualapai tribal land. It is assumed that look-and-leave flights into the canyon from Grand Canyon West and Las Vegas and land above the high-water mark will continue to operate regardless of which set of alternatives is selected. As such, the analyses for natural soundscape and visitor experience in the Quartermaster area consider impacts from this use.
- *Helicopter Use Associated with Pontoon Operations*—Currently, all pontoon trip passengers access the docking facilities via helicopter flights that land at pads at RM 262 and RM 263. It is assumed that pontoon trip passengers will continue to use helicopters for access. It is also assumed that these pads may also be used for other types of helicopter tours. The NPS has no authority over helicopter flights that land and take off on Hualapai tribal land.

Resource-specific assumptions are discussed per impact topic in the following sections of this chapter.

4.1.2.5 IMPACT ANALYSIS

The impact analysis uses the tools and methodology discussed above to determine how each alternative would impact the environment and meets the management objectives for each impact topic.

4.1.2.6 Cumulative Impacts

Federal agencies must assess cumulative effects in an environmental impact statement. According to the CEQ regulations (40 CFR 1508.7), cumulative effects are defined as "the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such actions." Cumulative effects are considered for each of the alternatives and are addressed per impact topic. ***For each impact topic, the analysis for each alternative includes an impact rating that represents the sum total of the cumulative effects plus the effects from the alternative. The analysis then presents the degree to which the alternative contributes to the sum total rating.*** Major past, present, and reasonably foreseeable future actions considered in this analysis include the following:

- Operation of Glen Canyon Dam, including proposed experimental dam releases, fluctuating flows, temperature stabilization efforts, and removal of nonnative fish
- Cooperative agreement between the Hualapai Tribe and Grand Canyon National Park, and cooperative management among the Hualapai Tribe, Grand Canyon National Park, and Lake Mead National Recreation Area of the area from ***upstream of*** National Canyon to Lake Mead
- Tamarisk management and tributary restoration at Grand Canyon National Park
- Lake Mead National Recreation Area's *Lake Management Plan*
    - Closure of Pearce Ferry due to drought and declining water levels
    - Increased use of the South Cove takeout
- Backcountry and wilderness management at Grand Canyon National Park
- Fire management at Grand Canyon National Park
- Hualapai Tribe actions solely on their lands
- Diamond Creek activities
- Grand Canyon Parashant National Monument planning
- Air tour management efforts at Grand Canyon National Park
- Comprehensive noise management plan at Grand Canyon National Park

4.1.2.7 Conclusions, Mitigations, and Impairment Assessment

The conclusion for each impact topic summarizes all major findings in the impacts analysis for each alternative. As part of this summary, reasonable mitigations are identified when applicable for reducing or eliminating impacts, and their effect on the impact assessment is discussed.

Finally, the conclusion includes a determination of whether the alternative is likely to cause impairment of park resources and values. NPS *Management Policies, 2001* (2000) require the analysis of potential effects to determine whether or not actions would impair park resources. The fundamental purpose of the national park system, as established by the Organic Act and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve park resources and values. NPS managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adversely impacting park resources and values. However, the laws do give the NPS the management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment of the affected resources and values. Although Congress has given the NPS the management discretion to allow certain impacts within parks, that discretion is limited by the statutory requirement that the NPS must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise. The prohibited impairment is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of these resources or values. Whether an impact meets this definition depends on the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question, along with other impacts that are in existence. An impact to any park resource or value may constitute impairment, but an impact would be more likely to constitute an impairment to the extent that it has a major or severe adverse effect on a resource or value whose conservation is:

- Necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park
- Key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or
- Identified as a specific goal in the park’s general management plan or other relevant NPS planning documents

Impairment may result from NPS activities in managing the park, visitor activities, or activities undertaken by concessioners, contractors, and others operating in the park. A determination on impairment is made for each impact topic.

4.2 IMPACTS ON NATURAL RESOURCES

4.2.1 SOILS

4.2.1.1 ISSUES

External and internal scoping sessions identified several river recreation related soil resource issues, as summarized below:

- Protection of ecological and cultural resources should be the NPS's first management priority
- Resources should be monitored for impacts
- Social trailing is a problem and should be reduced; the NPS should mark and maintain trails
- The NPS should modify terrain only where habitat preservation is necessary
- Visitor impacts on beaches are a problem
- Beaches show little evidence of visitor impact
- Restore beaches by sediment infusion, stabilization, and reduction of encroaching vegetation
- Consider closing areas experiencing excessive impacts
- Tributaries are an exceptional resource that should be managed and protected from visitor impacts
- Many sites are at or near thresholds for acceptable condition. They need frequent mitigation
- River recreational activities contribute to beach erosion
- Impacts of large groups are a problem when group size exceeds the amount of suitable camping area on diminishing beaches
- NPS funding is inadequate to accomplish the amount of mitigation necessary at current use levels

4.2.1.1.1 Shoreline and the New High-Water Zone

Direct effects on sand, silt, and loam substrates are evident in areas regularly used for river recreation along the three hydrologic zones (the shoreline, the new high-water zone, and the old high-water zone) found along the mainstem of the Colorado River. Howard and Dolan (1976) and Phillips et al. (1986) reported erosion of beach and pre-dam terrace deposits in the new and old high-water zones that were caused by river runners camping overnight, stopping for lunch, and/or visiting attraction sites. Heavy foot traffic along shorelines, particularly between moored boats and the high-use areas of sites, creates access trails and dislodges sand downslope. This effect is most pronounced on steep slopes in the new high-water zone that are composed of coarse sand and devoid of vegetation that anchors sand and soil. These young alluvial substrates erode easily and regenerate very slowly. Drier, looser substrates move downhill in greater volume than moist, wet packed sand, so beaches are highly susceptible to erosion during hot dry months when evaporation rates are high (Valentine and Dolan 1979). Foot traffic also dislodges soil along tributary streams, seeps, and springs, increasing alluvial erosion in valuable riparian habitats. With repeated use, access trails created by river runners can become entrenched, funneling additional sand down to the river, especially during summer rainstorms or spring runoff. Foot traffic also roughens the surface of sand and silt, increasing the effects of wind and water erosion.

Erosion impacts to shorelines are also caused by moored boats jostling against sand banks (Howard and Dolan 1976) and turbulence and wakes created by motorboats and jetboats (Kakoyannis and Stankey 2002). Below Separation Canyon in the Lower Gorge, substantial wakes are thrown by 40-foot-long jetboats equipped with engines generating 400 to 1,050 horsepower (hp) per boat, traveling up to 40 mph (see Photo 4- 1) (Mengel, pers. comm. 2003b). Soil erosion indirectly affects water quality by making water more turbid. Erosion from recreational activities also contributes to beach sediment loss caused by Glen Canyon Dam operations. Additional ***indirect*** impacts in the new high-water zone include trampling of vegetation or intentional removal of plants, which destabilizes the soil, increasing the potential for soil erosion.

PHOTO 4- 1: BANK EROSION AND MOTORBOAT WAKES IN THE LOWER GORGE

4.2.1.1.2 Old High-Water Zone and Uplands

In the old high-water zone and upland talus slopes, poorly developed, fine-grained eolian sediments are easily impacted by river recreationists. Soils on flat upland terraces and cliffs are slightly more stable due to the presence of older, more mature native vegetation. These sediments can become less resistant if river runners cut multiple trails through the vegetation, damage well-established desert scrub, and erode the terrace banks. Multiple trails in the old high-water zone are often created when group members leave the main established trail and blaze new trails while hiking to attractions. Multiple trails are more likely to form on the flat terraces (see Photo 4- 2), since it is easier for users to spread out in open areas (Hendee, Stankey, and Lucas 1990).

Many groups of visitors walking repeatedly over the same trails day after day compact the trail substrates, packing soil particles closer together and causing a reduction in the volume of air. Ideal soil conditions for the development of vegetation allow for about 50% of the total soil volume to be pore space filled with equal volumes of air and water. When these soil conditions are altered, vegetation growth becomes limited (McBride, Martin, and Kennedy 1988) and soil microbiota lack sufficient oxygen and find it difficult to penetrate dense soil (Reeves et al. 1979). During dry periods, dense soils increase runoff and absorb less water (Settergen and Cole 1970). During the summer monsoon season and spring runoff, wet soils in the old high-water zone become more susceptible to compaction by foot traffic, and trails can become gullies as draining water follows the path of least resistance.

PHOTO 4- 2: MULTIPLE TRAILING AT NANKOWEAP

Fragile biological (cryptogamic) soil crusts composed of fungi, cyanobacteria and lichens cover much of the old high-water zone, upland, and side canyon soils. These colonizing organisms contribute organic matter that aids water retention and paves the way for the growth of higher plants. The cyanobacteria component of the soil fixes atmospheric nitrogen into amino acids and enriches the soil for plant growth. When river recreationists walk off established trails, they inadvertently trample the stabilizing soil crusts (see Photo 4- 3). Once the crust are crushed by footprints, their functions are reduced, and trampling effects remain obvious for a many years due to slow crust regeneration (Cole 1990). Soils subject to the direct effects of human disturbance can also provide a competitive edge to invasive exotic plant species and are more susceptible to dust generation. Helicopter use at Whitmore and Quartermaster further increases dust generation.

PHOTO 4- 3: EXAMPLE OF BIOLOGICAL SOIL CRUST DAMAGE

Larger groups are also more likely to disturb larger areas (Hendee, Stankey, and Lucas 1990). When large groups use medium or small sized camping beaches, visitors searching for privacy establish new tent sites in the old high-water zone. This expands the camping area, denudes stabilizing native vegetation, creates multiple barren cores, damages biological soil crusts, exposes mineral soil, and compacts old high-water zone soils. The Colorado River Human Impact Monitoring Program (Brown and Jalbert 2003) has documented significant changes to soil and vegetation resources caused by recreationists, as well as a strong relationship between beach size and vegetation and soil impacts. As beach size is diminished, impacts to soil and vegetation increase in the old high-water zone (Brown, pers. comm. 2004). Recreationists on longer trips have more time to explore the old high-water zone and hike to nearby attractions, increasing the area of possible impact and the probability of impacts occurring. Washburne and Cole (1983) observed that parties that stay longer at sites are more likely to develop or improve them.

4.2.1.2 GUIDING REGULATIONS AND POLICIES

Overarching laws, including the NPS Organic Act of 1916, the National Environmental Policy Act of 1969, and the National Parks Omnibus Management Act of 1998 are described in Chapter 1.

The National Park System Resource Protection Act (16 U.S.C. 590a and 590b) states that soils erosion on federal lands is a menace to the national welfare and that it shall be national policy to permanently control and prevent soil erosion and thereby to preserve natural resources.

Pursuant to 36 CFR 2.1(b), the park superintendent may restrict hiking or pedestrian use to a designated trail or walkway system. Leaving a trail or walkway to shortcut between portions of the same trail or walkway, or to shortcut to an adjacent trail or walkway in violation of designated restrictions is prohibited.

The NPS *Management Policies 2001* state that the NPS "will actively seek to understand and preserve soil resources of parks, and to prevent to the extent possible, the unnatural erosion, physical removal, or contamination of the soil, or its contamination of other resources" (NPS 2000a, sec. 4.8.2.4.). Management action will be taken by superintendents to prevent or minimize adverse, potentially irreversible, impacts to soils. Soil conservation and soil amendment practices may be implemented to reduce impacts.

Grand Canyon National Park 2004 Commercial Operating Requirements state the following with regard to multiple trails and campsite impacts:

> *Section IV.G. Multiple Trails:* Multiple trailing, with its consequent impacts on vegetation and soils, comprises a perennial problem at attraction sites and along backcountry trails. Guides should stress to their passengers the need to stay on established trails. A guide or trip leader familiar with the trail to be taken will lead all group hikes.
>
> *Section IV.H. Campsite Impacts:* Impacts above the sandy, post-dam riparian zone at camping areas continue to be a problem. Desert and old pre-dam riparian plant communities are particularly susceptible to damage and erosion due to trampling. Guides should stress the necessity of conducting camp activities in the more resistant post-dam sandbar areas. Passengers should be instructed not to blaze new hiking routes or sleeping areas in the fragile desert zones.

4.2.1.3 Management Objectives for Soils

As stated in Chapter 1, the *Colorado River Management Plan* management objective for soil resources is to preserve and protect natural soil conditions by minimizing impacts to soils from river recreational activities. How well each alternative would meet this management objective is included in Table 2-4 and Table 2-7 in Chapter 2.

4.2.1.4 Methodology for Analyzing Soil Impacts

The general methodology for analyzing impacts to resources is discussed in Section 4.1 of Chapter 4. The impact analysis was based on the interaction of context, duration, timing, and intensity of visitor impacts. Intensity of impacts was defined using resource specific impact thresholds.

4.2.1.4.1 Tools Used to Analyze Effects to Soils

In addition to the river trip simulator, the user discretionary time model, and the Colorado River Management Plan Mixed Resource Map, data from the 2003 NCRS Grand Canyon Soil Survey and the Colorado River Impact Monitoring Program (Brown and Jalbert 2003) were used. NPS staff compiled all available information on soil resources and soil impacts in the area of effect. NPS files, GCMRC research, and Hualapai Tribe resource files were used, as well as personal communications with resource specialists.

4.2.1.4.2 Impact Thresholds

Impacts specific to soils are characterized for each alternative based on the impact thresholds presented below. Context, duration, and timing are also defined. The methodology for how the determination of impact intensity, context, duration, and timing for a specific impact topic then relates to the cumulative impact analysis and the determination of impairment is presented in Section 4.1 of Chapter 4.

Intensity

Negligible—Adverse impacts to soils, including biological crusts, would not be perceptible or measurable. Beneficial impacts would improve the condition of soils at minute levels. Any changes to soil productivity, integrity, stability, or fertility would be imperceptible.

Minor—Beneficial or adverse effects to soils and biological crusts would be barely perceptible or measurable. Any adverse impacts to soil productivity, integrity, stability, or fertility would be small and reversible. Beneficial effects would improve the condition of soils slightly. If mitigation was needed to offset adverse effects, it would be relatively simple to implement and would likely be successful. A beneficial effect would slightly reduce the level of mitigation needed.

Moderate—Beneficial or adverse impacts to soils and biological crusts would be readily perceptible and measurable. Effects to soil productivity, integrity, stability, or fertility would be readily apparent, and they would result in a change to the soil character. Mitigation measures would be necessary to offset adverse effects and would likely be successful. Beneficial effects would substantially improve the condition of soils, greatly reducing the amount of necessary mitigation.

Major—Adverse impacts to soils and biological crusts would be readily perceptible, measurable, and constitute a substantial change from natural conditions. Effects to soil productivity, integrity, stability, or fertility would be readily apparent and would substantially change the character of the soils. Mitigation measures to offset adverse effects would be needed, they would be extensive, and their success would not be guaranteed. Beneficial effects would return soils back to natural conditions, and mitigation would not be necessary.

Context

Localized—Impacts occur at campsites, lunch stops, attraction sites, and along trails within a hydrologic zone (shoreline, new high-water zone, old high-water zone), and up side canyons or at seeps and springs.

Regional—Impacts occur within an entire recreational opportunity spectrum ***zone:*** Zone***s*** 1, 2, or 3.

Duration

Short-term—Short-term impacts occur over one season, and soils return to pre-disturbance condition the next year.

Long-term—Long-term impacts occur over several seasons, lasting longer than one year.

Timing

Soils are susceptible to erosion, compaction, and gullying during spring runoff and summer monsoons. Sand erosion in the new high-water zone is worse during the dry, hot months of the year.

Biological soil crusts are susceptible year-round, but crusts are particularly vulnerable during the dry, hot months.

4.2.1.4.3 Mitigation of Effects

Previous mitigation efforts indicate that specific measures can be effective in reducing impacts to soils if adequate funding, staffing, monitoring, and implementation of the measures are maintained. ***A list of possible*** mitigation measures ***to be considered singly or in combination, that are*** not already incorporated into the alternatives, ***but*** are judged likely to reduce impacts to soils ***if implemented*** include the following:

- Increase educational efforts and teach users how to avoid impacting soils
- Provide river runners a map of small, medium, and large campsites and ***encourage*** parties of 12 or fewer people to use small campsites, 13–24 to use medium campsites, and 25 or larger to use large campsites
- Identify protocols for hardening, closing and resting, or rehabilitating campsites or attraction sites and link them to systematic monitoring programs
- Delineate campsites, harden sites, and clear nonnative vegetation when feasible so there are sufficient tent sites in the new high-water zone
- Maintain single main trails, and move or obliterate trails in undesirable areas (e.g., social trailing or trails over cultural sites). Build and/or maintain erosion control structures as needed to protect sensitive resources and stabilize soils. Recontour ground surfaces to promote drainage to appropriate areas
- Revegetate impacted areas, restore native plant associations, and remove noxious weeds
- Work with the Adaptive Management Work Group to attempt to reduce beach erosion and restore beach sediments
- ***Revise existing and create new*** limits of acceptable change ***standards*** (standards that indicate the level of change at which action is to be taken) ***specifically*** for the soil resource in order to trigger mitigation actions before impacts become major and irreversible

4.2.1.4.4 Cumulative Impacts

Cumulative impacts on soils were determined by combining the impacts of each alternative with other past, present, and reasonably foreseeable future actions, as listed in Section 4.1 of Chapter 4 (see page ***249***).

Impacts to soils from river recreational activities would compound existing impacts from Glen Canyon Dam operations, the existence of Hoover Dam, backcountry hiker and angler use, administrative use, past feral burro use, and naturally occurring storms and flash floods that wash down tributary canyons. As previously discussed, Glen Canyon Dam impedes natural sediments from moving downstream to replace eroding beaches through Grand Canyon National Park. Fluctuating flows and experimental floods heavily affect removal and deposition of beach sediments in Marble Canyon. In the Lower Gorge, Hoover Dam impedes the flow of sediment downstream, and large amounts of sand and silt are deposited in the west end of the canyon. The presence of these dams have adverse, regional to localized, year-round, long-term, moderate to major effects on soils. Backcountry hikers and anglers access campsites at several sites along the river and contribute to soil erosion, trailing, and compaction. Administrative trips, although mostly limited to group sizes of 16 or less, contribute to soil impacts in the corridor and up side canyons. ***These additional users have localized***, adverse, year-round, short- to long-term, minor to ***moderate*** effects on soils. In the late 1970s feral burros were impacting old high-water zone soils in areas such as around Rampart Cave, Shinumo, and RM 209 (NPS 1979b); impacts continued into the 1980s. Researchers from the Museum of Northern Arizona studying the effects of feral burros on soils in 1977 concluded that feral burros change the natural conditions of park soils through soil compaction, soil erosion, and trampling of *Tortula* spp. moss crusts. Park staff revisited these plots in 2003 and noted that the multiple trails created by the feral burros were still apparent after 20 years (Leslie 2004a). Past feral burro impacts on soils have been localized, adverse, year-round, long-term, and moderate to major.

4.2.1.4.5 Assumptions

General assumptions used for analysis of effects are discussed in Section 4.1 of Chapter 4. Assumptions that specifically relate to the management alternatives and their effect on soils are presented below:

- The geographic area evaluated for soil impacts includes the river corridor from Lees Ferry to Lake Mead, areas accessible to river users for a distance of two miles from the river corridor, and the three riparian soil zones (shoreline, new high-water zone, and old high-water zone, including uplands) at campsites, lunch stops, attraction sites, and along tributaries.
- Impacts to biological soil crusts are long-term because when they are trampled, it takes many years for them to recover.
- Noncommercial and commercial groups are considered to behave similarly at campsites; however impacts to soils from small groups compared to large groups are different. Large groups tend to spread out more and affect old high-water zone soils, especially on smaller sized beaches.
- The more time groups are at a site, the greater the probability for impacts to soil resources to occur in the old high-water zone and up side canyons.
- The shorter the trip length, the fewer opportunities parties have to layover at sites.
- Only a small portion of all of the soils in Zone 1 are affected by river-running activities, so regional impacts to soils are negligible for all Lees Ferry alternatives.
- Increased user discretionary time is a better indicator of estimated impacts to the old high-water zone and side canyons than impacts to the shoreline and new high-water zone, because even if parties have minimal discretionary time, they still need to camp each night and will be

using the shoreline and new high-water zone on a daily basis. Increasing user time allows parties time to hike into the old high-water zone and side canyons.

- Longer trips have ***more opportunities for layover days and therefore,*** increased amounts of time for visitors to interact with the canyon environment. This increased time has the potential to allow greater interaction with soil resources. This is particularly true for side canyons, as longer trips are designed to allow visitors opportunities for exploration. Off-season hiking (shoulder and winter months) is more conducive to exploring side canyons, as the extreme heat of the summer precludes hiking too far from the river itself.

4.2.1.5 Impact Analysis—Lees Ferry Alternatives

The differences between alternatives are described in the following sections. The Lees Ferry alternatives are not compared to the Lower Gorge alternatives due to the differences in management, density of users, and the length of the river (226 miles from Lees Ferry to Diamond Creek and 50 miles from Diamond Creek to Lake Mead).

4.2.1.5.1 Alternative A (Existing Condition)

Under Alternative A, management of recreational use would continue to allow large group sizes, with a maximum commercial group size of 43, long trips with a maximum winter trip length of 30 days, and spikes in trips at one time, people at one time, and daily launches (see ***Table 4-*** 1). User-days would remain capped at current levels, which would result in approximately 22,500 passengers per year. Highest use occurs in the summer months and lowest use in the winter months. User discretionary time would remain relatively similar to current levels (the lowest of all the alternatives). Whitmore exchanges would occur year-round, and there would be a three-month no-motor season in the fall. Commercial motor and oar trips would be allowed in the winter.

Analysis. The limits of acceptable change in the 1989 *Colorado River Management Plan* state that there will be no more than one primary trail from a mooring location to a destination site, through the old high-water and desert (uplands) zones per site. The NPS has attempted to block and revegetate unwanted trails; however, due to a lack of funding and resources, these efforts have been minimally successful. Results from the Colorado River human impact monitoring program (Brown and Jalbert 2003) show that 96% of the 25 campsites inventoried during July and October 2003 have more than 10 social trails per campsite (see Table 4- 4***)***, which far exceeds the 1989 limits of acceptable change.

TABLE 4- 4: NUMBER OF SOCIAL TRAILS

	Trails per Site					
	0–10	11–20	21–30	31–40	41–50	51+
Number of Sites	1	3	7	4	3	7
Percentage of Sites	4%	12%	28%	16%	12%	28%

SOURCE: Preliminary data from biophysical impact survey conducted in 2003 by Mathieu Brown, Northern Arizona University. Provided by Grand Canyon National Park Science Center.

The Colorado River "Commercial Operating Requirements" prohibit camping activities in the old high-water zone (NPS 2003e), yet 63% of the 25 camp pads surveyed in 2003 Colorado River human impact monitoring program (Brown and Jalbert 2003) have pads in the old high-water zone, with a maximum of 16 campsites. More than half of these sites show soil and vegetation resource impacts related to camping activities. About 78% of the campsites inventoried by Brown and Jalbert in 2002 showed evidence of biological soil crust trampling.

Current park management efforts to mitigate soil erosion and compaction due to impacts ***associated with recreational use*** include campsite delineation, trail maintenance and obliteration of social trails, erosion control, site stabilization, beach hardening, and revegetation. Park vegetation and trails staff routinely examine the condition of 148 campsites and attraction sites to determine mitigation actions needed to restore soil resources. Of these localities, approximately 60% require routine (semiannual, annual, or biannual) maintenance to remedy visitor impacts to soils. Table 4- 5 indicates the proportion of these sites that require erosion control/site stabilization, social trail obliteration, trail maintenance, and/or revegetation on a routine basis.

TABLE 4- 5: CAMPSITES AND ATTRACTIONS REQUIRING ROUTINE MAINTENANCE TO REMEDY VISITOR-RELATED SOIL IMPACTS

	Erosion Control/ Site Stabilization	Social Trail Obliteration	Trail Maintenance	Native Plant Revegetation
Number of Sites	75	88	77	68
Percentage	50.7%	59.5%	52.0%	46.0%

SOURCE: Unpublished data on file at Grand Canyon National Park Science Center.

NOTE: 148 total campsites monitored.

Under Alternative A erratic launch patterns (with a maximum of nine launches per day in summer) create crowding at attraction sites. This alternative would continue to allow for large group sizes, increasing the probability that soil impacts (erosion and multiple trailing) would occur. When several large groups visit attraction sites at the same time, the probability of soil impacts magnifies. Only 25% of the campsites along the river can accommodate groups of 36 people or more. Large groups using the more abundant medium-sized beaches (with capacities of 24 or less) tend to spread out into the old high-water zone, adversely affecting biological soil crusts, damaging stabilizing vegetation, and creating barren areas for tent sites. This alternative has the highest number of trips at one time and people at one time, so soils at campsites and attraction sites would continue to be impacted repeatedly on a daily basis. This repetitive activity increases soil compaction. Together these factors have localized, adverse, short- to long-term, seasonal to year-round, moderate to major effects on soils.

Soils in the new high-water zone are susceptible to erosion during hot, dry months. Soils in the old high-water zone are vulnerable to foot traffic and gullying during spring runoff and late summer monsoons, as well as to trampling of sprouting, stabilizing vegetation in the spring. This alternative has the lowest user discretionary time and total annual user-days in winter and shoulder seasons, which has a minor, beneficial effect on soils; however, the total number of summer user-days is the second highest of all the alternatives, increasing potential impacts to soils during critical summer months. The high-use in the late spring and summer has localized, adverse, seasonal, short- to long-term, minor to moderate effects on soils.

The current mix of trip types creates an overall summer discretionary time that is lower than other alternatives, but longer allowable trip lengths allow users to layover at sites and to hike into side canyons, affecting upland and tributary soils. This alternative would continue to allow for the longest trip lengths of all the alternatives in the winter months when soil resources are less susceptible to erosion, but users who are allowed to spend multiple days at sites are more likely to contribute to multiple trailing and soil compaction impacts in the old high-water zone, uplands, and up side canyons. This has localized, adverse, year-round, short- to long-term, minor to moderate effects on soils.

Biological soil crusts are susceptible to trampling throughout the year, and groups with more time to hike into the old high-water zone and up side canyons are more likely to impact soil crusts. Larger groups that tend to spread out more have a greater potential to inadvertently trample biological soil crusts. This has localized, adverse, long-term, year-round, major impacts to soil crusts. Soil impacts at Whitmore are localized, but dust generation from helicopters can occur year-round.

Mitigation of Effects. Actions to mitigate effects would ***include a subset*** of the actions listed in the "Methodology for Analyzing Soil Impacts: Mitigation of Effects" section above. To attempt to reduce impacts to minor to negligible levels, an increase in the number of NPS staff to educate users about soil impacts, ***an increase in*** NPS patrols at campsites to ensure that river runners ***do*** not camp in the old high-water zone, and several more full-time staff to revegetate barren areas and block undesirable multiple trails would be required. This level of mitigation would only be reasonable and attainable in the new high-water zone with an increase in funding and staff. Impacts in the old high-water zone could not be reduced to minor under this alternative, even if increased levels of the proposed mitigations were employed.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Soil Impacts: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative A, when combined with these other past, present, and reasonably foreseeable actions, are regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on soils. Alternative A makes a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

Conclusion. Under Alternative A adverse impacts to soils at sites along the mainstem shoreline would continue to be perceptible and measurable, requiring mitigation, with greater impacts in both the new and old high-water zones during the summer months due to soil vulnerability and the highest use. Soil impacts would occur primarily during summer, since winter and shoulder season use drops significantly. Motor use would continue to be allowed nine months a year, and some shoreline erosion can be contributed to motorboat wakes. However, within this dynamic hydrologic zone, sediment is constantly being removed and deposited due to other influences such as flash floods and debris flows, as well as Glen Canyon Dam operations, so impacts at many sites are more likely to be short-term. At sites that never experience beach sediment replenishment, erosion impacts would be long-term. Shoreline soil impacts ***due to recreational use*** would be adverse, localized, short-term to long-term, seasonal, and minor to moderate.

In the new high-water zone and along tributaries, soil impacts would continue to be readily perceptible and measurable at the majority of campsites and attraction sites. Compaction impacts along trails have changed the soil character. Soil impacts in this zone occur year-round; however, mitigation measures when fully employed can reverse many of the trailing, gullying, vegetation damage, and soil compaction impacts. New high-water zone soil impacts under Alternative A would be adverse, localized, short- to long-term, year-round, and moderate.

In the old high-water zone, including uplands and side canyons, soil impacts would often continue to be long-term, especially to biological soil crusts. Impacts would occur year-round, but would be localized, tending to occur at campsites, attraction sites, and on trails leading up side canyons. Trailing, barren core, mineral soil exposure and compaction impacts, as well as biological soil crust impacts, have also changed the character of the soil. Many of these long-lasting impacts would take extensive mitigation to reverse. Therefore, soil impacts in the old high-water zone would be adverse, localized, long-term, year-round, and moderate to major.

Alternative A would have adverse, localized, short- to long-term, seasonal to year-round, minor to major effects on soils compared to natural conditions ***and without additional mitigation measures***. Alternative A would not result in the impairment of soil resources in Grand Canyon National Park. Cumulatively, impacts to soils are adverse, localized to regional, short- to long-term, and minor to major compared to natural conditions. Alternative A makes a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.2.1.5.2 Alternative B

Under Alternative B recreational motor trips would be prohibited and group sizes, the number of trips and people at one time, daily launches, user-days, and estimated total yearly passengers ***are the lowest of all the action alternatives*** (see Table 4- 1***)***. Maximum trip length would be substantially reduced from 21 days in the shoulder seasons and 30 days in the winter to 18 days in these seasons and 16 days in the summer, and maximum commercial group size would be reduced from 43 to 25 people. An eight person noncommercial trip would be added. Total user discretionary time would increase in all seasons due to the lack of shorter motor trips. There would be no Whitmore helicopter exchanges. Total user-days would be about the same as ***Alternative A***; however, the total number of passengers per year would decrease by around 10,000. No commercial trips would be allowed in the winter.

Analysis. Four launches per day would be allowed in the summer, two per day in the shoulder seasons, and one per day in the winter. This would even out launch patterns and reduce crowding at major attraction sites. This action would have localized, beneficial, short- to long-term, seasonal, minor effects on soils from current conditions. Total summer user-days would decrease, which would have minor benefits to soils, and use would be spread into the spring and winter. Spring use would be slightly higher than current, and winter use would double. Since winter is not a critical time for soils, this reallocation of user-days from summer to winter would be beneficial to soil resources and the protection of biological soil crusts. Reducing group sizes would also be beneficial to soils year-round, as smaller groups tend to spread out less than larger ones. Groups of 25 would be better able to utilize the more abundant medium-sized campsites, with less probability of having to move into the old high-water zone to camp. Small noncommercial trips with groups of eight could use small beaches with capacities of less than 12 people. A reduction in group size to 25 would have localized, beneficial, long-term, year-round, minor to moderate effects on soils from current conditions. Shorter trip lengths would require trips to move through the canyon faster, allowing less time for layover days and hikes to attraction sites and into uplands and side canyons. This would most likely reduce impacts to soils in these areas; however, parties would still use campsites nightly, and impacts to the shoreline and new high-water zone might not be reduced. A reduction in trip length from current conditions would have localized, beneficial, short- to long-term, seasonal to year-round, minor effects to soils in the old high-water zone and up side canyons.

Overall user discretionary time would increase due to the absence of short motor trips, but this would be balanced by smaller group sizes, shorter trip lengths, fewer trips and people at one time, and fewer passengers, so soil impacts would likely be reduced. The absence of motorized boats would eliminate one source of shoreline erosion. Not allowing helicopter use would eliminate blowing dust at Whitmore. These actions would have localized, beneficial, short-term, seasonal, minor effects from current conditions.

Mitigation of Effects. The beneficial effects of Alternative B would reduce the amount of mitigation required compared to Alternative A; however, the level needed would be similar to the level currently occurring. The level of mitigation would be reasonable and attainable. ***A subset of*** the mitigations listed under "Methodology for Analyzing Soil Impacts: Mitigation of Effects" section should be employed, but levels of patrols, educational efforts, and rehabilitation staff would be similar to current levels. This level of mitigation would be reasonable and attainable.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Soil Impacts: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative B, when combined with those other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on soils. Alternative B would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. Under Alternative B a beneficial change from current condition would be expected in all three hydrologic zones. Mitigation would still be required, although less than under Alternative A. Soil conditions in the new high-water zone could improve faster than in the old high-water zone, but neither zone would return to pre-use conditions. Fewer launches per day, a 10,000 person reduction in total number of passengers, smaller group sizes, shorter trip lengths, lack of motorized craft, reduced number of trips and people at one time would all be beneficial to soil resources. Effects in the shoreline zone would be short- to long-term, while resources in the old high-water zone would continue to experience long-term effects. Use would still be highest in the summer, even though more use would be spread into shoulder and winter seasons; however, changes to the other variables would result in an overall improvement to soil conditions.

Alternative B would have beneficial, localized, short- to long-term, year-round, minor to moderate effects on soils compared to current conditions. Compared to natural conditions ***and without additional mitigation measures***, Alternative B would have adverse, localized, short- to long-term, year-round, minor to moderate effects. Alternative B would not result in the impairment of the soil resources in Grand Canyon National Park. Cumulative impacts, as described for Alternative A, would continue to be localized to regional, adverse, short- to long-term, year-round, and minor to major. Alternative B would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.1.5.3 Alternative C

Under Alternative C motors would be eliminated, maximum group size would be reduced to 30 people, and maximum trip length to 21 days. The number of trips and people at one time would be reduced, while total annual user-days would increase by around 100,000 (see Table 4- 1). User-day levels would double in the shoulder season***s. T***otal user discretionary time ***would be the highest of all alternatives***, with the greatest increase in the winter and shoulder seasons. Launches per day would be reduced to four in the summer and three in the shoulder seasons, but increased to two per day in the winter months. There would be approximately 3,000 more passengers per year. Commercial oar trips would be allowed in the winter.

Analysis. A reduction in group size to 30 would have localized, beneficial, long-term, year-round, minor effects on soils from current conditions in all three hydrologic zones, with a potential reduction in impacts from multiple social trails and use in the old high-water zone. Shortening trip lengths would require trips to move through the canyon faster, allowing less time for layover days and hikes to attraction sites and into uplands and side canyons. This would most likely reduce impacts to soils in these areas and have localized, beneficial, short- to long-term, seasonal to year-round, minor effects to soils in the old high-water zone and up side canyons from current conditions. However, parties would still use campsites nightly, and impacts to the shoreline and new high-water zone might not be reduced. Although launches per day would be managed, the high numbers of users traveling at the same speed would likely not improve crowding problems at attraction sites and would result in a negligible effect to soils from current conditions.

The increase in total annual user-days, user discretionary time, and total passengers would result in more feet on the ground over the course of a year. The repetitive use of campsites and more trail users would increase soil compaction and the potential for gullying to occur during rain storms. More use on the shoreline and in the new high-water zone would disturb more sediment year-round, increasing erosion. This would have localized, adverse, short- to long-term, seasonal to year-round, moderate to major effects on soils. The greatest increase in use would be in the winter, when soils are less susceptible to impacts, but total number of passengers would double in the spring during spring runoff when the potential for gullying increases and trampling of sprouting vegetation would decrease soil stability. Eliminating motor trips would remove one source of shoreline erosion, which would have a beneficial effect. Allowing no Whitmore helicopter exchanges would reduce the amount of blowing dust. Eliminating motorized uses would have localized, beneficial, short- to long-term, seasonal, minor effects on soils from current conditions.

Mitigation of Effects. Mitigations would be similar to those described in Alternative A except with a greater increase in staffing levels for patrols, educational efforts, and rehabilitation. In addition, new staffing would be needed in the spring and winter months. A considerable increase in funding would be needed. This level of increased mitigation may not be reasonable or attainable.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Soil Impacts: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of alternative C, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on soils. Alternative C would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

Conclusion. Reducing group size would have substantial beneficial effects to soils in all three hydrological zones by reducing the potential for multiple trail creation, biological soil crust damage, and camping impacts in the old high-water zone. Reducing trip lengths would benefit uplands and side canyons. A substantial increase in total numbers of users and user discretionary time would increase soil compaction and erosion impacts, adversely affecting soils. Eliminating motors and reducing summer use while increasing winter use would be beneficial to soils. Doubling shoulder season use would have an adverse effect on soils. Adverse impacts to soils would be perceptible and measurable, and extensive mitigation would be necessary to reduce soil impacts. Local mitigation efforts would likely be successful, but would not reduce impacts down to minor levels. Impacts to the shoreline would be short- to long-term, while impacts in the old high-water zone would be long-term. Impacts to all three zones would be year-round.

Alternative C would have beneficial, localized, short- to long-term, year-round, minor effects on soils compared to current conditions (Alternative A). Alternative C, ***without additional mitigation measures*** would have adverse, localized, short- to long-term, year-round, moderate to major effects on soils. Alternative C would not result in the impairment of soil resources in Grand Canyon National Park. Cumulative impacts to soils would continue to be adverse, localized to regional, short- to long-term, and minor to major. Alternative C would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.2.1.5.4 Alternative D

Alternative D is a mixed-use alternative, with eight months of motor use and four months of no-motor use in the shoulder seasons to coincide with the high backcountry use season. Maximum commercial group size would be 25 people. Trip lengths would be reduced in the summer and shoulder seasons, but a maximum trip length of 30 days would be allowed in the winter. An eight-person noncommercial trip would be added. Total annual user-days would increase by about 50,000 (see Table 4- 1). This alternative would have the ***second*** highest total user discretionary time. The number of trips and people at one time would be reduced from current levels. There would be no Whitmore helicopter exchanges. Commercial motor and oar trips would be allowed in the winter.

Analysis. The reduction in group size to 25 would have localized, beneficial, long-term, year-round, minor to moderate effects on soils from current conditions in all three hydrologic zones. Smaller groups could utilize more abundant medium-sized beaches, with less potential for camping impacts in the old high-water zone. Shorter summer and shoulder season trip lengths would benefit soils during the critical months by reducing layover days and opportunities for hiking into the uplands and side canyons. This would have localized, beneficial, short- to long-term, seasonal to year-round, minor effects to soils from current conditions and would most likely reduce impacts to soils in these areas. However, parties would still use campsites nightly, and impacts to the shoreline and the new high-water zone might not be reduced.

Longer winter trips would occur when soils are less susceptible to erosion impacts. Allowing five launches per day in summer, three per day in the shoulder seasons, and one per day in winter would be greater than under Alternative B, but trips would be shorter. No-motor use in the spring would have localized, beneficial, short- to long-term, seasonal, minor effects on shoreline soils by reducing erosion caused by wakes during spring. This alternative would have the highest summer user discretionary time, but smaller group sizes would help reduce the likelihood of multiple social trail creation and impacts to biological soil crusts. With shorter trip lengths, use would be concentrated at sites along the river, resulting in a possible minor beneficial effect on tributary soils. The increase in total user-days would mean more people walking on the soils, which would increase soil compaction and erosion impacts and result in localized, adverse, short- to long-term, year-round, moderate impacts. Not allowing helicopter exchanges would eliminate dust generation at Whitmore and would have minor beneficial effects.

Mitigation of Effects. Mitigations would be similar to those described for Alternative A except staffing levels would increase above the levels needed in A, but not as high as under Alternative C. The increase would be reasonable and attainable.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in “Methodology for Analyzing Soil Impacts: Cumulative Impacts.” The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of alternative D, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on soils. Alternative D would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. Alternative D would have beneficial effects to soils (including biological soil crusts) in the new and old high-water zones compared to current conditions because of reduced group sizes, and shorter trips would benefit upland and side canyon soils. The high user discretionary time would mean more available time for visitors to move about the site, potentially increasing soil impacts in the old high-water zone. Soil compaction would continue to change the character of the soil. There would be a slight benefit to shoreline soils because no motor wakes would occur in the spring. Impacts to soils in the shoreline zone would be short- to long-term, while impacts in the old high-water zone would be long-term. With increased use in the winter and shoulder seasons, impacts would likely occur year-round. Increased use in the summer would increase soil impacts during a critical season. Impacts would continue to be perceptible and measurable, and mitigation would likely be successful given adequate funding and resources.

Alternative D would have beneficial, localized, short- to long-term, year-round, minor to moderate effects on soils compared to current conditions. Compared to natural conditions ***and without additional mitigation measures***, there would be adverse, localized, short- to long-term, year-round, moderate effects. Alternative D would not result in the impairment of soil resources in Grand Canyon National Park. Cumulative impacts to soils would be adverse, localized to regional, short- to long-term, and minor to major compared to natural conditions. Alternative D would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.1.5.5 Alternative E

Alternative E is a mixed-use alternative with equal periods of motor and no-motor use (October to March). Maximum commercial group sizes would be reduced to 30 people for motor trips and 25 people for oar trips. An eight-person noncommercial trip would be added. Maximum trip lengths in all seasons would be reduced from current levels (see Table 4- 1***)***. Helicopters at Whitmore would be allowed from April to September. The maximum number of trips and people at one time would be reduced compared to current conditions, while total annual user-days would increase by approximately 60,000. Six launches per day would be allowed in the summer, three during the shoulder seasons, and two in the winter. No commercial trips would be allowed in the winter.

Analysis. Reduced trip lengths and commercial group sizes would have localized, beneficial, long-term, year-round, minor effects on soils from current conditions by reducing hiking impacts in the uplands and side canyons and the probability of multiple trailing, biological soil crust trampling, camping impacts in the old high-water zone. Reducing the numbers of trips and people at one time, along with evening out launch patterns, would reduce impacts from crowding, having localized, beneficial, short- to long-term, seasonal, minor impacts to soils from current conditions. Six launches per day in the summer might cause more competition for campsites, but the new launch patterns would likely reduce congestion at attractions. Reducing the motor season to six months would eliminate motor wakes during the fall and winter, but not during the critical seasons, having a negligible effect. Dust generation from helicopters would be limited to six months of the year, having a negligible effect. The increase in user discretionary time and a 60,000 user-day increase, with a significant increase occurring in the spring, would likely increase soil compaction and erosion impacts, having localized, adverse, short- to long-term, year-round, moderate effects on soils.

Mitigation of Effects. Mitigations would be similar to those described in Alternative A except staffing levels would increase somewhat higher than Alternative D, but not as high as Alternative C. This level of mitigation would likely be reasonable and attainable.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in “Methodology for Analyzing Soil Impacts: Cumulative Impacts.” The impact rating from all cumulative actions is regional to localized, adverse, short-term to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative E, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on soils. Alternative E would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. Reduced group sizes would benefit soils in all three hydrologic zones. Increased user-days and user discretionary time would likely increase erosion and soil compaction in terms of more foot traffic and more use during spring. A six-month no-motor season would benefit shoreline soils. Soil compaction impacts would continue to change the character of the soil. Impacts to soils in the shoreline zone would be short- to long-term and year-round, while impacts in the old high-water zone would be long-term and year-round. Impacts would continue to be perceptible and measurable, and mitigation would likely be successful given adequate funding and resources.

Alternative E would have beneficial, localized, short- to long-term, year-round, and minor effects on soils compared to current conditions. Compared to natural conditions ***and without additional mitigation measures***, there would be adverse, localized, short- to long-term, year-round, moderate effects on soils. Alternative E would not result in the impairment of soil resources in Grand Canyon National Park. Cumulative impacts to soils would be adverse, localized to regional, short- to long-term, and minor to major. Alternative E would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.1.5.6 Alternative F

Alternative F is a mixed-use alternative, with equal motor and no-motor seasons (July through December). Daily launches would allow a maximum of six trips per day in the summer, four in the shoulder seasons, and two in the winter (see Table 4- 1***)***. Helicopter exchanges at Whitmore would occur only during the January to June motor season. Commercial winter trips would be allowed. Maximum commercial group size would be 30 people, and trip lengths would be reduced in all seasons. An eight-person noncommercial trip would be added. The maximum number of trips and people at one time would be reduced, while annual user discretionary time would increase, and the number of total passengers per year would rise by around 3,000.

Analysis. Reduced group sizes, trip lengths, launches per day, and a six-month no-motor season under Alternative F would have localized, beneficial, short- to long-term, seasonal to year-round, minor effects on soils from current conditions. Part of the no-motor season would occur during the critical summer months, and motorboat wakes would no longer be a source of erosion from July to December, having localized, beneficial, short- to long-term, seasonal, minor effects from current conditions. Reducing the number of trips and people at one time and evening out launch patterns would reduce impacts from crowding and would also have minor beneficial effects. Six launches per day in the summer would cause more competition for campsites, but the new launch pattern would likely reduce congestion at attractions. User-days would decrease in the summer, reducing impacts to soils during the early summer hot and dry months and the late summer monsoons, but they would almost double from current levels in the spring. Increasing use in the spring months would increase the probability of impacts to soils during spring runoff, and trampling of sprouting vegetation would decrease soil stability. This would have localized, adverse, short- to long-term, seasonal, moderate effects on soils.

Mitigation of Effects. Mitigations would be similar to those described in Alternative E, but levels of mitigation necessary to reduce impacts to minor in the spring might not be reasonable or attainable.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Soil Impacts: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of alternative F, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on soils. Alternative F would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. Reduced group sizes would benefit soils in all three hydrologic zones and would reduce the probability of camping in the old high-water zone, biological soil crusts being trampled, and multiple trails being created. Reduced trip length would benefit soils in the old high-water zone, as well as upland and side canyon soils, by limiting layover days and long hikes. Increased user-days (total feet and spring season) and user discretionary time would have adverse effects on soils because of increased erosion and soil compaction. A six-month no-motor season, with summer months included, would benefit shoreline soils. Specified launch patterns and a reduction in the number of trips and people at one time would reduce soil impacts from crowding. Soil compaction impacts would continue to change the character of the soil. Impacts to soils in the shoreline zone would be short- to long-term and year-round, while impacts in the old high-water zone would be long-term and year-round. Impacts would continue to be perceptible and measurable, and mitigation would likely be successful given adequate funding and resources.

Alternative F would have beneficial, localized, short- to long-term, year-round minor effects on soils compared to current conditions, and adverse, localized, short- to long-term, year-round, moderate effects on soils compared to natural conditions ***and without additional mitigation measures***. Alternative F would not result in the impairment of soil resources in Grand Canyon National Park. Cumulative impacts to soils would be adverse, localized to regional, short- to long-term, and minor to major. Alternative F would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.1.5.7 Alternative G

Alternative G is a mixed-use alternative, with an eight-month motor season and a four-month no-motor season (September to December). Under this alternative, maximum group size for commercial motor trips would be 40 people, similar to current conditions *(see Table 4- 1)*.

Commercial oar trips would have a maximum group size of 30 people. Maximum trip lengths would be reduced in all seasons compared to current conditions. Launch patterns would allow for six trips per day to launch in the summer, five in the shoulder seasons, and two in the winter. Shoulder month launches would be the highest of all alternatives aside from Alternative A. Total annual user-days would grow by around 78,000, with a slight decrease during summer, doubling in the spring, and increasing tenfold in the winter. Trips at one time would decrease substantially, with a modest reduction in people at one time from current. User discretionary time would be the second lowest. This alternative would allow for an increase of around 6,000 passengers annually. Winter commercial use would not be allowed, and Whitmore helicopter exchanges would be allowed from January to August.

Analysis. Localized, adverse, short- to long-term, seasonal, moderate to major effects on soils due to large group sizes would be similar to those described in Alternative A, occurring in both the new and old high-water zones. Only 25% of the campsites along the river can accommodate groups of 36 or more people. Large groups using the more abundant medium-sized beaches, with capacities of 24 or fewer people, tend to spread out into the old high-water zone, damaging stabilizing vegetation and creating barren areas for tent sites. Larger groups hiking on upland terraces also tend to spread out more, creating multiple trails and trampling biological soil crusts.

Shorter trip lengths require trips to move through the canyon faster, resulting in less user discretionary time and reduced time for layover days and hikes into the old high-water zone, uplands, and side canyons. This would have localized, beneficial, short- to long-term, year-round, minor effects on soils from current conditions in the uplands, along tributaries, and at attraction sites; however, trips would still be camping each night and affecting shoreline and new high-water zone soils at campsites.

Reducing numbers of trips and people at one time and evening out launch patterns would reduce impacts from crowding, having localized, beneficial, short- to long-term, seasonal, minor effects from current conditions. Six launches per day in the summer would cause more competition for campsites, but the new launch patterns would likely reduce congestion at attractions. A decrease in user-days in the summer would be beneficial to soils, while an increase in the spring would be adverse. The repetitive use of campsites and increased number of total feet on trails would increase soil compaction impacts. More feet on the shoreline and in the new high-water zone would disturb more sediment, increasing erosion. Much of the increase in use would be in the winter, when soils are less susceptible to impacts, but the total number of passengers would more than double in the spring. Together these actions would have localized, adverse, short- to long-term, seasonal to year-round, moderate to major effects on soils. Wakes from motorboats would occur in both critical spring and summer seasons, and these effects would be localized, adverse, short- to long-term, seasonal, and minor to moderate.

Mitigation of Effects. Mitigations would be similar to those described in Alternative C, with the highest staffing levels of all of the alternatives for educational programs, law enforcement patrols, and trail maintenance and revegetation staff. This alternative would require the greatest increase in funding and resources. This increase would not be reasonable or attainable. Increased use with larger parties would most likely require more site closures.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in Section 4.2.1.4.4. The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative G, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on soils. Alternative G would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to this cumulative effect.

Conclusion. Adverse impacts to soils under Alternative G would occur due to large group sizes, increased user-days, motor wakes during critical months, higher number of launches per day in spring, and increased number of passengers. Reduced user-days in the summer would be beneficial to soils. Reduced trip lengths would be beneficial to side canyon and upland area soils. Soil compaction impacts would continue to change the character of the soil. Impacts to soils in the shoreline zone would be short-term to long-term, while impacts in the old high-water zone would be long-term. Year-round impacts are expected due to use being spread out throughout the year. Impacts would continue to be perceptible and measurable and mitigation measures to offset adverse effects would be needed, extensive and their success would not be guaranteed.

Alternative G would have adverse, localized, short- to long-term, year-round, minor effects on soils compared to current conditions ***and without additional mitigation measures***. Compared to natural conditions there would be adverse, localized, short- to long-term, year-round, moderate to major effects on soils. Alternative G would not result in the impairment of soil resources in Grand Canyon National Park. Cumulative impacts to soils would be adverse, localized to regional, short- to long-term, and minor to major. Alternative G would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to this cumulative effect.

4.2.1.5.8 Modified Alternative H (NPS Preferred Alternative)

Modified Alternative H is a mixed-use alternative, with ***five and a half mixed use months and six and a half*** nonmotor ***months***. This alternative would allow six trips to launch in the summer ***plus the first two weeks of September***, three in the shoulder seasons ***with the exception of four from April 16-30*** and one in the winter. Summer maximum commercial group size would be 32 people, and shoulder seasons would be 24. No commercial trips would be allowed in the winter. An eight-person noncommercial trip would be added. Trip lengths would be reduced from current levels in all seasons. Whitmore helicopter ***and hiking*** exchanges would occur to accommodate trips launching in the mixed use season ***from April to September.*** User-days ***would increase by 58,000 annually,*** with noncommercial user-days almost doubling. Total number of passengers would increase by around 4,000, and user discretionary time would increase in all seasons.

Analysis. Reduced group sizes would be beneficial to soils year-round, helping protect biological soil crusts, because smaller groups tend to spread out less than larger groups. Groups of 24 in the shoulder seasons would be better able to use the more abundant medium-sized campsites with less probability of moving into the old high-water zone to camp. Small noncommercial trips with groups of eight could use small beaches with capacities of less than 12 people. A reduction in group size would have localized, beneficial, short- to long-term, ***seasonal to*** year-round, minor to moderate effects on soils from current conditions. Shorter trip lengths would require trips to move through the canyon faster, allowing less time for layover days and hikes to attraction sites and into uplands and side canyons, and this would have localized, beneficial, short- to long-term, year-round, minor effects on soils from current conditions. This would most likely reduce impacts to soils in these areas; however, parties would still use campsites nightly so impacts to the shoreline and new high-water zone might not be reduced.

Reducing the numbers of trips and people at one time and evening out launch patterns would reduce impacts from crowding, having localized, beneficial, short- to long-term, seasonal, minor effects on soils from current conditions. Six launches per day in the summer would cause more competition for campsites, but the new launch patterns would likely reduce congestion at attractions.

Whitmore helicopter use would be reduced ***to April to September***, decreasing dust generation, having minor beneficial effects. Hiking exchanges at Whitmore ***may*** increase local impacts to soils in the Whitmore area due to ***a slight increase in*** use on trails that do not receive much use under current conditions. Overall, the Whitmore hiking component of this alternative would have localized, adverse, short- to long-term, seasonal, ***minor*** effects on soils.

Mitigation of Effects. Mitigations would be similar to those described in Alternative A, with approximately the same increase in staffing levels over Alternative A as described for Alternative D. This increase would be reasonable and attainable.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in “Methodology for Analyzing Soil Impacts: Cumulative Impacts.” The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of ***Modified*** Alternative H, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on soils. ***Modified*** Alternative H would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to this cumulative effect.

Conclusion. Reduced group sizes would benefit soils in all three zones and would reduce the probability of camping in the old high-water zone, biological soil crusts being trampled, and multiple trails being created. Reduced trip lengths would benefit soils in the old high-water zone, as well as upland and side canyon soils, by limiting layover days and long hikes. Increased user-days (total feet and spring season) and user discretionary time would have adverse effects on soils because of increased erosion and soil compaction. A six ***and a half*** month nonmotor season would benefit shoreline soils. Specified launch patterns and a reduction in the number of trips and people at one time would reduce soil impacts from crowding. Soil compaction impacts would continue to change the character of the soil. Impacts to soils in the shoreline zone would be short- to long-term and year-round, while impacts in the old high-water zone would be long-term and year-round. Impacts would continue to be perceptible and measurable, and mitigation would likely be successful, given adequate funding and resources.

Modified Alternative H would have beneficial, localized, short- to long-term, year-round, minor effects on soils compared to current conditions, and adverse, localized, short- to long-term, year-round, moderate effects on soils compared to natural conditions ***and without additional mitigation measures***. ***Modified*** Alternative H would not result in the impairment of soil resources in Grand Canyon National Park. Cumulative impacts to soils would be adverse, localized to regional, short- to long-term, and minor to major. ***Modified*** Alternative H would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to this cumulative effect.

4.2.1.6 Impact Analysis—Lower Gorge Alternatives

4.2.1.6.1 Alternative 1 (Existing Condition)

River recreational use below Diamond Creek occurs in recreational opportunity spectrum Zones 2 and 3. Mixed use includes both commercial and noncommercial oar and motor trips from Lees Ferry continuing on to Lake Mead, noncommercial and HRR trips launching from Diamond Creek, noncommercial boaters traveling upriver from Lake Mead, pontoon boats and helicopter tours in the Quartermaster area, and jetboat upriver passenger takeouts and noncommercial boat tow-outs. Current maximum group size for HRR day trips is 100 people year-round, with an average launch of one per day. Overnight trips average one launch per week, with a maximum group size of 34. No additional campsites would be added, maintaining the current number of 15. There are two small floating docks in the Quartermaster area, and at least one make-shift docking facility near RM 262.5, with no additional docks proposed. For pontoon operations, passengers average 188 per day during the peak season and ***130*** during the non-peak season. Upriver travel is unlimited below Separation Canyon (RM 239.5). There are currently no kayak/canoe delivery trips.

Analysis. Very little recreational impact research has been conducted by Grand Canyon National Park staff between Diamond Creek and Lake Mead; however, the Hualapai Division of Cultural Resources (HDCR) documented recreational impacts to various traditional cultural properties in 2001 and 2002. Five of the properties evaluated in 2001 (Whitmore Canyon, Granite Park, Pumpkin Springs, Three Springs Canyon, and RM 223) had been affected from trailing and onsite camping, with impacts ranging from heavy to severe (Jackson et al. 2002).

During the HDCR 2002 survey, human-caused impacts at Bridge Canyon were reported to be heavy, with modification of the campsite area, increased trailing, moderate to heavy vegetation clearing, and camping in the upper portions of the site. At Spencer Canyon the resource staff observed moderate to heavy human impacts from trailing in the new and old high-water zones, especially around the toilet area. At Travertine Falls there were also moderate to heavy impacts from trailing along the spring and up to the ledge, and also on the upstream side of the spring and in front of the falls. They also noted broken and damaged vegetation along the trail. The recommendation in 2002 was to obliterate the social trails to protect resources.

With the drop in Lake Mead water levels, silt banks and mud flats have become prevalent along the river's edge. Wakes from motorboats and jetboats contribute to erosion of these newly exposed deposits, changing gentle slopes to sharply cut banks, as shown in ***Photo 4-*** 1 (Mengel, pers. comm. 2004). The Hualapai Tribe has been particularly concerned about the adverse impacts caused by the wakes from the 40-foot-long jetboats equipped with 1,050-hp engines and traveling at high speeds (Christensen, pers. comm. 2004). Effects from wakes have regional, adverse, seasonal to year-round, short- to long-term, minor to moderate effects on soils. Human foot traffic from all types of trips using the lower gorge, also contributes to shoreline and new high-water zone erosion at popular campsites and attractions, as described under "Issues" above. At these sites heavy foot traffic between moored boats and the core of the site creates access trails and dislodges sand and silt downslope. Noncommercial and commercial groups spending more off-river time hiking side canyons contribute to foot traffic that dislodges soil along tributary streams and at seeps and springs, increasing alluvial erosion in valuable riparian habitats. This has localized, adverse, year-round, short- to long-term, minor to moderate effects on soils. Use occurs year-round, with noncommercial trips from Diamond Creek downriver becoming popular in the shoulder and winter seasons due to warmer temperatures. Soils are more sensitive to erosion during the hot, dry early summer months and during the summer monsoon season and spring runoff, when trails can become gullies as draining water follows the path of least resistance. With repeated use, these access trails can become entrenched, funneling additional sand down to the river, especially during rain storms. This has localized, adverse, seasonal, short- to long-term, moderate to major effects on soils. Foot traffic also roughens the surface in sand and silt area, increasing the effects of wind and water erosion. At current levels of helicopter use associated with river running activities, blowing dust occurs locally at helipads, but for eight hours a day. This has localized, adverse, year-round, short- to long-term, minor to moderate effects on soils.

Under Alternative 1, peak-season group sizes of 100 on HRR trips would have the most detrimental localized effects on soils. Large groups walking the same trails day after day compact soil substrates along the trail. This has localized, adverse, year-round, short- to long-term, moderate to major effects on soils. Multiple trails are often created when members of parties leave the main established trail and blaze new trails while hiking to portable toilets and attractions or while exploring the old high-water zone. Multiple trails are more likely to form on the flat terraces in the Lower Gorge since it is easier for users to spread out in open areas. Larger groups are also more likely to disturb larger areas (Hendee, Stankey, and Lucas 1990).

Erosion due to Glen Canyon Dam operations and fluctuating and experimental flows is less of an impact on beaches in the Lower Gorge than in the Lees Ferry to Diamond Creek stretch. Currently, campsites in the Lower Gorge are becoming overgrown with exotic species of plants. Alternative 1 would continue to allow camping at existing beaches without NPS vegetation manipulation or specific designation of HRR overnight trip campsites on the left bank. River running parties currently attempting to use these overgrown beaches haphazardly cut vegetation to expand the sites and blaze multiple trails, which has localized, adverse, year-round, short- to long-term, moderate effects on soils.

Alternative 1 would allow for two small floating docks in the Quartermaster area. These docks have localized, beneficial, year-round, short- to long-term, minor effects to soils, limiting the amount of erosion impacts created from moored boats at RM 262 to 263. Passengers on Hualapai/OTI helicopter and pontoon boat trips would continue to compact soils on established trails at RM 262.5, walking from the helicopter pad to the pontoon boats. Although passengers are encouraged to stay on established, well marked trails, numerous multiple trails are present in the area due to boat operators walking to and from stored fuel caches (Shearin, pers. comm. 2004).

Mitigation of Effects. To mitigate adverse effects, ***a subset*** of the actions listed in the "Methodology for Analyzing Soil Impacts: Mitigation of Effects" section above should be implemented. To attempt to reduce impacts to minor levels, a substantial increase in the number of NPS staff would be needed to educate users about soil impacts, to patrol campsites to ensure that river runners ***do*** not camp in the old high-water zone, and to revegetate barren areas and block undesirable multiple trails. This level of increase would likely not be attainable.

In addition, the Hualapai Tribe has considered developing a visitor management plan to address use patterns at heavily used sites, such as Diamond Creek, Quartermaster, and Travertine Falls. In cooperation with the Hualapai Tribe, develop limits of acceptable change thresholds, which would trigger mitigations and management actions at all Lower Gorge sites. A cooperative monitoring and site rehabilitation program should then be initiated. The Hualapai Tribe is considering plans to address dust abatement, gasoline storage, human waste disposal, and use restrictions at Travertine Canyon. They have also proposed that HRR boatman monitor client activities so that natural resources are not impacted by visitors.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Soil Impacts: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative 1, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on soils. Alternative 1 has a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

Conclusion. Direct, localized, adverse, year-round, short- to long-term, moderate to major impacts would continue to occur to soils at specific sites in the Lower Gorge as a result of large group sizes using sites on a daily basis. Heavy impacts, including soil compaction, mineral soil exposure, and denuded vegetation resulting in barren cores, would continue at specific high-use sites. Boat wakes from motorboats and jetboats have a major impact on the riverbank from Lake Mead up to Separation Canyon (in Zone 3) due to the high number of powerboat users, higher horsepower motors, and faster travel speeds. Similar to the upper stretch, some impacts in the shoreline zone are short-term, while impacts in the new high-water zone and the more stable old high-water zone are long-term (biological soil crust trampling, native vegetation damage leading to barren cores and destabilized soils). Use and resulting impacts occur year-round. Pontoon boat tours also run throughout the year. Blowing dust from helicopter use associated with river running activities would continue throughout the year. Under Alternative 1 mitigation measures to offset adverse effects at heavily used sites would be needed, extensive, and their success would not be guaranteed.

Alternative 1 would have adverse, localized to regional, short- to long-term, year-round, moderate to major effects on soils compared to natural conditions ***and without additional mitigation measures.*** Alternative 1 would not result in the impairment of soil resources in Grand Canyon National Park. Cumulative impacts to soils would continue to be adverse, localized to regional, short- to long-term, and minor to major. Alternative 1 has a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

4.2.1.6.2 Alternative 2

Under Alternative 2 recreational use would be reduced to the lowest levels of any Lower Gorge alternative. For HRR day trips the maximum group size during the peak season would be 30, down from 100 people now. There would be two HRR day trip launches per day during the peak season and one per day during the rest of the year. Overnight HRR trips would have a slightly smaller group size than now, down to 30 from 34, with one launch per day, and the total number of daily passengers would be 48 in the peak season and 24 in the non-peak season, compared to 80 passengers per day year-round currently. One additional campsite would be created, requiring some vegetation removal. There would be no docks at Quartermaster. Pontoon boat tours and their associated helicopter shuttles would be eliminated. All upriver travel would be restricted to the section of river below RM 262, including jetboats per day to pick up commercial passengers.

Analysis. Smaller group sizes and fewer total people per day would have localized, beneficial, year-round, short- to long-term, moderate benefits to soils from current conditions in all three hydrologic zones. A reduction in the number of people per HRR day trip during the critical summer season would have localized, beneficial, seasonal, short- to long-term, minor to moderate effects on soils from current conditions. Although overnight trip launches would increase from one per week to one per day, the trips would use a designated campsite on the left riverbank, and group sizes would be more manageable. Vegetation removal would occur in the new high-water zone at the new campsite, which would destabilize some soils, increase the barren core, and expose soils to human impacts. These impacts would be offset because HRR overnight groups could use the new high-water zone and not blaze trails and create tent sites in the old high-water zone.

Wakes from pontoon use would be eliminated, as well as the foot traffic on the trails at RM 262.5. There would likely be a decrease in the number of helicopter flights associated with river recreation at RM 262.5, which would reduce the amount of blowing dust in the area. These actions would have localized, beneficial, year-round, short- to long-term, minor effects on soils from current conditions. The removal of docks would require HRR boats to moor directly along the banks. This would increase erosion at these specific sites and have localized, adverse, year-round, long-term, moderate effects on soils from current conditions. Commercial jetboat pickup use would be reduced to two boats per day, and exchanges would occur at RM 262, farther downriver. This reduction would minimize jetboat wakes and would have localized to regional, beneficial, seasonal, short- to long-term, minor to moderate effects on soils from current conditions.

Limiting the number of nights that parties could camp to four nights in the peak season and five nights in the off-season would help spread out use and reduce competition and crowding at campsite and attraction sites. Reducing the number of parties at one time at specific sites would reduce the probability that groups would spread out into new areas, creating multiple trails and trampling biological soil crusts. Limiting the number of days that river runners could camp in the Lower Gorge would also reduce soil impacts along tributaries and in side canyons, protecting the alluvial substrates in sensitive riparian areas. Together these actions would have localized, beneficial, year-round, short- to long-term, moderate effects on soils from current conditions.

Mitigation of Effects. Mitigations would be similar to those described in Alternative 1; however the level of NPS staffing required to reduce impacts to minor would be similar to current levels. This level of mitigation is both reasonable and attainable.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Soil Impacts: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative 2, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on soils. Alternative 2 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. Overall, Alternative 2 would have beneficial effects to soils in the Lower Gorge compared to current conditions. Fewer total feet on the ground, smaller group sizes, fewer layover days, fewer jetboats, no pontoon boats, and possibly fewer helicopter flights would most likely improve soil conditions slightly. These actions would have both short- and long-term, year-round effects. The level of mitigation needed would be less than under Alternative 1.

Alternative 2 would have beneficial, localized to regional, short- to long-term, year-round, minor to moderate effects on soils, compared to current conditions under Alternative 1. Compared to natural conditions ***and without additional mitigation measures*** there would be adverse, localized to regional, short- to long-term, year-round, minor to moderate effects on soils. Alternative 2 would not result in the impairment of soil resources in Grand Canyon National Park. Cumulative effects would be adverse, localized to regional, short- to long-term, and minor to major. Alternative 2 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.1.6.3 Alternative 3

Alternative 3 would allow a similar mix of recreational opportunities as current conditions, but at different levels. The maximum group size for HRR day trips would be 30 (compared to 100 people now). Three HRR day trip launches per day would be allowed during the peak season and two per day during the rest of the year. The maximum group size for overnight trips would be 30 (compared to 34 now), but two launches per day would be allowed. Two campsites would be created, requiring vegetation removal below the old high-water zone and supply storage. A small floating dock would be installed at RM 262.5 to accommodate five pontoon boats and two HRR boats. Pontoon tours in the Quartermaster area would be allowed to expand to up to 400 passengers per day, and associated helicopter use would increase accordingly. Four jetboat pickups would be allowed, with exchanges occurring at Separation Canyon. All four jetboats could deliver kayak/canoe trips upriver to RM 273.

Analysis. Smaller group sizes and fewer total people per day would have localized, beneficial, year-round, short- to long-term, moderate benefits to soils from current conditions in all three hydrologic zones. A reduction in the daily number of HRR passengers in the critical summer season would have localized, beneficial, seasonal, short- to long-term, minor to moderate effects on soils from current conditions. Although overnight use would increase from one trip per week to two per day, the trips would use designated campsites on the left riverbank, and group size would be more manageable. Vegetation removal would occur in the new high-water zone at the two new campsites below Separation Canyon, destabilizing some new high-water zone soils, increasing the barren core, and exposing soil to human impacts. However, the new campsites would allow HRR overnight groups to use the new high-water zone and not blaze trails and create tent sites in the old high-water zone.

Pontoon passenger numbers would be allowed to rise to 400 passengers per day, which would increase the number of pontoon trips motoring up and down river within a 2-mile stretch in the Quartermaster area. This would increase the amount of erosion created by pontoon boat wakes. Higher levels of foot traffic on trails at RM 262.5 would exacerbate soil compaction. The number of associated helicopter flights would substantially increase the amount of blowing dust in the Quartermaster area. With higher levels of pontoon use, additional fuel storage areas would be required, indirectly increasing the number of multiple trails leading to these new storage areas. All of these actions would have localized, adverse, year-round, short- to long-term, minor to ***major*** effects on soils at RM 262.5.

This alternative would allow one small floating dock at RM 262.5. This small dock would help eliminate erosion caused by HRR boats mooring directly along the riverbank. It would also eliminate foot-induced erosion to the riverbank that would otherwise occur if 400 pontoon passengers per day walked down the sandy slope to access the pontoon boats. The dock would have localized, beneficial, year-round, short- to long-term, minor to moderate effects to soils, but negligible effects from current conditions.

Commercial jetboat pickup use would be reduced from six to four boats per day, but exchanges would continue to be made at Separation Canyon. Fewer jetboats would reduce the effects of wakes on soil banks, but the boats would be allowed to travel farther upriver than under Alternative 2. This reduction would have localized to regional, beneficial, seasonal, short- to long-term, minor effects on soils from current conditions. Allowing overnight parties to camp only five nights in the peak season and eight nights in the off-season would help spread out use and reduce campsite and attraction site competition and crowding, but not as well as in Alternative 2. Allowing fewer parties at one time at specific sites would reduce the probability of groups spreading out into new areas, creating multiple trails, and trampling biological soil crusts. Limiting the number of days all types of river trips could camp in the Lower Gorge would also greatly reduce soil impacts along tributaries and in side canyons, protecting alluvial substrates in sensitive riparian areas. Reducing trip length would have localized, beneficial, year-round, minor to moderate effects on soils from current conditions. Depending on the group size, the four one-day kayak/canoe trips should not impact soils any more than existing uses. Since these users would be on the river most of the day, they would be less likely to impact side canyon soils. These kayak/canoe trips would likely have negligible effects on Lower Gorge soils.

Mitigation of Effects. Mitigations would be similar to those described for Alternative 1. The level of NPS staffing required to effectively carry out the mitigations and reduce impacts to minor would be slightly higher than under Alternative 1 due to the increase in pontoon passengers. However this increase would be reasonable and attainable.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Soil Impacts: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative 3, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on soils. Alternative 3 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. Although smaller group sizes, fewer layover days, and fewer jetboat pick-ups would likely improve soil conditions ***regionally*** compared to current condition, increased pontoon boat use and helicopter use would have adverse localized effects in the Quartermaster area. Regionally within the two Lower Gorge zones, impacts to soils would be adverse and minor to moderate, and mitigation would likely be effective given adequate funding and resources. ***Even with the construction of a new dock,*** locally around RM 262, impacts to soils would continue to be ***moderate*** to major.

Compared to Alternative 1, Alternative 3 would have localized to regional, beneficial, short- to long-term, seasonal to year-round, minor effects on soils. Compared to natural conditions ***and without additional mitigation measures***, impacts would be adverse, localized to regional, short- to long-term, year-round, and minor to ***major***. Alternative 3 would not result in the impairment of the soil resources in Grand Canyon National Park. Cumulative impacts to soils would be adverse, localized to regional, short- to long-term, and minor to major. Alternative 3 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.1.6.4 Modified Alternative 4 (NPS Preferred Alternative)

Modified Alternative 4 is characterized by a redistribution of HRR operations in accordance with a consensus between the NPS and the Hualapai Tribe on levels of HRR use and other uses originating at Diamond Creek. This alternative represents the NPS's ***compromise on*** levels of pontoon boat use ***based upon all Lower Gorge operations coming under a concessions contract.*** Under this ***Modified*** Alternative HRR group sizes and trip lengths would be reduced compared to current conditions, and upriver jetboat numbers would be below current levels.

The maximum group size for HRR day trips would be 40 people during peak season with a variable number of launches per day, but no more than 96 passengers total per day. Maximum group size would be reduced to 35 during the non-peak season, with two launches per day. This would reduce the maximum group size from current conditions of 100 people per trip. Overnight trips would also have a smaller group size than now, down to 20 from 34 during both the peak and non-peak seasons. There would be three HRR overnight trips per day in the peak season and one in the non-peak season. Three new campsites would be added, resulting in the removal of exotic vegetation below the old high-water zone. All multiday trips in the Lower Gorge would be limited to three nights in the peak season and five nights the rest of the year. A floating dock would be installed at RM 262.5 to accommodate pontoon boats and two HRR boats; all other makeshift docking facilities would be removed. Pontoon tours in the Quartermaster area would ***grow to a maximum of 480 with the possible expansion to 600*** passengers per day ***based upon a favorable concessions evaluation and resource monitoring data***. Four jetboat pick-ups and all noncommercial raft tow-outs would be allowed to travel upriver ***to*** Separation Canyon (RM 240).

Analysis. The reduction in HRR day-trip group size from 100 people to 40 would have localized, beneficial, year-round, short- to long-term, minor effects on soils from current conditions at both lunch stop and attraction sites; however, total number of HRR passengers would rise, increasing the total number of people per day visiting these sites. This would have localized, adverse, year-round, short- to long-term, minor to moderate effects on soils from current conditions. While these actions would reduce crowding and the potential for multiple trailing impacts, soil compaction might worsen. Use for HRR overnight trips would increase from about one launch per week to three launches per day, but the trips would be using three new designated campsites on the left riverbank, and maximum group size would be 20 people, so effects would likely be negligible from current conditions. Vegetation would be removed in the new high-water zone to create these three campsites. While nonnative vegetation removal would destabilize some soils in the new high-water zone, along with increasing the barren core and exposing soils to human-caused impacts, it would allow the HRR overnight groups to utilize the new high-water zone and not blaze trails and create tent sites in the old high-water zone.

Limiting the number of nights that parties could camp to three nights in the peak season and five nights the rest of the year would help spread out use and reduce competition and crowding at campsites and attraction sites, similar to Alternative 2. This would have localized, beneficial, year-round, short- to long-term, minor to moderate effects on soils from current conditions. Reducing the number of parties at one time at specific sites would decrease the probability that groups would spread out into new areas, create multiple trails, and trample biological soil crusts. Limiting the number of days all types of river trips could camp in the Lower Gorge would also greatly reduce soil impacts along tributaries and in side canyons, protecting alluvial substrates in sensitive riparian areas.

Pontoon passenger numbers would be ***allowed to rise to 480 passengers per day (and possibly up to 600), which would increase the number of pontoon trips motoring up and down river within a 2-mile stretch in the Quartermaster area. This would increase the amount of erosion created by pontoon boat wakes. Higher levels of foot traffic on trails at RM 262.5 would exacerbate soil compaction. The number of associated helicopter flights would substantially increase the amount of blowing dust in the Quartermaster area. With higher levels of pontoon use, additional fuel storage areas would be required, indirectly increasing the number of multiple trails leading to these new storage areas. All of these actions would have localized, adverse, year-round, short-to long-term, minor to major effects on soils at RM 262.5.***

This alternative would allow one floating dock at RM 262.5 that could accommodate pontoon boats and HRR boats. This dock would help eliminate erosion caused by HRR boats mooring directly along the river bank. It would also eliminate the foot-induced erosion that would occur to the riverbank if ***480*** pontoon passengers per day had to walk down the sandy slope to access the pontoon boats. The dock would have localized, beneficial, year-round, short- to long-term, moderate effects to soils, but a negligible effect from current conditions. Commercial jetboat pickups would be reduced from six to four boats per day, and exchanges would occur at Separation Canyon (RM 240). Fewer jetboats would reduce the effects of wakes on soil banks. This would have regional, beneficial, seasonal, short- to long-term, minor to moderate effects on soils over current conditions.

Mitigation of Effects. Mitigations would be similar to those described for Alternative 1. The level of NPS staffing required to effectively carry out the mitigations to reduce impacts to minor would be higher than that described in Alternative ***3***, but lower than that described in Alternative 1. This increase would be reasonable and attainable.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Soil Impacts: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of ***Modified*** Alternative 4, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on soils. ***Modified*** Alternative 4 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. Increasing the total number of day and overnight HRR passengers per day would adversely affect soils by increasing the total number of feet compacting soils on trails and dislodging sand in the new high-water zone. Use would occur year-round, with a slight reduction in total numbers in the winter. Increasing HRR use in the summer months would increase impacts during this critical season. Limiting jetboat use would benefit the river banks, reducing wake-caused erosion. There would be short- to long-term impacts along the shoreline, while long-term impacts would occur in the old high-water zone. ***Although smaller group sizes, fewer layover days, and fewer jetboat pick-ups would likely improve soil conditions at many sites compared to current condition, increased pontoon boat use, helicopter use and fuel storage would have adverse localized effects in Quartermaster area. Regionally within the two Lower Gorge zones, impacts to soils would be adverse and minor to moderate, and mitigation would likely be effective given adequate funding and resources. Locally, around RM 262, impacts to soils would continue to be moderate to major.***

Modified Alternative 4 would have localized to regional, beneficial, short- to long-term, year-round, minor to moderate effects to soils, compared to current conditions under Alternative 1. Compared to natural conditions ***and without additional mitigation measures***, there would be adverse, localized to regional, short- to long-term, year-round, minor to ***major*** effects on soils. ***Modified*** Alternative 4 would not result in impairment of the soil resources of Grand Canyon National Park. Cumulative impacts would continue to be adverse, localized to regional, short- to long-term, and minor to major compared to natural conditions. ***Modified*** Alternative 4 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.1.6.5 Alternative 5 (Hualapai Tribe Proposed Action)

Alternative 5 is characterized by a redistribution of HRR operations and represents a consensus between Grand Canyon National Park and the Hualapai Tribe on levels of HRR use and other uses originating at Diamond Creek. However, this alternative represents the Hualapai Tribe's proposed higher levels of pontoon boat use than the current average. Under this alternative, HRR group sizes and trip lengths would be at substantially lower levels than under current conditions, and upriver jetboat trips would be eliminated.

Alternative 5 would have exactly the same level of HRR use as described in ***Modified*** Alternative 4, along with the creation of three additional campsites, requiring vegetation to be removed only below the old high-water zone. This alternative differs from ***Modified*** Alternative 4 in that there would be a larger floating dock installed at RM 262.5 accommodating seven pontoon boats and two HRR boats. Pontoon tours in the Quartermaster area would be allowed to increase up to a maximum of 960 passengers per day, and associated helicopter use would also increase substantially. There would be no jetboat pick-ups, and noncommercial tow-outs would only travel upriver to RM 273. There would be no kayak/canoe upriver delivery.

Analysis. HRR use would be exactly the same as in ***Modified*** Alternative 4, so impacts to soil resources would be similar to those described above. Pontoon passenger numbers would be allowed to increase to 960 passengers per day, which would likely increase the number of river-related helicopter flights at RM 262.5 to a little over 200 flights per day. Doubling the number of helicopter flights would substantially increase the amount of blowing dust in the Quartermaster area. Increasing the level of pontoon boat use and number of boats from five to seven would increase the amount of erosion created by pontoon boat wakes. Raising the number of daily passengers from an average of 188 people to 960 people would increase foot traffic on the trails at RM 262.5, exacerbating soil compaction. With higher levels of pontoon use, additional fuel storage areas would be required, which would indirectly increase the number of trails leading to new storage areas. All of these actions would have localized, adverse, year-round, short- to long-term, moderate to major impacts to soils in the Quartermaster area.

Limiting the number of nights that parties could camp in the Lower Gorge to three nights in the peak season and five nights the rest of the year would help spread out use and reduce competition and crowding at campsites and attractions, similar to Alternative 2. Reducing the number of parties at one time at specific sites would reduce the probability that groups would spread out into new areas, create multiple trails, or trample biological soil crusts. Limiting the number of days all types of river trips could camp in the Lower Gorge would also greatly reduce soil impacts along tributaries and in side canyons, protecting alluvial substrates in sensitive riparian areas. There would be no one-day kayak/canoe trips. This would have localized, beneficial, year-round, short- to long-term, minor to moderate effects on soils from current conditions.

This alternative would allow for one large floating dock at RM 262.5 that could accommodate seven pontoon boats and two HRR boats. This dock would help eliminate erosion caused by HRR boats mooring directly along the riverbank. It would also eliminate foot-induced erosion that would occur to the river bank from 960 pontoon passengers per day if they were required to walk down the sandy slope to get on the pontoon boats. The dock would have localized, beneficial, year-round, short- to long-term, minor to moderate effects on soils, but a negligible effect from current conditions. Commercial jetboat pickups would be eliminated, which would stop the effects of jetboat wakes on soil banks and have regional, beneficial, seasonal, short- to long-term, minor to moderate effects on soils from current conditions within Zone 3.

Mitigation of Effects. Mitigations would be similar to those described in Alternative 1. The level of NPS staffing required to effectively carry out the mitigations and attempt to reduce impacts to minor levels would be significantly higher than current levels. This increase would not be reasonable or attainable.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in Section 4.2.1.4.4. The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative 5, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on soils. Alternative 5 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

Conclusion. Under Alternative 5 smaller HRR group sizes and shorter trip lengths would have beneficial, localized and regional (within Zone 3) effects on soils in all three hydrologic zones. Increasing the total number of day and overnight HRR passengers would adversely affect soils by increasing foot traffic, compacting soils on trails and dislodging sand in the new high-water zone. Use would occur year-round, with a slight reduction in the total numbers in the winter. Increasing HRR use in the summer months would increase impacts during the critical season. Eliminating jetboat use would benefit the riverbanks, reducing wake-caused erosion. Substantially increasing pontoon boat passengers would have major localized effects on soils in the Quartermaster area. There would be short- to long-term impacts along the shoreline, and long-term impacts in the old high-water zone. Reducing group size, limiting the number of days that parties could camp, and removing vegetation in the new high-water zone would all be beneficial to old high-water zone soils. Effects to soil productivity, integrity, stability, or fertility in the Quartermaster area would be readily apparent and would substantially change the character of the soils. Extensive mitigation measures to offset adverse effects would be needed, and their success could not be guaranteed. At other sites in the Lower Gorge, mitigation measures would be necessary to offset adverse effects and would likely be successful given appropriate levels of funding and resources.

Compared to existing conditions under Alternative 1, Alternative 5 would have regional to localized, beneficial, seasonal to year-round, short- to long-term, minor to moderate effects on soils. Compared to natural conditions ***and without additional mitigation measures***, there would be adverse, localized, short- to long-term, year-round, moderate to major effects on soils. Alternative 5 would not result in the impairment of the soil resources in Grand Canyon National Park. Cumulatively, impacts to soils would be adverse, localized to regional, short- to long-term, and minor to major. Alternative 5 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

4.2.2 WATER QUALITY

4.2.2.1 ISSUES

Water quality, which is determined by the chemical, physical, and biological quality of ambient waters at any point in time, can be affected by gases, aerosols and particulates from the atmosphere, weathering and erosion of rocks and soils, solutes and precipitants that are products of biogeochemical cycles, and the introduction of contaminants from the cultural activities of humans (such as drinking, swimming or fishing). Often subtle changes in water quality can result in substantial changes in dependent aquatic flora and fauna. Water quality is also related to the health of dependent aquatic communities and the variety of human uses for specific water sources. Water quality impacts, such as pollution and contamination, are measured by the degree to which threaten to eliminate natural ecological attributes or human uses of water (e.g. recreation).

Specific issues related to impacts on water quality from recreational activities along the Colorado River were raised during public and internal scoping:

- Pollution from human personal-care products (introduced through swimming, bathing, and washing), camp waste (primarily food scraps) and human fecal waste that wash into tributaries, mainstem backwaters, and springs can affect water quality and the aquatic resources that depend on them
- Motorboat use introduces contaminants such as hydrocarbons and burned and unburned fuel and motor oil
- Recreation in tributary streams adversely affects water quality by changing stream channel geometry (which effects temperature and bank stability) and contributing to turbidity and sediment/habitat distribution
- Grand Canyon National Park needs to have enhanced monitoring and treatment for pollutants and contaminants to reduce effects to drinking water and dependent ecosystems
- Water sources, particularly seeps and springs, are extremely important to some tribes, and should be protected from the impacts of visitation

4.2.2.2 GUIDING REGULATIONS AND POLICIES

The Clean Water Act (33 U.S.C. 1251 et seq.) provides the basis for the legal and technical mechanisms to protect and restore the quality of natural waters through the establishment of water quality standards (sec. 303(a)); the identification and restoration of quality-impaired waters (sec. 303(d)); and the management of point- and non-point source pollution (sec. 319 and 402). Point sources are managed through the national pollutant discharge elimination system (NPDES) permit program. Non-point sources of pollution are largely managed through voluntary programs that strive to incorporate Best Management Practices into the routine daily operation of the activity.

States are given a central role for the establishment of water quality standards and for the management of water quality. States administer the various provisions of the Clean Water Act in an integrated fashion under the oversight of the Environmental Protection Agency (EPA) and in compliance with EPA regulations. EPA regulations require that a water quality standard consist of the following three elements: (1) designating uses to be made of the water; (2) setting minimum narrative or numeric criteria sufficient to protect the uses, and; (3) preventing degradation of water quality through antidegradation provisions.

The antidegradation policy (40 CFR 131.12) is an important component of water quality standards, and has important management implications to most units of the National Park System. Antidegradation should not be interpreted to mean that "no degradation" can or will occur. Degradation may be allowed even in the most pristine waters for certain pollutants as long as it is temporary and short-term in nature. In most cases, human actions and activities that introduce pollutants that threaten to exceed ambient water quality standards are contrary to the NPS Organic Act and the park's enabling legislation.

Waterbodies that fail to comply with water quality standards are compiled by states into a list, commonly referred to as a 303(d) list, for submittal to the EPA. The agency approves the list only if it meets applicable requirements. Waterbodies on an approved 303(d) list require the establishment of a total maximum daily load (TMDL), which specifies the amount of a particular pollutant that may be present in a waterbody, allocates allowable pollutant loads among sources, and provides the basis for attaining or maintaining water quality standards.

All management actions must be in compliance with Arizona and EPA water quality criteria for designated protected uses on the river and its tributaries (as per Arizona Official Compilation of Administrative Rules and Regulations Sec. R18-11-102). The public must be informed of situations where natural ambient levels pose human health risks. Management actions must also be performed to prevent or minimize alteration of the physical channel to maintain habitat requirements for aquatic organisms and to preserve its natural flow and temperature regime.

The NPS *Management Policies 2001* (NPS 2000a) direct park managers to understand, maintain, restore, and protect the inherent integrity of natural resources, processes, systems and values of the park. To the extent possible, the NPS allows natural processes, including the evolution of species, to control landscape and population level dynamics, assuming that all of the components of the natural systems remain intact. The preservation of fundamental physical and biological processes, as well as individual species, plant communities, and other components of naturally evolving ecosystems, is inherent in management direction. The NPS will maintain as parts of the natural ecosystems through:

- Preserving and restoring the natural abundance, diversities, dynamics, distributions, genetic and ecological integrity, and behaviors of native species and the communities and ecosystems in which they occur
- Restoring native species in parks when they have been extirpated by past human-caused actions
- Initiating the return of human-disturbed areas to natural conditions (or the natural trajectory), including the processes characteristic of the ecology zone
- Minimizing human impacts on native species, communities, and ecosystems, and the processes that sustain them
- Preventing the introduction of exotic species and removing established populations

- Monitoring natural systems and human influences upon them to detect change and developing appropriate management actions
- Protecting watersheds, as complete hydrologic systems, primarily by avoiding impacts to watershed and riparian vegetation, and by allowing natural fluvial processes to proceed unimpeded
- Preserving, enhancing and restoring the natural and beneficial values of wetlands

Grand Canyon National Park 2004 Commercial Operating Requirements address impacts to water quality from visitation, as highlighted below:

- Cans, rubbish and other refuse may not be discarded in the water or along the shore of the river, in side canyon, on trails, along escape routes, or in any other portions of the canyon. All refuse material must be carried out
- The use of soap is restricted to the mainstem of the Colorado River only. Use of soap in side streams or within 100 yards of the confluence of any side stream and the main river is prohibited
- Each boat party must carry a washable/reusable toilet system capable of containing and removing solid human waste from the canyon. A washable/reusable toilet must be accessible during the day
- Two-stroke motors, which emit high levels of hydrocarbons and leak burned and unburned fuel into the water, are not permitted. Cleaner burning four-stroke motors are the only boat motors allowed in the park

The “Superintendent’s Compendium” restricts some areas including the following tributaries, springs and seeps, to day use only:

- Little Colorado River confluence (river left-mile 60–65)
- Shinumo Creek (RM 109)
- Elves Chasm (RM 116.5)
- Deer Creek confluence (1/2 mile upstream or downstream on the north side of the river at RM 136)
- Columbine Falls (within 200 yards of the bay at RM 274.3)

4.2.2.3 MANAGEMENT OBJECTIVES FOR WATER QUALITY

The management objective for water quality for the *Colorado River Management Plan* is to manage river recreation use in a manner that minimizes adverse chemical, physical, and biological changes to the water quality in the mainstem Colorado River, tributaries, seeps, and springs.

4.2.2.4 METHODOLOGY FOR ANALYZING EFFECTS TO WATER QUALITY

The general process for assessing impacts to the environment is discussed in Section 4.1 of this chapter. Impacts on water quality were analyzed using the best available data on ambient water quality status and trends, and the nature and behavior of the pollutants known to be associated with recreational river use. Evaluation of the potential impacts to water quality was based on regulatory information from the Environmental Protection Agency, the Arizona Department of Environmental Quality, and the Hualapai Tribe Natural Resource Department. Effects specific to water quality are characterized for each alternative based on the impact thresholds presented in this Section. In order to analyze the effect of each alternative on water sources, a map with locations of known water sources, as well as visitor stopping points (camp, lunch, and attraction sites) and other sensitive resources was created. Using data from the Grand Canyon River Trip Simulator program, including data on use intensity, staff identified areas of resource concern, in which concentrations of sensitive resources overlapped with visitor use areas. These data were used to predict levels and types of use and potential levels of visitor impacts for each alternative.

The overall impact rating depends upon the interaction of context, duration, timing, and intensity of each identified impact. Impacts to water quality could be negligible, minor, moderate, and major. Additionally, each alternative was evaluated to determine whether effects are direct or indirect.

4.2.2.4.1 Impact Thresholds

Intensity

Negligible—Chemical, physical, or biological changes to water quality due to recreational activities would not be detectable.

Minor—Adverse: Chemical, physical, or biological changes to water quality due to recreational activities would be detectable and would degrade water quality, but would be within historical baseline or desired water quality conditions.

Beneficial: Impacts would result in detectable improvements to water quality.

Moderate—Adverse: Chemical, physical, or biological changes to water quality due to recreational activities would be detectable, but historical baseline or desired water quality conditions would only be temporarily degraded.

Beneficial: Impacts would result in detectable improvements to water quality and overall achievement of desired water quality conditions.

Major—Adverse: Chemical, physical, or biological changes to water quality due to recreational activities would represent a significant degradation from historical baseline water quality conditions. Alterations could be long-term.

Beneficial: Impacts would result in significant improvement in water quality. Impacts would result in improved water quality parameters affected by human use.

Context

Localize—Localized impacts would be to small areas such as tributaries, eddies, attraction sites, or springs.

Regional—Regional impacts would affect all or most water sources associated with the Colorado River as it flows through Grand Canyon National Park.

Duration

Short-term—The impact would last less than one month.

Long-term—The impact would last longer than one month.

Timing

Impacts to water resources may be time sensitive. For example, mainstem impacts are likely to be more pronounced during low volume discharge months. Summer is a period of low discharge, high recreational use, and peak water temperatures. Monsoon storms (summer-fall) and late winter storms can cause flooding that impacts water resources. Biotic communities associated with side canyon water sources are more vulnerable in the spring growing season.

4.2.2.4.2 Cumulative Impacts

Cumulative impacts on water quality were determined by combining the impacts of each alternative with other past, present, and reasonably foreseeable future actions (see Section 4.1 of Chapter 4 for detailed list of all actions). Actions that specifically affect water quality are:

Runoff/Flash Flooding—The primary impact from flash flooding is an increase in turbidity, which results in elevated bacteria counts. Flash floods and runoff also carry chemicals (e.g., from pesticides), pathogens (e.g., *E. coli*, animal waste), and other contaminants (e.g., trash, byproducts from mining) from the surrounding region and further degrade water quality. The adverse affects from episodes of contamination can be localized to regional and minor to moderate, but relatively short-term.

Effects from Glen Canyon Dam—Glen Canyon Dam fundamentally changed the character of the Colorado River in Grand Canyon from a flood-prone river with a wide range of water temperatures and sediment loads, to a dam-controlled flow with a narrow range of water temperatures and significantly reduced sediment. Currently, long periods of constant and/or low flows in the mainstem may contribute to build-up of contaminants in areas such as eddies. Under natural conditions, these pollutants would periodically be swept away. Overall, effects to water quality from the dam are localized to regional, minor to moderate, and long-term.

Sewage Treatment Plant in Glen Canyon—Several outbreaks of gastrointestinal illness have occurred among river users since 1972. Recent outbreaks in 1994, 2000, and 2002 involved more than 300 persons (Higgins 2002). In 2002, specimens taken from afflicted individuals were positive for the enteric Norovirus, which originates only from humans. Samples collected from the mainstem near Lees Ferry and from the sewage treatment plant at Glen Canyon Dam also tested positive for the Norovirus. ***Other potential sources of contamination from sewage are the septic and/or toilet systems at Roaring Springs residence, Cottonwood camps, Indian Gardens and Phantom Ranch***. This potential impact to water quality is adverse, minor to moderate, short-term and regional. Identification of mitigation measures is currently being conducted.

Impacts from Animals—Studies in Grand Canyon suggest that levels of coliform bacteria, which often renders water unfit for drinking, were generally low in the mainstem except during flood episodes (Doyle et al. 1983). Fecal coliform to fecal streptococcus ratios generally suggest that the source of contamination appears to be from domestic livestock or wildlife (Mazzu 1995; Rihs 1995, 1996). Exceptions occur for very short durations at a small number of tributaries that experience heavy and seasonal visitation. Overall, effects to water quality from domestic livestock and wildlife are localized to regional, minor to moderate, and short-term.

Other Recreationists—Anglers and backcountry users who access the river corridor also contribute to visitor impacts in the mainstem, tributaries, seeps and springs. Their effects are adverse, localized, negligible to minor, and short-term.

4.2.2.4.3 Mitigation of Effects

A list of possible mitigation measures ***to be considered singly or in combination, that are*** not already incorporated into the alternatives, ***but*** are judged likely to reduce impacts to water quality ***if implemented*** include the following:

- Keep areas of new disturbance ***in the river corridor*** to a minimum (1 acre or less) and incorporate appropriate best management practices and stormwater pollution controls into maintenance, construction, operations, and land-use activities in order to reduce quantities of sediment, hydrocarbons, pesticides, nutrients and other pollutants entering surface waters
- Initiate a program to monitor levels of chemical and microbiological agents, particularly those associated with recreational use, in mainstem and tributary waters
- If limits are exceeded by natural sources of contamination, prescribe educational efforts to inform the public of the hazards, health risks and preventative measures
- If recreational use results in noncompliance with applicable standards for water quality, implement the following measures to reasonably mitigate effects:

  (1) *Education*—Inform the public of the hazards, health risks, and preventative measures

  (2) Closures— Provide warning information to recreationists about swimming or wading in areas that routinely exceed water quality standards

  (3) Change in Use Regulation— Modify the Commercial Operating Requirements to ensure the use of safe sanitation practices

4.2.2.4.4 Assumptions

General assumptions used for analysis of effects from each alternative are discussed in the introduction to this chapter. Assumptions that specifically relate to the alternatives considered in this document and their effect on water quality are presented below:

- Because there are no data to empirically differentiate impacts to water quality between guided and noncommercial trips, the assumption is made that all individuals, whether guided or private have an equal opportunity to affect, or be affected by, water quality.

- Impacts on water quality from recreational uses are highly localized and occur largely in the immediate vicinity of attraction sites including many tributaries, lunch stops, and campsites.
- Because bacteria adhere to sediments they are generally found in larger concentrations in sediments at the bottom of lake, rivers, and stream than in the overlying waters. However, when activities that roil substrates (stir up bottom sediments), such as wading, swimming and flash flooding, there is an increase in turbidity (suspension of sediments in water) that consequently results in elevated levels of bacteria.
- Variables that contribute to congestion (e.g., group size, trip length, number of passengers, and user discretionary time) contribute to higher concentrations of pollutants and contaminants in localized areas. However, the interaction of all variables taken together must be evaluated as a whole.
- Longer trips, by their nature, increase the amount of time visitors have to interact with the canyon environment. This increased time has the potential to allow greater interaction with water resources. This is particularly true for side canyons, as longer trips are designed to allow visitors opportunities for exploration. Off-season hiking (shoulder and winter months) are more conducive to exploring side canyons, as the extreme heat of the summer precludes hiking too far from the river itself.
- Impacts to water quality from visitor use are largely short-term.
- The park's current "Commercial Operating Requirements" reduce impacts to water quality by addressing issues such as fuel storage, use of soaps in the river corridor and its side canyons, and containment and disposal of food and human waste. While the majority of visitors are conscientious about protecting water resources, a small percentage of visitors will ignore park regulations and engage in acts that degrade the resource.
- Regional impacts to water quality are not anticipated from recreational uses of the Colorado River because sources of pollutants are minor compared to the river's volume.
- Indirect impacts from water quality degradation in both the river and in tributaries and springs can be adverse for visitors, aquatic species and for nearby vegetation. Aquatic species and wetland vegetation can be adversely impacted by increases in turbidity, salinity, and/or nutrient levels. Pollutants, such as fuels or lubricants, can also adversely impact aquatic species and wetland vegetation. The health of visitors may also be impacted by poor water quality in the river and in tributaries and springs.
- Detailed analysis of the consequences of implementation of each alternative on the biotic communities that are associated with the river and its associated seeps and springs is presented in the Aquatic Resources section of Chapter 4.
- Drinking water quality standards that are exceeded naturally and not from human causes are beyond the scope of this impact analysis.
- While motorized trips contribute contaminates to the mainstem of the river, their effect on tributaries, seeps, and springs is considered negligible.
- ***All transport of fuel (motor, jet, helicopter, other) in Grand Canyon National Park or Lake Mead National Recreational Area will be conducted in accordance with commercial operating requirements, noncommercial operating requirements,***

concession contracts or other agreements with NPS. Transport of fuel must adhere to all applicable regulations for the storage and transport of petrochemicals.

4.2.2.5 Impact Analysis—Lees Ferry Alternatives

The sections below describe the direct and indirect potential environmental effects of each of the alternatives on water quality. The overall impact would depend on the interaction of context, duration, timing, and intensity of the impact upon the resources. Sources of information used for the analysis are described in Chapter 3.

4.2.2.5.1 Alternative A (Existing Condition)

Analysis. Management of recreational use under Alternative A would continue to allow large group sizes with a maximum commercial group size of 43, long trips with a maximum winter trip length of 30 days, and spikes in trips at one time, people at one time, and daily launches (see Table 4- 1). User-days would remain capped at current levels, which would result in approximately 22,500 passengers per year. Highest use occurs in the summer months and lowest use in the winter months. User discretionary time would be similar to current levels (the lowest of all the alternatives). This alternative would also allow for large group sizes, increasing the probability that a larger surface area will be impacted. Larger groups are more likely to disturb larger areas (Hendee, Stankey, and Lucas 1990). When several large groups visit attraction sites at the same time, the probability of impacting water quality magnifies and impacts such as increases in turbidity, bank erosion, dam building, introduction of contaminants, and trampling of aquatic and riparian species and habitat are more likely to occur. Whitmore exchanges would occur year-round and there would be a three-month nonmotor season in the fall. Both motor and oar commercial trips would be allowed in the winter.

Impacts to water quality from recreation are primarily from direct contact between visitors and water sources. In the mainstem of the Colorado River, increases in turbidity (and the subsequent elevation of bacteria levels) are caused by recreational activities such as wading, swimming, and boat launching and docking near camp and attraction sites and lunch stops. The adverse effects of increased turbidity are short-term. Recreational uses also impact water quality of the Colorado River by introducing pollutants in the form of personal care and cleansing products, human waste, pharmaceuticals, and dishwater. The effects of these contaminants, the level of which are minute compared to the river's volume, generally dissipate as they are dispersed downriver. Generally, impacts to the river corridor from direct visitor contact are adverse, minor to moderate, very short-term and highly localized. Under Alternative A these impacts are most noticeable in the peak season.

Impacts to the physical character of tributary and spring waters from recreational use are more visible than those on the Colorado River because of the relatively smaller volume of flow. Some tributaries, seeps, and springs are attraction sites (Saddle Creek, Little Colorado River, Royal Arch at Elves Chasm, Deer Creek, etc.) and often experience large numbers of daily visitors and visitors at one time. People exploring side streams bring chemical and biological contaminants that have the potential to degrade water quality. Disturbance of streambed sediments by waders and hikers increases turbidity and results in increased levels of suspended bacteria that have the potential to impact the health of visitors who ingest them. Direct adverse effects from visitor access to tributaries are minor to moderate and short-term, because sediments settle naturally after visitors leave the site and contaminants generally dissipate or wash out within one month. Longer periods of visitation caused by spikes in use in the summer season results in longer periods of turbidity.

Consultation with American Indian groups has indicated that water sources, especially seeps and springs, are extremely important. These groups have also reported impacts to seeps and springs that include redirection of water flow and accumulations of human waste, in addition to increases in turbidity and introduction of contaminants. These adverse affects are, short- to long-term, minor to moderate and highly dependent on accessibility from the river corridor.

Group size, trip length, maximum allowable launches per day, and trips at one time and people at one time in the summer season are at their highest in this alternative, indicating a higher probability of crowding at certain attraction sites. Due to erratic launch schedules, many of these variables regularly spike in the summer. User discretionary time, however, is relatively low, indicating that groups have less time for exploration and are interacting more with resources close to the river. During spikes in use, up to nine groups can launch together, leading to congestion and crowding at attraction sites, some of which are water sources. During the summer season, the major attraction sites with aquatic features would experience numerous days (up to ***79*** in Havasu Creek) with more than 100 people visiting in a single day. Similarly, these sites would experience numerous days (up to 36 in Havasu Creek) with more than 150 people visiting in a single day (Table 4- 6). This level of use results in localized increases in turbidity, as well as higher concentrations of contaminants, especially at attraction sites. Adverse effects to water quality from summer use are minor to moderate, short-term, localized and highly dependent on accessibility from the river corridor.

TABLE 4- 6: PREDICTED VISITATION LEVELS AT MAJOR ATTRACTION SITES WITH AQUATIC FEATURES, MAY—AUGUST

	Alternative							
	A	B	C	D	E	F	G	H
Days with 100+ Visitors								
Little Colorado River	28	0	1	11	0	0	0	0
Shinumo Creek	53	0	5	86	0	2	3	0
Elves Chasm	75	0	80	98	2	11	5	0
Deer Creek	66	1	64	109	12	4	8	0
Matkatamiba	4	0	48	3	0	0	0	0
Havasu Creek	79	0	73	102	11	0	4	0
Days with 150+ Visitors								
Little Colorado River	11	0	0	0	0	0	0	0
Shinumo Creek	14	0	2	11	0	0	0	0
Elves Chasm	18	0	8	30	0	1	0	0
Deer Creek	24	0	27	32	0	0	0	0
Matkatamiba	0	0	9	0	0	0	0	0
Havasu Creek	36	0	39	31	0	0	0	0

Under this alternative, overall use levels as measured by user-days, total passengers and total user discretionary time in the winter and shoulder seasons are at or near the lowest levels for all alternatives (see Table 4- 2). While these variables indicate some of the lowest levels of off season use, they coincide with the highest allowable group sizes and trip lengths. Low use in the spring is beneficial to water resources, especially in the mainstem, but longer trip lengths that encourage layover days and allow people more time to hike further up tributaries, make tributaries more vulnerable to impacts. The probability of increasing turbidity and modifying stream channels increases with large groups of people with more time to hike further up tributaries. Impacts to water quality in colder winter months are negligible, as hikers generally avoid getting wet. Overall, effects to water quality from winter and shoulder season use are adverse, minor, short-term, localized and highly dependent on accessibility from the river corridor.

Under this alternative, motorized trips are permitted nine months of the year. Effects of recreational use on water quality of the Colorado River include gasoline and motor oil pollution from motorized watercraft. Before conversion from two-stroke to four-stroke motors (completed in 2001), it was estimated that approximately 5,750 pounds of petroleum residue, as measured by non-volatile suspended solids, entered the Colorado River annually (NPS 1979). The primary source was exhaust in the water, although leakage from gas tanks and accidental spills contributed pollutants as well. That amount, while seeming large, was too small compared to the volume of river flow to be measurable. The conversion to four-stroke motors is thought to have substantially reduced water pollution from exhaust. Tests conducted by the Canadian government's Environmental Technology Centre showed that four-stroke outboards discharged one-twelfth (8.3%) the amount of toxic hydrocarbons (benzene, toluene, ethylbenzene, and xylenes) as did two-strokes, and one-fifth (20%) the amount of oil and grease (Environment Canada 2000). While the impact of motors has decreased since conversion to four-stroke motors, some gasoline, oil, and grease still enter Colorado River water from marine motors. River dynamics and the large volume of the Colorado River diffuse and disperse these contaminants. Contamination can become more concentrated in backwaters and eddies, however. Motor use under this alternative results in localized adverse, short-term, minor effects to the mainstem. This effect occurs throughout the entire motorized season, but is most pronounced during the high-use summer season.

Mitigation of Effects. Actions needed to mitigate effects would include a ***subset*** of those discussed above (monitoring, changes in regulations, education, etc.), but because current management of the river corridor allows substantial spikes in use, as well as the longest allowable trip lengths and the largest group size of any of the alternatives, and because it does not include a focused management/mitigation plan, it is unlikely that mitigations would be implemented at a level sufficient to reduce impacts to a minor intensity.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, domestic livestock and wild animals, non-river related recreational use, flash floods, run-off, sewer treatment plant and dam operations, introduce chemical, physical, and biological changes to water quality in the area of effect that are detectable, and at times historical baseline or desired water quality conditions are altered. With the exception of effects from the operation of Glen Canyon Dam, these effects are generally adverse, localized, minor to moderate and short-term (because contaminants diffuse or dissipate in a short time period). Effects from the dam are longer term and regional.

Cumulatively, the effects of alternative A, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to moderate effect to water quality. Alternative A would result in an adverse, short-term, negligible to minor contribution to this cumulative effect.

Conclusion. Recreational use under this alternative results in chemical, physical, and biological changes to water quality that are detectable and at times historical baseline or desired water quality conditions are altered. However, these effects generally diffuse or dissipate in a short time period. Thus, effects would continue to be adverse, minor to moderate, short-term, highly localized, and dependent on accessibility to the river corridor. Effects would continue to occur year-round, with most impacts during use spikes in the summer. Because current management of the river corridor allows substantial spikes in use, as well as the longest allowable trip lengths of any of the alternatives, it is unlikely that that mitigations would be implemented at a level sufficient to reduce impacts to a minor intensity. Alternative A would not result in the impairment of water quality in Grand Canyon National Park. Cumulatively, the effects of alternative A, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to moderate effect to water quality. Alternative A would result in an adverse, short-term, negligible to minor contribution to this cumulative effect.

4.2.2.5.2 Alternative B

Analysis. Under Alternative B, recreational motor trips would be prohibited and group sizes, maximum daily launches, and estimated total yearly passengers would be the lowest of any of the alternatives (see Table 4- 1). Implementation of a launch-based system would eliminate spikes in use.

Summer use under this alternative would decrease from 121,869 total user-days currently to 107,418 and total passengers from 18,128 currently to 8,492. This, along with reductions in group size, trip length, trips at one time, and people at one time, would help reduce crowding and localized impacts to water sources (such as increases in turbidity or the introduction of contaminants). During the summer season, only one of the major attraction sites with aquatic features (Deer Creek) would experience any days with more than 100 people visiting in a single day. None of these sites would experience days with more than 150 visitors. This would be a substantial decrease from current conditions (Table 4- 6). Shorter trip lengths, which reduce the accessibility of side canyon resources, would be somewhat offset by an increase in user discretionary time (from 294,506 hours currently to 431,444), which might result in increased interaction with all water resources, but to the less vulnerable mainstem waters in particular. Overall, summer use would have a beneficial, short-term, localized, and minor to moderate effect compared to current use.

Under this alternative, overall use levels in the winter and shoulder seasons, as measured by user-days, total passengers, and user discretionary time, would increase above current levels, but would be at much lower levels than the remainder of the alternatives. Compared to current use, these increases would result in greater interaction with water resources, but because these levels of off-season use would coincide with the lowest allowable group sizes and shorter trip lengths, and because visitors are less inclined to walk in tributaries during colder months, increased impacts would generally occur in the less vulnerable mainstem waters. The effects on water quality from off-season use would be negligible and short-term, compared to current use.

Under this alternative, motorized trips would not be permitted. This would result in a beneficial, short-term, localized, minor effect to the mainstem from current condition. This effect would occur throughout the year.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed above (monitoring, changes in regulations, education, etc.), and would be needed primarily to mitigate new use in the winter and shoulder seasons.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, domestic livestock and wild animals, non-river related recreational use, flash floods, run-off, sewer treatment plant and dam operations introduce chemical, physical, and biological changes to water quality in the area of effect that are detectable, and at times historical baseline or desired water quality conditions are altered. With the exception of effects from the operation of Glen Canyon Dam, these effects are generally adverse, short-term, localized, and minor to moderate (because contaminants diffuse or dissipate in a short time). Effects from the dam are longer term and regional.

Cumulatively, the effects of Alternative B, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to moderate effect to water quality. Alternative B would result in an adverse, short-term, negligible, contribution to this cumulative effect.

Conclusion. Compared to current use, Alternative B would directly reduce potential impacts to water quality, especially those in the mainstem. This would represent a beneficial, localized, minor to moderate effects that would be localized and dependent on site accessibility. Chemical, physical, or biological changes to water quality due to recreational activities would still be detectable, however, but generally within historical baseline or desired water quality conditions. These changes would be short-term and highly localized. Thus, most of the effects from visitation would be direct, adverse, localized, minor to moderate, and highly dependent on accessibility from the river. Effects would continue to occur year-round, with most impacts during summer when greater user discretionary time would offer additional opportunities for visitors to access water resources. Impacts to water quality could be reduced to a minor intensity with reasonable mitigation. Alternative B would not result in the impairment of water quality in the park. Cumulatively, the effects of Alternative B, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to moderate effects to water quality. Alternative B would result in an adverse, short-term, negligible contribution to these cumulative effects.

4.2.2.5.3 Alternative C

Analysis. Under Alternative C, recreational motor trips would be prohibited. Group sizes and trip lengths would be at lower levels than current, but estimated total user-days and user discretionary time would be the highest of any of the alternatives (see Table 4- 1). Estimated yearly passengers would increase from 22,461 currently to 25,228. Implementing a launch-based system would eliminate spikes in use.

Summer use under this alternative would represent a decrease in total user-days (down to 110,120 from 121,869 currently) and total passengers (down to 11,252 from 18,128). This, along with moderate reductions in group size, trip length, trips at one time, and people at one time, would serve to lessen crowding, thus reducing localized impacts to water resources. These variables would be somewhat offset, however, by an increase in user discretionary time from 294,506 hours currently to 335,089, which might result in increased accessibility to all water resources, particularly tributaries, seeps, and springs. While user discretionary time could represent an increase in excursions per trip that river runners visit, it could also represent an increase in the amount of time that visitors spend at fewer sites. During the summer season, the major attraction sites with aquatic features would experience numerous days (up to 80 in Elves Chasm) with more than 100 visitors in a single day. Similarly, these sites would experience numerous days (up to 39 in Havasu Creek) with more than 150 visitors in a single day (Table 4-6). This would be a negligible change from current conditions (Table 4- 6). Overall, summer use would have an adverse, short-term, negligible effect on localized effect on water quality compared to current use.

Under this alternative, overall use levels in the winter and shoulder seasons, as measured by user-days and total passengers, would increase considerably above current levels (see Table 4- 2) and in most cases would be the highest use of all the alternatives. Compared to current use, these increases would result in more opportunities for visitors to interact with water resources. This would be somewhat offset because these levels of off-season use would coincide with the lower allowable group sizes and shorter trips, and because visitors would be less inclined to walk in tributaries during colder months, increased impacts in winter would generally occur in the less vulnerable mainstem waters. The effects on water quality from increases in shoulder and winter season use would be adverse, localized, short-term, and minor to moderate compared to current use. Adverse effects would be primarily to side canyon water resources in the shoulder seasons when new use would increase opportunities for physical contact with water resources at a time when dependent biota are particularly sensitive.

Under this alternative, motorized trips would not be permitted. This would result in a localized, beneficial, short-term, minor effect to the mainstem from current conditions. This effect would occur throughout the year.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed above (monitoring, changes in regulations, education, etc.), and would be needed primarily to mitigate new use in the winter and shoulder seasons.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, domestic livestock and wild animals, non-river related recreational use, flash floods, run-off, sewer treatment plant and dam operations introduce chemical, physical, and biological changes to water quality in the area of effect that are detectable, and at times historical baseline or desired water quality conditions are altered. With the exception of effects from the operation of Glen Canyon Dam, these effects are generally adverse, localized, short-term, and minor to moderate (because contaminants diffuse or dissipate in a short time). Effects from the dam are long-term and regional.

Cumulatively, the effects of Alternative C, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to moderate effect to water quality. Alternative C would result in an adverse, short-term, negligible to minor contribution to this cumulative effect.

Conclusion. Compared to current use, Alternative C would result in minor beneficial and minor to moderate adverse short-term localized effect to water quality. New adverse effects would be primarily in the shoulder seasons when new use would increase opportunities for physical contact with water resources at a time when dependent biota is particularly sensitive. Chemical, physical, or biological changes to water quality due to recreational activities would still be detectable, however, and at times historical baseline or desired water quality conditions would be altered. However, these effects generally dissipate in a short time. Thus, effects are adverse, minor to moderate, short-term, highly localized and dependent on accessibility to the river corridor. Effects would continue to occur year-round, with most impacts occurring during the shoulder and winter months from substantial use increases. Impacts to water quality could be reduced to a minor intensity with reasonable mitigation. Alternative C would not result in impairment of water quality in Grand Canyon National Park. Cumulatively, the effects of Alternative C, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to moderate effect to water quality. Alternative C would result in an adverse, short-term, negligible to minor contribution to this cumulative effect.

4.2.2.5.4 Alternative D

Analysis. Under Alternative D, recreational motor trips would be permitted from May to August and from December to February. Group sizes and trip lengths would be lower than current, but user discretionary time would be among the highest of any of the alternatives (see Table 4- 1). Estimated yearly passengers would decrease from 22,461 now to 20,427, and estimated total user-days would increase from 171,131 now to 223,314. Implementing a launch-based system would eliminate spikes in use.

Summer use under this alternative would see a small increase in total user-days (to 122,739 from 121,869 now) and a large increase in total user discretionary time (to 461,641 hours from 294,506 now), but a decrease in total projected passengers (down to 13,765 from 18,128 currently). These numbers indicate that fewer people would have more time to interact with the environment, which might result in increased accessibility to all water resources, particularly tributaries, seeps, and springs. During summer the major attraction sites with aquatic features would experience numerous days (up to 109 in Deer Creek) with more than 100 visitors in a single day. Similarly, these sites would experience numerous days (up to 32 in Deer Creek) with more than 150 visitors in a single day. This would represent an overall increase in visitation from current levels (Table 4- 6). Reductions in group size, trip length, trips at one time, and people at one time would somewhat offset impacts to localized water resources (such as increases in turbidity or the introduction of contaminants). Overall, summer use would have an adverse, short-term, localized, minor to moderate effect compared to current use. Adverse effects would be most noticeable in tributaries, seeps, and springs that are accessible from the river corridor.

Under this alternative, overall use levels in the winter and shoulder seasons, as measured by user-day, user discretionary time and total passengers, would increase above current levels (see Table 4- 2***)***. Overall, allowable trip lengths would be reduced from current, except for non-commercial 30-day oar trips, which would remain the same. Compared to current use, these increases would result in increased interaction with water resources, but because these levels of off-season use would coincide with lower allowable group sizes, and because visitors are less inclined to walk in tributaries during colder months, increased impacts in winter would generally occur in the less vulnerable mainstem waters. Adverse effects from increases in shoulder season use would be most noticeable in side canyon water resources where new use would increase opportunities for physical contact with water resources at a time when dependent biota are particularly sensitive. Increased shoulder season use would have less effect on the less vulnerable mainstem waters. Compared to current use, the effects on water quality from increases in shoulder and winter season use would be adverse, localized, short- to long-term, and minor to moderate.

Motorized trips would be allowed for eight months of the year, as compared to nine months now. This change would be negligible.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed above (monitoring, changes in regulations, education, etc.), and would be needed primarily to mitigate new use in the winter and shoulder seasons.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, domestic livestock and wild animals, non-river related recreational use, flash floods, run-off, sewer treatment plant and dam operations, introduce chemical, physical, and biological changes to water quality in the area of effect that are detectable, and at times historical baseline or desired water quality conditions are altered. With the exception of effects from the operation of Glen Canyon Dam, these effects are generally adverse, localized, and minor to moderate and short-term (because contaminants diffuse or dissipate in a short time period). Effects from the dam are long-term and regional.

Cumulatively, the effects of Alternative D, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to moderate effect to water quality. Alternative D would result in an adverse, short-term, negligible to minor contribution to this cumulative effect.

Conclusion. Compared to current use, Alternative D would result in beneficial, minor impacts and adverse, short-term, localized, minor to moderate impacts to water quality. New adverse effects would occur primarily in the shoulder seasons when new use would increase opportunities for physical contact with water resources at a time when dependent biota are particularly sensitive. Chemical, physical, or biological changes to water quality due to recreational activities would still be detectable, however, and at times historical baseline or desired water quality conditions would be altered. However, these effects generally dissipate in a short time. Thus, effects would be adverse, short-term, highly localized, minor to moderate, and dependent on accessibility to the river corridor. Effects would continue to occur year-round, with most impacts occurring during the shoulder and winter months due to substantial use increases. Impacts to water quality could be reduced to a minor intensity with reasonable mitigation. Alternative D would not result in the impairment of water quality in Grand Canyon National Park. Cumulatively, the effects of Alternative D, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to moderate effect to water quality. Alternative D would result in an adverse, short-term, negligible to minor contribution to this cumulative effect.

4.2.2.5.5 Alternative E

Analysis. Under Alternative E, recreational motor trips would be permitted April through September. Group sizes would be lower and trip lengths shorter than under current conditions, but user discretionary time would be among the highest (see Table 4- 1). Estimated yearly passengers would increase to 23,812 from 22,461 currently, and estimated total user-days would increase to 237,183 from 171,131. A launch-based system would eliminate spikes in use.

Summer use under this alternative would decrease negligibly in total user-days (121,836 from 121,869 now), and total user discretionary time would increase to 373,761 hours from 294,506 currently, but total projected passengers would decrease (down to 15,230 from 18,128). These numbers indicate that fewer people would have more time to interact with the environment, which could result in increased accessibility to water resources. Increased accessibility could result in localized increases in turbidity, but because trip lengths would be relatively low, most effects would be concentrated in the less vulnerable mainstem waters. During the summer season, only three of the major attraction sites with aquatic features would experience any days with more than 100 visitors in a single day. Deer Creek would have the highest number of such days (12), but this would be significantly lower than the highest level of visitation (79 at Havasu Creek) under current conditions. None of these sites would experience days with more than 150 people in a single day. This would be a substantial decrease from current conditions (Table 4- 6). Reductions in group size, trip length, trips at one time, and people at one time would reduce crowding and impacts to localized water resources (such as increases in turbidity or the introduction of contaminants). Overall, summer use would have a beneficial, short-term, localized, negligible to minor effect compared to current use.

Under this alternative, overall use levels in the winter and shoulder seasons, as measured by user-days, user discretionary time, and total passengers, increase considerably above current levels (Table 4- 2), but would be relatively low compared to some of the alternatives. Compared to current use, these increases would result in increased interaction with water resources, but because these levels of off-season use would coincide with the lower allowable group sizes and among the shortest allowable trip lengths, and because visitors are less inclined to walk in tributaries during colder months, increased impacts would generally occur in the less vulnerable mainstem waters. Adverse effects would be most noticeable in the side canyon water sources during the warmer shoulder seasons, especially in spring when dependent species are most vulnerable to trampling, turbidity, and contaminants. Overall, the effects on water quality from off-season use would be adverse, short-term, and negligible to minor, compared to current use.

Motorized trips would be allowed for six months a year, as compared to nine months under current conditions. This would result in a minor beneficial change.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed above (monitoring, changes in regulations, education, etc.), and would be needed primarily to mitigate new use in the winter and shoulder seasons.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, domestic livestock and wild animals, non-river related recreational use, flash floods, run-off, sewer treatment plant and dam operations, introduce chemical, physical, and biological changes to water quality in the area of effect that are detectable, and at times historical baseline or desired water quality conditions are altered. With the exception of effects from the operation of Glen Canyon Dam, these effects are generally adverse, localized, and minor to moderate and short-term (because contaminants diffuse or dissipate in a short time period). Effects from the dam are longer term and regional.

Cumulatively, the effects of Alternative E, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to moderate effect to water quality. Alternative E would result in an adverse, short-term, negligible to minor contribution to this cumulative effect.

Conclusion. Compared to current use, Alternative E would result in beneficial minor impacts and adverse short-term localized impacts to water quality. New adverse effects would be primarily in the shoulder seasons when new use would increase opportunities for physical contact with water resources at a time when dependent biota are particularly sensitive. Chemical, physical, or biological changes to water quality due to recreational activities would still be detectable, however, and at times historical baseline or desired water quality conditions would be altered. However, these effects generally dissipate in a short time. Thus, effects would be adverse, short-term, highly localized, minor to moderate, and dependent on accessibility to the river corridor. Effects would continue to occur year-round, with most impacts occurring during the shoulder and winter months due to use increases. With mitigation could be reduced to a minor intensity. Alternative E would not result in the impairment of water quality in Grand Canyon National Park. Cumulatively, the effects of Alternative E, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to moderate effect to water quality. Alternative E would result in an adverse, short-term, negligible to minor contribution to this cumulative effect.

4.2.2.5.6 Alternative F

Analysis. Under Alternative F, recreational motor trips would be permitted January through June. Group sizes would be lower and trip lengths shorter than under current conditions. User discretionary time would be higher than it is currently, but relatively low as compared to several other alternatives (see Table 4- 1). Estimated yearly passengers would increase from 22,461 currently to 25,415, and estimated total user-days would increase from 171,131 currently to 235,146. A launch-based system would eliminate spikes in use.

Summer use under this alternative would represent a considerable decrease in total user-days (down to 102,291 from 121,869), total user discretionary time (down to 269,507 hours from 294,506 currently), and total projected passengers (down to 13,954 from 18,128). These numbers indicate an overall decrease in use. Additionally, reductions in group sizes, trip lengths, trips at one time, and people at one time would help reduce crowding and impacts, such as increases in turbidity and contaminants, to localized water resources. During the summer season, only three of the major attraction sites with aquatic features would experience any days with more than 100 people in a single day. Elves Chasm would have the highest number of such days (11), but this would be substantially lower than the highest level of visitation (79 at Havasu Creek) under current conditions. One site, Elves Chasm, would experience one day with more than 150 visitors in a single day. This would represent a significant decrease from current conditions (Table 4- 6). Overall, summer use would have a beneficial, short-term, localized, minor effect compared to current use.

Under this alternative, overall use levels in the winter and shoulder seasons, as measured by user-days and total passengers, would increase considerably above current levels (Table 4- 2). Compared to current use, these increases would result in increased interaction with water resources, but because these levels of off-season use would coincide with the lower allowable group sizes and trip lengths, and because visitors are less inclined to walk in tributaries during colder months, increased impacts would generally occur in the less vulnerable mainstem waters. Adverse effects would be most noticeable in the side canyon water sources during the warmer shoulder seasons, especially in spring when dependent species are most vulnerable. Overall, the effects on water quality from off season use would be adverse, short-term, and minor, compared to current use.

Motorized trips would be allowed for six months of the year, as compared to nine months under current conditions. This change would result in a minor, beneficial impact.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed above (monitoring, changes in regulations, education, etc.), and would be needed primarily to mitigate new use in the winter and shoulder seasons.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, domestic livestock and wild animals, non-river related recreational use, flash floods, run-off, sewer treatment plant and dam operations, introduce chemical, physical, and biological changes to water quality in the area of effect that are detectable, and at times historical baseline or desired water quality conditions are altered. With the exception of effects from the operation of Glen Canyon Dam, these effects are generally adverse, localized, and minor to moderate and short-term (because contaminants diffuse or dissipate in a short time period). Effects from the dam are long-term and regional.

Cumulatively, the effects of Alternative F, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to moderate effect to water quality. Alternative F would result in an adverse, short-term, negligible to minor contribution to this cumulative effect.

Conclusion. Compared to current use, Alternative F would result in beneficial, minor impacts and adverse, short-term, localized impacts to water quality. New adverse effects would occur primarily in the shoulder seasons when new use would increase opportunities for physical contact with water resources at a time when dependent biota are particularly sensitive. Chemical, physical, or biological changes to water quality due to recreational activities would still be detectable, however, and at times historical baseline or desired water quality conditions would be altered. However, these effects generally dissipate in a short time. Thus, effects would be adverse, short-term, highly localized, minor to moderate, and dependent on accessibility to the river corridor. Effects would continue to occur year-round, with most impacts from use increases occurring during the shoulder and winter months. With mitigation, effects could be reduced to a minor intensity. Alternative F would not result in the impairment of water quality in Grand Canyon National Park. Cumulatively, the effects of Alternative F, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to moderate effect to water quality. Alternative F would result in an adverse, short-term, negligible to minor contribution to this cumulative effect.

4.2.2.5.7 Alternative G

Analysis. Under Alternative G recreational motor trips would be permitted January through August. Group sizes would be somewhat lower than current, but higher than any of the other alternatives. Trip lengths would be generally at the lowest levels of all of the alternatives, except for noncommercial winter oar trips, which would still be reduced to 21 from 30 (current condition). Yearly user discretionary time would be higher than current condition, but would be at the lowest levels of all the other alternatives (see Table 4- 1). Estimated yearly passengers would increase to 28,680 from 22,461 currently, and estimated total user-days would increase to 249,910 from 171,131. A launch-based system would eliminate spikes in use.

Summer use under this alternative would represent a considerable decrease in total user-days (down to 101,984 from 121,869 currently), total user discretionary time (down to 229,958 hours from 294,506), and total projected passengers (down to 14,939 from 18,128). These numbers indicate an overall decrease in use, particularly in the amount of time that visitors would have to interact with the environment and water resources, as represented by user discretionary time, which would be lower than any other alternative. This would be offset, however, by the large group size (40) for commercial motor trips. Because these large groups do not have sufficient time to access side canyon sites, it is anticipated that the impacts, such as increases in turbidity and contaminants, would generally be restricted to the most easily accessible sites along the river. During the summer season, four of the six major attraction sites with aquatic features would experience a few days with more than 100 visitors in a single day. Deer Creek would have the highest number of such days (8), which would be substantially lower than the highest level of visitation (79 at Havasu Creek) under current conditions. None of these sites would experience days with more than 150 people in a single day, a significant decrease from current conditions (Table 4- 6). Compared to current use, summer use would have a beneficial, short-term, localized, minor effect that would be highly dependent on accessibility from the river corridor.

Under this alternative, overall use levels in the winter and shoulder seasons, as measured by user-days and total passengers, would increase considerably above current levels and would be among the highest of all the alternatives (Table 4- 2). Additionally, winter launches would be twice those currently allowed, and shoulder launches, while reduced from current levels, would be higher than any other alternative. Compared to current use, these increases would result in greater potential interaction with water resources, but because these levels of off-season use coincide with shorter trip lengths and relatively low user discretionary time, and because visitors are less inclined to walk in tributaries during colder months, increased impacts would generally occur in the less vulnerable mainstem waters. Adverse effects would be most noticeable in the side canyon water sources during the warmer shoulder seasons, especially in spring when dependent species are most vulnerable. Overall, the effects on water quality from off-season use would be adverse, short-term, and minor, compared to current use.

Motorized trips would be allowed for eight months of the year, as compared to nine months under current condition. This would be a negligible change from current conditions.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed above (monitoring, changes in regulations, education, etc.), and would be needed primarily to mitigate new use in the winter and shoulder seasons.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, domestic livestock and wild animals, non-river related recreational use, flash floods, run-off, sewer treatment plant and dam operations, introduce chemical, physical, and biological changes to water quality in the area of effect that are detectable, and at times historical baseline or desired water quality conditions are altered. With the exception of effects from the operation of Glen Canyon Dam, these effects are generally adverse, localized, and minor to moderate and short-term (because contaminants diffuse or dissipate in a short time period). Effects from the dam are longer term and regional.

Cumulatively, the effects of Alternative G, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to moderate effect to water quality. Alternative G would result in an adverse, short-term, negligible to minor contribution to this cumulative effect.

Conclusion. Compared to current use, Alternative G would result in beneficial, minor impacts and adverse, short-term, localized impacts to water quality. New adverse effects would be primarily in the shoulder seasons when new use would increase opportunities for physical contact with water resources at a time when dependent biota are particularly sensitive. Chemical, physical, or biological changes to water quality due to recreational activities would still be detectable, however, and at times historical baseline or desired water quality conditions would be altered. However, these effects generally dissipate in a short time. Thus, effects would be adverse, short-term, highly localized, minor to moderate, and dependent on accessibility to the river corridor. Effects would continue to occur year-round, with most impacts from use increases occurring during the shoulder and winter months. With mitigation, effects could be reduced to a minor intensity. Alternative G would not result in the impairment of water quality in Grand Canyon National Park. Cumulatively, the effects of Alternative G, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to moderate effect to water quality. Alternative G would result in an adverse, short-term, negligible to minor contribution to this cumulative effect.

4.2.2.5.8 Modified Alternative H (NPS Preferred Alternative)

Analysis. Under ***Modified*** Alternative H, recreational motor trips would be permitted from ***April 1 to September 15.*** Group sizes would be lower than currently in the summer and considerably lower in the shoulder seasons. Trip lengths would be lower than current conditions, with some opportunities for longer trips in the winter. Yearly user discretionary time would be higher than current conditions, but lower than several other alternatives (see Table 4- 1). Estimated yearly passengers would increase to ***24,657*** from 22,461 currently, and estimated total user-days would increase to ***228,986*** from 171,131. A launch-based system would eliminate spikes in use.

Summer use under this alternative would represent the highest level of user-days (***124,316***) ***of all the alternatives, including current conditions (121,869).*** Total projected passengers ***for this season (16,655) would decrease from current condition (18,128).*** These numbers suggest that summer use levels would be comparable to current condition, but user discretionary time would be relatively high (***393,513*** hours) compared to current conditions (294,506 hours) and several other alternatives. This indicates that visitors would have more time to interact with all water resources, particularly those in the side canyons. This would be somewhat offset, however, by reductions in group sizes, trip lengths, people at one time, and trips at one time, which would help reduce crowding and localized water resource impacts, such as increases in turbidity and contaminants. During summer, none of the six major attraction sites with aquatic features would experience any days with more than 100 people in a single day. This would represent the lowest level of concentrated visitation at these sites and a substantial decrease from current conditions (Table 4- 6). Overall, summer use would have an adverse, short-term, negligible, and localized effect compared to current use. Effects would be most noticeable in tributaries, seeps, and springs.

Under this alternative, overall use levels in the winter season, as measured by user-days and total passengers, would increase above current levels but would be among the lowest of all of the alternatives (Table 4- 2). ***User-days and total passenger estimates would increase in the shoulder seasons; however, much of this increase is the result of the high use in September.*** Group sizes in the off-seasons would be at the lowest level of all of the alternatives, with shoulder commercial trips reduced to 24 people (including guides) in the shoulder seasons. Compared to current use, these increases would result in increased interaction with water resources, but because these levels of off-season use would coincide with the shorter lengths and relatively low user discretionary time, and because visitors are less inclined to walk in tributaries during colder months, increased impacts would generally occur in the less vulnerable mainstem waters. Adverse effects would be most noticeable in the side canyon water sources during the warmer shoulder seasons, especially in ***September, but also somewhat in the*** spring when dependent species are most vulnerable. Overall, the effects on water quality from off-season use would be adverse, short-term, and negligible to minor, compared to current use.

Motorized trips would be allowed for ***five and one-half*** months of the year, as compared to nine months under current conditions. This would be a minor beneficial change from current conditions.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed above (monitoring, changes in regulations, education, etc.), and would be needed primarily to mitigate new use in the winter and shoulder seasons.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, domestic livestock and wild animals, non-river related recreational use, flash floods, run-off, sewer treatment plant and dam operations, introduce chemical, physical, and biological changes to water quality in the area of effect that are detectable, and at times historical baseline or desired water quality conditions are altered. With the exception of effects from the operation of Glen Canyon Dam, these effects are generally adverse, localized, and minor to moderate and short-term (because contaminants diffuse or dissipate in a short time period). Effects from the dam are long-term and regional.

Cumulatively, the effects of ***Modified*** Alternative H, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to moderate effect to water quality. ***Modified*** Alternative H would result in an adverse, short-term, negligible to minor contribution to this cumulative effect.

Conclusion. Compared to current use, ***Modified*** Alternative H would result in beneficial and adverse, short-term, localized, minor effects to water quality. New adverse effects would occur primarily in the shoulder seasons when new use would increase opportunities for physical contact with water resources at a time when dependent biota are particularly sensitive. Chemical, physical, or biological changes to water quality due to recreational activities would still ***be*** detectable, however, and at times historical baseline or desired water quality conditions would be altered. However, these effects generally dissipate in a short time. Thus, effects would be adverse, short-term, highly localized, minor to moderate, and dependent on accessibility to the river corridor. Effects would continue to occur year-round. With mitigation, effects could be reduced to a minor intensity. ***Modified*** Alternative H would not result in the impairment of water quality in Grand Canyon National Park. Cumulatively, the effects of ***Modified*** Alternative H, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to moderate effect to water quality. ***Modified*** Alternative H would result in an adverse, short-term, negligible to minor contribution to this cumulative effect.

4.2.2.6 Impact Analysis—Lower Gorge Alternatives

Mitigation measures for the Lower Gorge alternatives include all of those stated for the Lees Ferry alternatives, plus the following:

- ***In cooperation with the Hualapai Tribe***, develop a hazardous material plan for the transport and storage of petroleum in the Quartermaster area
- Ensure that federal and state regulations for the storage of petrochemicals are adhered to ***on NPS lands***
- ***Work with the Hualapai Tribe to*** remove all petrochemical storage facilities from floodplains and riparian zone
- ***In cooperation with the Hualapai Tribe, the State of Arizona, and other partners,*** implement a monitoring and treatment program to collect baseline data ***for basic water***

quality parameters in the mainstem and tributaries, including pathogen indicators, nutrients, and hydrocarbons, establish toxicity thresholds, and ***monitor future water quality trends. These data would be used to adaptively manage the river,*** incorporating appropriate management actions to mitigate noncompliance with applicable water quality standards

- ***Implement a spill prevention control plan that is developed in cooperation with the NPS, the EPA and the Hualapai Tribe. This plan should address transport, storage, and disposal of human waste, trash, and hazardous materials. Waste materials would be transported or stored only in appropriate containers that would not leak or spill.***
- ***Work with the Hualapai Tribe to determine the appropriate number and type of toilets at Quartermaster Canyon. Approximately one toilet would be needed for every 100 visitors per hour located out of the flood plain (above the high water mark). They could be vault (permanent concrete lined structure), evaporative (self-contained), or chemical and each type would require proper disposal. Hand washing facilities could include a portable hand washing unit (requiring proper disposal of grey water) or a hand sanitizer dispenser***

4.2.2.6.1 Alternative 1 (Existing Condition)

Analysis. Recreational river use below Diamond Creek includes commercial and noncommercial oar and motor downriver trips continuing to Lake Mead from Lees Ferry, noncommercial and HRR trips launching from Diamond Creek, private boaters traveling upriver from Lake Mead, Hualapai/Oriental Tour pontoon boats operating in the Quartermaster area, jetboats that run upriver for passenger takeouts, and noncommercial boat tow-outs. The maximum group size for HRR day trips is 100 people year-round; on average, one trip launches per day. Overnight trips average three launches per month and have a maximum group size of 34 (including guides). ***Estimates of current use, based on 2003 data provided by the Hualapai Tribe indicate that*** pontoon operations average 188 passengers per day during peak season and 160 year-round. Commercial downriver trips continuing on to Lake Mead have a maximum group size of 43. There are two small floating docks in the Quartermaster area for pontoon boat and HRR operations. Upriver travel is unlimited below Separation Canyon (RM 240).

Direct and indirect impacts to water quality in the Lower Gorge would be essentially the same as those identified under Lees Ferry Alternative A. Pollution from human personal care products, camp waste (primarily food scraps), motor fuel, and human fecal waste can wash into mainstem waters, tributaries, mainstem backwaters, and springs affecting water quality and the aquatic resources that depend on them. The intensity of the impacts varies, however, since the Lower Gorge is a different use zone in which the types and levels of use vary dramatically from the Lees Ferry to Diamond Creek portion of the corridor. ***To accommodate the use levels from upriver trip takeouts as well as commercial operations, the Hualapai Tribe has installed limited facilities at the following locations:***

Diamond Creek	***2 ramadas, 1 toilet***
Spencer Canyon	***1 toilet***
RM 259	***2 helicopter pads, 4 shade umbrellas***
RM260	***4 helicopter pads, 2 ramadas***

RM262 ***2 helicopter pads, 1 ramada, 1 fuel storage area, 1 boat mooring facility***
RM263 ***7 helicopter pads, 3 ramadas, 2 toilets, 1 boat mooring facility***

The Lower Gorge is unique in that it is included in the 108 miles along the Colorado River that lies adjacent to Hualapai tribal land. This land status has resulted in overlapping management by Grand Canyon National Park and the Hualapai Tribe. The Hualapai Tribe has a Lower Gorge water quality monitoring program in cooperation with the US Geological Survey. Eighteen seeps and springs in the Lower Gorge that are significant to the tribe are monitored (HDNR 2003). Use of the water sources includes aquatic and wildlife, full body contact, domestic, fish consumption, and agriculture (irrigation and livestock).

Under current management, HRR day trips generally launch one large trip per day from Diamond Creek, and passengers exit the river via helicopter at Quartermaster. According to the 2001 use moratorium, these trips can carry 80 passengers and 20 guides. While smaller trips are the norm, larger trips have been reported by Grand Canyon Resort Corporation and NPS river rangers. The greatest effect to water quality from HRR trips is from the impacts (the introduction of personal care products and human wastes, and disturbance of the substrate) caused by large groups coming in direct contact with localized water sources. These impacts, are generally restricted to Diamond Creek, Quartermaster, and lunch and attraction sites such as Travertine Canyon and Falls and Spencer Canyon. The springs at Diamond Creek, Spencer Canyon, Travertine Springs, and Travertine Falls are listed as outstanding tribal resource waters by the tribe (Hualapai Department of Natural Resources 2003). One of these water sources, Spencer Canyon Creek, is regularly monitored by the Hualapai Tribe. While visitor impacts are not quantified in the *2003 Water Assessment* (Hualapai Department of Natural Resources 2003), the report does identify litter, human waste contamination, fires, and unspecified water contaminants as potential problems associated with recreational use of the area. Large groups result in higher concentrations of contaminants in localized areas. Because access to water resources by day trips is generally restricted to the mainstem or immediately adjacent waters, contaminants diffuse quickly. Some contaminants can concentrate in eddies and backwater areas, however, resulting in localized degradation of water resources. This results in an adverse, short-term, minor to moderate effect that is highly dependent on the proximity to established HRR day trip stopping points.

HRR overnight trips generally occur once a week and carry 34 passengers, including crew. These motorized trips usually only spend one or two nights in the Lower Gorge before taking out by means of helicopter at Quartermaster (RM 262). Generally, these trips have a set itinerary and little time for passengers to explore side canyons. Thus, impacts such as increases in turbidity and contaminants are generally limited to the less vulnerable waters of the mainstem. Because these trips are short and infrequent, effects to water quality are adverse, short-term, negligible to minor, and highly localized. This effect occurs almost exclusively in the high-use peak season.

All HRR trips are motorized and use four-stroke motors. While the impact of motors has decreased since conversion to four-stroke motors, some gasoline, oil, and grease still enter Colorado River water from marine motors. River dynamics and the large volume of the Colorado River diffuse and disperse these contaminants. Contamination can become more concentrated in backwaters and eddies, however. Motor use under this alternative results in adverse, short-term, localized, minor effects to the mainstem. This effect occurs throughout the entire motorized season, but is most pronounced during the high-use peak season.

Noncommercial groups that launch from Diamond Creek have no time limits on their trips. Thus, access to water resources in the Lower Gorge is relatively unlimited. Although silt and thick nonnative vegetation make access to side canyons more difficult, longer trips allow visitors more opportunities to hike up tributaries and access sensitive springs and seeps. Group sizes are relatively small, however, which decreases crowding and localized impacts to water resources. Overall, private use has a direct, adverse, long-term, minor to moderate effect on localized resources. This impact occurs year-round.

Pontoon operations during peak seasons average 188 passengers per day, although daily spikes above 500 passengers have been documented. During the non-peak season (October to March), operators average ***130*** passengers per day. Six pontoon boats are located in the Quartermaster area, but only five boats are in operation at any one time. The pontoon tours generally last 20 minutes, with access at the same location. Passengers on pontoon trips rarely have time for exploration, even in the direct vicinity of the helicopter pad and launch area. The pontoons generally take up to 10 passengers on each excursion, and the daily total for boat trips varies widely. Pontoon visitors have a negligible effect on the water quality, since they do not come into direct contact with the water because they embark and disembark via floating docks. Some gasoline, oil, and grease enter Colorado River water from the pontoon motors, but river dynamics and the large volume of the Colorado River diffuse and disperse these contaminants. Contamination can become more concentrated in backwaters and eddies, however. Motor use under this alternative results in localized adverse, short-term, minor effects to the mainstem. This effect occurs throughout the entire motorized season, but is most pronounced during the high-use peak season.

To support these pontoon operations, fuel is being stored in a containment basin. This fuel cache is within the riparian zone below the high-water mark at RM 262. It is estimated that at least 40–60 gallons of gasoline are currently stored in this location at any one time. Fuel ***has been*** sling loaded via helicopter to the site from a Grand Canyon West facility ***and brought in via boat from Lake Mead***. Boat/motor repair, including the disassembly of motors and lower units of the outboards, is also conducted at the dock site. ***Because there is not currently a spill prevention control plan developed in cooperation with the NPS, the EPA and the Hualapai Tribe, fuel storage and transport for pontoon use*** represents a substantial environmental contamination risk that could cause major, adverse, short- to long-term affects to the localized waters and habitat downriver.

Upriver commercial traffic consists of tow-outs (using four-stroke motors) and commercial passenger pick-ups (using jetboats) and is largely unlimited under this alternative. Use levels rarely exceed six trips per day, and given the dynamics and large volume of the Colorado River, contaminants from marine motors are quickly diffused and dispersed. Contamination can become more concentrated in backwaters and eddies, however. Motor use under this alternative results in adverse, short-term, localized, minor effects to the mainstem. This effect occurs throughout the entire motorized season, but is most pronounced during the high-use peak season.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed above (monitoring, changes in regulations, education, etc.), but because this alternative includes fuel storage hazards, large group sizes, unlimited trip lengths, and unregulated use, and because it does not include a focused management/mitigation plan ***or spill prevention control plan***, it is unlikely that mitigations would be implemented at a level sufficient to reduce impacts to a minor intensity.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, domestic livestock and wild animals, non-river related recreational use, flash floods, runoff, sewer treatment plant and dam operations, introduce chemical, physical, and biological changes to water quality in the area of effect that are detectable, and at times historical baseline or desired water quality conditions are altered. These effects are generally adverse, localized, and minor to moderate and short-term (because contaminants diffuse or dissipate in a short time period).

Cumulatively, the effects of Alternative 1, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to major effect to water quality. Alternative 1 would result in an adverse, short-term, minor contribution to this cumulative effect.

Conclusion. Overall, continued recreational use in the Lower Gorge under Alternative 1 would result in chemical, physical, and biological changes that would be detectable, and desired water quality conditions would continue to be temporarily altered. However, unregulated use and current fuel storage practices associated with pontoon use represent a potential hazard that could significantly alter water quality conditions. Thus, Alternative 1 would result in adverse, localized, minor to major adverse effects that would generally be short-term, but could reach the long-term threshold. These effects would be primarily in the peak season. Because this alternative includes fuel storage hazards, large group sizes, unlimited trip lengths, and unregulated use and because it does not include a focused management/mitigation plan, it is unlikely that mitigations would be implemented at a level sufficient to reduce impacts to a minor intensity. Alternative 1 would not result in the impairment of water quality in Grand Canyon National Park. Cumulatively, the effects of Alternative 1, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to major effect to water quality. Alternative 1 would result in an adverse, short-term, minor contribution to this cumulative effect.

4.2.2.6.2 Alternative 2

Analysis. Under Alternative 2, group sizes, total number of daily passengers, and allowable upriver travel would be at the lowest levels of all alternatives (Table 4- 3). Additionally, pontoon use and all associated operations and facilities would be eliminated.

Alternative 2 would allow two HRR peak-season day trips per day, each with up to 30 passengers, including guides. One trip of 30 people would be allowed during the non-peak season. Because the greatest current effect to water resources from HRR day trips use is from impacts such as increases in turbidity and contaminants caused by large groups, this alternative represents a direct, beneficial, short-term, negligible to minor effect from current condition at localized water sources, particularly at Diamond Creek, Quartermaster, and lunch and attraction sites such as Travertine Canyon and Falls and Spencer Canyon.

HRR overnight trips could launch one trip per day, all year, and carry 30 passengers, including crew. It is unknown whether demand would eventually increase for this type of trip. Current trips are infrequent, but group size, trip length, and number of launches are unregulated. Thus, this alternative would provide for greater protection of water resources, should demand continue to grow. Overall, HRR overnight use would have a direct, beneficial, short-term, negligible to minor effect on water quality, compared to current conditions.

The number of private trips allowed to launch from Diamond Creek would remain unchanged, but trip length would be limited to four nights in the peak season and five nights in the non-peak season. This decrease in allowable trip length would limit access to sensitive tributaries, seeps, and springs. Group sizes would remain relatively small, decreasing the likelihood of crowding and its associated effects at attraction and camp sites. Compared to current conditions, private use would have a direct beneficial, long-term, minor to moderate effect on the quality of localized water sources.

Eliminating pontoon operations and associated fuel storage facilities would reduce the potential for a fuel spill or inundation, thus resulting in a beneficial, long-term, minor to moderate effect to water quality.

Upriver traffic under this alternative would be limited to two trips per day below RM 262. This reduction in allowable use would represent a beneficial, long-term, negligible to minor ***effect*** compared to current condition.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed above (monitoring, changes in regulations, education, etc.), and would be necessary primarily to address effects from expansion of use into non-peak seasons. A monitoring and treatment plan to determine and mitigate impacts from visitation would be needed and would be sufficient to reduce localized impacts to a minor intensity. Exact levels of mitigation would be determined based on the results of the monitoring program.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, domestic livestock and wild animals, non-river related recreational use, flash floods, runoff, sewer treatment plant and dam operations, introduce chemical, physical, and biological changes to water quality in the area of effect that are detectable, and at times historical baseline or desired water quality conditions are altered. These effects are generally adverse, localized, and minor to moderate and short-term (because contaminants diffuse or dissipate in a short time period).

Cumulatively, the effects of Alternative 2, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to moderate effect to water quality. Alternative 2 would result in an adverse, short-term, negligible contribution to this cumulative effect.

Conclusion. Compared to current conditions, Alternative 2 would result in beneficial, short-term, localized, minor to moderate effects. Benefits would be derived primarily from reductions in trip lengths and group sizes, regulation of use, and elimination of the pontoon fuel storage cache. Chemical, physical, or biological changes to water quality due to recreational activities would still be detectable, however, but would generally be within historical baseline or desired water quality conditions. These changes would be short-term and highly localized. Thus, most of the effects from visitation would be direct, adverse, localized, minor, and highly dependent on accessibility from the river. Impacts to water quality could be reduced to a minor intensity with reasonable mitigation. The effect would be year-round. Alternative 2 would not result in the impairment of water quality in Grand Canyon National Park. Cumulatively, the effects of Alternative 2, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to moderate effect to water quality. Alternative 2 would result in an adverse, short-term, negligible contribution to this cumulative effect.

4.2.2.6.3 Alternative 3

Analysis. Under Alternative 3, group sizes and trip lengths would be substantially lower than under current conditions. The total number of pontoon passengers, HRR passengers, and upriver trips would be near or above current levels (Table 4- 3).

Alternative 3 would allow three HRR peak-season day trips per day, each with up to 30 passengers, including guides. Two trips of 30 people would be allowed during the non-peak season. Summer passenger totals would be comparable to current conditions, although smaller group sizes would substantially reduce localized water resource impacts such as increases in turbidity and contaminants from crowding. Winter use would allow for fewer passengers per day in addition to restricting group size. Overall, this alternative would represent a direct, beneficial, short-term, negligible to minor effect on localized water sources, particularly at Diamond Creek, Quartermaster, and lunch and attraction sites such as Travertine Canyon and Falls and Spencer Canyon.

HRR overnight trips could launch two trips per day, all year, and carry 30 passengers, including crew. It is unknown whether demand would eventually increase for this type of trip. Current trips are infrequent, but group size, trip length, and number of launches are unregulated. Thus, this alternative would provide for greater protection of water resources should demand continue to grow. Overall, HRR overnight use would have a direct, beneficial, short-term, and negligible to minor effect on water quality compared to current conditions.

The number of private trips allowed to launch from Diamond Creek would remain unchanged, but trip length would be limited to five nights in the peak season and eight nights in the non-peak season. This decrease in allowable trip length would limit access to sensitive tributaries, seeps, and springs. Group sizes would remain relatively small, decreasing the likelihood of crowding and its associated effects at attraction and camp sites. Compared to current conditions, private use would have a direct, beneficial, short-term, minor to moderate effect on localized water resources.

Pontoon operations would be limited to 400 passengers per day. While this level of use would be higher than the current average, it would be lower than the current spikes in use. Compared to current conditions, pontoon use would have a direct, short-term, negligible effect on localized water resources in the Quartermaster area.

Boat/motor repair and the transport and storage of fuel create the potential for a fuel spill or inundation and thus would continue to represent a substantial environmental risk that could cause adverse, short- to long-term, major effects to the localized waters and habitat below RM 262.

Upriver traffic under this alternative would be limited to six trips per day below Separation Canyon. This use would represent a short-term, localized, negligible effect to water quality compared to current conditions.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed above (monitoring, changes in regulations, education, etc.), and would be necessary primarily to address fuel transport and storage and the effects from expansion of use into non-peak seasons. A monitoring and treatment plan to determine and mitigate impacts from visitation would be needed and would be sufficient to reduce localized impacts to a minor intensity. Exact levels of mitigation would be determined based on the results of the monitoring program.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, domestic livestock and wild animals, non-river related recreational use, flash floods, runoff, sewer treatment plant and dam operations, introduce chemical, physical, and biological changes to water quality in area of effect that are detectable, and at times historical baseline or desired water quality conditions are altered. These effects are generally adverse, localized, and minor to moderate and short-term (because contaminants diffuse or dissipate in a short time period).

Cumulatively, the effects of Alternative 3, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to major effect to water quality. Alternative 3 would result in an adverse, short-term, minor contribution to this cumulative effect.

Conclusion. Compared to current conditions, Alternative 3 would generally result in beneficial, localized, short-term, minor to moderate effects. Benefits would be derived primarily from the regulation of use and reductions in trip lengths and group sizes. Chemical, physical, or biological changes to water quality due to recreational activities would still be detectable, however, but would generally be within historical baseline or desired water quality conditions. These changes would be short-term and highly localized. However, fuel storage practices associated with pontoon use would continue to represent a potential hazard that could significantly alter water quality conditions. Thus, most of the effects from visitation would be direct, adverse, localized, minor to major, and highly dependent on accessibility from the river. The effect would be year-round. Impacts to water quality could be reduced to a minor intensity with reasonable mitigation. Alternative 3 would not result in the impairment of water quality in Grand Canyon National Park. Cumulatively, the effects of Alternative 3, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to major effect to water quality. Alternative 3 would result in an adverse, short-term, minor contribution to this cumulative effect.

4.2.2.6.4 Modified Alternative 4 (NPS Preferred Alternative)

Analysis. ***Modified*** Alternative 4 is characterized by a redistribution of HRR operations and represents a agreement between Grand Canyon National Park and the Hualapai Tribe on levels of HRR use and other uses originating at Diamond Creek. ***This alternative, however, presents the NPS's preference for lower levels of pontoon boat use in the Quartermaster area compared to levels proposed by the Hualapai Tribe. Pontoon use levels in this alternative allow for economic growth within the constraints of resource protection.*** Under this ***Modified*** Alternative HRR group sizes and trip lengths would be at substantially lower levels than current conditions, and upriver trips would be below current levels (Table 4- 3).

Daily ***HRR*** passenger totals during the peak season would be limited to 96, with group sizes (including guides) not to exceed 40. No limits would be placed on trips per day in the peak season. This would allow HRR managers increased flexibility in scheduling launches, while encouraging the booking of smaller trips. Two trips of 20 people would be allowed during the non-peak season. Summer passenger totals would be somewhat higher than current condition, but smaller group sizes would reduce potential water resource impacts such as increases in turbidity and contaminants from crowding. Winter use would allow for fewer passengers per day, in addition to restricting group size. Compared to current conditions, this alternative overall would represent a direct, beneficial, long-term, negligible to minor effect at localized waters sources, particularly at Diamond Creek, Quartermaster, and lunch and attraction sites such as Travertine Canyon and Falls and Spencer Canyon.

HRR overnight trips could launch three trips per day in the peak season and one trip per day in the non-peak seasons and carry 20 passengers per trip, including crew. It is unknown whether demand would eventually increase for this type of trip. Current trips are infrequent, but group size, trip length, and number of launches are unregulated. Thus, this alternative would provide for greater protection of water resources should demand continue to grow. Overall, HRR overnight use would have a direct, beneficial, long-term, negligible to minor effect on water resources, compared to current conditions.

The number of private trips allowed to launch from Diamond Creek would remain unchanged, but trip length would be limited to three nights in the peak season and five nights in the non-peak season. This decrease in allowable trip length would limit access to sensitive tributaries, seeps, and springs. Group sizes would remain relatively small, decreasing crowding and reducing localized impacts to water quality. Compared to current conditions, private use would have a direct, beneficial, long-term, minor to moderate effect on localized resources.

Pontoon operations would continue with six boats in the Quartermaster area, with a preliminary maximum daily capacity of 480 passengers. Maximum daily pontoon passengers could be increased to 600 per day based on favorable performance reviews of concession operations and resource monitoring data. This level of use would be higher than the current average. Compared to current conditions, pontoon use would have a direct, long-term, negligible ***to minor adverse*** effect on localized water quality in the Quartermaster area.

Boat/motor repair and the transport and storage of fuel create the potential for a fuel spill or inundation and thus would represent a significant environmental risk that could cause adverse, short- to long-term, major effects to the localized waters and habitat below the RM 262.

Upriver traffic in this alternative is estimated to be five trips per day in the peak season and two trips per day in the non-peak season. This use would be restricted to below RM 240 (Separation Canyon). This use would result in a negligible effect to water quality compared to current conditions.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed above (monitoring, changes in regulations, education, etc.), and would be necessary primarily to address effects from fuel transport and storage and expansion of use into nonpeak seasons. A monitoring and treatment plan to determine and mitigate impacts from visitation would be needed and would be sufficient to reduce localized impacts to a minor intensity. Exact levels of mitigation would be determined based on the results of the monitoring program. ***GRCA will be responsible for monitoring and treatment of impacts from use below the high-water mark as part of the implementation of the CRMP. The NPS is exploring options for a dedicated funding source for this effort. Impacts from facilities, equipment or use above the high-water mark occur on sovereign Hualapai tribal land. The NPS would work to facilitate the development of a cooperative spill prevention control plan that is developed between the NPS, the EPA and the Hualapai Tribe.***

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, domestic livestock and wild animals, non-river related recreational use, flash floods, run-off, sewer treatment plant and dam operations, introduce chemical, physical, and biological changes to water quality in the area of effect that are detectable, and at times historical baseline or desired water quality conditions are altered. These effects are generally adverse, localized, and minor to moderate and short-term (because contaminants diffuse or dissipate in a short time period).

Cumulatively, the effects of ***Modified*** Alternative 4, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to major effect to water quality. ***Modified*** Alternative 4 would result in an adverse, short-term, minor contribution to this cumulative effect.

Conclusion. Compared to current conditions, ***Modified*** Alternative 4 would generally result in beneficial, localized, short-term, ***negligible*** to moderate ***and adverse, localized, short-term, and negligible to minor*** effects. Benefits would be derived primarily from the regulation of use and reductions in trip length and group size. Chemical, physical, or biological changes to water quality due to recreational activities would still be detectable, however, but would generally be within historical baseline or desired water quality conditions. These changes would be short-term and highly localized. However, fuel storage practices associated with pontoon use represent a potential hazard that could significantly alter water quality conditions. Thus, most of the effects from visitation would be direct, adverse, localized, minor to major, and highly dependent on accessibility from the river. The effect would be year-round. Impacts to water quality could be reduced to a minor intensity with reasonable mitigation. ***Modified*** Alternative 4 would not result in the impairment of water quality in Grand Canyon National Park. Cumulatively, the effects of

Modified Alternative 4, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to major effect to water quality. ***Modified*** Alternative 4 would result in an adverse, short-term, minor contribution to this cumulative effect.

4.2.2.6.5 Alternative 5 (Hualapai Tribe Proposed Action)

Analysis. Alternative 5 is characterized by a redistribution of HRR operations and represents a consensus between Grand Canyon National Park and the Hualapai Tribe on levels of HRR use and other uses originating at Diamond Creek. This alternative, however, represents the Hualapai Tribe's proposed higher levels of pontoon boat use than the current average. Under this alternative, HRR group sizes and trip lengths would be at substantially lower levels than current conditions, and upriver trips would be below current levels (see Table 4- 3***)***.

Daily passenger totals during the peak season would be limited to 96, with group sizes (including guides) not to exceed 40. No limits have been placed on trips per day in the peak season. This would allow HRR managers increased flexibility in scheduling launches, while encouraging the booking of smaller trips. Two trips of 20 people would be allowed during the non-peak season. Summer passenger totals would be somewhat higher than current conditions, but smaller group sizes would reduce potential water resource impacts such as increased turbidity and contaminants from crowding. Winter use would allow for fewer passengers per day in addition to restricting group size. Overall, this alternative would result in a direct, beneficial, long-term, negligible to minor effect at localized waters sources, particularly at Diamond Creek, Quartermaster, and lunch and attraction sites such as Travertine Canyon and Falls and Spencer Canyon.

HRR overnight trips could launch three trips per day in the peak season and one trip per day in the non-peak seasons and carry 20 passengers per trip, including crew. It is unknown whether demand would eventually increase for this type of trip. Current trips are infrequent, but group size, trip length, and number of launches are unregulated. Thus, this alternative would provide for greater protection of resources should demand continue to grow. Overall, HRR overnight use would have a direct, beneficial, long-term, negligible to minor effect on water resources, compared to current conditions.

The number of noncommercial trips allowed to launch from Diamond Creek would remain unchanged, but trip length would be limited to three nights in the peak season and five nights in the non-peak season. This decrease in allowable trip length would limit access to sensitive tributaries, seeps, and springs. Group sizes would remain relatively small, which would decrease crowding and reduce localized impacts to water quality. Compared to current conditions, private use would have a direct, beneficial, long-term, minor to moderate effect on localized resources.

Pontoon operations would be limited to 960 passengers per day. This level of use would be substantially higher than the current average, or any known spikes in daily use. Compared to current conditions, pontoon use would have a direct, adverse, long-term, minor effect on localized water resources at Quartermaster.

Boat/motor repair and the transport and storage of fuel create the potential for a fuel spill or inundation and thus would represent a significant environmental risk that could cause adverse, short- to long-term, major effects to the localized waters and habitat below RM 262.

Upriver traffic in this alternative would not be allowed above RM 273, except for pontoon traffic. This use would result in a beneficial, short-term, negligible to minor effect to water quality compared to current conditions.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed above (monitoring, changes in regulations, education, etc.), and would be necessary primarily to address effects from fuel transport and storage and expansion of use into non-peak seasons. A monitoring and treatment plan to determine and mitigate impacts from visitation would be needed and would be sufficient to reduce localized impacts to a minor intensity. Exact levels of mitigation would be determined based on the results of the monitoring program.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, domestic livestock and wild animals, non-river related recreational use, flash floods, run-off, sewer treatment plant and dam operations, introduce chemical, physical, and biological changes to water quality in the area of effect that are detectable, and at times historical baseline or desired water quality conditions are altered. These effects are generally adverse, localized, and minor to moderate and short-term (because contaminants diffuse or dissipate in a short time period).

Cumulatively, the effects of Alternative 5, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to major effect to water quality. Alternative 5 would result in an adverse, short-term, minor to moderate contribution to this cumulative effect.

Conclusion. Compared to current conditions, Alternative 5 would generally result in beneficial, localized, minor to moderate impacts and adverse, short-term, minor effects. Benefits would be derived primarily from regulation of use and reductions in trip length and group size. Chemical, physical, or biological changes to water quality due to recreational activities would still be detectable, however, but generally within historical baseline or desired water quality conditions. These changes would be short-term and highly localized. However, fuel storage practices associated with pontoon use represent a potential hazard that could significantly alter water quality conditions. Thus, most of the effects from visitation would be direct, adverse, localized, minor to major, and highly dependent on accessibility from the river. The effect would be year-round. Impacts to water quality could be reduced to a minor intensity with reasonable mitigation. Alternative 5 would not result in the impairment of water quality in Grand Canyon National Park. Cumulatively, the effects of Alternative 5, when combined with other past, present, and reasonably foreseeable actions, would result in an adverse, localized, short-term, minor to major effect to water quality. Alternative 5 would result in an adverse, short-term, minor to moderate contribution to this cumulative effect.

4.2.3 AIR QUALITY

4.2.3.1 ISSUES

External and internal scoping sessions identified several air quality issues related to river recreation:

- Air quality in Grand Canyon is generally good, but enough human-caused air pollution is present to affect various park resources (see the description in Chapter 3)
- Activities related to recreation on the Colorado River contribute to air pollution
- Activities such as hiking, cooking and smoking generate some air pollutants, but not in significant amounts
- Significant air pollution sources associated with recreational use of the Colorado River are motorized transportation, including outboard motors, helicopter shuttles, and jetboats
- Campfire emissions also contribute to air pollution

4.2.3.2 GUIDING REGULATIONS AND POLICIES

Air quality in Grand Canyon National Park is managed under the Clean Air Act, as amended, and implemented according to regulations issued by the Environmental Protection Agency and Arizona. Section 176(c)(1) of the act requires federal agencies to adhere to all applicable federal, tribal and/or state "implementation plans." Grand Canyon National Park is designated as a Class I area under the Clean Air Act, which allows very little deterioration in air quality. The act also includes an affirmative responsibility for the NPS to protect park resources from adverse impacts caused by air pollution, and requires the Service to adhere to applicable state regulations issued under the act. Under Section 165(d)(2)(B) "the Federal Land Manager and the Federal official charged with direct responsibility for management of such lands shall have an affirmative responsibility to protect the air quality related values (including visibility) of any such lands within a Class I area and to consider, in consultation with the administrator, whether a proposed major emitting facility will have an adverse impact on such values."

The Hualapai tribal lands are designated a Class II area under the Clean Air Act, which allows only moderate deterioration of air quality. Under no circumstances are conditions to violate the national ambient air quality standards established by the Environmental Protection Agency to protect human health and welfare. The Hualapai Tribe has been concerned about air quality on their lands, and has pursued redesignation of their lands as a class I area.

NPS *Management Policies* call for the agency to "assume an aggressive role in promoting and pursuing measures to protect these [park] values from the adverse impacts of air pollution. In cases of doubt as to the impacts of existing or potential air pollution on park resources, the Service will err on the side of protecting air quality and related values for future generations" (sec. 4.7.1).

In 1996 the Environmental Protection Agency issued its final rule for spark-ignited marine engines, including outboard motors (U.S. EPA 1996). This rule calls for manufacturers to phase in lower emission engines, which will be completed by 2007. This conversion will be accomplished by replacing relatively dirty carbureted two-stroke engines with fuel injected two-strokes or four stroke engines. Although the four-stroke engines produce more nitrogen oxides (NO_x), their overall emissions and their contribution to ozone formation is substantially lower. All outboard motors used in the Grand Canyon are four-stroke engines and thus already meet these more stringent standards. The use of personal watercraft ("jet skis") is prohibited within the park (36 CFR 1.5, "Compendium of Designations, Closures, Use and Activity Restrictions, Permit Requirements and Other Regulations" September 1998).

4.2.3.3 MANAGEMENT OBJECTIVE FOR AIR QUALITY

Management objectives for the *Colorado River Management Plan* are included in Chapter 1. The objective for air quality is to ensure that exhaust emissions from river recreation-related craft do not degrade ambient air quality or adversely affect air quality related values, such as visibility, human and ecological health, and cultural resources.

4.2.3.4 METHODOLOGY FOR ANALYZING EFFECTS TO AIR QUALITY

The general process for assessing impacts to the environment is discussed in Section 4.1 of Chapter 4. Effects specific to air quality are characterized for each alternative based on the impact thresholds presented below. Additionally, each alternative was evaluated to determine whether effects would be direct or indirect.

Emissions were calculated for volatile organic compounds (VOC), carbon monoxide (CO), nitrogen oxides (NO_x), fine particulates less than ten micrometers in aerodynamic diameter (PM_{10}), and sulfur dioxide (SO_2). ***After release of the Draft Environmental Impact Statement, errors were found in the outboard motor calculations.*** Outboard motor emissions were ***re***calculated for a four-stroke 30 horsepower gasoline engine operating at 21% load using ***EPA*** emission factors ***(US EPA 2004). The corrected emissions made a substantial difference in air quality impact determinations (especially for carbon monoxide) in this Final Environmental Impact Statement***. Table 4- 7 summarizes outboard motor use trip variables applied to the different alternatives.

TABLE 4- 7: OUTBOARD MOTOR TRIP VARIABLES

Trip Type	Motor Hours	Motors per Trip
Lees Ferry to Diamond Creek motor trips	54	1.6
Lower Gorge commercial (80% of trips)	12	1.6
Lower Gorge noncommercial (10% of trips)	12	1.6
HRR day trips	6	1
HRR overnight trips	12	1
Pontoon tours	0.33	1

Jetboat emissions for the Lower Gorge alternatives were calculated for the same pollutants except SO_2 assuming an average trip of two hours for jetboat tours and four hours for the tow-outs, using a single, 10-year-old, 725-horsepower marine diesel engine at 35% load and emission factors developed by the U.S. Environmental Protection Agency (US EPA 2002).

Aircraft emissions for Whitmore exchanges (Lees Ferry alternatives A, E–H) were calculated from one fixed-wing Dornier 288 aircraft making two flights per day, six days per week during the commercial season, and a Bell Jetrunner Helicopter making eight flights per day, six days per week during the commercial season, using the EDMS Modeling System (Heaton pers. comm., 2003). Helicopter emissions at Quartermaster (all Lower Gorge alternatives) were calculated using a Bell Jetrunner helicopter within the EDMS Modeling System to simulate helicopter takeoffs and landings (see Appendix E).

Campfire emissions for the Lees Ferry alternatives were calculated based on one fire per trip per night during the winter, one fire every other night during the shoulder seasons, and no campfires during the summer. Each fire was estimated to consume 10 pounds of wood. Emission factors were derived from the park's 2000 microinventory (EA Engineering, Science, and Technology, 2002). ***Campfire emissions below*** Diamond Creek were calculated using the same method. However, due to different reporting methods, winter and shoulder seasons were not identified separately, so it was assumed there would be three campfires for every four non-summer nights spent camping per trip.

A table for each alternative shows emissions and the numbers of watercraft, aircraft, and campfires that form the basis for the ***impact analyses***. The numbers of watercraft, aircraft, and campfires were calculated by multiplying the expected number each day by the number of days to get a yearly total. In the case of aircraft, the number of aircraft is for helicopter shuttles of river passengers and is based upon the number of passengers allowed each day divided by five passengers per flight.

A calculation referred to as SUM06 (parts per million per hour) was used for evaluating the impacts of ozone. The highest three-month, five-year average commonly used for the area was determined by comparing ambient air quality data collected on the South Rim near Grand Canyon Village (available from the NPS Air Resources Division) to the Environmental Protection Agency proposed SUM06 level of 25 parts per million per hour (ppm/hr) that is associated with injury effects on vegetation.

Visibility impacts were determined by assessing particulate matter levels from local monitoring data, and from qualitative evidence such as personal observations and photographs.

Cumulative impacts were analyzed qualitatively and quantitatively. Emissions from river recreation were examined in the context of pollutant-specific monitoring conducted within the park and an emission microinventory of the park conducted for calendar year 2000 augmented with river-specific data (see Chapter 3). Wildland fire emissions were not considered for the analysis, since these emissions vary tremendously over the course of the year and between years. In addition, many fire emissions are part of the natural ecological process in many park forests. The cumulative impact analysis also considers emissions from Clark County, Nevada (Las Vegas) qualitatively to assess ambient air quality conditions in the western Grand Canyon (Lower Gorge alternatives). Although emissions from river-related activities do not drive pollutant concentrations in Clark County, the canyon is usually downwind of this area. Consequently, ambient conditions in Clark County have a profound influence on the background pollution levels into which Lower Gorge emissions occur. The analysis did not consider specific emissions from point sources, such as the Navajo Generating Plant near Page, Arizona and the Mohave Power Project near Laughlin, Nevada.

4.2.3.4.1 Impact Thresholds

Impact thresholds for air quality depend on the type of pollutants produced, the background air quality, and the resources in the environment that may be affected by airborne pollutants (air quality related values). Air quality related values include "visibility and those scenic, cultural, biological, and recreation resources of an area that are affected by air quality" (43 FR 15016). Impacts are also affected by the spatial and temporal extent under which they occur.

Impact thresholds may be qualitative, such as photos of degraded visibility. They can also be quantitative, based on impacts on air quality related values or federal air quality standards, or emissions based on emission factor models. The types of thresholds used in an analysis depend on what type of information is appropriate or available.

Impact Intensity

The Environmental Protection Agency has established standards that are regulated by states to protect human health and the environment. Consequently, two categories of potential airborne pollution impacts from recreational use of the Colorado River in Grand Canyon are analyzed for determining impact intensities. They include: (1) impacts on human health; and (2) impacts on air quality related values in the canyon. Impact intensity thresholds for each impact category are discussed below.

Established threshold levels of total emissions that would characterize the significance criteria for mobile sources (such as helicopters and outboard motors) are not available. Therefore, estimates of total annual emissions under each alternative were compared to prevention of significant deterioration thresholds established in the Clean Air Act (40 CFR 51.166 (b)(1)(i)(b)) for stationary sources. Under prevention of significant deterioration, a major stationary source is:

- Any source in a fixed location that emits at least 250 tons per year of any pollutant regulated under the *Clean Air Act*; or
- Any source of 28 EPA-specified source categories that emit at least 100 tons per year of any regulated criteria pollutant.

The NPS has applied these prevention of significant deterioration stationary thresholds as significance criteria for non-road mobile sources for this analysis following the format used to evaluate personal watercraft in Glen Canyon National Recreation Area (NPS 2003f).

Human Health Effects from Airborne Pollutants. Based on the national standards and the methods described above, the following impact intensity thresholds for human health effects from airborne pollutants were defined. To assess a level of impact on human health from airborne pollutants, both the emissions of each pollutant related to recreational activity on the Colorado River, and the background air quality were evaluated and then considered according to the thresholds defined below.

Air Quality Related Values. Impacts on environmental resources and values include visibility and biological resources (specifically ozone effects on plants) that may be affected by airborne pollutants emitted by recreational use. These pollutants include ozone, nitrogen oxides, total hydrocarbons, and particulate matter. Particulate matter and nitrogen oxide emissions are evaluated for visibility impairment. Volatile organic compounds and nitrogen oxides are precursors to the formation of ozone and are evaluated in lieu of ozone ***since ozone forms*** as a secondary pollutant.

	Activity Analyzed *(Direct Impacts)*		**Current Air Quality** *(Cumulative Indirect Impacts)*
Negligible:	Emission levels would be less than 50 tons per year for each pollutant.	**and**	The first highest three-year maximum for each pollutant is less than 60% of the national ambient air quality standards.
Minor:	Emission levels would be less than 100 tons per year for each pollutant.	**and**	The first highest three-year maximum for each pollutant is less than 80% of the national ambient air quality standards.
Moderate:	Emission levels would be greater than or equal to 100 tons per year for any pollutant.	**or**	The first highest three-year maximum for each pollutant is greater than 80% of the national ambient air quality standards.
Major:	Emission levels would be greater than or equal to 250 tons per year for any pollutant.	**and**	The first highest three-year maximum for each pollutant is greater than 80% of the national ambient air quality standards.

To assess the impact of ozone on plants, the five-year ozone index value was calculated and is represented as SUM06. The NPS Air Resources Division, based on local monitoring site data, developed SUM06 values used in this analysis.

To assess a level of impact on air quality related values from airborne pollutants, both the emissions of each pollutant related to motorized activity and the background air quality were evaluated and then considered according to the intensity thresholds defined below.

	Activity Analyzed *(Direct Impacts)*		Current Air Quality *(Cumulative or Indirect Impacts)*
Negligible:	Emission levels would be less than 50 tons per year for each pollutant. or No visibility impacts (exhaust plumes, exhaust odors, haze) are produced.	**and**	There are no perceptible visibility impacts (photos or anecdotal evidence) and There is no observed ozone injury to plants; and SUM06 ozone is less than 12 parts per million per hour (ppm/hr).
Minor:	Emission levels would be less than 100 tons per year for each pollutant. and Visibility and odor impacts are of very short duration and limited aerial extent.	**and**	SUM06 ozone is less than 15 ppm/hr.
Moderate:	Emission levels would be greater than 100 tons per year for any pollutant. or Visibility impacts from cumulative emissions would be likely (based on past visual observations).	**or**	Ozone injury symptoms are identifiable on plants. and SUM06 ozone are less than 25 ppm/hr.
Major:	Emission levels would be equal to or greater than 250 tons per year for any pollutant. or Visibility impacts from cumulative emissions would be likely (based on modeling or monitoring).	**and**	Ozone injury symptoms are identifiable on plants. or SUM06 ozone is greater than 25 ppm/hr.

Context

Regional impacts from recreational activities have been considered along the entire river corridor in Grand Canyon, such as outboard motor exhaust from downstream travel. Localized impacts would occur in the immediate vicinity of sources producing air pollutants, such as campfires, or in a nearby area affected by a concentration of sources, such as attraction sites, launch or takeout areas, or exchange points.

Duration

Air quality is in a state of constant flux, responding to the production of air pollutants and the atmosphere's ability to disperse, dilute, or remove those pollutants. All alternatives produce some air pollution year-round, although the Lees Ferry alternatives would produce very little during those times when motors were not allowed (ranging from 3 to 12 months of the year). Local impacts, like an exhaust plume, generally dissipate quickly. Local haze and pollutant concentrations are very responsive to pollution production, and the pollutants are generally removed from the canyon over a period of hours (in summer) to a few days (during winter inversion episodes). Other impacts, such as leaf damage by ozone, are cumulative over the growing season.

Timing

Most emissions are generated during the daytime hours where dispersion is generally greater. Time of day has a bearing on effects to air quality since winds in the canyon often blow upstream during the day and downstream at night. Seasonal conditions such as winter stagnation periods would tend to reduce the potential for dispersion resulting in potentially greater impacts. Winter cold fronts and high spring winds tend to disperse river-related pollutants rapidly, removing them from the canyon in a few days at most.

4.2.3.4.2 Mitigation of Effects

Previous mitigation efforts indicate that specific measures can be effective in reducing impacts to air quality, if adequate funding, staffing, monitoring, and implementation of the measures are maintained. ***A list of possible mitigation measures to be considered singly or in combination, that are not already incorporated into the alternatives, but are judged likely to reduce impacts to air quality if implemented include the following***:

- Spreading use to reduce peak concentrations of air pollutants
- Use of cleaner-burning fuels and engines
- ***Where feasible***, substitution of non- or less-polluting methods of power (i.e., use of oars instead of motors)
- Not allowing engines to idle unnecessarily
- ***Collect baseline information and monitor sensitive plant species in the river corridor for leaf injury from ozone exposure***
- ***Continue NPS engagement with local, state, tribal, and federal air quality regulators to reduce air pollution transported into the park***
- ***Reduce campfire use***

In addition to direct mitigation measures, monitoring pollutant concentrations and effects of air pollution on park resources provide important information to assess real world conditions. Results might suggest strategies as appropriate (or inappropriate) for dealing with observed conditions ***and addressing these problems with regulatory agencies***.

Additional mitigation actions common to all Lees Ferry alternatives include the following:

- Measure CO levels at attraction and exchange sites to ensure levels measured on the South Rim are representative of the river corridor

Additional mitigation actions common to all Lower Gorge alternatives include the following:

- Measure CO and ozone levels at attraction and exchange sites to establish better relationships between levels in the river corridor and those at the South Rim and in Clark County
- Continue monitoring ozone and PM_{10} at Meadview to characterize ambient conditions in the Lower Gorge

4.2.3.4.3 Cumulative Impacts

Air quality in the Grand Canyon area is generally good, but pollution levels are high enough to create haze that often reduces visibility. Most of this visibility degradation is attributable to a widespread, homogeneous haze from a multitude of sources (U.S. EPA 1999) that is transported to the area predominantly from industrial and metropolitan sources in southern Arizona, Nevada, California, and northern Mexico (EA Engineering, Science, and Technology 2002). These sources are outside the park's and the tribe's direct influence and control and are the subject of a collaborative pollution-reduction effort by western states, tribes, and the federal government.

Road vehicles, wildland fires, and prescribed burning are the chief sources of emissions in the park overall. Within the river corridor, sources of pollutants include motorized boats, helicopters, and campfires in the winter that can attribute to localized haze due to temperature inversions.

4.2.3.4.4 Assumptions

General assumptions used for analysis of effects from each alternative are discussed in the Section 4.1. Assumptions that specifically relate to the alternatives in this document and their effect on air quality are presented below:

- Watercraft emissions are assumed to be constant, not changing in response to river flows. Although different flow regimes cause more or less use of outboard motors on river trips, data to define the relationships between flows, motor use, and trip lengths are not available.
- All outboard engines are assumed to be four-stroke engines.
- No engine degradation or nonexhaust total hydrocarbon/volatile organic compound emissions were considered in the emission estimates. Nonexhaust hydrocarbon emissions from watercraft are less than exhaust emissions but are not negligible. For watercraft, the

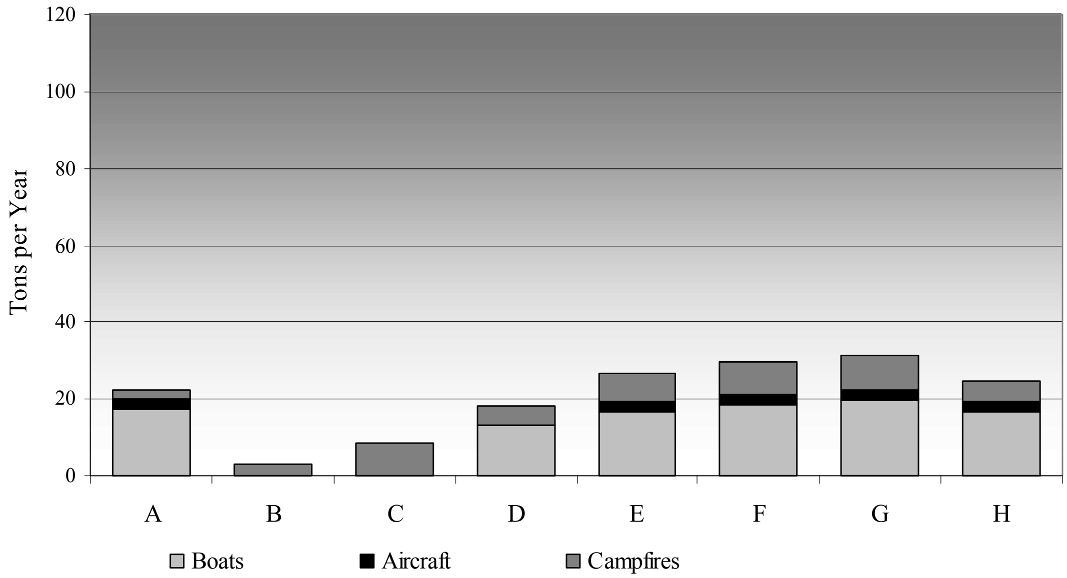
principal sources of nonexhaust emissions are evaporative emissions from fuel tanks when the engine is not in use and refueling emissions. The quantities of these emissions are related to the number of pieces of equipment, number of trips, and watercraft fuel tank volume.

- Current engine types are assumed for all alternatives. Although other technologies have been discussed and even tested to varying degrees (i.e., electric motors, hydrogen fuel cells), these options are still unproved and their applications hypothetical during the analysis period.
- Emissions from up lake recreational boating from Lake Mead are not analyzed as part of the alternatives. With fluctuating lake levels, this use can vary dramatically, but this variation is independent from the plan alternatives. Adjacent waters of Lake Mead will be zoned “rural natural” or “semi-primitive” depending on the final decisions of this environmental impact statement, and the use of noncarbureted two-stroke engines will be prohibited on Lake Mead after 2012 (NPS 2002b).
- Recreational use of the Colorado River will remain at the permitted levels (emissions will not change significantly) over the life of the plan. ***The only exception is for Lower Gorge Modified Alternative 4, in which a defined increase may occur, based on performance reviews. Both lower and higher levels were modeled for this alternative. For any alternative, permitted levels (modeled for this EIS) may change in response to future management issues. However, the need for, magnitude and direction of these changes cannot be defined for emission modeling.***
- Helicopters used for passenger exchanges at Whitmore and Quartermaster land and take off solely on Hualapai Tribe lands. In the case of Quartermaster, the Hualapai Tribe has indicated that helicopter flights will occur in that area independent of the alternatives considered in this document and independent of whether any of the helicopter passengers are also river passengers.

4.2.3.5 Impact Analysis—Lees Ferry Alternatives

Total emissions for each of these alternatives are summarized in ***Figure 4-1***. ***Direct impacts on air quality for any of these alternatives is negligible, since total emissions of all pollutants are well below the 50 tons/year threshold***. To assess cumulative impacts, air pollution generated under Alternative 1 for the Lower Gorge was used in calculating existing total park emissions. The potential for impacts for the Lees Ferry alternatives are based on comparison among Lees Ferry alternatives.

FIGURE 4-1: EMISSIONS DUE TO RECREATIONAL RIVER USE ABOVE DIAMOND CREEK



4.2.3.5.1 Alternative A (Existing Condition)

Analysis. Under Alternative A management of recreational use would remain relatively similar to current levels. Use would remain concentrated during the summer months (May–October). A mix of nonmotorized and motorized trips would continue to be allowed for nine months of the year, with a three-month no-motor season in the fall. Whitmore helicopter exchanges would continue. Estimated emissions under Alternative A, and their relationship to total emissions in Grand Canyon National Park, are presented in Table 4- 8.

TABLE 4- 8*: ALTERNATIVE A EMISSIONS*

tons/year

	Launches	VOC	CO	NO_x	PM_{10}	SO_2
Watercraft	***894***	***0.71***	***16.11***	***0.35***	***<0.01***	***0***
Aircraft	1,660	0.21	1.39	0.98	0.03	0.13
Campfires		1.10	1.21	0.01	0.17	***<0.01***
Total	***2554***	***2.02***	***18.71***	***1.35***	***0.20***	**0.13**
Percentage of Park Total		***1.09%***	***2.51%***	***1.32%***	***0.34%***	4.06%

Human Health Impacts from Airborne Pollutants—Emissions of all pollutants would be much less than 50 tons per year, making impacts on human health negligible. Current ozone concentrations in the park are greater than 80% of the 8-hour ozone standard, resulting in adverse, moderate impacts to human health. Ozone concentrations are driven by NO_x and VOC emissions, but only negligible amounts of these pollutants would be generated annually under this alternative. Although these emissions contribute to ozone production, their contributions under this alternative would be negligible and would not be expected to change the park's attainment status for ozone.

Air Quality Related Values Impacted by Airborne Pollutants—Emissions of all pollutants are much less than 50 tons a year, making their adverse impacts on air quality related values generally negligible. During the motor season, exhaust odors and plumes may occur under calm weather conditions at attraction sites, but dissipate rapidly, with negligible to minor adverse impacts. Localized, seasonal campfire plumes and odors also dissipate quickly, and are generally not considered objectionable. Visibility within the park is usually below natural levels, indicating moderate impacts, but the small amount of PM_{10} emitted under Alternative A would have a negligible adverse contribution to visibility problems. Ozone exposure statistics for the park are well above 25 ppm/hr, which indicates a potentially major adverse impact on plants. Nearly all ozone in the park is the result of emissions upwind of the park (see "Cumulative Effects"). The low combined NO_x and VOC emissions would result in a negligible contribution to these elevated exposures as they react to produce ozone.

Mitigation of Effects. See air quality mitigation actions common to all alternatives and common to all Lees Ferry alternatives beginning on page ***323***.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter.

Emissions from recreational use of the Colorado River under Alternative A make a generally small (less than 5%) contribution to air pollution produced in the Grand Canyon ***with*** a negligible adverse effect on human health. Cumulative ***health*** impacts ***would continue*** from high ozone exposure levels, ***but*** this alternative makes ***only*** a negligible, adverse ***contribution***. Cumulatively, the effects of Alternative A ***on air quality related values***, when combined with these other past, present, and reasonably foreseeable actions, would continue to be adverse, regional, and moderate ***due to*** ozone exposure levels and degraded visibility. ***However,*** Alternative A would make ***only a negligible*** adverse, contribution to these cumulative effects.

Conclusion. ***Direct impacts of air pollutants*** produced by continuing current recreational use of the Colorado River under Alternative A would have ***negligible*** adverse, localized, impacts on human health and adverse to minor impacts on air quality related resources. ***Cumulative impacts of air pollution on human health and air quality related resources would remain at essentially current levels since*** emissions from Alternative A would result in a negligible, adverse, regional contribution to these exposures. ***Alternative A would not result in the impairment of air quality and its related resources in Grand Canyon National Park.***

4.2.3.5.2 Alternative B

Analysis. Under Alternative B, recreational motor trips are prohibited, eliminating watercraft air pollutant emissions. Group sizes, trips and people at one time, daily launches, user-days, and estimated total yearly passengers would be at their lowest (see ***Table 4-*** 1), reducing campfire emissions. Trip lengths would be substantially reduced from current conditions, although user discretionary time would increase from current levels. There would be no passenger exchanges at Whitmore, eliminating aircraft emissions. Consequently, Alternative B would have the lowest air pollutant emissions of the Lees Ferry alternatives. Estimated emissions under Alternative B, and their relationship to total emissions in Grand Canyon National Park, are presented in Table 4- 9.

TABLE 4- 9*: ALTERNATIVE B EMISSIONS*

tons/year

	Launches	VOC	CO	NO_x	PM_{10}	SO_2
Watercraft	***735***	0	0	0	0	0
Aircraft	0	0	0	0	0	0
Campfires		1.33	1.47	0.02	0.20	***<0.01***
Total	***735***	**1.33**	**1.47**	**0.02**	**0.20**	***<0.01***
Percentage of Park Total		***0.72%***	***0.20%***	***0.02%***	0.34%	0.07%
Change from Alternative A (Current Conditions)						
Alternative B		***-34%***	***-92%***	***-99%***	***-1%***	-98%
Total Park		***-0%***	***-2%***	***-1%***	0%	-4%

Human Health Impacts from Airborne Pollutants—Emissions of all pollutants would be much less than 50 tons per year, making their ***direct*** impacts on human health negligible. ***Cumulatively,*** current ozone concentrations in the park are greater than 80% of the 8-hour ozone standard, producing moderately adverse impacts to human health. Ozone concentrations would be driven by NO_x and VOC emissions, but only negligible amounts of these pollutants would be generated under Alternative B annually. Although these emissions would contribute to ozone production, their contributions under this alternative would be negligible and would not change the park's attainment status for ozone.

Air Quality Related Values Impacted by Airborne Pollutants—Emissions of all pollutants would be much less than 50 tons a year, making their ***direct*** impacts on air quality related values negligible. No exhaust odors or plumes would occur. Localized campfire plumes and odors dissipate quickly and are generally not considered objectionable. ***Cumulatively,*** visibility within the park is usually below natural levels, indicating moderate impacts, but the minuscule amount of PM_{10} emitted under this alternative would result in a negligible adverse contribution to visibility problems. Ozone exposure statistics for the park are well above 25 ppm/hr, which indicates a potentially major adverse impact on plants. Nearly all ozone in the park is the result of emissions upwind of the park (see "Cumulative Effects"). The low combined NO_x and VOC emissions under Alternative B would result in a negligible (essentially unmeasurable) contribution to these elevated exposures.

Mitigation of Effects. See air quality mitigation actions common to all alternatives and common to all Lees Ferry alternatives beginning on page ***323***.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter.

Emissions from recreational use of the Colorado River under Alternative B would make a tiny (less than 1%) contribution to air pollution produced in Grand Canyon. Overall production of all pollutants in the canyon would be reduced from current levels, causing a negligible but beneficial impact on air quality. The most serious cumulative impacts would result from continued high ozone exposure levels. Reductions in VOC and NO_x production under Alternative B would have a negligible beneficial impact on ozone exposures. Cumulatively, the effects of Alternative B, when combined with these other past, present, and reasonably foreseeable actions, would continue to be adverse, regional, and moderate from ozone exposure levels and degraded visibility. Alternative B would make a beneficial, negligible (essentially unmeasurable) contribution to these cumulative effects.

Conclusion. Reduced levels of VOCs, CO, SO_2, PM_{10} and NO_x that would be produced under Alternative B would have ***negligible*** beneficial, long-term, impacts on human health and air quality related resources. ***Cumulative impacts of air pollution on human health and air quality related resources would remain at essentially current levels, since emission reductions under Alternative B would result in a negligible, beneficial, regional contribution to these exposures. Alternative B would not result in the impairment of air quality and its related resources in Grand Canyon National Park.***

4.2.3.5.3 Alternative C

Analysis. Under Alternative C visitor use would increase compared to Alternative B; however, air quality impacts would be largely the same. Motorized watercraft would not be permitted, and passenger exchanges at Whitmore would be by hiking, not aircraft. Increases in use during the shoulder and winter months would triple the number of campfires compared to current conditions, thus increasing campfire emissions. Estimated emissions under Alternative C, and their relationship to total emissions in Grand Canyon National Park, are presented in Table 4- 10**.**

TABLE 4- 10*: ALTERNATIVE C EMISSIONS*

tons/year

	Launches	VOC	CO	NO_x	PM_{10}	SO_2
Watercraft	***1,094***	0	0	0	0	0
Aircraft	0	0	0	0	0	0
Campfires		***3.67***	***4.05***	0.04	***0.55***	0.01
Total	**1,094**	***3.67***	***4.05***	**0.04**	***0.55***	**0.01**
Percentage of Park Total		***1.97%***	***0.55%***	0.04%	***0.93%***	***0.021%***
Change from Alternative A						
Alternative C		***82%***	***-78%***	***-97%***	***179%***	-95%
Total Park		***1%***	***-2%***	***-1%***	1%	-4%

Human Health Impacts from Airborne Pollutants—Emissions of all pollutants would be much less than 50 tons per year, making their impacts on human health negligible. Current ozone concentrations in the park are greater than 80% of the 8-hour ozone standard, producing moderately adverse impacts to human health. Ozone concentrations would be driven by NO_x and VOC emissions, but only negligible amounts of these pollutants would be generated under Alternative C annually. Although these emissions contribute to ozone production, their contributions under this alternative would be negligible and would not change the park's attainment status for ozone.

Air Quality Related Values Impacted by Airborne Pollutants—Emissions of all pollutants would be much less than 50 tons a year, making their impacts on air quality related values negligible.

No exhaust odors and plumes would occur. Localized seasonal campfire plumes and odors dissipate quickly and are generally not considered objectionable. Visibility within the park is usually below natural levels, indicating moderate impacts, but the amount of PM_{10} emitted under Alternative C would result in a negligible, seasonal, adverse contribution to visibility problems. Ozone exposure statistics for the park are well above 25 ppm/hr, which indicates a potentially major adverse impact on plants. Nearly all ozone in the park is the result of emissions upwind of the park (see “Cumulative Effects”). The low combined NO_x and VOC emissions under Alternative C would result in a negligible (essentially unmeasurable) contribution to these elevated exposures.

Mitigation of Effects. See air quality mitigation actions common to all alternatives and common to all Lees Ferry alternatives beginning on page ***323***.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter.

Emissions from recreational use of the Colorado River under Alternative C would result in a small (less than 2%) contribution to air pollution produced in Grand Canyon. PM_{10} emissions from river-related activities would be substantially higher than current emissions, their contribution to overall park emissions would only be 1%, causing a negligible adverse impact on visibility. The most serious cumulative impacts would continue to result from high ozone exposure levels. ***An increase in combined*** VOC and NO_x production under Alternative C would have a negligible ***adverse*** impact on ozone exposure. Cumulatively, the effects of Alternative C, when combined with these other past, present, and reasonably foreseeable actions, would continue to be adverse, regional, and moderate from ozone exposure levels and degraded visibility. Alternative C would make a ***negligible*** contribution to these cumulative effects.

Conclusion. ***Although some pollutant emissions increase while others decrease*** under Alternative C, ***overall direct impacts on human health*** and air quality related resources are negligible. ***Cumulative impacts would remain essentially unchanged because of the negligible contributions of pollutants under Alternative C, and the small changes relative to current exposures. Alternative C would not result in impairment of air quality or its related values in Grand Canyon National Park.***

4.2.3.5.4 Alternative D

Analysis. Under Alternative D moderate user-day levels are projected, with a mid-range of trips at one time and low levels of people at one time. There would be a mix of motorized and nonmotorized trips, with four motor-free months (March-April, September-October). Passenger exchanges at Whitmore would by hiking, eliminating aircraft emissions. Increased use in the shoulder and winter seasons would double the number of campfires compared to current conditions. Estimated emissions under Alternative D, and their relationship to total emissions in Grand Canyon National Park, are presented in ***Table 4-*** 11**.**

TABLE 4- 11*: ALTERNATIVE D EMISSIONS*

tons/year

	Launches	VOC	CO	NO_x	PM_{10}	SO_2
Watercraft	***1,010***	***0.54***	***12.28***	***0.27***	***<0.01***	0
Aircraft	0	0	0	0	0	0
Campfires		***2.27***	***2.50***	0.03	***0.34***	***<0.01***
Total	***1,010***	***2.81***	***14.78***	***0.30***	***0.34***	***<0.01***
Percentage of Park Total		***1.51%***	***1.99%***	***0.29%***	***0.58%***	***0.13%***
Change from No-Action Alternative						
Alternative		***39%***	***-21%***	***-78%***	***73%***	-97%
Total Park		0%	***-1%***	-1%	0%	-4%

Human Health Impacts from Airborne Pollutants— Emissions of all pollutants would be much less than 50 tons a year, making ***direct*** adverse impacts on air quality related values negligible. Current ozone concentrations in the park are greater than 80% of the 8-hour ozone standard, producing moderate adverse impacts to human health. Ozone concentrations would be driven by NO_x and VOC emissions, but only negligible amounts of these pollutants would be generated under this alternative annually. Although these emissions contribute to ozone production, their contributions under this alternative would be negligible and would not change the park's attainment status for ozone.

Air Quality Related Values Impacted by Airborne Pollutants—Emissions of all pollutants would be much less than 50 tons a year, making ***direct*** adverse impacts on air quality related values negligible. During the motorized use season exhaust odors and plumes could occur under calm weather conditions at attraction sites, but tend to dissipate rapidly, with negligible to minor, adverse, local impacts. Localized campfire plumes and odors also dissipate quickly, and are generally not considered objectionable. Visibility within the park is usually below natural levels, indicating moderate impacts, but the small amount of PM_{10} emitted under Alternative D would result in a negligible contribution to visibility problems. Ozone exposure statistics for the park would continue to be well above 25 ppm/hr, which indicates a potentially major adverse impact on plants. Nearly all ozone in the park is the result of emissions upwind of the park (see "Cumulative Effects"). The low combined NO_x and VOC emissions make a negligible contribution to these elevated exposures.

Mitigation of Effects. See air quality mitigation actions common to all alternatives and common to all Lees Ferry alternatives beginning on page ***323***.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter.

Emissions from recreational use of the Colorado River under Alternative D would result in a generally small (less than ***2%***) contribution to air pollution produced in the Grand Canyon. Implementation of Alternative D would reduce overall park emissions of CO, NO_x, and SO_2. These decreases would produce a negligible, but beneficial, cumulative impact. Overall park emissions of VOCs and PM_{10} would remain essentially unchanged from current conditions. The most serious cumulative impacts would result from high ozone exposure levels, to which this alternative would result in a negligible, beneficial impact by its small reduction in ***combined***

VOC and NO_x emissions. Cumulatively, the effects of Alternative D, when combined with these other past, present, and reasonably foreseeable actions, would continue to be adverse, regional, and moderate from ozone exposure levels and degraded visibility. Alternative D***'s emission reductions*** would make a negligible, ***although beneficial*** contribution to these cumulative effects.

Conclusion. Reduced overall park emissions of CO, SO_2, and NO_x ***and unchanged emissions of*** PM_{10} ***and VOCs*** under Alternative D would have ***negligible,*** beneficial, local impacts on human health and air quality related resources. ***Cumulative air pollution impacts would remain at essentially current levels due to the negligible, although beneficial, reductions in some pollutants' contributions to those exposures***. Alternative D would not result in the impairment of air quality and related resources in Grand Canyon National Park.

4.2.3.5.5 Alternative E

Analysis. Under Alternative E longer trip lengths result in lower maximum numbers of trips and people at one time, with mid-range numbers of user-days and user discretionary time. River trips would use a mix of motorized and nonmotorized watercraft for half the year, with motors prohibited from October through March. Although passenger exchanges at Whitmore would be allowed year-round, helicopter exchanges would be prohibited in the nonmotor season (October through March). Increased river recreation in the shoulder and winter months relative to current patterns would result in a tripling of campfires from current levels. Estimated emissions under Alternative E, and their relationship to total emissions in Grand Canyon National Park, are presented in Table 4- 12.

TABLE 4- 12*: ALTERNATIVE E EMISSIONS*

tons/year

	Launches	VOC	CO	NO_x	PM_{10}	SO_2
Watercraft	***1,173***	***0.69***	***15.68***	***0.34***	***<0.01***	0
Aircraft	1,660	0.21	1.39	0.98	0.03	0.13
Campfires		***3.14***	***3.47***	0.04	***0.48***	0.01
Total	***2,833***	***4.04***	***20.54***	***1.36***	**0.51**	**0.14**
Percentage of Park Total		***2.16%***	***2.75%***	***1.34%***	***0.85%***	4.16%
Change from Alternative 1						
Alternative		***100%***	***10%***	***1%***	***155%***	3%
Total Park		1%	***0%***	0%	1%	0%

Human Health Impacts from Airborne Pollutants—Emissions of all pollutants would be much less than 50 tons per year, making ***direct*** adverse impacts on human health negligible. Current ozone concentrations in the park are greater than 80% of the 8-hour ozone standard, producing moderate adverse impacts to human health. Ozone concentrations are driven by NO_x and VOC emissions, but only negligible amounts of these pollutants would be generated annually under this alternative. Although these emissions would contribute to ozone production, their negligible emissions under this alternative would not be expected to change the park's attainment status for ozone.

Air Quality Related Values Impacted by Airborne Pollutants—Emissions of all pollutants would be much less than 50 tons a year, making adverse impacts on air quality related values negligible. During the motor season, exhaust odors and plumes could occur under calm weather conditions at attraction sites, but should dissipate rapidly since use would be during non-winter months, resulting in adverse, local, negligible to minor impacts. Localized, seasonal campfire plumes and odors also dissipate quickly and would generally not be considered objectionable. Visibility within the park is usually below natural levels, indicating moderate impacts, but the small amount of PM_{10} emitted under Alternative E would have a negligible, adverse, generally local and in-season contribution to visibility problems. Ozone exposure statistics for the park are well above 25 ppm/hr, which indicates a potentially major, adverse, regional impact on plants. Nearly all ozone in the park is the result of emissions upwind of the park (see "Cumulative Effects"). The low combined NO_x and VOC emissions make a negligible contribution to these elevated exposures.

Mitigation of Effects. See air quality mitigation actions common to all alternatives and common to all Lees Ferry alternatives beginning on page ***323.***

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter.

Emissions from recreational use of the Colorado River under Alternative E would result in a generally small (less than 5%) contribution to air pollution produced in the Grand Canyon. ***Although there is a*** large percentage increase in VOC and PM_{10} emissions above current conditions ***(Alternative A), implementing Alternative E*** would still drive only a 1% change in total park emissions for those pollutants, so adverse impacts from this change would probably not be measurable. The most serious cumulative impacts would result from high ozone exposure levels, to which this alternative would contribute a negligible amount due to a small increase in ***combined*** VOC ***and*** NO_x ***emissions.*** Cumulatively, the effects of Alternative E, when combined with these other past, present, and reasonably foreseeable actions, would continue to be adverse, regional, and moderate from ozone exposure levels and degraded visibility. Alternative E would make an adverse, negligible contribution to these cumulative effects.

Conclusion. Overall park emissions under Alternative E would remain virtually the same as current conditions. ***Direct impacts to human health and resource related values would be negligible, although adverse. Cumulative air pollution impacts would remain at essentially current levels due to the negligible, although adverse, increases in some pollutants' contributions to those exposures.*** Alternative E would not result in the impairment of air quality and related resources in Grand Canyon National Park.

4.2.3.5.6 Alternative F

Analysis. Under Alternative F use patterns would generally result in a mid-range level of user-days, trips and people at one time, and user discretionary time. A mix of motorized and nonmotorized use would occur for the first half of the year, and motorized watercraft and Whitmore exchange aircraft would be prohibited from July through September. Increased non-summer recreational use would triple the number of expected campfires from current levels.

Estimated emissions under Alternative F, and their relationship to total emissions in Grand Canyon National Park, are presented in ***Table 4-*** 13**.**

TABLE 4- 13*: ALTERNATIVE F EMISSIONS*

tons/year

	Launches	VOC	CO	NO_x	PM_{10}	SO_2
Watercraft	***1,231***	***0.77***	***17.50***	***0.38***	***<0.01***	0
Aircraft	1,660	0.21	1.39	0.98	0.03	0.13
Campfires		***3.74***	***4.13***	0.04	0.57	0.01
Total	***2,891***	***4.72***	***23.02***	***1.41***	***0.60***	**0.14**
Percentage of Park Total		***2.52%***	***3.07%***	***1.38%***	***1.00%***	4.19%
Change from Alternative 1						
Alternative		***134%***	***23%***	***5%***	***201%***	***3%***
Total Park		1%	1%	0%	1%	0%

Human Health Impacts from Airborne Pollutants— Emissions of all pollutants would be much less than 50 tons per year, resulting in ***negligible,*** adverse ***direct*** impacts ***on*** human health**.** ***Cumulative current*** ozone concentrations in the park are greater than 80% of the 8-hour ozone standard, resulting in moderate adverse impacts to human health. Ozone concentrations are driven by NO_x and VOC emissions, but only negligible amounts of these pollutants would be generated annually under this alternative. Although these emissions would contribute to ozone production, their negligible emissions under this alternative would not change the park's attainment status for ozone.

Air Quality Related Values Impacted by Airborne Pollutants—Emissions of all pollutants would be much less than 50 tons a year, resulting in adverse, negligible impacts on air quality related values. Exhaust odors and plumes could occur under calm weather conditions at attraction sites during the motor season, but would dissipate rapidly, with adverse, local, negligible to minor impacts. Localized campfire plumes and odors would also dissipate quickly, and are generally not considered objectionable. Visibility within the park is usually below natural levels, indicating moderate impacts, but the small amount of PM_{10} emitted under Alternative F would result in a negligible, seasonal, adverse contribution to visibility problems. Ozone exposure statistics for the park are well above 25 ppm/hr, which indicates a potentially major, adverse, regional impact on plants. Nearly all ozone in the park is the result of emissions upwind of the park (see "Cumulative Effects"). The low increase in combined NO_x and VOC emissions would have a negligible adverse contribution to these elevated exposures.

Mitigation of Effects. See air quality mitigation actions common to all alternatives and common to all Lees Ferry alternatives beginning on page ***323.***

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter.

Emissions from recreational use of the Colorado River under Alternative F would have a generally small (less than 5%) contribution to air pollution produced in Grand Canyon. The large percentage increases in VOC and PM_{10} emissions from current conditions would cause only a 1% change in total park emissions for those pollutants, so adverse impacts from this change would probably not be measurable. Alternative F would make virtually no change in overall park emissions (0%–1%). The most serious cumulative impacts would result from high ozone exposure levels, to which this alternative would result in a negligible, adverse, regional impact by its small increase in VOC emissions. Cumulatively, the effects of Alternative F, when combined with these other past, present, and reasonably foreseeable actions, would continue to be adverse, regional, and moderate from ozone exposure levels and degraded visibility. Alternative F would make an adverse, negligible contribution to these cumulative effects.

Conclusion. Overall park emissions under Alternative F would remain virtually the same as current conditions. Recreational use would continue to have ***negligible*** adverse, ***local*** impacts on human health and air quality related resources. ***Cumulative impacts would remain virtually unchanged from current conditions, since small*** emission ***increases*** under Alternative F would result in a negligible contribution to these exposures. Alternative F would not result in the impairment of air quality and related resources in Grand Canyon National Park.

4.2.3.5.7 Alternative G

Analysis. Alternative G proposes the largest group sizes (except for Alternative A) and largest number of noncommercial user-days of any of the alternatives, with the lowest maximum number of trips at one time but the second highest maximum number of people at one time. User discretionary time would be the second lowest due in large part to the shortest trip lengths. It would have a mix of motorized and nonmotorized trips, with a three-month nonmotorized season (September-December), during which time there would be no Whitmore helicopter exchanges (although hiking exchanges would be allowed). Use would be spread throughout the year, resulting in more campfires than the other alternatives. Overall, Alternative G would have the highest projected emissions of the Lees Ferry alternatives. Estimated emissions under Alternative G, and their relationship to total emissions in Grand Canyon National Park, are presented in ***Table 4-*** 14**.**

TABLE 4- 14*: ALTERNATIVE G EMISSIONS*

tons/year

	Launches	VOC	CO	NO_x	PM_{10}	SO_2
Watercraft	***1,317***	***0.81***	***18.46***	***0.41***	***<0.01***	0
Aircraft	1,660	0.21	1.39	0.98	0.03	0.13
Campfires		***3.98***	***4.39***	***0.05***	***0.60***	0.01
Total	***2,977***	***5.00***	***24.24***	***1.43***	***0.63***	**0.14**
Percentage of Park Total		***2.66%***	***3.23%***	***1.41%***	***1.06%***	4.20%
Change from Alternative 1						
Alternative		***148%***	***30%***	***6%***	***219%***	4%
Total Park		2%	***1%***	0%	1%	0%

Human Health Impacts From Airborne Pollutants—Emissions of all pollutants would be much less than 50 tons per year, resulting in negligible ***direct*** impacts on human health. ***Cumulative*** current ozone concentrations in the park are greater than 80% of the 8-hour ozone standard, resulting in adverse, moderate impacts to human health. Ozone concentrations are driven by NO_x and VOC emissions, but negligible amounts of these pollutants would be generated under this alternative. The ***small increase in their combined*** emissions would adversely contribute to ozone production, but their contributions would be negligible and would not be expected to change the park's attainment status for ozone.

Air Quality Related Values Impacted by Airborne Pollutants—Emissions of all pollutants would be much less than 50 tons a year, resulting in adverse, negligible impacts on air quality related values. Exhaust odors and plumes during the motorized use season might occur under calm weather conditions at attraction sites, but would dissipate rapidly, with adverse, local, short-term, negligible to minor impacts. Localized campfire plumes and odors would ***increase, but*** dissipate quickly and are generally not considered objectionable. Visibility within the park is usually below natural levels, indicating moderate impacts, but the small amount of PM_{10} emitted under Alternative G would result in a negligible, local, short-term contribution to visibility problems, even though there would be a substantial percentage increase ***in PM emissions*** from current conditions. Ozone exposure statistics for the park are well above 25 ppm/hr, which indicates a potentially adverse, regional, major impacts on plants. Nearly all ozone in the park is the result of emissions upwind of the park (see "Cumulative Effects"). The low combined NO_x and VOC emissions would have an adverse, regional, negligible contribution to these elevated exposures.

Mitigation of Effects. See air quality mitigation actions common to all alternatives and common to all Lees Ferry alternatives beginning on page ***323.***

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter.

Emissions from recreational use of the Colorado River under Alternative G would result in a generally small (less than 5%) contribution to air pollution produced in the Grand Canyon. The most serious cumulative impacts would result from high ozone exposure levels, to which this alternative would make a ***negligible,*** adverse, regional, impact because of increased VOC and NO_x emissions. Cumulatively, the effects of Alternative G, when combined with these other past, present, and reasonably foreseeable actions, would continue to be adverse, regional, and moderate from ozone exposure levels and degraded visibility. Alternative G would make an adverse, negligible contribution to these cumulative effects.

Conclusion. *Direct* impacts of ***air pollutants*** produced by recreational use of the Colorado River under Alternative G would have ***negligible adverse impacts on*** human health and air quality related resources. ***Cumulative adverse air quality impacts would remain essentially unchanged, due to the negligible increases in emissions.*** Alternative G would not result in the impairment of air quality and related resources in Grand Canyon National Park.

4.2.3.5.8 Modified Alternative H (NPS Preferred Alternative)

Analysis. *Under the Modified Alternative H a large number of passengers would pass through Grand Canyon. Maximum numbers of people at one time would be relatively high, but maximum numbers of trips at one time would be moderate, as well as total user discretionary time. A mix of motorized and nonmotorized use would occur for five and a half months, with a six and a half month (September 15 through March 31) no-motor season. Whitmore helicopter and hiking exchanges would occur to accommodate trips launching in the mixed*

use season. Seasonal use would be distributed such that there would be about twice as many campfires as are expected under current conditions. Estimated emissions under Modified Alternative H, and their relationship to total emissions in Grand Canyon National Park, are presented in Table 4- 14.

TABLE 4- 15: *MODIFIED ALTERNATIVE H EMISSIONS*

tons/year

	Launches	VOC	CO	NO_x	PM_{10}	SO_2
Watercraft	1,101	0.68	15.48	0.34	>0.01	0
Aircraft	1,580	0.21	1.39	0.98	0.03	0.13
Campfires		2.41	2.66	0.03	0.36	>0.01
Total	2,681	3.30	19.53	1.35	0.40	0.13
Percentage of Park Total		1.77%	2.62%	1.33%	0.67%	4.12%
Change from Alternative 1						
Alternative		64%	4%	0%	100%	2%
Total Park		1%	0%	0%	0%	0%

Human Health Impacts from Airborne Pollutants—*Emissions of all pollutants would be much less than 50 tons per year, resulting in negligible adverse direct impacts on human health. Current ozone concentrations in the park are greater than 80% of the 8-hour ozone standard, resulting in adverse, moderate impacts to human health. Ozone concentrations are driven by NO_x and VOC emissions, but only negligible amounts of these pollutants are generated under this alternative annually. Although these emissions contribute to ozone production, negligible emissions under Modified Alternative H would not change the park's attainment status for ozone.*

Air Quality Related Values Impacted by Airborne Pollutants—*Emissions of all pollutants would be much less than 50 tons a year, resulting in negligible adverse impacts on air quality related values. Exhaust odors and plumes could occur under calm weather conditions at attraction sites during the motorized use season, but would dissipate rapidly, with adverse, short-term, seasonal, negligible to minor impacts. Localized campfire plumes and odors also dissipate quickly, and are generally not considered objectionable. Visibility within the park is usually below natural levels, indicating moderate impacts, but the small amount of PM_{10} emitted under Modified Alternative H would result in a negligible, largely local and short-term contribution to visibility problems. Ozone exposure statistics for the park are well above 25 ppm/hr, which indicates a potentially major, adverse, regional, long-term impact on plants. Nearly all ozone in the park is the result of emissions upwind of the park (see "Cumulative Effects"). The small increase in combined NO_x and VOC emissions would result in a negligible contribution to these elevated exposures.*

Mitigation of Effects. ***See air quality mitigation actions common to all alternatives and common to all Lees Ferry alternatives beginning on page 323.***

Cumulative Effects. ***Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter.***

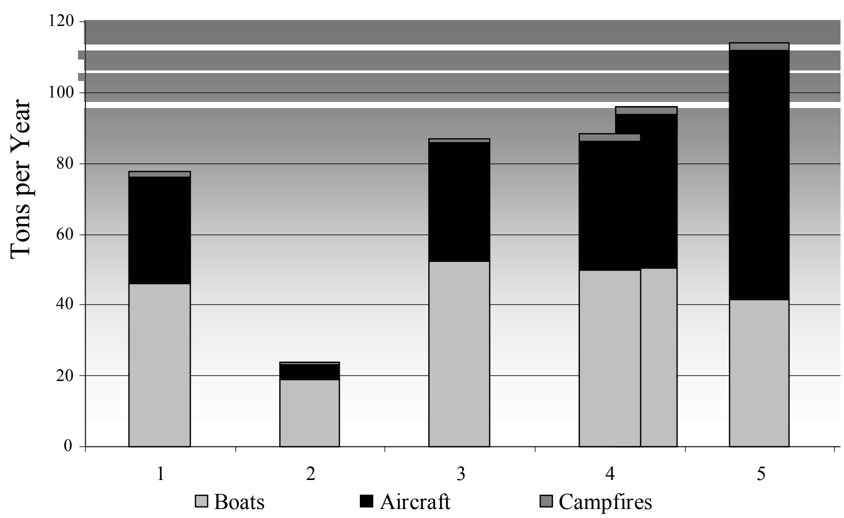
Emissions from recreational use of the Colorado River under Modified Alternative H would result in a generally small (less than 5%) contribution to the air pollution produced in the Grand Canyon. The larger percentage increases in VOC and PM_{10} emissions from current conditions would change total park emissions for those pollutants by 1% or less, so adverse impacts from this change would not be measurable. Implementation of Modified Alternative H makes virtually no change in overall park emissions. The most serious cumulative impacts result from high ozone exposure levels, to which this alternative would result in a negligible, adverse impact by its small increase in combined VOC and NO_x emissions compared to current operations. Cumulatively, the effects of Modified Alternative H, when combined with these other past, present, and reasonably foreseeable actions, would continue to be adverse, regional, and moderate from ozone exposure levels and degraded visibility. Modified Alternative H would make a negligible, adverse contribution to these cumulative effects.

Conclusion. Since overall park emissions under Modified Alternative H remain virtually the same as current conditions, little or no change from current conditions would be expected. Recreational use would continue to have negligible, adverse, regional impacts on human health and air quality related resources. Existing cumulative impacts from air pollution would remain essentially unchanged, Modified Alternative H would only make a negligible, although adverse, contribution to existing exposures. Modified Alternative H would not result in the impairment of air quality and related resources in Grand Canyon National Park.

4.2.3.6 IMPACT ANALYSIS—LOWER GORGE ALTERNATIVES

The potential impacts of the Lower Gorge alternatives are based on a comparison among Lower Gorge alternatives. An overview of total emissions from the ***five*** alternatives is shown in ***Figure 4-2. Direct impacts of various air pollutants produced under the alternative range from negligible to minor.***

FIGURE 4-2: EMISSIONS DUE TO RECREATIONAL RIVER USE BELOW DIAMOND CREEK



For

the analysis of cumulative impacts, air pollution generated under current conditions as described in Lees Ferry Alternative A was used in calculating total park emissions. Ambient air quality in Clark County, Nevada (Las Vegas), is also considered qualitatively in evaluating conditions in the Lower Gorge because of its geographic proximity. ***Since the release of the Draft Environmental Impact Statement, the U.S. EPA has determined which portions of Clark County violate national standards for ozone (USEPA 2005a). EPA has also determined that the county has met national carbon monoxide standards, but has not proposed redesignating it as in "attainment" for this standard (USEPA 2005b).***

Depending on the surface elevation of Lake Mead, there can be varying amounts of up-lake recreational boating. The amount of private up-lake boating is not regulated under these alternatives (although personal watercraft or jet skis are prohibited). This use varies in response to lake levels, independent of the management alternatives, and statistics on these varying use levels is not available. Consequently, private upriver watercraft emissions are not included in this analysis.

4.2.3.6.1 Alternative 1 (Existing Condition)

Analysis. Alternative 1 represents the current diverse mix of recreational activities on the Colorado River below Diamond Creek and Lake Mead within the Grand Canyon. Uses include private and commercial trips, pontoon boat tours, and upriver takeouts. Most watercraft use engines, either four-stroke outboard or diesels (on the takeout jetboats). Helicopters are used to shuttle pontoon tour and some commercial passengers to and from the south rim near Quartermaster. Overall emissions of air pollutants under Alternative 1 are summarized in Table 4- 16.

TABLE 4- 16*: ALTERNATIVE 1 EMISSIONS*

TONS/YEAR

	Launches	VOC	CO	NO_x	PM_{10}	SO_2
Watercraft	***17,986***	***1.68***	***30.15***	***13.92***	***0.40***	***0***
Aircraft	33,215	3.41	23.09	3.27	***0.00***	0.40
Campfires		0.57	0.63	0.01	0.09	***<0.01***
Total	***51,111***	***5.66***	***53.87***	***17.19***	**0.49**	**0.40**
Percentage of Park Total		***3.06%***	***7.23%***	***16.91%***	***0.82%***	12.20%

Human Health Impacts from Airborne Pollutants—Emissions of all pollutants except CO are less than 50 tons per year, making their impacts on human health negligible. CO emissions are ***minor (between 50 and 100*** tons per year). Levels of CO measured in the eastern section of the park are very low, while those measured in the Las Vegas metropolitan area are substantially higher (see Chapter 3). Although Clark County is designated nonattainment for CO (meaning it does not meet the national standards), all monitoring stations in the county reported levels less than 80% of the national ambient air quality standards for CO from 2001-2003 (U.S. EPA 2004) ***and has attained the standard (USEPA 2005B).*** Consequently, continued implementation of this Alternative should not cause CO in the Lower Gorge to exceed national standards, and impacts to human health would remain adverse, ***minor*** and regional. Combined emissions of VOCs and NO_x are less than 50 tons per year, and thus at the negligible impact level for ozone-producing emissions. Current ozone concentrations in the park are greater than 80% of the 8-hour ozone standard. ***Portions of*** Clark County were designated nonattainment for ozone under the 8-hour standard ***(USEPA 2005a)***, violating the standard in 2002 and 2003. Although River-related ***VOCs and NOx*** emissions contribute to ozone production, their contributions under this alternative are negligible, and would not be expected to change the park's attainment status for ozone. Impacts to human health from ozone would remain regional, adverse and moderate.

Air Quality Related Values Impacted by Airborne Pollutants—Emissions of all pollutants except CO would be less than 50 tons a year, making their adverse impacts on air quality related values generally negligible. Exhaust odors and plumes may occur under calm weather conditions at attraction sites, particularly near Quartermaster. Fuel odors associated with helicopter traffic are sometimes noticeable over a half-mile radius. Localized campfire plumes and odors dissipate quickly, and are generally not considered objectionable. These impacts are minor, local and adverse. Visibility within the park is usually below natural levels, indicating moderate impacts, but the small amount of PM_{10} emitted under Alternative 1 makes a negligible, local, adverse contribution to visibility problems. Ozone exposure statistics for the park are well above 25 ppm/hr, ***but emissions are less than 100 tons per year, indicating*** a potentially ***moderate*** impact on plants. Nearly all ozone in the park is the result of emissions upwind of the park (see Chapter 3). The low combined NO_x and VOC emissions make a negligible contribution to these elevated exposures.

Mitigation of Effects. Air quality mitigation actions would be common to all alternatives, including the ***Lower Gorge*** alternatives, and are listed beginning on ***page 323.***

Cumulative Effects. As described in Chapter 3 and for the Lees Ferry alternatives, road vehicles, wildland fires, and prescribed burning are the chief sources of emissions in the park overall. Within the river corridor, sources of pollutants include motorized boats, helicopters, and campfires in the winter that can attribute to localized haze due to temperature inversions.

Emissions of PM_{10} from recreational use of the Colorado River under Alternative 1 would result in a minimal (below 1%) contribution to air pollution produced in Grand Canyon. All other pollutants would make more significant contributions. Emissions of CO would be about ***7%*** of total park emissions for this pollutant. The Lower Gorge meets national standards for air quality (attainment or unclassified), but ***portions of*** nearby Clark County are classified as a nonattainment area for CO, PM_{10}, and ozone. River-related emissions do not drive these elevated concentrations (Grand Canyon is almost always downwind of Clark County). However, transport of this polluted air into the Lower Gorge exacerbates the adverse effects of river-related emissions on human health, visibility, and ozone exposure. The most serious cumulative human health concerns result from ozone levels, which under Alternative 1 would remain adverse, regional, and moderate. Cumulatively, the effects of Alternative 1 ***on air quality related resources***, when combined with these other past, present, and reasonably foreseeable actions, would continue to be adverse, regional, and moderate from ozone exposure levels and degraded visibility. Alternative 1 would make an adverse, negligible contribution to these cumulative effects.

Conclusion. ***Direct*** impacts of the VOCs, SO_2, PM_{10} and NO_x produced by continuing current recreational use of the Colorado River under Alternative 1 would have negligible, adverse, regional impacts on human health and air quality related resources. Emissions of CO would continue to ***have minor adverse impacts to human health. Cumulative impacts to air quality related resources would continue to range from negligible through minor (visibility, odor) to moderate (ozone exposure), although*** emissions from Alternative 1 make a negligible, local, short-term contribution to these impacts. Alternative 1 would not result in the impairment of air quality and related resources in Grand Canyon National Park.

4.2.3.6.2 Alternative 2

Analysis. Under Alternative 2 recreational use of the Lower Gorge is reduced from current levels. Raft trips continue, but use levels are capped, generally near current levels. Only helicopter shuttles associated with HRR exchanges would continue. Pontoon boat tours and their associated helicopter shuttles would be eliminated. Jetboats would be used for commercial takeouts, but at reduced levels compared to Alternative 1. Overall emissions of air pollutants under Alternative 2 are lower than the other Diamond Creek alternatives, and are summarized in Table 4- 17.

Human Health Impacts from Airborne Pollutants—Emissions of all pollutants are much less than

TABLE 4- 17*: ALTERNATIVE 2 EMISSIONS*

TONS/YEAR

	Launches	VOC	CO	NO_x	PM_{10}	SO_2
Watercraft	3,985	***0.73***	***14.60***	***3.65***	0.10	***0***
Aircraft	4,265	0.44	2.97	0.42	***0.00***	0.05
Campfires		0.34	0.38	***<0.01***	0.05	***<0.01***
Total	**8,250**	***1.51***	***17.94***	***4.07***	0.15	0.05
Percentage of Park Total		***0.84%***	***2.53%***	***4.60%***	0.26%	1.77%
Change from Alternative 1						
Alternative		***-73%***	***-67%***	***-76%***	***-68%***	-87%
Total Park		***-2%***	***-5%***	***-13%***	***-1%***	-11%

50 tons per year, making their ***direct*** impacts on human health negligible. ***Cumulative impacts from pollutants other than ozone are negligible.*** Combined emissions of VOCs and NO_x are less than 50 tons per year, and thus at the negligible impact level for ozone-producing emissions. Current ozone concentrations in the park are greater than 80% of the 8-hour ozone standard. ***Part of*** Clark County was designated nonattainment for ozone under the 8-hour standard. Although River-related emissions contribute to ozone production, their contributions under this alternative are negligible, and would not be expected to change the park's attainment status for ozone. Impacts to human health from ozone would remain adverse, regional and moderate.

Air Quality Related Values Impacted by Airborne Pollutants—Emissions of all pollutants less than 50 tons a year, making their adverse impacts on air quality related values generally negligible. Exhaust odors and plumes may occur under calm weather conditions at attraction sites. Fuel odors associated with helicopter traffic may be noticeable near Quartermaster, but greatly reduced compared to Alternative 1. Localized campfire plumes and odors dissipate quickly, and are generally not considered objectionable. These impacts are minor, local and adverse. Visibility within the park is usually below natural levels, indicating moderate impacts, but the small amount of PM_{10} emitted under Alternative 2 makes a negligible, adverse, regional contribution to visibility problems. Ozone exposure statistics for the park are well above 25 ppm/hr, ***but emissions are less than 100 tons per year, indicating*** a potentially ***moderate*** impact on plants. Nearly all ozone in the park is the result of emissions upwind of the park (see Chapter 3). The low combined NO_x and VOC emissions make a negligible contribution to these elevated exposures.

Mitigation of Effects. Air quality mitigation actions would be common to all alternatives, including the ***Lower Gorge*** alternatives, and are listed beginning on ***page 323.***

Cumulative Effects. As described in Chapter 3 and for the Lees Ferry alternatives, road vehicles, wildland fires, and prescribed burning are the chief sources of emissions in the park overall. Within the river corridor, sources of pollutants include motorized boats, helicopters, and campfires in the winter that can attribute to localized haze due to temperature inversions.

Emissions from recreational use of the Colorado River under Alternative 2 would result in a small (less than ***5***%) contribution to total air pollution produced in Grand Canyon. Compared with current conditions under Alternative 1, Alternative 2 would result in substantial ***emission*** reductions (***67***%–87%). Reductions in the total ***park*** emissions would be much less. However, the ***76***% reduction in emissions would reduce overall park ***NO_x*** emissions by ***13***%, a beneficial, regional impact. The Lower Gorge meets national standards for air quality (attainment or unclassified), but ***portions of*** nearby Clark County ***are*** classified nonattainment for CO, PM_{10}, and ozone. River-related emissions do not drive these elevated concentrations, but transport of this polluted air into the Lower Gorge exacerbates the adverse effects of river-related emissions on human health, visibility, and ozone exposure. Even though local pollutant concentrations would benefit from reduced emissions under Alternative 2, cumulative impacts from air pollution will remain. The most serious cumulative human health concerns result from ozone levels, which under Alternative 2 would remain moderate, regional, and adverse. Cumulative effects of Alternative 2 ***on air quality related resources***, when combined with these other past, present, and reasonably foreseeable actions, would continue to be adverse, regional, and moderate from ozone exposure levels and degraded visibility. ***Emission reductions under*** Alternative 2 would make a beneficial, negligible contribution to these cumulative effects.

Conclusion. ***Direct*** impacts of ***pollutants*** produced by recreational use of the Colorado River under Alternative 2 would have negligible, regional adverse impacts on human health and air quality related resources. ***Cumulative impacts would remain unchanged by the negligible, although beneficial, emission reductions under Alternative 2. Human health and vegetation would still receive moderate impacts from ozone exposure, and moderate visibility degradation would continue.*** Alternative 2 would not result in the impairment of air quality and related resources in Grand Canyon National Park.

4.2.3.6.3 Alternative 3

Analysis. Alternative 3 allows the same mix of recreational opportunities as current conditions, but at different levels. HRR day use would decline slightly, but overnight trips increase. Pontoon tours in the Quartermaster area increase, as do commercial takeouts. Helicopter shuttles for pontoon trips and passenger takeouts continue. Overall emissions of air pollutants under Alternative 3 are summarized in Table 4- 18.

TABLE 4- 18: ALTERNATIVE 3 EMISSIONS

TONS/YEAR

	Launches	VOC	CO	NO_x	PM_{10}	SO_2
Watercraft	***32,139***	***1.79***	***27.81***	***22.02***	***0.65***	***0***
Aircraft	36,992	3.80	25.72	3.64	0.00	0.44
Campfires		0.46	0.50	0.01	0.07	***<0.01***
Total	***69,131***	***6.05***	***54.03***	***25.67***	***0.71***	**0.44**
Percentage of Park Total		***3.26%***	***7.25%***	***23.30%***	***1.20%***	13.39%
Change from Alternative 1						
Alternative		***7%***	***0%***	***49%***	***47%***	11%
Total Park		***0%***	***0%***	***8%***	0%	1%

Human Health Impacts from Airborne Pollutants—Emissions of all pollutants except CO would be less than 50 tons per year, making their ***direct*** impacts on human health negligible. CO emissions would be ***minor*** (between ***50 and 100*** tons per year). Levels of CO measured in the eastern section of the park are very low, while those measured in the Las Vegas metropolitan area are substantially higher (see Chapter 3). Although Clark County is designated nonattainment for CO (meaning it does not meet the national standards), all monitoring stations in the county reported levels less than 80% of the national ambient air quality standards for CO from 2001 to 2003 (U.S. EPA 2004). Implementation of Alternative 3 ***would not change*** CO emissions in the Lower Gorge and would not cause CO to exceed national standards, ***so*** impacts to human health would remain adverse, regional and ***minor***. Combined emissions of VOCs and NO_x would be less than 50 tons per year, and thus at the negligible impact level for ozone-producing emissions. Current ozone concentrations in the park are greater than 80% of the 8-hour ozone standard. Clark County was designated nonattainment for ozone under the 8-hour standard. River-related emissions contribute to ozone production, but their combined contributions under this alternative would be negligible and would not be expected to change the park's attainment status for ozone. Impacts to human health from ozone would remain adverse, regional, and moderate.

Air Quality Related Values Impacted by Airborne Pollutants—Emissions of all pollutants except CO would be less than 50 tons a year, making their adverse impacts on air quality related values generally negligible. Exhaust odors and plumes may occur under calm weather conditions at attraction sites, particularly near Quartermaster. Fuel odors associated with helicopter traffic may be noticeable over a half-mile radius. Localized campfire plumes and odors dissipate quickly and are generally not considered objectionable. These impacts are adverse, local, and minor. Visibility within the park is usually below natural levels, indicating moderate impacts, but the small amount of PM_{10} emitted under Alternative 3 ***and its reduction compared to current conditions*** would result in a ***beneficial,*** negligible, regional contribution to visibility problems. Ozone exposure statistics for the park are well above 25 ppm/hr, ***but emissions are less than 100 tons per year, indicating*** a potentially ***moderate*** impact on plants. Nearly all ozone in the park is the result of emissions upwind of the park (see Chapter 3). The combined NO_x and VOC emissions would have an adverse, negligible, regional contribution to these elevated exposures.

Mitigation of Effects. Air quality mitigation actions would be common to all alternatives, including the ***Lower Gorge*** alternatives, and are listed beginning on ***page 323.***

Cumulative Effects. As described in Chapter 3 and for the Lees Ferry alternatives, road vehicles, wildland fires, and prescribed burning are the chief sources of emissions in the park overall. Within the river corridor, sources of pollutants include motorized boats, helicopters, and campfires in the winter that can attribute to localized haze due to temperature inversions.

Air pollution emissions from recreational use of the Colorado River under Alternative 3 would result in negligible ***changes*** to air pollution produced in the Grand Canyon ***compared to current conditions***. The Lower Gorge meets national standards for air quality (attainment or unclassified), but nearby Clark County is classified nonattainment for CO, PM_{10}, and ozone. River-related emissions do not drive these elevated concentrations, but transport of this polluted air into the Lower Gorge exacerbates the adverse effects of river-related emissions on human health, visibility, and ozone exposure. The most serious cumulative human health concerns result from ***ozone exposure***, to which ***increases*** in ***combined*** NO_x ***and VOCs*** under Alternative 3 would result in a negligible, ***adverse*** impact to adverse, regional, and moderate impacts. ***CO emissions produce a minor, adverse impact to human health.*** Cumulatively, the effects of Alternative 3, when combined with other past, present, and reasonably foreseeable actions, would continue to be adverse, regional, and moderate from ozone exposure levels and degraded visibility. Alternative 3 would make a negligible contribution to all ***of these*** cumulative effects ***except carbon monoxide, which would make an adverse, minor contribution.***

Conclusion. ***Direct*** impacts of the pollutants produced by recreational use of the Colorado River under Alternative 3 would have negligible ***to minor***, adverse, regional impacts on human health, ***and negligibly increase ozone exposure***. ***Impacts to air quality related values would remain*** negligible to ***moderate, and*** adverse. Alternative 3 would not result in the impairment of air quality and related resources in Grand Canyon National Park.

4.2.3.6.4 Modified Alternative 4 (NPS Preferred Alternative)

Analysis. ***Under Modified Alternative 4, the number of HRR trips (both day and overnight) increase throughout the year. Pontoon tours are above current use and could increase further with favorable performance reviews. Helicopter shuttles would continue to operate near Quartermaster. Jetboats are used for commercial pick-ups, but not for tours. In general, emissions under Modified Alternative 4 would be slightly higher than current conditions, as outlined*** in ***Table 4-*** 18***. The following analysis assumes favorable performance reviews and thus, emissions based on the maximum amount of pontoon boat and helicopter use.***

TABLE 4- 19: MODIFIED ALTERNATIVE 4 EMISSIONS

TONS/YEAR

(values before/after pontoon use increases)

	Launches	VOC	CO	NO_x	PM_{10}	SO_2
Watercraft	*38,072/45,377*	*1.88/1.92*	*36.83/37.74*	*10.74/10.76*	*0.30*	*0*
Aircraft	*40,059/51,239*	*4.12/5.27*	*27.85/35.62*	*3.94/5.05*	*0*	*0.48/0.61*
Campfires		*1.00*	*1.10*	*0.01*	*0.15*	*<0.01*
Total	*78,136/96,616*	*7.00/8.19*	*65.78/74.46*	*14.69/15.81*	*0.45*	*0.48/0.61*
Percentage of Park Total		*3.76/4.37%*	*8.69/9.72%*	*14.81/15.77%*	*0.77%*	*14.36/17.65%*
Change from Alternative 1						
Alternative		*24/45%*	*22/38%*	*-15/-8%*	*-7%*	*21/54%*
Total Park		*1/1%*	*2/3%*	*-2/-1%*	*0%*	*3/7%*

Human Health Impacts from Airborne Pollutants—*Emissions of all pollutants except CO would be less than 50 tons per year, making their direct impacts on human health negligible. CO emissions would be minor. Levels of CO measured in the eastern section of the park are very low, while those measured in the Las Vegas metropolitan area are substantially higher (see Chapter 3). Although Clark County is designated nonattainment for CO (meaning it does not meet the national standards), all monitoring stations in the county reported levels less than 80% of the national ambient air quality standards for CO from 2001 to 2003 (U.S. EPA 2004). Consequently, reduced CO emissions should not cause CO in the Lower Gorge to exceed national standards, and impacts to human health would remain adverse, regional, and minor. Combined emissions of VOCs and NO_x would be less than 50 tons per year, and thus at the negligible impact level for ozone-producing emissions. Current ozone concentrations in the park are greater than 80% of the 8-hour ozone standard. Parts of Clark County were designated nonattainment for ozone under the 8-hour standard. Although river-related emissions contribute to ozone production, their combined contributions under this alternative would be similar to current conditions, and they would not be expected to change the park's attainment status for ozone. Impacts to human health from ozone would be adverse, regional, and moderate.*

Air Quality Related Values Impacted by Airborne Pollutants—*Emissions of all pollutants except CO would be less than 50 tons a year, making their adverse impacts on air quality related values generally negligible. Exhaust odors and plumes may occur under calm weather conditions at attraction sites, particularly near Quartermaster. Fuel odors associated with helicopter traffic would be increased slightly compared with Alternative 1. Localized campfire plumes and odors dissipate quickly and are generally not considered objectionable. These impacts are adverse, local, and minor. Visibility within the park is usually below natural levels, indicating moderate regional impacts, but the small reduction in PM_{10} emitted under Modified Alternative 4 would result in a negligible (though beneficial) change in contribution to adverse, regional, moderate visibility problems. Ozone exposure statistics for the park are well above 25 ppm/hr, but emissions are less than 100 tons per year, which indicates a potentially moderate impact on plants. Nearly all ozone in the park is the result of emissions upwind of the park (see Chapter 3). The low combined NO_x and VOC emissions would result in a virtually unchanged negligible contribution to these elevated exposures.*

Mitigation of Effects. Air quality mitigation actions would be common to all alternatives, including the ***Lower Gorge*** alternatives, and are listed beginning on ***page 323.***

Cumulative Effects. ***As described in Chapter 3 and for the Lees Ferry alternatives, road vehicles, wildland fires, and prescribed burning are the chief sources of emissions in the park overall. Within the river corridor, sources of pollutants include motorized boats, helicopters, and campfires in the winter that can attribute to localized haze due to temperature inversions.***

Emissions of PM_{10} from recreational use of the Colorado River under Modified Alternative 4 would result in a negligible (below 1%) contribution to air pollution produced in Grand Canyon. Emissions of VOCs, NO_x, and SO_2 would range from 4%–17% of total park emissions. Emissions of CO would increase 36% but would remain at the minor level for this pollutant. The Lower Gorge meets national standards for air quality (attainment or unclassified), but nearby Clark County is classified nonattainment for CO, PM_{10}, and ozone. River-related emissions do not drive these elevated concentrations (Grand Canyon is almost always downwind of Clark County). However, transport of this polluted air into the Lower Gorge exacerbates the adverse effects of river-related emissions on human health, visibility, and ozone exposure. The most serious cumulative human health concerns would result from ozone levels, which under Modified Alternative 4 would remain adverse, regional, and moderate, with virtually no change in combined NO_x and VOC emissions compared to Alternative 1. Cumulatively, the effects of Modified Alternative 4, when combined with other past, present, and reasonably foreseeable actions, would continue to be adverse, regional, and moderate from ozone exposure levels and degraded visibility. Modified Alternative 4 would make a negligible contribution to these cumulative effects.

Conclusion. ***Direct impacts of the VOCs, SO_2, PM_{10} and NO_x produced by recreational use of the Colorado River under Modified Alternative 4 would have adverse, regional, negligible impacts on human health and air quality related resources. Emissions of CO under this alternative would continue to be minor. Cumulative impacts would be moderately adverse for human health, and range from negligible to moderate for air quality related resources. Modified Alternative 4 would not result in the impairment of air quality and related resources in Grand Canyon National Park.***

4.2.3.6.5 Alternative 5 (Hualapai Tribe Proposed Action)

Analysis. Alternative 5 is the same as ***Modified*** Alternative 4 except for actions at and downstream of the Quartermaster area (e.g., pontoon boat operations and associated helicopter operations, and upriver travel from Lake Mead). Alternative 5 includes a substantial increase in pontoon tours. However, jetboat use would not be allowed. Overall emissions expected under Alternative 5 reflect the increase in aircraft emissions but show a decline in watercraft emissions compared with current conditions (Alternative 1). These projected emissions, and their relationship to total park emissions, are presented in Table 4- 20.

TABLE 4- 20 *ALTERNATIVE 5 EMISSIONS*

TONS/YEAR

	Launches	VOC	CO	NO_x	PM_{10}	SO_2
Watercraft	***66,543***	***1.71***	***38.91***	***0.86***	0.01	***0***
Aircraft	77,519	7.97	53.89	7.63	0.00	0.92
Campfires		1.00	1.10	0.01	0.15	***<0.01***
Total	***114,062***	***10.67***	***93.90***	***8.50***	**0.16**	**0.93**
Percentage of Park Total		***5.62%***	***11.96%***	***9.14%***	***0.27%***	24.47%
Change from Alternative 1						
Alternative		***89%***	***74%***	***-51%***	***-68%***	133%
Total Park		***3%***	***5%***	-9%	-1%	16%

Human Health Impacts from Airborne Pollutants—Emissions of all pollutants except CO would be less than 50 tons per year, making their ***direct*** impacts on human health negligible. CO emissions would be ***minor***, slightly less than ***100*** tons per year. Levels of CO measured in the eastern section of the park are very low, while those measured in the Las Vegas metropolitan area are substantially higher (see Chapter 3). Although Clark County is designated nonattainment for CO (meaning it does not meet the national standards), all monitoring stations in the county reported levels less than 80% of the national ambient air quality standards for CO from 2001 to 2003 (U.S. EPA 2004). Alternative 5 would result in higher CO emissions than current operations, but its implementation should not cause CO in the Lower Gorge to exceed national standards, ***and*** impacts to human health would remain adverse, regional, and ***minor***. Combined emissions of VOCs and NO_x would be less than 50 tons per year, and thus at the negligible impact level for ozone-producing emissions. Current ozone concentrations in the park are greater than 80% of the 8-hour ozone standard. ***Part of*** Clark County was designated nonattainment for ozone under the 8-hour standard. Although river-related emissions contribute to ozone production, their combined contribution under this alternative would be negligible, and would not be expected to change the park's attainment status for ozone. Impacts to human health from ozone would remain adverse and moderate.

Air Quality Related Values Impacted by Airborne Pollutants—Emissions of all pollutants except CO would be less than 50 tons a year, making their ***direct*** adverse impacts on air quality related values generally negligible. Exhaust odors and plumes may occur under calm weather conditions at attraction sites, particularly near Quartermaster. Fuel odors associated with helicopter traffic would be much greater than under Alternative 1, since helicopter use would be more than doubled. Localized campfire plumes and odors dissipate quickly, and they are generally not considered objectionable. These impacts would be adverse, local, and minor. Visibility within the park is usually below natural levels, indicating moderate impacts, ***and*** the small amount of PM_{10} ***reductions*** under Alternative 5 would ***not change the cumulative impacts.*** Ozone exposure statistics for the park are well above 25 ppm/hr, which indicates a potentially adverse, regional, ***moderate*** impact on plants. Nearly all ozone in the park is the result of emissions upwind of the park (see Chapter 3). The low combined NO_x and VOC emissions would ***be reduced from current conditions, but would not be expected to change*** these elevated exposures.

Mitigation of Effects. Air quality mitigation actions would be common to all alternatives, including the ***Lower Gorge*** alternatives, and are listed beginning on ***page 323.***

Cumulative Effects. As described in Chapter 3 and for the Lees Ferry alternatives, road vehicles, wildland fires, and prescribed burning are the chief sources of emissions in the park overall. Within the river corridor, sources of pollutants include motorized boats, helicopters, and campfires in the winter that can attribute to localized haze due to temperature inversions.

Despite a large percentage reduction in PM_{10} emissions from recreational use of the Colorado River under Alternative 5, overall park production would remain essentially unchanged. Combined emissions of VOCs and NO_x would be negligibly lower than current Lower Gorge emissions and would result in a smaller contribution to total park emissions. The relative percentage of SO_2 emitted under Alternative 5 would increase dramatically due to increased helicopter traffic. However, the actual amount emitted would remain low (the Grand Canyon area sources produce very little SO_2, magnifying small amount changes into large percentages). Parkwide emissions of CO would increase slightly, as increases in helicopter emissions would be largely offset by the elimination of jetboat traffic. ***The Lower Gorge meets national standards for air quality (attainment or unclassified), but nearby Clark County is classified nonattainment for CO, PM_{10}, and ozone. River-related emissions do not drive these elevated concentrations (Grand Canyon is almost always downwind of Clark County). However, transport of this polluted air into the Lower Gorge exacerbates the adverse effects of river-related emissions on human health, visibility, and ozone exposure. The most serious cumulative human health concerns result from ozone levels, which under Alternative 5 would remain adverse, regional, and moderate, despite the negligible change in combined NO_x and VOC emissions compared to Alternative 1. Cumulatively, the effects of Alternative 5, when combined with other past, present, and reasonably foreseeable actions, would continue to be adverse, regional, and moderate from ozone exposure levels and degraded visibility. Alternative 5 would make a negligible contribution to these cumulative effects except CO, where the contribution is minor.***

Conclusion. ***Direct air quality impacts of recreational use of the Colorado River under Alternative 5 would be negligibly adverse for all pollutants except for minor adverse impacts on human health from CO. Emission reductions would make beneficial, regional and local, negligible contributions to adverse, regional, moderate impacts on air quality related resources (visibility and plant ozone exposure). Alternative 5 would not result in the impairment of air quality and related resources in Grand Canyon National Park.***

4.2.4 NATURAL SOUNDSCAPE

4.2.4.1 ISSUES

Major issues and concerns regarding natural soundscapes from public and internal scoping include:

- Motorized versus nonmotorized trips
- Address noise impacts (helicopters, motorboats, electronics, loud visitors)
- Provide a primitive experience and wilderness character
- Provide access to a variety of trip types and trip lengths

- Incorporate best available pollution control (i.e., quiet) technology
- Appropriateness of helicopter exchanges

Human noise sources from activities associated with river recreation in the section of river from Lees Ferry to Lake Mead include motorized rafts, river human activities (camp noise, generators, stoves, transfer and gathering areas, loud voices, electronic sounds, etc.), backcountry users sharing river access, and helicopter shuttles in the Whitmore area. There would also be cumulative impacts from sources not associated with river recreation including commercial air tours, high altitude commercial jet aircraft, and military, general aviation, and park administrative flights.

The section of river from Diamond Creek to Lake Mead includes all of the above river-related human noise sources, except that helicopter shuttles occur in the Quartermaster area instead of Whitmore, and different motorized boat types occur in the Lower Gorge, including pontoon boats and high-powered jetboats.

Noise related to river recreation activities would include aircraft noise only to the extent that helicopter shuttles transport passengers who are also river passengers. This would be limited to alternatives that include helicopter shuttles for river passengers in the Whitmore area (for Lees Ferry Alternatives), and in the Quartermaster area (for Lower Gorge Alternatives). All other aircraft activity and associated noise would be a cumulative effect independent of the management alternatives, but considered in the sections on cumulative effects. Such aircraft activity would include commercial air tours between helicopter pads on Hualapai tribal lands in the Quartermaster area and Grand Canyon West Airport (i.e., those that do not involve river passengers), aircraft using Special Flight Rules Area 50-2 for commercial air tour and support flights, high altitude commercial jet traffic, and military, general aviation, and park administrative flights.

In this EIS, the terms "sound" and "noise" are sometimes used interchangeably in relation to human sound sources, with no implication of appropriateness or inappropriateness attached to either term. Some of the sound sources considered in this EIS, especially motorized boats, are the subject of considerable controversy, rendering a definition using the term "unwanted sound" difficult to apply in a neutral analysis. Therefore, unless a specific context indicates otherwise, the terms may be used interchangeably in this document.

4.2.4.2 Guiding Regulations and Policies

Grand Canyon National Park Enlargement Act, 1975 (Public Law 93-620)—This law established the current boundary of Grand Canyon National Park. Section 8, titled "Aircraft Regulation" states:

> Whenever the Secretary (Interior) has reason to believe that any aircraft or helicopter activity or operation may be occurring or about to occur within the Grand Canyon National Park, … which is likely to cause an injury to the health, welfare, or safety of visitors to the park or to cause a significant adverse effect on the natural quiet and experience of the park, the Secretary shall submit…such complaints, information, or recommendations for rules and regulations or other actions as he believes appropriate to protect the public health, welfare, and safety or the natural environment within the park. After reviewing the submission of the Secretary, the responsible

agency shall consider the matter, and after consultation with the Secretary, shall take appropriate action to protect the park and visitors.

National Parks Overflights Act of 1987 (Public Law 100-91)—Section 3 of this act identified noise associated with aircraft overflights at Grand Canyon National Park as causing “a significant adverse effect on the natural quiet* and experience of the park,” and that current aircraft operations at the park “have raised serious concerns regarding public safety, including concerns regarding the safety of park users.” The act required the Secretary of the Interior, working through the NPS, to submit recommendations to the Federal Aviation Administration regarding “the actions necessary for the protection of resources in the Grand Canyon from adverse impacts associated with aircraft overflights.” The recommendations were to “provide for substantial restoration of the natural quiet and experience of the park and protection of public health and safety from adverse effects associated with aircraft overflight,” and the Federal Aviation Administration was to implement the recommendations of unless they would adversely affect aviation safety. Subsection (3)(c) of the act specifies that “helicopter flights shall not be prohibited (1) which fly a direct route between a point on the north rim outside of Grand Canyon National Park and locations on the Hualapai Indian Reservation (as designated by the tribe); and (2) whose sole purpose is transporting individuals to or from boat trips on the Colorado River and any guide of such trip.”

Executive Memorandum April 22, 1996, Regarding the Impact of Transportation in National Parks—Specifically, the President directed the Secretary of Transportation to issue regulations for Grand Canyon National Park that would place appropriate limits on sightseeing aircraft to reduce noise immediately, and to make further substantial progress towards restoration of natural quiet, as defined by the Secretary of Interior, while maintaining aviation safety in accordance with Public Law 100-91. With regard to Grand Canyon National Park it stated “should any final rule making determine that issuance of a further management plan is necessary to substantially restore natural quiet in the Grand Canyon NP, [the Secretary of Transportation, in consultation with Heads of relevant departments and agencies] will complete within five (5) years a plan that addresses how the Federal Aviation Administration and the NPS…will achieve the statutory goal not more than 12 years from the date of the directive [i.e.,2008].”

NPS Report to Congress, *Report on Effects of Aircraft Overflights on the National Park System*, July 1995—The report defines “substantial restoration of natural quiet,” as it relates to aircraft overflights in Public Law 100-91, as “a substantial restoration requires that 50% or more of the park achieve ‘natural quiet’ (i.e., no aircraft audible) for 75-100 percent of the day.” The report also lists the following goals and objectives developed to further assist in evaluating the effectiveness of measures to meet the requirements of Public Law 100-91:

(1) Substantially restore natural quiet as a resource;

(2) Provide recreation opportunities and experiences for park visitors, consistent with park policies, where the opportunity for natural quiet is an important component;

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* Current NPS policy refers to natural soundscapes, in part because a natural setting is not necessarily quiet, and it may contain numerous “natural sounds.” It may also be noted that what is generally intended with the earlier usage was not “quiet,” but rather the absence of human-caused sounds. Outside of the formal legal use of the older term, natural quiet is replaced, following NPS Policy, by the term “natural soundscape(s).”

(3) Mitigate any aircraft-related impacts on other natural and cultural resources; and

(4) Address issues of health, safety and welfare of on-ground visitors and employees.

The management objectives (and the management zones they apply to) were:

a. Restore and maintain natural quiet by protecting the wilderness character of remote areas. (Backcountry Use Zone, River Corridor Use Zone)

b. Provide primitive recreation opportunities without aircraft intrusions in most backcountry areas, most locations on the river and at destination points accessed by both. (Backcountry Use Zone, River Corridor Use Zone, Corridor Trail System Use Zone)

c. Provide developed recreation opportunities with limited aircraft intrusions for visitors at rim developed areas and major front-country destination points accessible by road. (Frontcountry (Paved Access) Use Zone)

d. Provide for the protection of sensitive wildlife habitat areas or cultural resources. (Backcountry Use Zone, River Corridor Use Zone, Corridor Trail System Use Zone, Frontcountry (Paved Access) Use Zone)

e. Provide for welfare and safety of below-rim, backcountry, and rim visitors. (Backcountry Use Zone, River Corridor Use Zone, Corridor Trail System Use Zone, Frontcountry (Paved Access) Use Zone)

f. Provide a quality aerial viewing experience while protecting park resources (including natural quiet) and minimizing conflicts with other park visitors. (Air Tour Use Zone, Backcountry Use Zone, River Corridor Use Zone, Corridor Trail System Use Zone, Frontcountry (Paved Access) Use Zone)

NPS Management Policies 2001, Section 4.9—Requires the managing agency to preserve, to the greatest extent possible, the natural soundscapes of the park. Natural soundscapes exist in the absence of human-caused sound, and are made up of an aggregate of all natural sounds that occur in the park, together with the physical capacity for transmitting natural sounds. This policy directs Superintendents to identify what levels of human caused sound can be accepted within the management purposes of the park.

Directors Order (DO) #47: Soundscape Preservation and Noise Management—*(Note: The sunset date for DO#47 was December 1, 2004.)*

4.2.4.3 Management Objectives for Natural Soundscape Resource

As stated in Chapter 1, the objective for natural soundscapes as it relates to management of recreational river use in the Grand Canyon is to manage river recreation***al*** use in a manner that is consistent with management zoning while minimizing the adverse effects of human caused noise impacts to the natural soundscape or natural quiet.

4.2.4.4 Methodology for Analyzing Soundscape Impacts

The general process for assessing impacts to the environment is discussed in Section 4.1 of this chapter. Effects specific to the natural soundscape are characterized for each alternative based on the impact thresholds presented below.

Context, timing (especially frequency of occurrence), duration, and intensity all interact in a complex manner that determines the level of noise impact from an activity. In some cases the analysis of all the factors can indicate a certain impact level where analysis of only a single factor may indicate a much different impact level. To help the reader understand how these varying factors combine to arrive at an impact level, the text below explains the criteria or factors considered in the impact thresholds.

Natural ambient sound levels used in the analysis were established by earlier field acoustic measurements at Grand Canyon National Park (Harris Miller Miller & Hansen [HMMH] 2003, 1993). Typical water influenced natural ambient levels along the Colorado River in the park varied between 24 dBA and ***66*** dBA, depending upon proximity to rapids ***and flow levels (cfs)***, with the area around Separation Canyon at full lake level as low as 11 dBA***, areas of flowing but calm water away from rapids in the 20's to 30's dBA, and rapids in the 60's dBA***.

In a brief look at potential motorized raft noise along the river corridor (HMMH 2003), a 35-foot S-rig ***raft powered by a 30 horsepower*** four-stroke ***outboard*** motor was measured traveling down the river at ¾ and full speed settings, similar to what one would expect on a river trip. The raft ***was measured in a relatively calm flowing water location next to the river (ambient 33.5 dBA), and in such a location its audibility was calculated at*** up to ***5,835 feet (1.1 miles)*** from the recording site ***and up to 538 seconds (approximately 9 minutes),*** when operating at ***full speed headed downstream (Lmax 55-60 dBA at a closest distance to the microphone of 56 yards). Near rapids (ambient 61-66 dBA), the same raft would have been audible at a distance of 484 to 592 feet and 45 to 55 seconds.*** For purposes of this analysis, ***9 minutes audibility is estimated for motorized rafts, and*** 3 minutes audibility is estimated for nonmotorized rafts, which would include sounds audible 100 feet or more from the source as rafts float by under quiet natural ambient conditions.

Audible sounds from nonmotorized trips would include sounds such as loud voices (not quiet conversation), waterfights, oars on oarlocks, etc. ***Such sounds are generally random, variable, and infrequent, in contrast to boat motor sounds that tend to be more constant and sustained when the motor is operating, varying as power is increased or decreased to the motor. Decibel levels for sounds from non-motorized trips can be at similar levels as sounds from motorized trips (e.g., normal conversation tends to be in the 50's to 60's dBA, so louder voices would be at higher decibel levels). In fact, both trip types include many of the same sounds listed at the beginning of this paragraph. However, the frequency spectra of the boat motors is quite different from these other sounds, and the louder sounds from nonmotorized trips would tend to be momentary pulses rather than sustained as boat motors would be. Helicopter sound levels would tend to be even louder (e.g., 70's to 80's dBA), recurring, and more sustained, with frequency spectra that lead to longer distance and greater duration sound propagation than 4-stroke boat motors. Readers should understand that there are substantial differences in the quality or character of the sounds and in people's reactions to the sounds (see Visitor Use and Experience). However, sounds from nonmotorized and motorized trips are human impacts to the natural soundscape, and are presented as such in the analysis.***

Human ***sound*** on the river, in general, tends to be random and audible for short spans of time***, but if it persists or recurs over long periods of time, it may have long-lasting impacts***. The "percent time audible," the amount of time human noise is audible over a typical day, and the "noise-free interval," the time between human noise events when only the natural soundscape is audible, are measures used to quantify noise impacts to the natural soundscape. The percent time audible and noise-free interval are related in that as ***the percent time audible*** increases during the 12-hour day, the amount of potential time ***available*** for large noise-free intervals decreases. With less opportunity for large noise-free intervals, the natural soundscape is impacted to a greater extent. ***Analyses involving detailed sound modeling were considered for this analysis, but were decided against because: (a) the NPS and Federal Aviation Administration had not resolved sound modeling issues at the time of the Draft EIS; (b) extensive data collection and sound modeling would be needed to improve upon the audibility analysis presented in this EIS; and (c) such data and modeling were considered not essential in making a well-reasoned decision for this plan. This decision does not necessarily apply to future planning efforts, including preparation of a soundscape management plan for the park, or planning or rules related to aircraft overflights. Such future efforts will consider data and modeling needs on a project-by-project basis***.

Calculations of "percent time audible" and related predictions of noise-free interval are used to assess ***impacts from river recreational activities and river-related aircraft*** to the natural soundscape. The associated noise indicators are calculated for a 12-hour day (7 A.M. to 7 P.M.) and seasonality of occurrence. Because there is insufficient data to consistently characterize any day other than peak days throughout all the alternatives, and because soundscape goals for the park are defined in terms of "any given day" (meaning that there would be no day with more impacts than the goal portrays), the analyses below are based upon peak days.

The average time used in the analysis that helicopters are audible at any given site is 3 to 3.5 minutes per flight, based upon the following:

- ***16 logged events measured in the field at Hermits Rest trailhead in 2004 by NPS (Ken McMullen).***
- ***Data from HMMH 1993 that measured helicopter time audible in Grand Canyon at 2 to 4 minutes.***
- ***Information provided by Bar 10 Ranch that Whitmore helicopter shuttle flights are in airspace over the park for about 3 minutes per round trip (Note: this data was given as flight time, not time audible. Each helicopter would be audible additional time when the helicopter is outside the park boundary but audible inside, especially when landing and taking off from the Whitmore helipad near the river).***
- ***The calculated time audible for Alternative A (Existing Condition) is 42-52.5 minutes per day while the new data indicates flight times over the park of about 26 minutes per day. As explained above, flight time does not include significant time audible when the helicopter would be outside the park but audible inside, so this new data is considered to be consistent with the EIS methodology.***
- ***Helicopters would also be audible when they are on the ground at the Whitmore helipad transferring passengers near the river, but this time is not specifically included in the analysis because there is no data to quantify it.***

4.2.4.4.1 Impact Thresholds

For the purposes of this analysis, impacts are evaluated for the noise produced at various locations along the river corridor (percent time audible), and contrasted to the amount of unaffected natural sounds (noise-free interval) to be expected or desired in the particular zone. Percent time audible and noise-free intervals are assessed in terms of a 12-hour day (7 A.M. to 7 P.M.) to provide an assessment of what would be expected during the time when most river-related noise would be expected. The following impact thresholds for the river soundscape incorporate intensity, context, timing and duration, as described above. The noise impact varies for each alternative, based primarily on the numbers of launches per day, numbers of motorized versus nonmotorized rafts per trip, and helicopter shuttles in the alternatives.

The soundscape impact thresholds were developed for this EIS based upon the best available data at the time this EIS was written, and are applicable only to this EIS.

Intensity—The “pitch” or sound frequency spectrum, and the “loudness” (energy or sound pressure level) of both the non-natural and the natural soundscape all interact to define the intensity of the impact from the noise event, including the distance and time a given noise event would be audible. Natural soundscapes that are “loud” (i.e., contain considerable energy) in portions of the sound frequency spectrum in which the noise source also produces sound can “mask” some or all of the noise, whereas a noise source, such as a boat motor or helicopter, can be readily audible even in the presence of a “loud” overall soundscape (such as a rapid or waterfall) when the frequency spectra are different. This, plus timing, is basically the same effect that allows, for example, a piccolo to be audible above the rest of the band during a loud passage of music (e.g., in Souza’s “Stars and Stripes Forever”).

The percent time audible and noise-free interval are the primary measures of intensity used in this analysis, as explained in Section 4.2.4.4.

The intensity of noise levels varies greatly by time and location along the river corridor. The distance that noise is audible from the noise source is ***often*** important in assessing the intensity of a ***noise*** impact***, however due to the terrain along the river corridor, the variability of the noise sources and ambient levels, and the nature of the best available data, distance could not be reasonably calculated for each alternative in the analysis, so it is not used in the intensity threshold.*** In general, noise from boat/raft motors and human activities generate the majority of noise associated with recreational use and enjoyment of the river corridor. These levels of noise are expected (and measured) to be audible at a distance of up to 1-1.5 miles (HMMH 2003). However, helicopter supported river activities at passenger exchange points or landing pads and river locations under defined aircraft routes will have greater levels of noise, which can be audible for five or more air miles from the source.

Context—Management zones are defined in Chapter 2, and they have different sensitivities for sound impacts as described in the impact thresholds below. ***The boats travel the entire river corridor (regional impact), whereas management alternatives with river-related aircraft use are confined to two areas, Whitmore and Quartermaster (localized impacts).***

Duration—Noise levels caused by river recreational activities within the river corridor are usually temporary, in that discontinuance of the source would allow the opportunity for the natural soundscape to return to the condition that existed prior to the particular recreational activity (however effects from the sound may have caused changes, such as displacement of birds, which result in a changed natural soundscape). The amount of time during each day that noise is present due to river running activities is percent time audible, which is factored into the intensity threshold. The duration threshold is defined in terms of the length of time the effect occurs, not the time the noise is present. It is the length of time the soundscape requires to return to a natural state after a noise impact (i.e., short-term to long-term effects).

Timing—Natural sounds and human-caused sounds vary daily, seasonally, and even minute-to-minute. During seasons with lower levels of use, noise levels are also generally lower than seasons with higher use. During daylight-hours noise levels are typically higher than night-time, due to increased human activity and available recreational opportunities. Noise often increases during evening camp activities and decreases as the night progresses. Motorized boat use on the river can be looked at as a "pulse" of noise that is introduced at various times of the day, along various sections of the river corridor, and for varying durations. The periods of time when only natural sounds are present is called the noise-free interval. Timing also considers periods of higher or lower sensitivity to noise impacts, and whether the noise occurs frequently or infrequently, occurs randomly or regularly, and whether it occurs for long or brief periods of time.

Intensity

*Negligible—**Zones 1 and 2:*** Human caused noise would be detectable or barely audible for 5% (36 minutes) or less of the day (7 A.M.–7 P.M.). There would be enough time when the natural soundscape was unaffected by humans that noise-free intervals of more than 3.5 hours could be common during the day.

Zones 3 and 4: Same as Minor threshold for Zones 1 and 2.

*Minor—**Zones 1 and 2:*** Human caused noise would be audible for 10% (72 minutes) or less of the day. There would be enough time when the natural soundscape was unaffected by humans that noise-free intervals of 1.5 to 3.5 hours could be common during the day.

Zones 3 and 4: Audible 15% or less of the day, noise-free intervals of 1 to 1.5 hours.

*Moderate—**Zones 1 and 2:*** Human caused noise would be audible for more than 10% but less than 25% of the day. There would be enough time when the natural soundscape was unaffected by humans that noise-free intervals of 1 to 1.5 hours could be common during the day.

Zones 3 and 4: Audible 15-30% of the day, noise-free intervals of 1 hour or less.

*Major—**Zones 1 and 2:*** Human caused noise would be audible for 25% or more of the day. The total time when the natural soundscape was unaffected by humans would commonly allow for noise-free intervals of no more than 1 hour during the day.

Zones 3 and 4: Audible 30% or more of the day, noise-free intervals less than 30 minutes.

Context

Localized—Impacts would occur to a small area such as a campsite or attraction site, or a segment of river no more than a mile in distance.

Intermediate—Impacts would occur over an intermediate area, such as a tributary or 1 to 20 miles of the river. The 20-mile distance is used because a nonmotorized trip generally travels up to 20 miles in a day.

Regional—Impacts would occur over a large area, such as more than 20 miles of the river.

Sensitivity—Sensitivity enters into the analysis in that the intensity levels apply differently to different zones. Areas in Zone 1 are the most sensitive to sound impacts, followed in order by Zones 2, 3 and 4, ***which is reflected in the Intensity thresholds above***.

Duration

Short-term—The natural soundscape would return to pre-disturbance conditions in a day or less.

Intermediate term—The natural soundscape would return to pre-disturbance conditions in more than a day but less than a month.

Long-term—The natural soundscape would not return to pre-disturbance conditions for more than a month.

Timing

Timing tends to indicate less of an impact when a noise occurs in a random or infrequent pattern, for brief periods of time, and/or outside sensitive periods. Timing tends to indicate more of an impact when a noise occurs in a regular or frequent pattern, for long periods of time, and/or during sensitive time periods.

4.2.4.4.2 Mitigation of Effects

Previous mitigation efforts indicate that specific measures can be effective in reducing impacts to the natural soundscape, if adequate funding, staffing, monitoring, and implementation of the measures are maintained. ***A list of possible mitigation measures to be considered singly or in combination, that are not already incorporated into the alternatives, but are judged likely to reduce impacts to natural soundscape if implemented include the following:***

- ***Consider*** use limits, curfews, or restrictions on the noise source such as time of day use is allowed, the volume and duration of use of the source, and/or how often the source can be used for various zones and sensitive areas of the park (e.g., endangered species nesting sites or critical habitat, traditional cultural properties, etc.)
- Limit the allowable sound emissions of equipment or motors utilized in an activity, project, or function (use of mufflers, hand operated (non-mechanized) equipment, and designated “quiet technology,” etc.)
- ***Do not allow motors to idle unnecessarily***

- ***Consider operating requirement restrictions on the use of electronic devices (e.g., "boom boxes") in addition to restrictions on the use of generators***
- ***Consider*** curfews on certain camping activities to reduce evening noise levels and duration
- Require the use of best available technology for all motors used for river operations in Grand Canyon National Park. Motors used in the park ***should be*** the cleanest and quietest ***commercially available while also meeting performance and other requirements for the application. As*** improvements in motor technology ***become commercially available, the standard for "best available"*** would be updated
- Recommend that quiet technology aircraft consistent with the best available technology concept be used by the air tour industry.
- Continue to monitor and model aircraft and motorized watercraft use in the park and conduct sound/noise monitoring to ensure the accuracy of model predictions, and to better characterize the natural soundscape and noise impacts to the soundscape.

4.2.4.4.3 Cumulative Impacts

Cumulative impacts on the natural soundscape were determined by combining the incremental impacts of each alternative with other past, present, and reasonably foreseeable future actions (see Section 4.1 of Chapter 4 for a list of such actions).

The primary activities with the potential to cumulatively affect the natural soundscape and related values are the impacts from aircraft overflights not associated with river recreation. Such flights are numerous over parts of the park, but they occur completely independent of the alternatives in this document. They include commercial air tours and their support operations, high altitude commercial jet traffic, military aircraft, general aviation, and most administrative aircraft activities.

Hualapai Tribe helicopter operations that utilize Grand Canyon West airport and/or aircraft landing sites within the canyon on tribal lands outside of the park, and which carry passengers who are not also river passengers are part of the cumulative effects analysis, and not part of the impacts of the alternatives. Helicopters used for passenger exchanges/shuttles at Whitmore and Quartermaster are controlled by the Hualapai Tribe, not the NPS. In the case of Quartermaster, the Hualapai Tribe has indicated that approximately the same number of helicopter flights will occur in that area independent of the alternatives and independent of whether any of the helicopter passengers are also river passengers.

The NPS has no authority over helicopter flights on Hualapai tribal land, nor on other means of transportation that a visitor may choose outside the park boundary. However, the use of helicopters for river passenger shuttles and ***exchanges*** at Whitmore and Quartermaster will be considered as part of the impacts of the alternatives as the use of helicopters in these cases ***can be*** directly tied to the number of river passengers needing ***to exchange (i.e., either to begin or end their river trips at that location) or to shuttle to and from the river associated with pontoon boats.***

4.2.4.4.4 Tools Used to Analyze Effects to the Natural Soundscape

The River Trip Simulator model was used to assess the distance and timing between trips under current conditions as analyzed in Alternative A (No Action). The noise-free intervals used in the impact thresholds above are based on this analysis.

4.2.4.4.5 Assumptions

General assumptions used for analysis of effects from each alternative are discussed in Section 4.1 of this chapter. Assumptions that specifically relate to the alternatives and their effect on the natural soundscape are presented below:

- The block of time available for noise-free intervals was arrived at by estimating the total time that periods of random and unscheduled noise events ***would be*** audible over a 12-hour day, and then subtracting that total from 12 hours. Because the human activity that introduces noise in the river corridor is often variable in amplitude, sporadic in nature, and can occur at various times of the day, it can be difficult to accurately determine the noise-free interval at any one location on the river; therefore, estimations of the noise-free interval are used in the following analysis to represent field conditions and seasonal use patterns.
- Average speed of the rafts is tied to Glen Canyon Dam release flows, but 3 to 5 mph is selected for nonmotorized watercraft, and up to 10–12 mph for motorized rafts. An average sized nonmotorized commercial raft will carry five people and gear, a nonmotorized noncommercial raft, four people and gear, and a motorized raft, 20–22 people and gear.
- Motorized rafts travel an average 40 miles per day, and run their motors for about 3.5 hours each to travel that distance, so that although the noise from motorboats is produced in a localized area, it also creates a regional impact because it occurs over the entire river corridor during the course of a trip.
- ***In the noise analysis, the following simplifying assumptions are used in analyzing noise from noncommercial trips:***
    - ***All noncommercial trips are assumed to use nonmotorized watercraft under all alternatives, even though it is recognized that about 9% of noncommercial trips currently utilize motors (i.e., an average of 16 trips per year from 1998 to 2003). To the extent that more noncommercial trips might decide to use more motors in the future, noise impacts would increase. Because there is no basis to assume that any of the alternatives allowing motorized use would encourage or discourage motorized noncommercial use any more than the others, this simplifying assumption would not affect the relative differences in impacts among the alternatives. Because the alternatives have no more than two noncommercial launches per day in the peak season, assuming that both launches would be nonmotorized is the most likely (or typical) scenario.***
    - ***Noncommercial trips may vary from one to sixteen boats for sixteen trip members based upon the wishes of individual trip participants, for both nonmotorized and motorized noncommercial trips. For the purposes of the***

noise analysis, an average of 4 people per raft, 16 people per trip, and 4 rafts per trip is assumed to be the most "typical" scenario, and is used to allow consistent relative comparisons among the alternatives. While it is possible for a noncommercial trip to have up to 16 motorized boats, that would be a highly unusual situation. However, to the extent that individual trips vary from the assumed scenario, actual noise could increase or decrease.

- Trips with multiple boats will sometimes bunch and sometimes spread out as they travel down the river, so noise overlap will sometimes occur, reducing the total amount of time raft activity noise is audible. Even when traveling in a group, boats can often be 15–20 minutes apart in traveling past a point on the river. Therefore, it is reasonable for a peak-period analysis to assess each boat separately.
- The aircraft and raft noise values presented for the following scenarios are based on actual field measurements conducted at Grand Canyon National Park. The calculation of "percent time audible," as used in the following analysis, is based on the maximum number of passengers and trips that could be launched ***each day, which represents expected conditions during peak days in the peak season*** under each alternative. It is understood that the number of raft trips and helicopter shuttles will fluctuate daily and seasonally, thus affecting the numbers of daily passengers, trips and noise generated. However, there was insufficient data to quantify the fluctuations. The maximums were used to assess the relative differences between alternatives in a consistent manner using the same basis for the inputs. It is recognized that days or time periods when the inputs are less than the maximums, the noise estimates would probably be less. ***It is also recognized that behavior has a great effect on impacts (i.e., in this context one "loud" group can have much more impact on the soundscape than many "quiet" groups).*** Rafters also do not make noise all the time; expected noise events would generally be infrequent and random. However, if the analyzed scenario does not cause major adverse impacts, then any other reasonable combination of trips, passenger numbers, and river activities less than the peak should also not lead to major adverse impacts.
- For purposes of this analysis, it is assumed that all helicopter shuttles carry 5 passengers on every flight (or are empty if there are passengers only on one end of the shuttle). As an example, if there are 20 passengers flying in to Whitmore or Quartermaster and 20 passengers flying out, eight flights are assumed (i.e., four flights in plus four flights out, each filled with five passengers each way). However, if there were 20 people to fly out, but only 10 to fly in, then eight flights would still be assumed (i.e., two flights carrying the 10 people in to the river and two flights returning with 10 of the people flying out, plus two flights for the remaining 10 people flying out, but an additional two flights coming in to the river empty to pick up those 10 people). ***After publication of the Draft EIS, the NPS received additional limited data concerning Whitmore helicopters from the Federal Aviation Administration and Bar 10 Ranch. The data indicates that helicopters currently used for the Whitmore shuttle operations are now almost all Bell Long Rangers that can hold up to 6 passengers. However, the Long Rangers are not always full, so the assumption of 5 passengers per flight is unchanged in this Final EIS. The number of exchange passengers and flights used for Alternative A in the Draft EIS are compared below with the range of values in the new data (the range depends upon which years are used (or averaged) in the analysis):***

- ◦ ***10,200 passengers vs. 10,159-10,265 passengers (excluding crew);***
- ◦ ***2,625 flights per year vs. 2,340-2,940 (the new data was for round-trips, which for consistency is converted here to single flights);***
- ◦ ***14-15 flights per day in peak season vs. 17-28 on average (with some days of the week often at only 2-4 flights);***

The passengers and flights per year are well within the ranges in the new data. The flights per day values used in the EIS appear to be a bit lower than the new data, but because the yearly numbers compare well, current flights per day are linked to current variable launch patterns, and the limited nature of the new data, the Draft EIS values continue to be used without change in this Final EIS for Alternative A. It is important to note that the new data does indicate a trend of fewer flights (and flight hours) per year due to use of the larger helicopters. The new data also indicate that almost all current shuttle flights are conducted between 7:00 A.M. and noon (see also Figure 4-3, and text on Whitmore exchanges in Section 4.4.5).

- ***Whitmore helicopter shuttle flights fly over Grand Canyon-Parashant National Monument between Bar 10 Ranch and the canyon rim, in addition to Grand Canyon National Park (GRCA) below the rim. It is assumed based upon geography that each Whitmore helicopter flight would be audible at Grand Canyon-Parashant National Monument for approximately the same amount of time that it is audible in GRCA.***
- ***The park has long recognized the nature of the experience provided by air tours as an opportunity and an enjoyable part of some people's visit to the region. As with many activities, though, they provide benefits to those who participate in them, but can create impacts for park resources and other visitors (NPS 1994; Gramann 1999).***
- It is understood that some trip members use other forms of watercraft than rafts for their recreational adventure (e.g., dory, kayak), but using rafts is a simplifying assumption considered reasonable for the nature of the analyses. It is recognized that noise produced by motorized trips is different from noise produced by nonmotorized trips, and off-river noise and helicopter noise are also different. Therefore, the noise is presented separately for all the different scenarios present in an alternative. However, because this is a peak-period analysis, and because there may be additional effects from the combination of noise produced by all sources, the analysis also considers the combined noise effects that may be present.
- Bottlenecks, ***attraction sites,*** gathering points, launch/retrieval sites, and camping areas will be noisier than lesser used natural areas, and moving water (rapids and fast flowing whitewater areas) and wind will help to reduce noise impacts by masking the noise source.
- Where river rapids raise the natural ambient levels, rafting noise is expected to be less impacting on the natural soundscape due to the masking effect of the sound from moving water, and by other natural sounds (wind, storm activity, insect activity, etc.).
- Human voices in reasonably quiet conversation are not considered noise impacts in this context, but human voices and activities that are clearly audible more than 100 feet away

from the source in a quiet natural ambient environment are included in noise impact considerations. Off-river noise considers such sources as electronic devices (e.g., boom boxes), camp stoves, and activities such as loading/unloading rafts and games. The noise is usually not continuous, and groups vary in their "loudness" and when and where such noise occurs during a trip. There are no data allowing such noise to be quantified or predicted, but its presence is considered in that larger groups tend to have more opportunity to create such noise.

- ***Sound impacts on wildlife are discussed in the section on "Terrestrial Wildlife" rather than in this section on Natural Soundscapes.***
- The impact analyses focus on the relative differences between alternatives within groups (i.e., Lees Ferry and Lower Gorge groups), not on the absolute amounts of noise estimated. Because the assumptions and approaches are similar, the relative differences among the Lees Ferry alternatives, and the relative differences among the Lower Gorge alternatives, are considered to be accurate to acceptable levels within those groups of alternatives.
- ***This analysis focuses on sound traveling through the air. Although sound from boat motors also travels underwater, the likelihood of significant underwater sound impacts from the type and number of motorboats used in the Grand Canyon is small enough to not warrant additional analysis. The limited information available about underwater sound propagation from outboard motors similar to the four-stroke motors used in Grand Canyon indicates that river organisms are more likely to be injured by physical contact with the propellers than by sound produced underwater by the motors (Dr. Kurt Fristrup, pers. comm. 2005). Expected broadband sound levels (integrated over all frequencies radiated by the motor) are expected to be below the level of 180 dB re 1 uPa at one meter, the level above which biologists are very concerned about the potential for injury of aquatic organisms. Behavioral effects would be expected to be limited, due to the limited range at which outboard motor sounds could be detected and the relatively brief exposure that each boat would normally present. The scenario with the greatest potential for impacts would be in a calm section of the river where several boats might be spaced not much more than the maximum distance of detection. Concerns would be tempered by the fact that freshwater fish do not generally have very sensitive hearing, and many species may not actively use sound for communication. In addition, rapids, air bubbles, eddies, and other characteristics of the flowing river would tend to attenuate underwater noise propagation in many places.***

4.2.4.5 Impact Analysis—Lees Ferry Alternatives

The potential for impacts for Lees Ferry alternatives are based on a comparison among Lees Ferry alternatives and the existing conditions.

4.2.4.5.1 Alternative A (Existing Condition)

Analysis. Under Alternative A, management of recreational use would continue to allow large group sizes, lengthy trips, and spikes in trips at one time, people at one time, and daily launches (see Table 4- 1). User-days would remain capped at current levels, which would result in approximately the same number of total yearly passengers. Similarly, user discretionary time would remain similar to current levels.

Alternative A has a range of 3 to 9 launches per day during the summer season, up to 3 launches per day during shoulder seasons, and very little use during winter. Maximum trip lengths are 18 days for all trips during the summer, and 30 in the winter. Shoulder season limits are 18 days for commercial motorized trips, to 21 days for either nonmotorized commercial or noncommercial (private).

Motorized Trips—For purposes of characterizing this, a typical peak day for a commercial motorized trip in the summer season would consist of the following:

- A motorized raft would run its motor approximately 3.5 hours per day at typical river levels and trip lengths.
- There would be two rafts per ***commercial*** motorized trip.
- Trips average 40 miles traveled per day and have similar trip lengths.
- Four ***commercial*** motorized trips would launch per day, or eight motorized rafts total per day.

This would result in motorboat noise passing by a single point on the river 8 times a day, at about 9 minutes audibility per boat, for a total of 72 minutes, or about 10% of the time audible, which over the 12-hour day is considered a moderate adverse impact. In addition, a person on the boat (or the natural soundscape alongside the boat) would experience noise from the boat's motor operating approximately 3.5 hours (210 minutes) per day. The total time the motor creates noise in the park's natural soundscape would be a regional impact over the average 40 miles of river that motorized rafts travel per day. However, the motor use would not be constant (i.e. there would be periods of no-motor use).

The noise-free interval on the motorized raft itself is expected to be low, with only 30 to 60 minutes between noise events when the motor is used. For the single spot on the river, which represents the natural soundscape in this scenario, the noise intrusions are expected to be random in nature and infrequent (Jalbert, pers. comm. 2004).

Nonmotorized Trips—For purposes of estimating the noise contributed by nonmotorized rafting activity, the following scenario is presented:

- For commercial nonmotorized trips, calculations assume an average of 5 people per raft and up to 39 people per group, so 8 rafts per trip;
- For noncommercial nonmotorized trips, calculations assume an average of 4 people per raft and 16 people per group, so 4 rafts per trip;
- Five nonmotorized trips launch on the busiest days, with up to two noncommercial and three commercial, so up to 32 nonmotorized rafts launch per day (24 + 8) in this scenario;

Noise from nonmotorized rafts as they float past a single point on the river is expected to be approximately 3 minutes per raft, or in the range of 12 to 24 minutes per trip (4 rafts × 3 minutes for noncommercial trip, 8 rafts × 3 minutes for commercial trips). With up to five trips per day, and a water flow of 3 to 5 miles per hour (mph), human noise at any one point is expected to be up to 96 minutes of total human raft activity noise per day ***(i.e., 32 rafts X 3 minutes),*** or about 13% of the day audible. Nonmotorized raft sounds would be mostly human voices and intermittent. The noise-free interval on the nonmotorized raft itself is expected to be high, with voices and oars being the primary human sounds. For the single spot on the river, which represents the natural soundscape in this scenario, the noise intrusions are expected to be random in nature and infrequent.

Combined Raft and Off-River Noise—Adding the noise expected at a single point on the river from both motorized (72 minutes) and nonmotorized trips (96 minutes) under this scenario gives a total from floating rafts of 168 minutes, which is a bit over 2.5 hours of the 12-hour day, or about 23% of the time audible, a moderate intensity level.

The human activity noise contribution off the river (e.g., at campsites, lunch areas, hiking trailheads, launch and takeout areas, river rapid scouting locations and other stops, etc.) cannot be quantified as discussed in the assumptions above, but relative comparisons can be made between alternatives in terms of numbers of launches, group sizes, and user discretionary time (i.e., alternatives with greater numbers of launches, larger group sizes, and/or higher user discretionary time would tend to have greater impacts). This noise would be spread out over 15 to 40 miles of river. It would not occur at the same time or place, but it could overlap (e.g., nine different trips at nine different locations). The noise-free intervals in this scenario are expected to be in the range of 1.5 to 3.5 hours.

Since human noise activity on the raft and in the off-river locations is not constant, or created in the same location at the same time, these values represent the ***peak*** noise intrusion that could be reasonably expected from all types of river rafts and river activities, given the above scenarios. Average noise-free intervals of 1.5 to 3.5 hours would be commonly expected when considering only the boat-related activities in Alternative A, including the time audible plus the noise that cannot be quantified. However, when cumulative effects are also considered (see below), such long noise-free intervals would probably be rare in most places. Helicopter shuttle impacts in the Whitmore area would also reduce noise-free intervals in that area (see below).The noise intrusions from all trips are expected to be short-term, of minor to moderate (at high-use gathering areas and campsites) intensity, random to periodic in nature (i.e., at common gathering areas like trailheads and takeouts), and infrequent, based on typical river use launch rates and practices.

Whitmore Helicopters—Using existing flight and passenger data from FAA and the Hualapai Tribe, approximately ***10,200*** passenger exchanges occur at Whitmore each year, with ***3,635*** people flying into Whitmore and ***6,630*** flying out. Assuming that there are five passengers per flight, and that operators carry the maximum number of people on every flight, a total of ***2,652*** flights occur from this transfer location over the course of a year (i.e., *727* flights for passengers in, plus *727* flights for passengers out, plus ***599*** flights empty in to pick up passengers, plus ***599*** flights for passengers out). River data show that approximately 66% of all yearly flights occur during summer (i.e., ***1,750*** flights during summer, or an average of 14-15 flights per day). The remaining flight transfers take place during the shoulder season, (i.e., ***902*** flights during shoulder seasons, or an average of 7-8 flights per day).

Using the average number of flights per day and ***3 to*** 3.5 minutes audibility per flight, summer days would average ***42***-52.5 minutes of audibility from helicopters, and shoulder days would average about ***21***-28 minutes. However, observations indicate that the average rarely occurs***, and up to 20-25 round-trip flights occur on busy days (i.e., 40-50 one-way flights)***. Many summer mornings at Whitmore tend to be noise saturated for most of the time between 7 A.M. to 11 A.M., which is approximately one-third of the total 12-hour day. Other days have few or no flights, corresponding to the uneven launch patterns and motor trips traveling at similar speeds. Helicopters exchanging river trip passengers at Whitmore have been measured at up to 83 dBA at a distance of 200 feet from the source (***HMMH 1993***). This is almost 50 dBA above existing natural ambient levels (34 dBA). Whitmore shuttle helicopters have also been observed on occasion to fly very low over the river rather than directly to their destination at Bar 10 Ranch. On the many days of heavy helicopter use, adverse, major impacts would occur to the natural soundscape in a 10–20 mile diameter area at Whitmore, with helicopter shuttles audible 25% or more of the day, and close to 100% of the morning hours. These flights are authorized by Public Law 100-91.

Non-Peak Periods—Almost all of the river use in Alternative A occurs from March through October, so there are few river-related impacts to the natural soundscape during other months. Within the March–October period, use and corresponding soundscape impacts peak dramatically from May through August.

Mitigation of Effects. Actions to mitigate effects would include ***a subset*** of the actions listed in Section 4.2.4.4.2, but given the history of the current situation, it is unlikely that mitigations would be implemented at a level sufficient to reduce the impacts of Alternative A to the natural soundscape to a minor intensity or less.

Generator use is currently allowed and causes minor to major localized impacts to the natural soundscape, depending upon the amount of time generators are used. However, generator use is being restricted under all alternatives, including no-action, so is not further evaluated here. This restriction is an important mitigation for the natural soundscape.

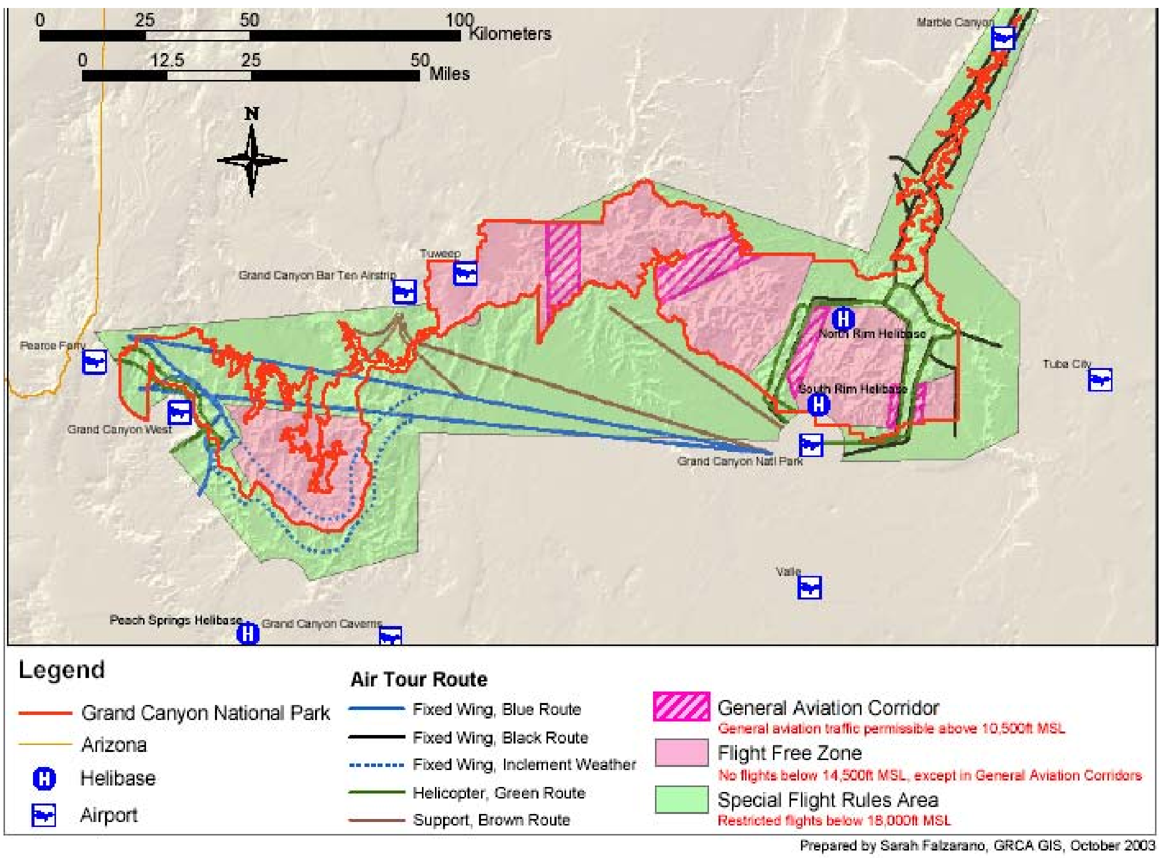
Cumulative Effects. Cumulative human noise impacts that adversely impact the park's natural soundscape come from the use of aircraft for commercial air tours, park administrative flights, high altitude commercial jet traffic, and to a lesser extent military and general aviation aircraft use over and adjacent to the park. As discussed above, several laws require the Federal Aviation Administration and the NPS to address the aircraft noise issue and to work together to "substantially restore natural quiet" to Grand Canyon National Park. There is a continuing effort to determine whether "substantial restoration of natural quiet" has been achieved. However, cumulative aircraft use is causing a "significant adverse effect" and an adverse, long-term, major impact on the natural soundscape. Alternative A adds a negligible increment to this adverse, major cumulative effect.

Commercial air tour numbers were at their highest in 1997 and 1998 when over 120,000 air tours took place annually over the park. Current numbers of air tours and support flights are about 83,000 annually (Joly, pers. comm. 2004). However, noise intrusions by high altitude commercial jet traffic over the park have increased significantly. Military use has been largely routed away from the park, and military compliance with NPS policies is good. General aviation aircraft and park administrative use of aircraft has remained fairly constant.

Commercial air tours have shown a slight increase over the park since 2002, with most of the increase occurring in the west end of the park, in support of Hualapai Tribe river recreation activities and commercial air tours.

Commercial air tour operations at Grand Canyon National Park occur in the Special Flight Rules Area 50-2, which includes all of the river corridor (Zones 1 through 3). Air tour routes are directly over the river in the Dragon and Zuni corridors (see Figure 4-3), ***Marble Canyon, approximately River Miles 200 to 215***, and in the Lower Gorge (i.e., flights originating from Las Vegas ***or Boulder City*** going to the airport in Tusayan or Grand Canyon West***, or conducting "west end" tours***).

FIGURE 4-3: SPECIAL FLIGHT RULES AREA GRAND CANYON NATIONAL PARK



To address the Grand Canyon National Park aircraft overflight noise issue, of the more than 300 hours of active logging data collected on September 10, 12, and 13, 1999, fixed-wing propeller aircraft and helicopters accounted for over 99.5 hours, and high altitude commercial jet aircraft were logged for just over 69 hours, for a total of about 168.5 hours of aircraft audibility data. This equates to approximately 56% of the day being impacted by aircraft noise**,** for all days monitored (HMMH 2004). Since the data was collected in September, which is not the peak month of commercial air tours over Grand Canyon National Park, these values may underrepresent the true number of commercial air tours typically conducted during the peak season. However, the data indicates that aircraft were audible for over half the day, thus reducing the percentage of time natural sounds were unaffected by humans to less than half the time in one-third to one-half of the park. The study showed that high altitude commercial jet aircraft are audible across all sites monitored, with time audible ranging from 14.8% to 68.2 % of the day, on a daily basis.

It is expected that further analysis would indicate that high altitude jet aircraft are audible for over 50% of the time in some of the most remote and quiet portions of Zone 1, in and around the river corridor. Adding flight information from Whitmore estimates, and estimating park administrative flights and general aviation aircraft flight additions, another 10% to 33% of the day can be added to the total time aircraft are audible in portions of Zone 1, on many summer days. Aircraft overflights thus represent major adverse cumulative impacts on the park natural soundscape for about 245 days per year in most of the park, and they are frequent and periodic, depending upon location. Adding motorboat and nonmotor boat noise from river recreation further increases the cumulative impact.

Given the history of aircraft overflights at Grand Canyon, mitigation is unlikely to be implemented that would reduce cumulative impacts on the natural soundscape to a minor or lower intensity level.

Conclusion. Under Alternative A, motorized rafts passing by a single point on the river are estimated to be audible approximately 10% of the 12-hour day, and nonmotorized rafts an additional ***13***%. Additional off-river noise would be created by recreationists, especially at gathering areas such as attraction sites, lunch stops and campsites, but this cannot be quantified.

Average noise-free intervals of 1.5 to 3.5 hours (minor intensity level) would be expected if raft-related noise was the only consideration, but the cumulative effects of aircraft overflights make it likely that noise-free intervals would be reduced to infrequent, small blocks of time in much of the river corridor. The raft-related impacts result in an overall minor to moderate adverse impact, with generally short-term impacts from each event, but they occur most days over enough of the year that some long-term effects are estimated. Motorboats travel over an average 40 miles per day and run their motors for about 3.5 hours each to travel that distance, so that although the noise from motorboats is produced in a localized area, it also creates a regional impact over the entire river corridor during the course of a trip.

Helicopter shuttles in the Whitmore area create major adverse impacts in an area up to 10–20 miles in diameter around the Whitmore landing site (i.e., localized). The helicopter river passenger shuttles average about ***42 to 52.5*** minutes audibility during the busy summer months, but on busy days can be audible during most of the time between 7am and 11am (almost one-third of the day). The noise is repeatable and periodic in nature, and easily audible (i.e., the noise intrusion is 50 dBA or greater than ambient). The noise-free interval is significantly reduced by the continuous nature of the morning passenger transfers, dropping to less than 10 minutes between flights for almost one-third of the day on busy days. Once the ***passenger exchanges*** are completed, the natural soundscape is expected to return to noise-free intervals similar to the up-river stretch. Because the flights are authorized in Public Law 100-91, it is unlikely that mitigation can be implemented to reduce impacts in the Whitmore area to minor levels or less. Alternative A would not result in the impairment of the natural soundscape in Grand Canyon National Park.

The cumulative effects of Alternative A are major adverse long-term regional impacts primarily due to extensive aircraft overflights of the park independent of the *Colorado River Management Plan*. The cumulative impacts are not likely to be able to be mitigated to minor intensity or less. There are "significant adverse effects" and "substantial restoration of natural quiet" has not been achieved as required by Public Law 100-91 and other mandates. Noise-free intervals due to aircraft overflights would be reduced to infrequent, small blocks of time in many parts of the park. Noise from river recreational activities contributes additional noise to the natural soundscape; however, even if all noise from all river recreation was eliminated from the park ***(including river-related flights at Whitmore)***, the cumulative effects of aircraft noise would still be an adverse, major impact.

4.2.4.5.2 Alternative B

Analysis. Under Alternative B, recreational motor trips are prohibited and group sizes, trips at one time, people at one time, daily launches, user-days, and estimated total yearly passengers would be at their lowest levels (see Table 4- 1).

Nonmotorized Trips—For purposes of estimating the noise contributed by nonmotorized rafting activity, the following scenario is presented:

- For commercial nonmotorized trips, calculations assume an average of 5 people per raft and up to 25 people per group, so five rafts per trip;
- For noncommercial nonmotorized trips, calculations assume an average of 4 people per raft and 16 people per standard group (so four rafts per trip) and 8 people per small group (so two rafts per trip);
- Four nonmotorized trips launch on the busiest days, with up to two commercial and one each noncommercial standard and small groups; so up to 16 nonmotorized rafts launch per day (10 + 4 + 2) in this scenario;

Noise from nonmotorized rafts as they float past a single point on the river is expected to be approximately three minutes per raft, or in the range of 6 to 15 minutes per trip (2 rafts × 3 minutes for noncommercial small trips, 4 rafts × 3 minutes for noncommercial standard trips, 5 rafts × 3 minutes for commercial trips). With up to 4 trips per day, and a water flow of 3 to 5 mph, the human noise at any one point is expected to be about 48 minutes of total human raft activity noise per day ***(i.e., 6 + 12 + 30)***, or about 7% of the day audible (a minor impact intensity level). Because there would be more than 11 hours without motorboat noise for a single location on the river under this scenario, noise-free intervals are expected to be high, in the range of 60 minutes to several hours (3.5 hours +) between boat noise intrusions. The noise-free interval on the nonmotorized raft itself is expected to be high. For the single spot on the river, the noise intrusions are expected to be random in nature and infrequent.

Combined Raft and Off-River Noise—The human activity noise contribution off the river (e.g., at campsites, lunch areas, hiking trailheads, launch and takeout areas, river rapid scouting locations and other stops) cannot be quantified as discussed in the assumptions above, but relative comparisons can be made between alternatives primarily in terms of numbers of launches and group sizes. Alternative B would have fewer launches per day and smaller group sizes than Alternative A, so less off-river noise would be expected. ***Nonmotorized raft noise would be audible about 48 minutes or 7% of the day.*** This noise would be spread out over 15 to 20 miles of river. It would not occur at the same time or place, but it could overlap (e.g., four different trips at four different locations).

Since human noise activity on the raft and in the off-river locations would not be constant, or created in the same location at the same time, these values represent the ***peak*** noise intrusion that could be reasonably expected from all types of river rafts and river activities, given the above scenario. The noise-free interval for Alternative B is expected to often exceed 3.5 hours (an adverse, negligible impact) when considering only boat-related activities, including the time audible plus the noise that cannot be quantified. However, when cumulative effects are also considered (see below), such long noise-free intervals would probably be rare in most places. The noise intrusions from all trips are expected to be adverse, short-term, negligible to minor, random to periodic in nature (i.e., at common gathering areas like trailheads and takeouts), and infrequent.

Non-Peak Periods—Most river use in Alternative B would occur from May through August, with half the summer level in the fall, and lower use the rest of the year. Because there would be no motor or helicopter use year-round, coupled with small group sizes and low launch levels, Alternative B would have lower shoulder and winter soundscape impacts than Alternative A and any of the action alternatives.

Mitigation of Effects. Actions to mitigate effects would include ***a subset*** of the actions listed in Section 4.2.4.4.2. Impacts are already expected to be at negligible to minor levels, but a noise monitoring program and quick action to address impacts would be necessary to ensure that impacts stayed at those levels.

Cumulative Effects. Cumulative impacts would be similar to those discussed under Alternative A. Alternative B would reduce overall noise compared to Alternative A, and would have a beneficial, negligible impact on cumulative effects. Aircraft overflights have an adverse, long-term, major cumulative effect on the park natural soundscape. Even if all river-related noise was removed from the park, the park would still experience major adverse effects from aircraft overflights independent of this river management plan. Frequent overflights commonly reduce noise-free intervals to considerably less than an hour in many parts of the park. Given the history of aircraft overflights at Grand Canyon, mitigation is unlikely to be implemented that would reduce cumulative impacts on the natural soundscape to a minor or lower intensity level.

Conclusion. The natural soundscape would benefit the most from adoption of Alternative B due to removal of motorized uses from the river, as well as the fewest overall daily launches, the lowest group sizes, and no helicopter exchanges at Whitmore. Removal of motors on the river would remove about 3.5 hours of motors running on each motorboat each day, and removal of Whitmore helicopter transfers would remove up to 4 hours of aircraft noise from that area. Noise from nonmotorized trips would be audible about 48 minutes or 7% of the 12-hour day at a single point along the river. There would be additional off-river noise, but it is not quantifiable.

That would leave almost 90% of the day noise-free from river-related activity, with expected noise-free intervals of 3.5 hours or more. Therefore, noise intrusions to the natural soundscape under this alternative would be adverse but localized, short-term, and negligible to minor (at high-use areas and gathering points). This would be a beneficial reduction in noise compared to Alternative A (no action) by providing ample opportunities for long periods of unaffected natural sounds (thus long noise-free intervals), consistent with desired experience in Zone 1. Alternative B would not result in the impairment of the natural soundscape in Grand Canyon National Park.

The cumulative effects of Alternative B would continue to be regional, adverse, long-term, major impacts primarily due to extensive aircraft overflights and could probably not be mitigated to a minor intensity or less. Alternative B would have a beneficial, negligible impact on cumulative effects as it would reduce noise compared to Alternative A, but it illustrates the point that even if all noise from all river recreation was eliminated from the park, the cumulative effects of aircraft noise would still be an adverse, major impact. There would still be “significant adverse effects” on the natural soundscape due to frequent, periodic, and noticeable noise from overflights, and “substantial restoration of natural quiet” would not be achieved as required by Public Law 100-91 and other mandates.

4.2.4.5.3 Alternative C

Analysis. Under Alternative C recreational motorized trips would be prohibited; group sizes, trips at one time, people at one time, daily launches, user-days, and estimated total yearly passengers would be mid way between Alternatives A and B (see Table 4- 1).

Nonmotorized Trips—For purposes of estimating the noise contributed by nonmotorized rafting activity, the following scenario is presented:

- For commercial nonmotorized trips, calculations assume an average of five people per raft and up to 30 people per group, so six rafts per trip.
- For noncommercial nonmotorized trips, calculations assume an average of four people per raft and 16 people per standard group (so four rafts per trip).
- Four nonmotorized trips launch on the busiest days, with up to two commercial and two noncommercial standard groups; so up to 20 nonmotorized rafts launch per day (12 + 8) in this scenario.

Noise from nonmotorized rafts as they float past a single point on the river is expected to be approximately 3 minutes per raft, or in the range of 12 to 18 minutes per trip (4 rafts × 3 minutes for noncommercial standard trips, 6 rafts × 3 minutes for commercial trips). With up to four trips per day, and a water flow of 3 to 5 mph, the human noise at any one point is expected to be about 60 minutes of total human raft activity noise per day ***(i.e., 20 rafts X 3 minutes)***, or about 8% of the day audible (a minor impact intensity level). For the single spot on the river, the noise intrusions are expected to be random in nature and infrequent.

Combined Raft and Off-River Noise—The human activity noise contribution off the river, (e.g., at campsites, lunch areas, hiking trailheads, launch and takeout areas, river rapid scouting locations and other stops, etc.) cannot be quantified as discussed in the assumptions above, but relative comparisons can be made between alternatives primarily in terms of numbers of launches and group sizes. Alternative C has fewer launches per day and smaller group sizes than Alternative A, so less off-river noise would be expected. ***Nonmotorized raft noise would be audible about 60 minutes or 8% of the day.*** This noise would be spread out over 15 to 20 miles of river. It would not occur at the same time or place, but it could overlap (e.g., four different trips at four different locations).

Since human noise activity on the raft and in the off-river locations is not constant, or created in the same location at the same time, these values represent the ***peak*** noise intrusion that could be reasonably expected from all types of river rafts and river activities, given the above scenario. The average noise-free interval for Alternative C is expected to often exceed 3.5 hours (negligible intensity impact) when considering only boat-related activities, including the time audible plus the noise that cannot be quantified. However, when cumulative effects are also considered (see below), such long noise-free intervals would probably be rare in most places. The noise intrusions from all trips are expected to be adverse, short-term, minor, random to periodic in nature (i.e., at common gathering areas like trailheads and takeouts), and infrequent. At any one location on the river, time audible noise events would be less than that for current conditions (Alternative A), but more launches and larger group sizes would increase impacts compared to Alternative B.

Non-Peak Periods—Alternative C would have relatively high-use levels all year. Thus, even though there would be no motorized use and no helicopter exchanges, soundscape impacts would tend to be higher from October through March than under Alternative A and many of the action alternatives.

Mitigation of Effects. Actions to mitigate effects would include ***a subset*** of the actions listed in Section 4.2.4.4.2. Impacts are already expected to be at minor levels, but a noise monitoring program and quick action to address impacts would be needed to ensure they would stay at those levels.

Cumulative Effects. Cumulative impacts would be similar to those discussed under Alternative A. Alternative C would reduce overall noise compared to Alternative A, but not as much as Alternative B, and would have a negligible beneficial impact on cumulative effects. Aircraft overflights have an adverse, long-term, major cumulative effect on the park's natural soundscape. Even if all river-related noise was removed from the park, the park would still experience adverse, major effects from aircraft overflights independent of this river management plan. Frequent overflights commonly reduce noise-free intervals to considerably less than an hour in many parts of the park. Given the history of aircraft overflights at Grand Canyon, mitigation is unlikely to be implemented that would reduce cumulative impacts on the natural soundscape to a minor or lower intensity level.

Conclusion. The natural soundscape would benefit from adoption of this alternative compared to Alternative A because removal of motors on the river removes about 3.5 hours of motors running on each motorboat each day, and removal of Whitmore helicopter transfers removes up to four hours of aircraft noise from that area. Noise from nonmotorized trips would be audible about 60 minutes or 8% of the 12-hour day at a single point along the river (a minor impact intensity level). There would be additional off-river noise, but it is not quantifiable. That would leave over 90% of the day free from noise generated by river-related activity, with expected noise-free intervals of 3.5 hours or more. Therefore, overall noise intrusions to the natural soundscape under this alternative would be localized (at high-use areas and gathering points), adverse, short-term, and minor. If mitigation was instituted at a reasonable level, impacts would likely remain at minor levels or less. Alternative C would not result in the impairment of the natural soundscape at Grand Canyon National Park.

The cumulative effects of Alternative C would continue to be regional, adverse, long-term, major impacts primarily due to extensive aircraft overflights of the park, and they could probably not be mitigated to minor intensity or less. Alternative C would have a beneficial, negligible impact on cumulative effects as it would reduce noise compared to Alternative A, but even if all noise from all river recreation was eliminated from the park, the cumulative effects of aircraft noise would still be adverse and major. There would still be "significant adverse effects" on the natural soundscape due to frequent, periodic and noticeable noise from overflights, and "substantial restoration of natural quiet" would not be achieved as required by Public Law 100-91 and other mandates.

4.2.4.5.4 Alternative D

Analysis. Under Alternative D recreational motor trips would be limited to eight months each year, with a four-month no-motor season. There would also be reductions in group sizes and trip lengths, increases in launches and user-days from March through October, and no helicopter operations at Whitmore under this alternative (see Table 4- 1).

Motorized Trips—For purposes of characterizing Alternative D, a typical peak day for a commercial motorized trip in the summer season would consist of the following:

- A motorized raft would run its motor approximately 3.5 hours per day at typical river levels and trip lengths.
- There would be up to two rafts per ***commercial*** motorized trip (i.e., with an assumption of 20 people per motorized raft and group sizes of 25, two rafts would be required).
- Trips average 40 miles traveled per day and have similar trip lengths.
- Up to three ***commercial*** motorized trips would launch per day, or up to six motorized rafts total per day.

This would result in motorboat noise passing by a single point on the river 6 times a day, at about 9 minutes audibility per boat, for a total of 54 minutes, or about ***7.5%*** of the time audible, which over the 12-hour day would be considered an adverse, minor impact. In addition, a person on the boat (or the natural soundscape alongside the boat) would experience noise from the boat's motor operating approximately 3.5 hours (210 minutes) per day. The total time the motor creates noise in the park's natural soundscape would be a regional impact over the average 40 miles of river that motorized rafts travel per day. However, the motor use would not be constant (i.e., there would be periods of no-motor use).

The noise-free interval on the motorized raft itself is expected to be low, with only 30 to 60 minutes between noise events when the motor is used. For the single spot on the river, the noise intrusions are expected to be random in nature and infrequent.

Nonmotorized Trips—For purposes of estimating the noise contributed by nonmotorized rafting activity, the following scenario is presented:

- For commercial nonmotorized trips, calculations assume an average of 5 people per raft and up to 25 people per group, so 5 rafts per trip;
- For noncommercial nonmotorized trips, calculations assume an average of 4 people per raft, 16 people per standard noncommercial group, so 4 rafts per trip;
- Two nonmotorized trips launch on the busiest days, with one commercial group, and one noncommercial standard group, so up to 9 nonmotorized rafts launch per day (5 + 4) in this scenario.

Noise from nonmotorized rafts as they float past a single point on the river is expected to be approximately 3 minutes per raft, or in the range of 12 to 15 minutes per trip (4 rafts × 3 minutes for noncommercial standard trips, 5 rafts × 3 minutes for commercial trips). With up to 2 trips per day, and a water flow of 3 to 5 mph, the human noise at any one point is expected to be about 27 minutes of total human raft activity noise per day ***(i.e., 12 + 15 minutes)***, or about 4% of the day audible (a negligible impact intensity level). For the single spot on the river, the noise intrusions are expected to be random in nature and infrequent.

Combined Raft and Off-River Noise—Adding the noise expected at a single point on the river from both motorized (54 minutes) and nonmotorized trips (27 minutes) under this scenario gives a total from floating rafts of 81 minutes, which is a bit a bit less than 1.5 hours of the 12-hour day, or about ***11***% of the time audible, an adverse, minor to moderate impact.

The human activity noise contribution off the river, (e.g., at campsites, lunch areas, hiking trailheads, launch and takeout areas, river rapid scouting locations and other stops, etc.) cannot be quantified as discussed in the assumptions above, but relative comparisons can be made between alternatives primarily in terms of numbers of launches and group sizes. Alternative D has fewer launches per day and smaller group sizes than Alternative A, so less off-river noise would be expected. This noise would be spread out over 15 to 40 miles of river. It would not occur at the same time or place, but it could overlap (e.g., five different trips at five different locations).

Since human noise activity on the raft and in the off-river locations is not constant, or created in the same location at the same time, these values represent the ***peak*** noise intrusion that could be reasonably expected from all types of river rafts and river activities, given the above scenario. Average noise-free intervals of 1.5 to 3.5 hours would be commonly expected when considering only the boat-related activities in Alternative D, including the time audible plus the noise that cannot be quantified. However, when cumulative effects are also considered (see below), such long noise-free intervals would probably be rare in most places. The noise intrusions from all trips are expected to be adverse, short-term, minor to moderate, and infrequent.

Non-Peak Periods—Most river use in Alternative D occurs from May through August, with less than half the summer level in the fall shoulder season, slightly lower still in the spring shoulder season, and some of lowest launch levels in winter. Because there would be no helicopter use, coupled with no motorized launches in the spring and fall shoulder seasons, Alternative D would have lower shoulder season soundscape impacts than Alternative A, but greater impacts in winter due to motorized winter launches and greater numbers of launches than Alternative A.

Mitigation of Effects. Actions to mitigate effects would include ***a subset*** of the actions listed in Section 4.2.4.4.2. To reduce impacts to minor levels or less, a noise monitoring program and quick action to address impacts would be necessary, especially for the increases in launches and user-days from March through October.

Cumulative Effects. Cumulative impacts would be similar to those discussed in Alternative A. Alternative D would have reduced impacts compared to Alternative A, in large part because no helicopter use would be allowed at Whitmore, and would contribute a beneficial, negligible increment to cumulative effects. Aircraft overflights have an adverse, long-term, major cumulative effect on the park's natural soundscape. Even if all river-related noise was removed from the park, the park would still experience adverse, major effects from aircraft overflights independent of this river management plan. Frequent overflights commonly reduce noise-free intervals to considerably less than an hour in many parts of the park. Given the history of aircraft overflights at Grand Canyon, mitigation is unlikely to be implemented that would reduce cumulative impacts on the natural soundscape to a minor or lower intensity level.

Conclusion. The natural soundscape would benefit from adoption of this alternative compared to Alternative A, because removal of Whitmore helicopter transfers removes up to 4 hours of aircraft noise from that area, and daily launches would be evened out along with smaller group sizes and fewer boats per day. Noise from commercial motorized trips would be audible about 54 minutes or ***7.5***% of the 12-hour day, and nonmotorized trips would be audible about 27 minutes or about 4% of the day at a single point along the river, for a combined total from all rafts of 81 minutes and ***11***% time audible (a minor to moderate intensity level). There would be additional off-river noise, but it is not quantifiable. Also, each motorized raft would run its motor about 3.5 hours to travel an average 40 miles, with noise impacts spreading out over that entire stretch of river during the course of each day. That would leave over 80% of the day free of noise from river-related activity, with expected noise-free intervals of 1.5 to 3.5 hours (an adverse, short-term, minor impact). Therefore, noise intrusions to the natural soundscape under this alternative would result in localized, adverse, short-term, and minor to moderate impacts (at high-use areas and gathering points). If mitigation is instituted at a reasonable level, it is likely that impacts can be maintained at minor levels or less. Alternative D would not result in the impairment of the natural soundscape in Grand Canyon National Park.

The cumulative effects of Alternative D would continue to be major adverse, long-term regional impacts primarily due to extensive aircraft overflights of the park, and are not likely to be able to be mitigated to minor intensity or less. Although Alternative D would have a beneficial, negligible impact on cumulative effects, even if all noise from all river recreation was eliminated from the park, the cumulative effects of aircraft noise would still be an adverse, major impact. There would still be "significant adverse effects" on the natural soundscape due to frequent, periodic and noticeable noise from overflights, and "substantial restoration of natural quiet" would not be achieved as required by Public Law 100-91 and other mandates.

4.2.4.5.5 Alternative E

Analysis. Under Alternative E, recreational motor trips would be limited to six months, with a six-month no-motor season. Compared to Alternative A, there would be increases in launches and user-days from March through October (see Table 4- 1).

Motorized Trips—For purposes of characterizing Alternative E, a typical peak day for a commercial motorized trip in the summer season would consist of the following:

- The motorized raft would run its motor approximately 3.5 hours per day at typical river levels and trip lengths.
- The maximum group size would be 30, so there would be two rafts per ***commercial*** motorized trip.
- Trips average 40 miles traveled per day and have similar trip lengths.
- Up to three ***commercial*** motorized trips would launch per day, or up to six motorized rafts total per day.

This would result in motorboat noise passing by a single point on the river six times a day, at about 9 minutes audibility per boat, for a total of 54 minutes, or about ***7.5***% of the time audible, which over the 12-hour day is considered a minor adverse impact. In addition, a person on the boat (or the natural soundscape alongside the boat) would experience noise from the boat's motor operating approximately 3.5 hours (210 minutes) per day. The total time the motor creates noise in the park's natural soundscape would be a regional impact over the average 40 miles of river that motorized rafts travel per day. However, the motor use would not be constant (i.e. there would be periods of no-motor use). For the single spot on the river, the noise intrusions are expected to be random in nature and infrequent.

Nonmotorized Trips—For purposes of estimating the noise contributed by nonmotorized rafting activity, the following scenario is presented:

- For commercial nonmotorized trips, calculations assume an average of 5 people per raft and up to 25 people per group, so five rafts per trip;
- For noncommercial nonmotorized trips, calculations assume an average of 4 people per raft, 16 people per standard noncommercial group (so 4 rafts per trip), and 8 people per small noncommercial group (so 2 rafts per trip);
- Up to three nonmotorized trips launch on the busiest days, with one commercial group, one noncommercial standard group, and one noncommercial small group, so up to 11 nonmotorized rafts launch per day (5 + 4 + 2) in this scenario.

Noise from nonmotorized rafts as they float past a single point on the river is expected to be approximately 3 minutes per raft, or in the range of 6 to 15 minutes per trip (2 rafts × 3 minutes for noncommercial small trips, 4 rafts × 3 minutes for noncommercial standard trips, 5 rafts × 3 minutes for commercial trips). With up to 3 trips per day, and a water flow of 3 to 5 mph, the human noise at any one point is expected to be about 33 minutes of total human raft activity noise per day ***(i.e., 6 + 12 + 15 minutes),*** or about ***4.6***% of the day audible, ***a negligible to minor adverse impact.*** The noise-free interval on the nonmotorized raft itself is expected to be high. For the single spot on the river, the noise intrusions are expected to be random in nature and infrequent.

Combined Raft and Off-River Noise—Adding the noise expected at a single point on the river from both motorized (54 minutes) and nonmotorized trips (33 minutes) under this scenario would give a total from floating rafts of 87 minutes, slightly less than 1.5 hours of the 12-hour day, or about 12% of the time audible, an adverse, short-term, moderate impact.

The human activity noise contribution off the river, (e.g., at campsites, lunch areas, hiking trailheads, launch and takeout areas, river rapid scouting locations and other stops.) cannot be quantified as discussed in the assumptions above, but relative comparisons can be made between alternatives primarily in terms of numbers of launches and group sizes. Alternative E would have fewer launches per day and smaller group sizes than Alternative A, so less off-river noise would be expected. This noise would be spread out over 15 to 40 miles of river. It would not occur at the same time or place, but it could overlap (e.g., six different trips at six different locations).

Since human noise activity on the raft and in the off-river locations is not constant, or created in the same location at the same time, these values represent the ***peak*** noise intrusion that could be reasonably expected from all types of river rafts and river activities, given the above scenario. Average noise-free intervals of 1.5 to 3.5 hours would be commonly expected when considering only the boat-related activities in Alternative E, including the time audible plus the noise that cannot be quantified. However, when cumulative effects are also considered (see below), such long noise-free intervals would probably be rare in most places. The noise intrusions from all trips would be expected to be adverse, short-term, minor to moderate, random to periodic in nature (i.e., at common gathering areas like trailheads and takeouts), and infrequent.

Whitmore Helicopters—For Alternative E, 5,000 passenger exchanges would occur by helicopter at Whitmore each year, with 2,500 flying into Whitmore and 2,500 flying out. Assuming that there would be five passengers per flight, and that operators would carry the maximum number of people on every flight they could, a total of 1,000 flights would occur from this transfer location over the course of a year (i.e., 500 flights for passengers in, plus 500 flights for passengers out).

Because Alternative E evens out the launch patterns, as many as three groups of 30 passengers could need helicopter shuttles during many summer days. This would correspond to 36 flights per day (18 in and 18 out for the 90 passengers), and at ***3 to*** 3.5 minutes audibility per flight would result in ***108 to 126*** minutes (about 2 hours) of helicopter audibility on many days. When helicopter shuttles occur, noise-free intervals would be less than 10 minutes. Helicopters exchanging river trip passengers at Whitmore have been measured at up to 83 dBA at a distance of 200 feet from the source. This is almost 50 dBA above existing natural ambient levels (34 dBA or less). On the many days of heavy helicopter use, moderate to major adverse impacts would occur to the natural soundscape in a 10–20 mile diameter in the Whitmore area, with helicopter shuttles audible about ***15 to 17.5***% of the day, and about 50% of the morning hours. It should be noted that such flights are authorized by Public Law 100-91, and that there would be days during even the summer season of low or no helicopter use.

Non-Peak Periods—Alternative E would have peak use from May through August and relatively high mixed use in April and September. It would also have higher use levels than Alternative A during the rest of the year, with correspondingly greater soundscape impacts. This would be partially offset because use from October through March would be nonmotorized, and Alternative E would have smaller group sizes.

Mitigation of Effects. Actions to mitigate effects would include ***a subset*** of the actions listed in Section 4.2.4.4.2. Implementing these mitigation actions would require increased funding and staff, and a monitoring program with quick response to reduce impact as needed. But it is reasonable to expect that sufficient implementation could be achieved to reduce impacts to minor levels or less.

Cumulative Effects. Cumulative impacts would be similar to those discussed in Alternative A. Alternative E would have adverse, minor to moderate impacts, the same overall level as Alternative A, and it would contribute a negligible adverse increment to cumulative effects. Aircraft overflights have an adverse, long-term, major cumulative effect on the park's natural soundscape. Even if all river-related noise was removed from the park, the park would still experience major adverse effects from aircraft overflights independent of this river management plan. Frequent overflights commonly reduce noise-free intervals to considerably less than an hour in many parts of the park. Given the history of aircraft overflights at Grand Canyon, mitigation is unlikely to be implemented that would reduce cumulative impacts on the natural soundscape to a minor or lower intensity level.

Conclusions. The natural soundscape would benefit from adoption of this alternative compared to Alternative A (no action). Noise from commercial motorized trips would be audible about 54 minutes or ***7.5***% of the 12-hour day, and nonmotorized trips would be audible about 33 minutes or about ***4.6***% of the day at a single point along the river, for a combined total from all rafts of 87 minutes and 12% time audible (an adverse, short-term, minor to moderate impact). That would leave over 80% of the day free of noise from river-related activity, with expected average noise-free intervals 1.5 to 3.5 hours when considering only river-related activity away from Whitmore. Other parts of the year would have less noise than the peak.

In addition, helicopter shuttle noise would be audible for up to two hours over a four-hour period on many days in the Whitmore area, a moderate to major intensity level localized in the 10–20 mile diameter area around Whitmore. There would be additional off-river noise, but it is not quantifiable, and each motorized raft would run its motor about 3.5 hours to travel an average 40 miles with the noise impacts spreading out over that entire stretch of river during the course of each day.

Therefore, overall noise intrusions to the natural soundscape under this alternative would be localized, adverse, short-term, and minor to moderate (at high-use areas and gathering points). If mitigation was instituted at a reasonable level, it is likely that impacts could be reduced to minor levels or less. Alternative E would not result in the impairment of the natural soundscape in Grand Canyon National Park.

The cumulative effects of Alternative E would be major adverse, long-term regional impacts primarily due to extensive aircraft overflights of the park, and are not likely to be able to be mitigated to minor intensity or less. Although Alternative E does contribute to the overall cumulative effects of noise on the park natural soundscape, even if all noise from all river recreation was completely eliminated from the park, the cumulative effects of aircraft noise would still be a major adverse impact. There would still be "significant adverse effects" on the natural soundscape due to frequent, periodic and noticeable noise from overflights, and "substantial restoration of natural quiet" would not be achieved as required by Public Law 100-91 and other mandates.

4.2.4.5.6 Alternative F

Analysis. Under Alternative F, a six-month motor season would occur from January through June, and a six-month no-motor season from July through December (see Table 4- 1). This is the only alternative that splits summer into motor and no-motor seasons.

Motorized Trips—For purposes of characterizing Alternative F, a typical peak day for a commercial motorized trip in May–June would consist of the following:

- The motorized raft would run its motor approximately 3.5 hours per day at typical river levels and trip lengths.
- The maximum group size would be 30, so there would be two rafts per ***commercial*** motorized trip.
- Trips average 40 miles traveled per day and have similar trip lengths.
- Up to five ***commercial*** motorized trips would launch per day, or up to 10 motorized rafts total per day.

This would result in motorboat noise passing by a single point on the river 10 times a day, at about 9 minutes audibility per boat, for a total of 90 minutes, or about 12.5% of the time audible, which over the 12-hour day is considered a moderate adverse impact. In addition, a person on the boat (or the natural soundscape alongside the boat) would experience noise from the boat's motor operating approximately 3.5 hours (210 minutes) per day. The total time the motor creates noise in the park's natural soundscape would be a regional impact over the average 40 miles of river that motorized rafts travel per day. However, the motor use would not be constant (i.e. there would be periods of no-motor use). For the single spot on the river, the noise intrusions are expected to be random in nature and infrequent.

Nonmotorized Trips—For purposes of estimating the noise contributed by nonmotorized rafting activity during May–June, the following scenario is presented:

- For commercial nonmotorized trips, calculations assume an average of 5 people per raft and up to 30 people per group, so six rafts per trip.
- For noncommercial nonmotorized trips, calculations assume an average of 4 people per raft, 16 people per standard noncommercial group (so four rafts per trip), and 8 people per small noncommercial group (so two rafts per trip).

- Up to one nonmotorized trip would launch on the busiest days, alternating days between one commercial group and one noncommercial standard group, so up to six nonmotorized rafts would launch per day in this scenario.

Noise from nonmotorized rafts as they float past a single point on the river is expected to be approximately 3 minutes per raft, or ***12*** to 18 minutes per trip (***4*** rafts × 3 minutes for noncommercial standard trips, 6 rafts × 3 minutes for commercial trips). With only one trip per day, and a water flow of 3 to 5 mph, the human noise at any one point is expected to be up to 18 minutes of total human raft activity noise per day, or about 2.5% of the day audible (an adverse, short-term, negligible impact). For the single spot on the river, the noise intrusions are expected to be random in nature and infrequent.

Combined Raft and Off-River Noise—Adding the noise expected at a single point on the river from both motorized (90 minutes) and nonmotorized trips (18 minutes) under this scenario gives a total from floating rafts of up to 108 minutes, which is a bit less than 2 hours of the 12-hour day, or about 15% of the time audible, an adverse, short-term, moderate impact.

The human activity noise contribution off the river, (e.g., at campsites, lunch areas, hiking trailheads, launch and takeout areas, river rapid scouting locations and other stops, etc.) cannot be quantified as discussed in the assumptions above, but relative comparisons can be made between alternatives primarily in terms of numbers of launches and group sizes. Alternative F would have fewer launches per day and smaller group sizes than Alternative A, so less off-river noise would be expected. This noise would be spread out over 15 to 40 miles of river. It would not occur at the same time or place, but it could overlap (e.g., six different trips at six different locations).

Since human noise activity on the raft and in the off-river locations is not constant, or created in the same location at the same time, these values represent the ***peak*** noise intrusion that could be reasonably expected from all types of river rafts and river activities, given the above scenarios. Average noise free intervals of 1 to 1.5 hours would be commonly expected when considering only the boat-related activities during the May–June peak period in Alternative F (an adverse, short-term, moderate impact), including the time audible plus the noise that cannot be quantified. However, when cumulative effects are also considered (see below), such long noise-free intervals would probably be rare in most places. The noise intrusions from all trips are expected to be adverse, short-term, moderate, random to periodic in nature (i.e., at common gathering areas like trailheads and takeouts), and infrequent.

Whitmore Helicopters—For Alternative F, 3,400 passengers would fly in to Whitmore by helicopter each year, and 6,600 would fly out. Assuming that there were five passengers per flight, and that operators would carry the maximum number of people on every flight, a total of 2,640 flights would occur from this transfer location over the course of a year (i.e., 680 flights for 3,400 passengers in, plus 680 flights for 3,400 passengers out, plus 640 flights for the remaining 3,200 passengers out, plus 640 flights coming in empty to pick up those 3,200 passengers).

Because Alternative F would even out the launch patterns, as many as five groups of 30 passengers could need helicopter shuttles during most summer days. This would correspond to 60 flights per day (30 in and 30 out for the 150 passengers), and at ***3 to*** 3.5 minutes audibility per flight would result in ***180 to 210*** minutes (***3 to 3.5*** hours) of helicopter audibility on many days (***assuming no overlap)***. When helicopter shuttles occur, noise-free intervals would be less than 10 minutes. Helicopters exchanging river trip passengers at Whitmore have been measured at up to 83 dBA at a distance of 200 feet from the source. This is almost 50 dBA above existing natural ambient levels (34 dBA or less). Whitmore shuttle helicopters have also been observed on occasion to fly very low over the river rather than directly to their destination at Bar 10 Ranch. On the many days of heavy helicopter use, major adverse impacts would occur to the natural soundscape localized in the Whitmore area, with helicopter shuttles audible ***25-***30% of the 12-hour day, and almost 90% of the morning hours. With so many motor launches in May–June, and generally the same number of motor launches per day, there would be few days during those months of low or no helicopter use. It should be noted that such flights are authorized by Public Law 100-91.

Non-Peak Periods—In terms of soundscape impacts, peak use in Alternative F would be in May and June, followed by March and April. While use levels would be relatively high during the rest of the year, it would be nonmotorized, with no helicopters at Whitmore. Compared to Alternative A, the July–September period would have fewer soundscape impacts in Alternative F, while the October–April period would have greater soundscape impacts due primarily to correspondingly lower and higher use levels in those months. This would be partially offset, though, because Alternative F would have smaller group sizes.

Mitigation of Effects. Actions to mitigate effects would include ***a subset*** of the actions listed in Section 4.2.4.4.2. Implementation of these mitigation actions would require increased funding and staff, and a monitoring program with quick response to reduce impact as needed. Due to high motorized use levels, it is unlikely that impacts could be reduced by reasonable mitigation to minor levels or less in the peak months of May and June, but it is reasonable to expect that impacts the rest of the year could be reduced to minor.

Cumulative Effects. Cumulative impacts would be similar to those discussed in Alternative A. Alternative F would have moderate overall impacts during peak periods ***(except major impacts at Whitmore)***, a greater overall level than Alternative A ***for the peak period***, but it would contribute an adverse, negligible increment to cumulative effects. Aircraft overflights have an adverse, long-term, major cumulative effect on the park's natural soundscape. Even if all river-related noise was removed from the park, the park would still experience major adverse effects from aircraft overflights independent of this river management plan. Frequent overflights commonly reduce noise-free intervals to considerably less than an hour in many parts of the park. Given the history of aircraft overflights at Grand Canyon, mitigation is unlikely to be implemented that would reduce cumulative impacts on the natural soundscape to a minor or lower intensity level.

Conclusions. Even with more motor use in May and June than under any of the other alternatives (including Alternative A), the natural soundscape would benefit overall from adoption of Alternative F compared to Alternative A. Noise from commercial motorized trips would be audible about 90 minutes or ***12.5***% of the 12-hour day, and nonmotorized trips would be audible up to 18 minutes or about 2.5% of the day at a single point along the river, for a combined total from all rafts of 108 minutes and 15% time audible (a moderate intensity level) during the two heaviest use months of the year (May-June). Average noise-free intervals would be expected to be 1 to 1.5 hours (an adverse, short-term moderate impact) when considering only river-related activity away from Whitmore during May and June. Other parts of the year would have less noise than the peak.

In addition, helicopter shuttle noise would be audible for up to 3.5 hours on many days during May and June localized in a 10–20 mile diameter at Whitmore area, an adverse, short-term, major impact. There would be additional off-river noise, but it is not quantifiable, and each motorized raft would run its motor about 3.5 hours to travel an average 40 miles with the noise impacts spreading out over that entire stretch of river during the course of each day.

Therefore, overall noise intrusions to the natural soundscape under this alternative would be localized and regional, adverse, generally short-term, and moderate (at high-use areas and gathering points). It is unlikely that impacts could be reduced to minor levels or less in May and June, but it is likely that they could be adequately reduced by mitigation the rest of the year. Alternative F would not result in the impairment of the natural soundscape in Grand Canyon National Park.

The cumulative effects of Alternative F would be major adverse, long-term regional impacts primarily due to extensive aircraft overflights of the park, and are not likely to be able to be mitigated to minor intensity or less. Although Alternative F does contribute to the overall cumulative effects of noise on the park natural soundscape, especially during May-June, even if all noise from all river recreation was completely eliminated from the park, the cumulative effects of aircraft noise would still be a major adverse impact. There would still be "significant adverse effects" on the natural soundscape due to frequent, periodic and noticeable noise from overflights, and "substantial restoration of natural quiet" would not be achieved as required by Public Law 100-91 and other mandates.

4.2.4.5.7 Alternative G

Analysis. Under Alternative G, the motorized season would be eight months (January–August), and the no-motor season would be four months (September–December). There would be considerable increases in March–October launches and user-days, with greatly increased use in the shoulder seasons (see Table 4- 1).

Motorized Trips—For purposes of characterizing Alternative G, a typical peak day for a commercial motorized trip would consist of the following:

- The motorized raft would run its motor approximately 3.5 hours per day at typical river levels and trip lengths.
- The maximum group size would be 40, so there would be two rafts per ***commercial*** motorized trip.
- Trips average 40 miles traveled per day and have similar trip lengths.
- Up to three ***commercial*** motorized trips would launch per day, or up to six motorized rafts total per day.

This would result in motorboat noise passing by a single point on the river 6 times a day, at about 9 minutes audibility per boat, for a total of 54 minutes, or about 8% of the time audible, which over the 12-hour day is considered a minor adverse impact. In addition, a person on the boat (or the natural soundscape alongside the boat) would experience noise from the boat's motor operating approximately 3.5 hours (210 minutes) per day. The total time the motor creates noise in the park's natural soundscape would be a regional impact over the average 40 miles of river that motorized rafts travel per day. However, the motor use would not be constant (i.e. there would be periods of no-motor use). For the single spot on the river, the noise intrusions would be random in nature and infrequent.

Nonmotorized Trips—For purposes of estimating the noise contributed by nonmotorized rafting activity, the following scenario is presented:

- For commercial nonmotorized trips, calculations assume an average of 5 people per raft and up to 30 people per group, so six rafts per trip;
- For noncommercial nonmotorized trips, calculations assume an average of 4 people per raft, 16 people per standard noncommercial group (so four rafts per trip), and 8 people per small noncommercial group (so two rafts per trip);
- Up to three nonmotorized trips launch on the busiest days, including one commercial group, one noncommercial standard group, and one noncommercial small group, so up to 12 nonmotorized rafts launch per day (6 + 4 + 2) in this scenario.

Noise from nonmotorized rafts as they float past a single point on the river is expected to be approximately 3 minutes per raft, or in the range of 6 to 18 minutes per trip (2 rafts × 3 minutes for noncommercial small trips, 4 rafts × 3 minutes for noncommercial standard trips, 6 rafts × 3 minutes for commercial trips). With three trips per day, and a water flow of 3 to 5 mph, the human noise at any one point is expected to be about 36 minutes of total human raft activity noise per day ***(i.e., 6 + 12 + 18 minutes)***, or about 5% of the day audible (a negligible ***to minor*** impact intensity level). The noise-free interval on the nonmotorized raft itself is expected to be high. For the single spot on the river, noise intrusions would be random in nature and infrequent.

Combined Raft and Off-River Noise—Adding the noise expected at a single point on the river from both motorized (54 minutes) and nonmotorized trips (36 minutes) under this scenario gives a total from floating rafts of 90 minutes, or 1.5 hours of the 12-hour day, or about ***12.5***% of the time audible, a moderate intensity level.

The human activity noise contribution off the river, (e.g., at campsites, lunch areas, hiking trailheads, launch and takeout areas, river rapid scouting locations and other stops, etc.) cannot be quantified as discussed in the assumptions above, but relative comparisons can be made between alternatives primarily in terms of numbers of launches and group sizes. Alternative G has fewer ***maximum*** launches per day and smaller group sizes than Alternative A, so less off-river noise would be expected ***during the peak summer months, however Alternative G has many more launches in the shoulder season so impacts during that season would be greater than for Alternative A.*** This noise would be spread out over 15 to 40 miles of river. It would not occur at the same time or place, but it could overlap (e.g., ***six*** different trips at ***six*** different locations).

Since human noise activity on the raft and in the off-river locations is not constant, or created in the same location at the same time, these values represent the ***peak*** noise intrusion that could be reasonably expected from all types of river rafts and river activities, given the above scenarios. Average noise-free intervals of 1 to 1.5 hours would be commonly expected when considering only the boat-related activities during the May–August peak period in Alternative G (an adverse, short-term, moderate impact), including the time audible plus the noise that cannot be quantified. However, when cumulative effects are also considered (see below), such long noise-free intervals would probably be rare in most places. The noise intrusions from all trips are expected to be adverse, short-term, moderate, and infrequent.

Whitmore Helicopters—For Alternative G, 3,700 passengers would fly in to Whitmore by helicopter each year, and 7,200 would fly out. Assuming that there were five passengers per flight, and that operators would carry the maximum number of people on every flight, a total of ***2,880*** flights would occur from this transfer location over the course of a year (i.e., 740 flights for 3,700 passengers in, plus 740 flights for 3,700 passengers out, plus 700 flights for the remaining 3,500 passengers out, plus 700 flights coming in empty to pick up those 3,500 passengers).

Because Alternative G evens out the launch patterns, as many as three groups of 40 passengers could need helicopter shuttles during most summer days. This would correspond to 48 flights per day (24 in and 24 out for the 120 passengers), and at ***3 to*** 3.5 minutes audibility per flight would result in ***144 to 168*** minutes (a bit less than 3 hours or ***about*** 25% of the day) of helicopter audibility on many days ***(assuming no overlap)***. When helicopter shuttles occur, noise-free intervals would be less than 10 minutes. Helicopters exchanging river trip passengers at Whitmore have been measured at up to 83 dBA at a distance of 200 feet from the source. This is almost 50 dBA above existing natural ambient levels (34 dBA or less). On the many days of heavy helicopter use, major adverse impacts would occur to the natural soundscape localized in the Whitmore area, with helicopter shuttles audible about 25% of the 12-hour day, and about 75% of the morning hours ***during peak periods***. With generally the same number of motor launches per day, there would be few days during summer months of low or no helicopter use. It should be noted that such flights are authorized by Public Law 100-91.

Non-Peak Periods—In terms of soundscape impacts, peak use in Alternative G would be from May through August, followed by March and April. Use levels would be among the highest of all the alternatives during the rest of the year, with motorized use and helicopters at Whitmore allowed from January through August (the only motorized use allowed in January and February would be noncommercial, which has been less than 10% of noncommercial use to date). Compared to Alternative A, almost all months would be expected to have greater soundscape impacts in Alternative G, due primarily to correspondingly higher use levels, and because Alternative G has only slightly smaller group sizes.

Mitigation of Effects. Actions to mitigate effects would include ***a subset*** of the actions listed in Section 4.2.4.4.2. The level of monitoring and mitigation required under Alternative G is such that it is unlikely that the actions would be implemented sufficiently to reduce impacts to minor levels or less.

Cumulative Effects. Cumulative impacts would be similar to those discussed in Alternative A. Alternative G would have adverse, short-term, moderate impacts during peak periods ***(except major impacts at Whitmore)***, a greater overall level than Alternative A, but it would contribute an adverse, negligible increment to cumulative effects. Aircraft overflights have a major adverse long-term cumulative effect on the park's natural soundscape. Even if all river-related noise was removed from the park, the park would still experience adverse, short-term, major effects from aircraft overflights independent of this river management plan. Frequent overflights commonly reduce noise-free intervals to considerably less than an hour in many parts of the park. Given the history of aircraft overflights at Grand Canyon, mitigation is unlikely to be implemented that would reduce cumulative impacts on the natural soundscape to a minor or lower intensity level.

Conclusions. Even with high-use levels during all seasons, the natural soundscape would benefit overall from adoption of Alternative G compared to Alternative A (no action). Noise from commercial motorized trips would be audible about 54 minutes or ***7.5***% of the 12-hour day, and nonmotorized trips would be audible about 36 minutes or about 5% of the day at a single point along the river, for a combined total from all rafts of 90 minutes and ***12.5***% of the time audible (a moderate intensity level) during the summer. Average noise-free intervals would be expected to be 1 to 1.5 hours (an adverse, short-term, moderate impact) when considering only river-related activity away from Whitmore from May through August. Other parts of the year would have less noise than the peak.

In addition, helicopter shuttle noise would be audible for a bit less than 3 hours (***144 to*** 168 minutes) on many days from May through August localized in a 10–20 mile diameter area at Whitmore, an adverse, short-term, major impact. There would be additional off-river noise, but it is not quantifiable, and each motorized raft would run its motor about 3.5 hours to travel an average 40 miles with the noise impacts spreading out over that entire stretch of river during the course of each day.

Therefore, overall noise intrusions to the natural soundscape under this alternative would be adverse, localized and regional, generally short-term, and moderate intensity (at high-use areas and gathering points). It is unlikely that impacts can be reduced to minor levels or less. Alternative G would not result in the impairment of the natural soundscape in Grand Canyon National Park.

The cumulative effects of Alternative G would be major adverse, long-term regional impacts primarily due to extensive aircraft overflights of the park, and are not likely to be able to be mitigated to minor intensity or less. Although Alternative G does contribute to the overall cumulative effects of noise on the park natural soundscape, even if all noise from all river recreation was completely eliminated from the park, the cumulative effects of aircraft noise would still be a major adverse impact. There would still be "significant adverse effects" on the natural soundscape due to frequent, periodic and noticeable noise from overflights, and "substantial restoration of natural quiet" would not be achieved as required by Public Law 100-91 and other mandates.

4.2.4.5.8 Modified Alternative H (NPS Preferred Alternative)

Analysis. Under ***Modified*** Alternative H, recreational motorized trips would be allowed to launch for ***5.5 months from April 1 through September 15***, and ***only*** nonmotorized ***trips would be allowed to launch*** from September ***16 through March 31*** (see Table 4- 1).

Motorized Trips—For purposes of characterizing ***Modified*** Alternative H, a typical peak day for a commercial motorized trip would consist of the following:

- The motorized raft would run its motor approximately 3.5 hours per day at typical river levels and trip lengths.
- The maximum ***commercial*** group size would be 32 in summer (24 the rest of the year), so there would be two rafts per motorized trip.
- Trips average 40 miles traveled per day and have similar trip lengths.
- Up to three ***commercial*** motorized trips would launch per day, or up to six motorized rafts total per day.

This would result in motorboat noise passing by a single point on the river up to six times a day, at about nine minutes audibility per boat, for a total of 54 minutes, or about ***7.5***% of the time audible, which over the 12-hour day is considered a minor adverse impact. In addition, a person on the boat (or the natural soundscape alongside the boat) would experience noise from the boat's motor operating approximately 3.5 hours (210 minutes) per day. However, the motor use would not be constant (i.e. there would be periods of no-motor use). For the single spot on the river, the noise intrusions would be expected to be random in nature and infrequent.

Nonmotorized Trips—For purposes of estimating the noise contributed by nonmotorized rafting activity, the following scenario is presented:

- For commercial nonmotorized trips, calculations assume an average of 5 people per raft and up to 32 people per group, so seven rafts per trip.
- For noncommercial nonmotorized trips, calculations assume an average of 4 people per raft, 16 people per standard noncommercial group (so four rafts per trip), and 8 people per small noncommercial group (so two rafts per trip).
- Up to three nonmotorized trips would launch on the busiest days, including one commercial group, one noncommercial standard group, and one noncommercial small group, so up to 13 nonmotorized rafts would launch per day (7 + 4 + 2) in this scenario.

Noise from nonmotorized rafts as they float past a single point on the river is expected to be approximately 3 minutes per raft, or in the range of 6 to 21 minutes per trip (2 rafts × 3 minutes for noncommercial small trips, 4 rafts × 3 minutes for noncommercial standard trips, 7 rafts × 3 minutes for commercial trips). With three trips per day, and a water flow of 3 to 5 mph, the human noise at any one point is expected to be about 39 minutes of total human raft activity noise per day, or about 5% of the day ***(6 + 12 + 21),*** or ***about 5.4***% of the day audible (an adverse, short-term, negligible ***to minor*** impact). For the single spot on the river, the noise intrusions are expected to be random in nature and infrequent.

Combined Raft and Off-River Noise—Adding the noise expected at a single point on the river from both motorized (54 minutes) and nonmotorized trips (39 minutes) under this scenario gives a total from floating rafts of 93 minutes, which is 1.5 hours or about 13% of the 12-hour day audible, an adverse, short-term, moderate impact.

The human activity noise contribution off the river, (e.g., at campsites, lunch areas, hiking trailheads, launch and takeout areas, river rapid scouting locations and other stops, etc.) cannot be quantified as discussed in the assumptions above, but relative comparisons can be made between alternatives primarily in terms of numbers of launches and group sizes. ***Modified*** Alternative H would have fewer launches per day in the peak season than Alternative A, so less off-river noise would be expected. This noise would be spread out over 15 to 40 miles of river. It would not occur at the same time or place, but it could overlap (e.g., up to six different trips at six different locations).

Since human noise activity on the raft and in the off-river locations is not constant, or created in the same location at the same time, these values represent the ***peak*** noise intrusion that could be reasonably expected from all types of river rafts and river activities, given the above scenarios. The noise intrusions from all trips are expected to be adverse, short-term, negligible to moderate, random to periodic in nature (i.e., at common gathering areas like trailheads and takeouts), and infrequent.

Whitmore Helicopters—For ***Modified*** Alternative H, Whitmore passenger exchanges would ***be allowed during the motorized season from April 1 through September 15; in addition, trips launching during the motorized season would also be allowed to exchange passengers at Whitmore even if the exchange date occurs during the nonmotorized season. While the NPS has no authority over transportation means that visitors may choose outside the park boundary, for this analysis it is assumed that 5,715 visitors would end their trips at Whitmore with a helicopter flight, that 3,635 visitors would begin their trips at Whitmore with a helicopter flight, and that 400 would begin their trips at Whitmore by hiking in to the river (but the hikers are assumed to not affect the noise analysis).*** Assuming that there are five passengers per flight, and that operators would carry the maximum number of people on every flight, a total of ***2,286*** flights would occur from this exchange location over the course of a year ***(i.e., 727 flights for 3,635 passengers in, plus 727 flights for 3,635 passengers out, plus 416 flights for the remaining 2,080 passengers out, plus 416 flights coming in empty to pick up those 2,080 passengers).***

Because ***Modified*** Alternative H evens out the launch patterns, as many as three groups of 32 passengers each could need helicopter shuttles ***before 10:00 am*** during many summer days. This would correspond to up to 40 flights per day (20 in and 20 out for the 96 passengers), and at ***3 to*** 3.5 minutes audibility per flight would result in ***120 to*** 140 minutes of helicopter audibility on many days. ***Because the requirement to complete exchanges by 10:00am leaves only 3 hours of the 12 hour day (7:00 AM to 7:00 PM) in which exchanges could occur, helicopter shuttles would be concentrated during those 3 hours but not audible at all during the rest of the day.*** When helicopter exchanges occur, noise-free intervals would be less than 10 minutes. Helicopters exchanging river trip passengers at Whitmore have been measured at up to 83 dBA at a distance of 200 feet from the source. This is almost 50 dBA above existing natural ambient levels (34 dBA or less). On the many days of heavy helicopter use, moderate to major adverse impacts would occur to the natural soundscape localized in the Whitmore area, with helicopter shuttles audible ***about 20***% of the 12-hour day, and during about 2 of the 3 morning hours before 10:00 A.M. With generally the same number of motor launches per day, there would be few days during summer months of low or no helicopter use. It should be noted that such flights are authorized by Public Law 100-91.

Non-Peak Periods—In terms of soundscape impacts, peak use under ***Modified*** Alternative H would be from May through August, followed by September ***1-15 then April***. Helicopters exchanges at Whitmore ***and motorized use on the river would be possible from April through September***. Compared to Alternative A, the October–***March*** period would have greater use levels so would be expected to have greater soundscape impacts. However, this would be offset by smaller group sizes, and more nonmotorized months under ***Modified*** Alternative H.

Mitigation of Effects. Actions to mitigate effects would include ***a subset*** of the actions listed in Section 4.2.4.4.2. The level of monitoring and mitigation required under ***Modified*** Alternative H is likely to be implemented sufficiently to reduce impacts to minor levels or less.

Cumulative Effects. Cumulative impacts would be similar to those discussed in Alternative A. ***Modified*** Alternative H would have adverse, short-term, minor to moderate impacts during peak periods ***(except major impacts at Whitmor***e), the same overall level as Alternative A, and it would contribute an adverse, negligible increment to cumulative effects. Aircraft overflights have an adverse, long-term, major cumulative effect on the park's natural soundscape. Even if all river-related noise was removed from the park, the park would still experience adverse, major effects from aircraft overflights independent of this river management plan. Frequent overflights commonly reduce noise-free intervals to considerably less than an hour in many parts of the park. Given the history of aircraft overflights at Grand Canyon, it is unlikely that mitigation could be implemented that would reduce cumulative impacts on the natural soundscape to a minor or lower intensity level.

Conclusions. The natural soundscape would benefit overall under ***Modified*** Alternative H compared to Alternative A during the peak season, but impacts would be slightly greater in the shoulder and winter seasons, due primarily to increased use levels. Noise from commercial motorized trips during peak days would be audible about 54 minutes or 8% of the 12-hour day, and nonmotorized trips would be audible about 36 minutes or about 5% of the day at a single point along the river, for a combined total from all rafts of 90 minutes and 13% of the time audible (a moderate intensity level) during the summer. Average noise-free intervals during the day would be expected to be 1.5 to 3.5 hours (an adverse, short-term, minor impact) when considering only river-related activity away from Whitmore ***during the peak motorized season***. Other parts of the year would have less noise than the peak.

In addition, helicopter shuttle noise would be audible for ***about 2 of the 3-hour period before 10:00am when exchanges must be completed, or about 20% of the day at Whitmore***, an adverse, short-term, moderate to major impact ***localized in a 10-20 mile diameter area at Whitmore***. ***However, the rest of the day would have no helicopter noise at Whitmore***. There would be additional off-river noise, but it is not quantifiable, and each motorized raft would run its motor about 3.5 hours to travel an average 40 miles with the noise impacts spreading out over that entire stretch of river during the course of each day.

Therefore, overall noise intrusions to the natural soundscape under this alternative would be adverse, localized and regional, generally short-term, and minor to moderate intensity (at high-use areas and gathering points). It is likely that impacts can be reduced to minor levels or less with adequate funding and staffing for a monitoring and mitigation program. ***Modified*** Alternative H would not result in the impairment of the natural soundscape in Grand Canyon National Park.

The cumulative effects of ***Modified*** Alternative H would be regional, adverse, long-term, and major primarily due to extensive aircraft overflights of the park, and they could probably not be mitigated to a minor intensity or less. Although ***Modified*** Alternative H would contribute to the overall cumulative effects of noise on the park natural soundscape, even if all noise from all river recreation was eliminated from the park ***(including river-related helicopter flights at Whitmore),*** the cumulative effects of aircraft noise would still be adverse, short- ***to long***-term, and major. There would still be "significant adverse effects" on the natural soundscape due to frequent, periodic and noticeable noise from overflights, and "substantial restoration of natural quiet" would not be achieved as required by Public Law 100-91 and other mandates.

4.2.4.6 Impact Analysis—Lower Gorge Alternatives

4.2.4.6.1 Methodology Considerations Specific to Lower Gorge Analysis

The Lower Gorge provides more open water, with fewer river rapids, than the upper stretch of river. When Lake Mead is full, water is backed up to Separation Canyon (RM 240) making motorboat tow-outs a more attractive option, and making upriver travel from Lake Mead easier. Upriver travel is prohibited above RM 240. With Lake Mead levels currently well below full pool, the river flows about the same as the upper river past the park boundary at RM 277. Pearce Ferry is currently unusable as a takeout location, so boats are having to take out at South Cove, a longer trip.

Analysis of human noise impacts in this section rely on "typical peak use" scenarios defined for the alternative. Noise sources are not well documented for the area from Diamond Creek to Lake Mead. At the time the few referenced sound measurements were taken, much of the current river activity was not in operation, and Lake Mead was backed-up beyond several of the measurement site locations. The sound measurements conducted in 1993 showed that the natural ambient level was 22–29 dBA, and aircraft were audible for only 12% of the time, for the site 1-mile above the Diamond Creek takeout (HMMH 1993). Separation Canyon (RM 240) had a natural ambient background level of 11–21 dBA, with aircraft audible 20% of the time. The last location measured in the Lower Gorge was at Burnt Springs Canyon (RM 260), with a natural ambient of 13–17 dBA, and aircraft audible for 49% of the time. Helicopter noise, when exchanging river trip passengers at Whitmore, was measured at maximum noise levels of 83 dBA at a distance of 200 feet from the source. This is almost 60 dBA above natural ambient levels measured in 1993.

The typical water influenced natural ambient level in the upper reach has been measured ***as low as 11 dBA where the lake backs up, to the 20's to 30's dBA in areas of flowing but calm water away from rapids,*** and can range up to ***66*** dBA near river rapids (HMMH 1993, 2003). There are few rapids below ***RM 240*** to mask human noise intrusions, so noise is expected to be somewhat more noticeable than in the upper sections of the river.

As described in Section 4.2.4.4, helicopter flights carrying passengers who are also river passengers (e.g., pontoon boat and HRR passengers) are analyzed under effects of the alternatives, but flights that carry passengers who are not also river passengers (e.g., look-and-leave flights) are part of cumulative effects. ***The NPS has no authority over flights on Hualapai tribal land.*** The Hualapai Tribe controls helicopter flights that land and takeoff solely on Hualapai tribal land. ***The NPS would work cooperatively with the Hualapai Tribe so that passenger exchanges that include access by helicopter would be allowed as described in the alternatives.*** In the case of Quartermaster operations, the Hualapai Tribe has indicated that approximately the same number of helicopter flights will occur in that area independent of the alternatives and independent of whether any of the helicopter passengers are river passengers.

Context plays a more prominent role in the analysis of Lower Gorge alternatives than for Lees Ferry alternatives, because the impact thresholds apply differently to the different management zones, with Zones 1 and 2 being more sensitive to noise impacts than Zones 3 and 4 (see page 356). The Lees Ferry alternatives all refer only to Zone 1, which ends at Diamond Creek. The analysis for Lower Gorge alternatives is separated into sections referring to Zone 2, which applies to the section from Diamond Creek (RM 226) to RM 260, and Zone 3, which applies to the section from RM 260 to the park boundary (RM 277). Zone 4 is outside the park in the upper reaches of Lake Mead National Recreation Area and is not analyzed in the same detail. ***In Zone 2, the intensity thresholds for audibility are: negligible 5% or less, minor 10% or less, moderate 10-25%, and major 25% or more audible. In Zone 3, however, the intensity thresholds for audibility are: negligible 10% or less, minor 15% or less, moderate 15-30%, major 30% or more audible.***

Continuation trips are those that launch at Lees Ferry but do not take out at Diamond Creek, continuing on to a take out on Lake Mead. For this analysis of Lower Gorge alternatives, four of the five commercial motorized trips in the Lees Ferry no-action scenario (Alternative A) are assumed to continue past Diamond Creek, and none of the no-motor trips are assumed to continue. This allows relative comparisons between the Lower Gorge alternatives using the same basis for these inputs. It is considered a reasonable assumption based upon observations as Lake Mead levels have decreased over the past few years.

As discussed further in Methodology common to all the alternatives above, motorized rafts are assumed to be audible for 9 minutes and nonmotorized rafts for 3 minutes. Jetboats ***and powerboats (used for pickups, tow-outs, and/or tours)*** are assumed to be audible for the same time as motorized rafts, because even though they produce more sound energy (i.e., are “louder”) than motorized rafts, they travel at much greater speeds so they move out of audibility range quicker.

For helicopters in the Quartermaster area, 3 minutes audibility is assumed based upon the geography of that area, whereas Whitmore helicopters, in an area of more open geography, were assumed to be audible 3 to 3.5 minutes (see Section 4.2.4.4).

There are no data quantifying the number of or noise produced by boats traveling upriver from Lake Mead, so a specific number of minutes of audibility is not presented, although it is a source of noise for the Lower Gorge. There is no information to indicate that numbers and types of these boats would change due to the Lower Gorge alternatives, so they are assumed to be a constant, not varying between alternatives, and they do not affect the relative differences among alternatives.

For pontoon boat operations, it is assumed that boat operators will be licensed to carry up to six passengers per boat. For HRR operations, it is assumed that operators will be licensed to carry up to eight passengers per boat.

Data for flight operations in the Quartermaster area are very limited, and the nature of the operations appears to be changing frequently. The limited data was compared to the calculated values included in the analysis of the alternatives, and found to be reasonably consistent.

4.2.4.6.2 Alternative 1: No Action (Existing Condition)

Analysis. *Zone 2*—The section of river from Diamond Creek to RM 260 is classified in Zone 2. The following scenario presents typical peak use under Alternative 1 (current situation) for this zone and section of river, with minutes of audibility at a single point along the river:

- Continuation trips from Lees Ferry:
    - 4 motorized trips × 2 rafts/trip × 9 minutes = 72 minutes audible/day
- HRR Day trips:
    - 1 trip/day × 10 motorized boats/trip × 9 minutes/boat = 90 minutes audible/day
- HRR overnight trip:
    - 1 trip/day × 4 motorized boats/trip × 9 minutes/boat = 36 minutes audible/day ***three trips per month*** on average
- Noncommercial trips:
    - 2 trips/day × 4 nonmotorized boats/trip × 3 minutes/boat = 24 minutes audible/day
- Jetboat pickups (to RM 240):
    - 2 boats/day × 2 passes (up and back) × 9 minutes/boat = 36 minutes/day
- Tow-outs (to RM 240):
    - This scenario does not include any nonmotorized continuation trips desiring tow-outs. There is insufficient data to quantify such tow-outs, but they do occur, and like jetboats they would make two passes per day, one going upriver and the other going back downriver.
- Other upriver boats from Lake Mead continuing as far as Separation Canyon
    - Cannot be quantified as discussed above in "Methodology Considerations Specific to Lower Gorge Analysis."

For Zone 2 the total time audible at a single point along the river from all of the above sources is 222 minutes without the HRR overnight trips (about 31% of the 12-hour day), and 258 minutes with the overnight trips (about 36% of the day audible), resulting in an adverse, short-term, major impact. This does not include other upriver traffic from Lake Mead or tow-outs.

The area of Zone 2 between Diamond Creek and Separation Canyon would be quieter than the area from Separation Canyon to RM 260, because jetboats and other boats from Lake Mead cannot travel past Separation Canyon. Noise-free intervals would average 1 to 1.5 hours during peak days (a moderate impact level). Overall, Alternative 1 would have a localized and regional, adverse, short- to long-term, moderate to major, random impact in Zone 2.

Zone 3—The section of river from RM 260 to the park boundary (RM 277) is classified in Zone 3. In addition to all of the elements listed above for Zone 2, the following would apply in Zone 3:

- Pontoon boat trips:
  - Average 188 passengers/day divided by 6 passengers/boat = 32 boats
    - Average 32 boats/day × 2 passes (up and back) × 9 minutes/boat = 576 minutes audible/day
  - Maximum 377 passengers/day divided by 6 passengers/boat = 63 boats
    - Maximum 63 boats/day × 2 passes (up and back) × 9 minutes/boat = 1,134 minutes audible/day
- Helicopter shuttles for pontoon boat passengers:
  - Average 188 passengers/day divided by 5 passengers/helicopter × 2 flights/helicopter × 3 minutes/flight = 228 minutes audible/day
  - Maximum 377 passengers/day divided by 5 passengers/helicopter × 2 flights/helicopter × 3 minutes/flight = 456 minutes audible/day
- Helicopter shuttles for HRR passengers:
  - Day trips: 100 passengers/day divided by 5 passengers/helicopter × 2 flights/helicopter × 3 minutes/flight = 120 minutes audible/day
  - Overnight trips: 34 passengers divided by 5 passengers/helicopter × 2 flights/helicopter × 3 minutes/flight = 42 minutes audible/day once per week on average.
- Upriver boats from Lake Mead that stay only in Zone 3:
  - Cannot be quantified as discussed above in Methodology Considerations Specific to Lower Gorge Analysis. However, more upriver boats would be expected in Zone 3 than in Zone 2, due to time and distance considerations.

For Zone 3 the total time audible at a single point along the river from all of the above sources (including those coming into Zone 3 from Zone 2) varies from a low of 1,146 minutes (using average pontoon boat numbers and no HRR overnight trips), to a high of ***2,010*** minutes (using maximum pontoon boat numbers and HRR overnight trips) (a major impact intensity level). Without the helicopters, audibility would vary from 798 minutes to 1,392 minutes, which would still be a major impact intensity level. Since there are only 720 minutes in a 12-hour day, much overlap of noise sources must occur (consistent with observations) and the natural soundscape would be essentially saturated by noise with very few noise-free intervals on a busy day.

The helicopter noise in combination with the boat noise only occurs in a 15–30 mile diameter area centered on the helipads in the Quartermaster area, and only during times when all boats are present (which does occur in the afternoons when HRR passengers are about ready to be picked up). The totals above do not include other upriver traffic from Lake Mead, tow-outs or additional off-river noise, because they are not quantifiable as discussed in Section 4.2.4.4. In addition, each motorboat would create regional impacts as it runs its motor for about 1.5 hours to travel the 18 miles through this zone. Noise-free intervals would average less than one hour during peak days. Overall, Alternative 1 would have a localized and regional, adverse, short- to long-term, frequent and periodic, major impact in Zone 3.

Zone 4—Zone 4 does not have any river recreation related helicopter or pontoon boat noise intrusions, but the continuing river activity (about the same as Zone 2) is added to by private watercraft on Lake Mead National Recreation Area, which may never enter Grand Canyon National Park.

Mitigation of Effects. Actions to mitigate effects would include ***a subset*** of the actions listed in Section 4.2.4.4.2, but given the current history of the current situation, it is unlikely that mitigations would be implemented at a level sufficient to reduce the impacts of Alternative 1 to the natural soundscape to a minor intensity or less in Zone 3. A large amount of effort, funding and staffing would be needed, but it is possible that mitigation could be reasonably implemented to reduce impacts in Zone 2 to minor levels or less.

Generator use is currently allowed and causes minor to major localized impacts to the natural soundscape, depending upon the amount of time generators are used. However, generator use is being restricted under all alternatives, including no-action, so is not further evaluated here. This restriction is an important mitigation for the natural soundscape.

Cumulative Effects. Cumulative impacts would be similar to those discussed under Alternative A, but the number of air tours and helicopter shuttle flights in the Quartermaster area exceed anything occurring anywhere else in the Grand Canyon. Alternative 1 would have adverse, major overall impacts during peak periods, but it would contribute an adverse, negligible to minor increment to cumulative effects. Aircraft overflights have an adverse, long-term, major cumulative effect on the park's natural soundscape. Even if all river-related noise including noise from boats and river-related helicopters was removed from the park, the park would still experience major adverse effects from aircraft overflights independent of this river management plan. In the Quartermaster area, the Hualapai Tribe expects about the same number of flights independent of the river alternatives. Frequent overflights commonly reduce noise-free intervals to considerably less than an hour in many parts of the park. Given the history of aircraft overflights at Grand Canyon, mitigation is unlikely to be implemented that would reduce cumulative impacts on the natural soundscape to a minor or lower intensity level.

Conclusion. Alternative 1, the no-action alternative for the Lower Gorge, would result overall in adverse, short- ***to long***-term, random, ***moderate to*** major impacts in Zone 2, which could possibly be reasonably mitigated, but adverse, short- to long-term, frequent, major impacts in Zone 3 ***that could not be mitigated***. The Quartermaster area would have the greatest soundscape impacts due to the combination of boats and helicopters. Noise from boats in Zone 2 would be audible about 222 minutes/day (or 31% of the 12-hour day) without considering HRR overnight trips that ***average three trips per month***, an adverse, major impact in that zone. Noise would be audible 258 minutes (36%) per day on busy days when HRR overnight trips operate. Also, each motorboat would create regional impacts as it runs its motor for about 3 hours to travel the 35 miles through this zone.

Noise from boats and helicopters in Zone 3 would be audible from 1,146 to ***2,010*** minutes/day (or essentially 100% of the 12-hour day with considerable overlap), considering pontoon boat and river-related helicopter trips plus all the boats assessed in Zone 2 floating down into Zone 3. During peak-use days, there would be very few noise-free intervals. This is an adverse, major impact in that zone with little likelihood that impacts would be able to be mitigated to a minor intensity level or less.

There would also be off-river noise and noise from upriver boats and tow-outs that is not quantifiable, and each motorized raft would run its motor up to 4 hours each in the course of its travels through all or part of the Lower Gorge, creating regional impacts over the area of travel (i.e., some rafts would travel the entire 53 miles from Diamond Creek to Lake Mead in a day, but others would travel shorter sections).

In summary, overall noise intrusions to the natural soundscape under Alternative 1 would be localized and regional, adverse, short- to long-term, and major at high-use areas and gathering points. It is not likely that any reasonable mitigation could reduce impacts to a minor level or less ***in Zone 3***. Alternative 1 would not result in the impairment of the natural soundscape in Grand Canyon National Park.

The cumulative effects of Alternative 1 would be major adverse, long-term regional impacts primarily due to extensive aircraft overflights of the park, and are unlikely to be able to be mitigated to a minor intensity or less. Alternative 1 contributes an adverse, minor increment to the overall cumulative effects of noise on the park natural soundscape, but even if all noise from all river recreation was eliminated from the park, the cumulative effects of aircraft noise would still be an adverse, major impact. There would still be “significant adverse effects” on the natural soundscape due to frequent, periodic and noticeable noise from overflights, and “substantial restoration of natural quiet” would not be achieved as required by Public Law 100-91 and other mandates.

4.2.4.6.3 Alternative 2

Analysis. *Zone 2*—The following scenario presents typical peak use under Alternative 2 for this zone and section of river, with minutes of audibility at a single point along the river:

- Continuation trips from Lees Ferry:
    - 4 motorized trips × 2 rafts/trip × 9 minutes = 72 minutes audible/day
- HRR Day trips:
    - 30 ***people***/trip divided by 10 ***people***/boat = 3 boats/trip
    - 2 trips/day × 3 motorized boats/trip × 9 minutes/boat = 54 minutes audible/day
- HRR overnight trip:
    - 30 ***people***/trip divided by 10 ***people***/boat = 3 boats/trip
    - 1 trip/day × 3 motorized boats/trip × 9 minutes/boat = 27 minutes audible/day
- Noncommercial trips:

    - 2 trips/day × 4 nonmotorized boats/trip × 3 minutes/boat = 24 minutes audible/day
- Jetboat pickups (to RM 240):
    - 2 boats/day × 2 passes (up and back) × 9 minutes/boat = 36 minutes/day
- Tow-outs (to RM 240):
    - This scenario does not include any nonmotorized continuation trips desiring tow-outs. There is insufficient data to quantify such tow-outs, but they do occur, and like jetboats they would make two passes per day, one going upriver and the other going back downriver.
- Other upriver boats from Lake Mead continuing as far as Separation Canyon
    - Cannot be quantified as discussed above in "Methodology Considerations Specific to Lower Gorge Analysis."

For Zone 2 the total time audible at a single point along the river from all of the above sources would be 186 minutes without the HRR overnight trips (about 26% of the 12-hour day), and 213 minutes with the overnight trips (about 30% of the day audible), an adverse, short-term, major impact. This does not include other upriver traffic from Lake Mead or tow-outs as discussed above. In addition, each motorboat would create regional impacts at it runs its motor for about three hours to travel the 35 miles through this zone. The trips would create additional off-river noise, but this is not quantifiable. Noise-free intervals in Zone 2 would be expected to average 1 to 1.5 hours during peak days when considering only boats traveling in the zone (an adverse, short-term, moderate impact). However, when cumulative effects are also considered (see below), such long noise-free intervals would probably be rare in most places. Overall, Alternative 2 would have a localized and regional, adverse, short- to long-term, moderate to major impact in Zone 2.

The area of Zone 2 between Diamond Creek and Separation Canyon would be quieter than the area from Separation Canyon to RM 260, because jetboats and other boats from Lake Mead cannot travel past Separation Canyon.

No commercial pickups would be allowed during the non-peak season,, which would reduce noise during that season.

Zone 3—In addition to all of the elements listed for Zone 2, the following would also occur in Zone 3:

- Alternative 2 would eliminate pontoon boat trips, so there would be no helicopter trips for pontoon boat passengers (but it is likely that cumulative effects would increase so that there would be about the same amount of total cumulative helicopter use in the Quartermaster area even with elimination of pontoon boats).
- Helicopter shuttles for HRR passengers:
    - Day trips: 60 passengers/day divided by 5 passengers/helicopter × 2 flights/helicopter × 3 minutes/flight = 72 minutes audible/day
    - Overnight trips: 30 passengers divided by 5 passengers/helicopter × 2 flights/ helicopter × 3 minutes/flight = 36 minutes audible/day
- Upriver boats from Lake Mead that stay only in Zone 3

- Cannot be quantified as discussed above in Methodology Considerations Specific to Lower Gorge Analysis. However, more upriver boats would be expected in Zone 3 than in Zone 2, due to time and distance considerations.

For Zone 3 the total time audible at a single point along the river from all of the above sources (including those coming into Zone 3 from Zone 2) varies from a low of ***258*** minutes or ***36***% of the day (with no HRR Overnight trips), to a high of 321 minutes or ***45***% (with HRR overnight trips) (a major impact intensity level). There would be some opportunities even during peak days for noise-free intervals to be greater than 1 hour (a moderate impact intensity level).

The above does not include other upriver traffic from Lake Mead, tow-outs, or additional off-river noise, because they are not quantifiable. In addition, each motorboat would create regional impacts as it runs its motor for about 1.5 hours to travel the 18 miles through this zone. Noise-free intervals would average less than one hour during peak days. Overall, Alternative 2 would have a localized and regional, adverse, frequent and periodic, short- to long-term, major impact in Zone 3.

Zone 4—Zone 4 does not have any helicopter or pontoon boat noise intrusions related to this plan, but the continuing river activity (about the same as Zone 2) is added to by private watercraft on Lake Mead National Recreation Area, which may never enter Grand Canyon National Park.

Mitigation of Effects. Actions to mitigate effects would include ***a subset*** of the actions listed in Section 4.2.4.4.2. It is likely that reasonable implementation of mitigation measures could reduce impacts no less than a moderate level in Zone 3 due to the activity in the Quartermaster area, even though such activity would be reduced compared to the other alternatives. A larger amount of effort, funding, and staffing than for Alternative 1 would be needed, but it is possible that mitigation could be reasonably implemented to reduce impacts in Zone 2 to minor levels or less.

Cumulative Effects. Cumulative impacts would be similar to those discussed in Alternative A. Alternative 2 would reduce impacts compared to Alternative 1, but would still have adverse, short-term, major overall impacts during peak periods. Alternative 2 would contribute an adverse, negligible to minor increment to cumulative effects. Aircraft overflights have an adverse, long-term, major cumulative effect on the park's natural soundscape. Even if all river-related noise (primarily from boats and helicopters) was removed from the park, the park would still experience major adverse effects from aircraft overflights independent of this river management plan. In the Quartermaster area, the Hualapai Tribe expects about the same number of flights independent of the river alternatives. Frequent overflights commonly reduce noise-free intervals to considerably less than an hour in many parts of the park. Given the history of aircraft overflights at Grand Canyon, mitigation is unlikely to be implemented that would reduce cumulative impacts on the natural soundscape to a minor or lower intensity level.

Conclusion. Alternative 2 would result in fewer impacts to the natural soundscape than Alternative 1. It would have adverse, short- ***to long-***term, random, ***moderate to*** major overall impacts in Zone 2, which could be reasonably mitigated, but adverse, short- to long-term, frequent, major impacts in Zone 3, especially in the Quartermaster area, which could not be reasonably mitigated to minor levels or less. Noise from boats in Zone 2 would be audible about 186 minutes/day (or 26% of the 12-hour day) without considering HRR overnight trips, which would be an adverse, major impact in this zone. Noise would be audible 213 minutes (30%) per day on busy days when HRR overnight trips operated. Also, each motorboat would create regional impacts as it runs its motor for about three hours to travel the 35 miles through Zone 2. Noise-free intervals would average 1 to 1.5 hours in Zone 2 (an adverse, moderate impact), but less than an hour in Zone 3 (an adverse, major impact).

Noise from boats and helicopters in Zone 3 would be audible from ***258*** to 321 minutes/day (or ***36-45%*** of the 12-hour day) considering helicopter shuttles for HRR day and overnight trip passengers, plus all the boats assessed in Zone 2 floating down to Zone 3. This would be an adverse, major impact in that zone, with little likelihood that impacts could be mitigated to a minor intensity level or less.

There would also be off-river noise and noise from upriver boats and tow-outs that is not quantifiable, and each motorized raft would run its motor up to 4 hours each in the course of its travels through all or part of the Lower Gorge, creating regional impacts over the area of travel (i.e., some rafts would travel the entire 53 miles from Diamond Creek to Lake Mead in a day, but others would travel shorter sections).

In summary, overall noise intrusions to the natural soundscape under Alternative 2 would be adverse, localized and regional, short-term to long-term, and major intensity (at high-use areas and gathering points). Alternative 2 would not result in the impairment of the natural soundscape in Grand Canyon National Park.

The cumulative effects of Alternative 2 would be regional, adverse, long-term, and major primarily due to extensive aircraft overflights of the park, and they could probably not be mitigated to minor intensity or less. Alternative 2 contributes to the overall cumulative effects of noise on the park's natural soundscape, but even if all noise from all river recreation was eliminated from the park, the cumulative effects of aircraft noise would still be an adverse, major impact. There would still be "significant adverse effects" on the natural soundscape due to frequent, periodic and noticeable noise from overflights, and "substantial restoration of natural quiet" would not be achieved as required by Public Law 100-91 and other mandates.

4.2.4.6.4 Alternative 3

Analysis. *Zone 2*—The following scenario presents typical peak use under Alternative 3 for this zone and section of river, with minutes of audibility at a single point along the river:

- Continuation trips from Lees Ferry:
  - 4 motorized trips × 2 rafts/trip × 9 minutes = 72 minutes audible/day
- HRR Day trips:
  - 30 ***people***/trip divided by 10 ***people***/boat = 3 boats/trip
  - 3 trips/day × 3 motorized boats/trip × 9 minutes/boat = 81 minutes audible/day
- HRR overnight trip:
  - 30 ***people***/trip divided by 10 ***people***/boat = 3 boats/trip
  - 2 trips/day × 3 motorized boats/trip × 9 minutes/boat = 54 minutes audible/day
- Noncommercial trips:

  - 2 trips/day × 4 nonmotorized boats/trip × 3 minutes/boat = 24 minutes audible/day

- Jetboat pickups (to RM 240):
  - ***4 commercial pickups/day + 2 jetboat tours/day = 6 jetboats/day***
  - ***6*** boats/day × 2 passes (up and back) × 9 minutes/boat = ***108*** minutes/day

- Tow-outs (to RM 240):
  - This scenario does not include any nonmotorized continuation trips desiring tow-outs. There is insufficient data to quantify such tow-outs, but they do occur, and like jetboats they would make two passes per day, one going upriver and the other going back downriver.

- Other upriver boats from Lake Mead continuing as far as Separation Canyon
  - Cannot be quantified as discussed above in "Methodology Considerations Specific to Lower Gorge Analysis."

For Zone 2 the total time audible at a single point along the river from all of the above sources would be 285 minutes without the HRR overnight trips (about 40% of the 12-hour day), and 339 minutes with the overnight trips (about 47% of the day audible) (a major impact intensity level). This does not include other upriver traffic from Lake Mead or tow-outs. In addition, each motorboat would create regional impacts at it runs its motor for about three hours to travel the 35 miles through this zone. The trips would create additional off-river noise, but this is not quantifiable. Noise-free intervals in Zone 2 would be expected to average 1 to 1.5 hours during peak days when considering only boats traveling in the zone (an adverse, short-term, moderate impact), even when considering that multiple boats would be audible at some times and no boats at other times. However, when cumulative effects are also considered (see below), such long noise-free intervals would probably be rare in most places. Overall, Alternative 3 would have a localized and regional, adverse, short- to long-term, major impact in Zone 2.

The area of Zone 2 between Diamond Creek and Separation Canyon would be quieter than the area from Separation Canyon to RM 260, because jetboats and other boats from Lake Mead cannot travel past Separation Canyon.

Zone 3—In addition to all of the elements listed for Zone 2, the following would occur under Alternative 3 for this zone and section of river:

- Pontoon boat trips:
  - Average 400 passengers/day divided by 6 passengers/boat = 67 boats
    - Average 67 boats/day × 2 passes (up and back) × 9 minutes/boat = 1,206 minutes audible/day

- Helicopter shuttles for pontoon boat passengers:
  - Maximum 400 passengers/day divided by 5 passengers/helicopter × 2 flights/ helicopter × 3 minutes/flight = 480 minutes audible/day

- Helicopter shuttles for HRR passengers:
  - Day trips: 90 passengers/day divided by 5 passengers/helicopter × 2 flights/helicopter × 3 minutes/flight = 108 minutes audible/day
  - Overnight trips: 60 passengers divided by 5 passengers/helicopter × 2 flights/ helicopter × 3 minutes/flight = ***72*** minutes audible/day

- Upriver boats from Lake Mead that stay only in Zone 3
  - Cannot be quantified as discussed above in "Methodology Considerations Specific to Lower Gorge Analysis." However, more upriver boats would be expected in Zone 3 than in Zone 2, due to time and distance considerations.

For Zone 3 the total time audible at a single point along the river from all of the above sources (including those coming into Zone 3 from Zone 2) varies from a low of 2,079 minutes (with no HRR Overnight trips), to a high of 2,205 minutes (with HRR overnight trips) (a major impact intensity level). Without the helicopters, audibility would vary from 1,491 minutes to 1,545 minutes, which would still be a major impact intensity level. Since there are only 720 minutes in a 12-hour use day, much overlap of noise sources would occur; consistent with current observations, multiple boats would be audible at some times and no boats at other times. However, the natural soundscape would be essentially saturated by noise, with very few noise-free intervals on a busy peak day.

Helicopter noise in combination with the boat noise would only occur in the Quartermaster area, and only during times when all boats are present (which does occur in the afternoons when HRR passengers are about ready to be picked up). This also does not include other upriver traffic from Lake Mead, tow-outs or additional off-river noise, because they are not quantifiable. In addition, each motorboat would create regional impacts as it runs its motor for about 1.5 hours to travel the 18 miles through this zone. Noise-free intervals would average less than one hour during peak days. Overall, Alternative 3 would have localized and regional, adverse, frequent and periodic, short- to long-term, major impacts in Zone 3.

Zone 4—Zone 4 does not have any plan-related helicopter or pontoon boat noise intrusions, but the continuing river activity (about the same as Zone 2) is added to by private watercraft on Lake Mead National Recreation Area, which may never enter Grand Canyon National Park.

Mitigation of Effects. Actions to mitigate effects would include ***a subset*** of the actions listed in Section 4.2.4.4.2. With the high level of visitor use in Alternative 3, it is very unlikely that mitigations would be implemented at a level sufficient to reduce the impacts to the natural soundscape to a minor intensity or less in Zone 3. A larger amount of effort, funding and staffing than for Alternative 1 would be needed in Zone 2 to implement the mitigation actions, but it is possible that impacts could be reasonably reduced to minor levels with mitigation.

Cumulative Effects. Cumulative impacts would be similar to those discussed in Alternative A. Alternative 3 would increase impacts compared to Alternative 1 and would have adverse, short-term, major overall impacts during peak periods. However, Alternative 2 would contribute an adverse, minor increment to cumulative effects. Aircraft overflights have an adverse, long-term, major cumulative effect on the park's natural soundscape. Even if all river-related noise including noise from boats and river-related helicopters was removed from the park, the park would still experience major adverse effects from aircraft overflights independent of this river management plan. In the Quartermaster area, the Hualapai Tribe expects about the same number of flights independent of the river alternatives. Frequent overflights commonly reduce noise-free intervals to considerably less than an hour in many parts of the park. Given the history of aircraft overflights at Grand Canyon, mitigation is unlikely to be implemented that would reduce cumulative impacts on the natural soundscape to a minor or lower intensity level.

Conclusion. Alternative 3 would increase impacts to the natural soundscape compared to Alternative 1. It would have adverse, short- ***to long***-term, random, major impacts in Zone 2, which could be reasonably mitigated, but adverse short- to long-term, frequent and periodic, major impacts in Zone 3, especially in the Quartermaster area, which could not be reasonably mitigated to minor levels or less. Noise from boats in Zone 2 would be audible about 285 minutes/day (or 40% of the 12-hour day) without considering HRR overnight trips, which would be an adverse, major impact in that zone. Noise would be audible 339 minutes (47%) per day on busy days when HRR overnight trips operate. Also, each motorboat would create regional impacts as it runs its motor for about three hours to travel the 35 miles through Zone 2. Noise-free intervals would average 1 to 1.5 hours in Zone 2 (an adverse, moderate impact), but less than an hour in Zone 3 (an adverse, major impact).

Noise from boats and helicopters in Zone 3 would be audible from 2,079 to 2,205 minutes/day. Because this is more than 100% of the 12-hour day, there would be considerable overlap of noise events (i.e., more than one noise source audible much of the time). During peak-use days, there would be very little time for noise-free intervals in Zone 3.

There would also be additional off-river noise and noise from upriver boats and tow-outs that is not quantifiable, and each motorized raft would run its motor up to 4 hours each in the course of its travels through all or part of the Lower Gorge, creating regional impacts over the area of travel (i.e., some rafts would travel the entire 53 miles from Diamond Creek to Lake Mead in a day, but others would travel shorter sections).

In summary, overall noise intrusions to the natural soundscape under this alternative would be adverse, localized and regional, short-term to long-term, and major intensity. Alternative 3 would not result in the impairment of the natural soundscape in Grand Canyon National Park.

The cumulative effects of Alternative 3 would be regional, adverse, long-term, and major, primarily due to extensive aircraft overflights of the park, and they could probably not be mitigated to minor intensity or less. Alternative 3 would contribute a minor increment to the overall cumulative effects of noise on the park natural soundscape, but even if all noise from all river recreation was eliminated from the park, the cumulative effects of aircraft noise would still be adverse and major. There would still be "significant adverse effects" on the natural soundscape due to frequent, periodic and noticeable noise from overflights, and "substantial restoration of natural quiet" would not be achieved as required by Public Law 100-91 and other mandates.

4.2.4.6.5 Modified Alternative 4 (NPS Preferred Alternative)

Analysis. *Zone 2*—The following scenario presents typical peak use under ***Modified*** Alternative 4 for this zone and section of river, with minutes of audibility at a single point along the river:

- Continuation trips from Lees Ferry:
  - 4 motorized trips × 2 rafts/trip × 9 minutes = 72 minutes audible/day
- HRR Day trips:
  - 96 passengers/***day limit*** divided by ***40 people/trip limit = 3 trips per day***
  - ***40 people/trip limit divided by 10 people/boat = 4 boats per trip***

- ◦ ***3 trips/day X 4 boats/trip = 12 boats/day***
- ◦ ***12*** motorized boats/day × 9 minutes ***audible***/boat = ***108*** minutes audible/day

- HRR overnight trip:
  - 20 ***people***/trip divided by 10 passengers/boat = 2 boats/trip
  - 3 trips/day × 2 motorized boats/trip × 9 minutes/boat = 54 minutes audible/day once per week on average
- Noncommercial trips:
  - 2 trips/day × 4 nonmotorized boats/trip × 3 minutes/boat = 24 minutes audible/day
- Jetboat pickups (to RM 240):
  - 4 boats/day × 2 passes (up and back) × 9 minutes/boat = 72 minutes/day
- Tow-outs (to RM 240):
  - This scenario does not include any nonmotorized continuation trips desiring tow-outs. There is insufficient data to quantify such tow-outs, but they do occur, and like jetboats they would make two passes per day, one going upriver and the other going back downriver.
- Other upriver boats from Lake Mead continuing as far as Separation Canyon
  - Cannot be quantified as discussed above in "Methodology Considerations Specific to Lower Gorge Analysis."

For Zone 2 the total time audible at a single point along the river from all of the above sources would be ***276*** minutes without the HRR overnight trips (about ***38***% of the 12-hour day), and ***330*** minutes with the overnight trips (about ***46***% of the day audible) (a major impact intensity level). This does not include other upriver traffic from Lake Mead or tow-outs as discussed above. In addition, each motorboat would create regional impacts as it runs its motor for about 3 hours to travel the 35 miles through this zone. The trips would create additional off-river noise, but this is not quantifiable. Noise free intervals in Zone 2 would be expected to average 1 to 1.5 hours during peak days when considering only boats traveling in the zone (an adverse, short-term, moderate impact), even when considering that multiple boats would be audible at some times and no boats at other times. However, when cumulative effects are also considered (see below), such long noise free intervals would probably be rare in most places. Overall, ***Modified*** Alternative 4 would have a localized and regional, adverse, short- to long-term, major impact in Zone 2.

The area of Zone 2 between Diamond Creek and Separation Canyon would be quieter than the area from Separation Canyon to RM 260, because jetboats and other boats from Lake Mead cannot travel past Separation Canyon.

Zone 3—In addition to all of the elements listed for Zone 2, the following would occur under ***Modified*** Alternative 4 for this zone and section of river:

- Pontoon boat trips:
  - ***Initial*** Maximum ***480*** passengers/day divided by 6 passengers/boat = ***80*** boats
    - Average ***80*** boats/day × 2 passes (up and back) × 9 minutes/boat = ***1,440*** minutes audible/day
  - ***Potential Maximum 600 passengers/day divided by 6 passengers/boat = 100 boats***

- ***Average 100 boats/day × 2 passes (up and back) × 9 minutes/boat = 1,800 minutes audible/day***

- Helicopter shuttles for pontoon boat passengers:
  - ***Initial*** Maximum ***480*** passengers/day divided by 5 passengers/helicopter × 2 flights/ helicopter × 3 minutes/flight = ***576*** minutes audible/day
  - ***Potential Maximum 600 passengers/day divided by 5 passengers/helicopter X 2 flights/helicopter X 3 minutes/flight = 720 minutes audible/day***
- Helicopter shuttles for HRR passengers:
  - Day trips: 96 passengers/day divided by 5 passengers/helicopter × 2 flights/helicopter × 3 minutes/flight = 120 minutes audible/day
  - Overnight trips: 60 passengers divided by 5 passengers/helicopter × 2 flights/ helicopter × 3 minutes/flight = 72 minutes audible/day
- Upriver boats from Lake Mead that stay only in Zone 3
  - Cannot be quantified as discussed above in "Methodology Considerations Specific to Lower Gorge Analysis." However, more upriver boats would be expected in Zone 3 than in Zone 2, due to time and distance considerations.

For Zone 3 the total time audible at a single point along the river from all of the above sources (including those coming into Zone 3 from Zone 2) would vary from a low of ***2,412*** minutes (with ***initial pontoon numbers and*** no HRR overnight trips), to a high of ***3,042*** minutes (with ***potential pontoon numbers and*** HRR overnight trips), resulting in an adverse, major impact. Without the helicopters, audibility would vary from ***1,716*** minutes ***(initial pontoon numbers and no HRR overnight trips)*** to ***2,130*** minutes ***(potential pontoon numbers and HRR overnight trips***), which would still be an adverse, major impact. Since there are only 720 minutes in a 12-hour use day, much overlap of noise sources would occur; consistent with observations, multiple boats would be audible at some times and no boats at other times. However, the natural soundscape would still be essentially saturated by noise, with very few noise-free intervals on a busy peak day.

The helicopter noise in combination with the boat noise would only occur in the Quartermaster area, and only during times when all boats were present (which would occur in the afternoons when HRR passengers were about ready to be picked up). This also would not include other upriver traffic from Lake Mead, tow-outs, or additional off-river noise, because they are not quantifiable. In addition, each motorboat would create regional impacts as it runs its motor for about 1.5 hours to travel the 18 miles through this zone. Noise-free intervals would average less than one hour during peak days. Overall, ***Modified*** Alternative 4 would have a localized and regional, adverse, frequent and periodic, short- to long-term, major impact in Zone 3.

Zone 4—Zone 4 does not have any plan-related helicopter or pontoon boat noise intrusions, but the continuing river activity (about the same as Zone 2) is added to by private watercraft on Lake Mead National Recreation Area, which may never enter Grand Canyon National Park.

Mitigation of Effects. Actions to mitigate effects would include ***a subset*** of the actions listed in Section 4.2.4.4.2. For ***Modified*** Alternative 4, a larger amount of effort, funding and staffing than for Alternative 1 would be needed in Zone 2 to implement the mitigation actions, but it is likely that impacts could be reasonably reduced to minor levels with mitigation. In Zone 3 it is unlikely that sufficient mitigation could be implemented to reduce impacts on the natural soundscape to minor levels or less.

Cumulative Effects. Cumulative impacts would be similar to those discussed in Alternative A. ***Modified*** Alternative 4 would have adverse, short-term, moderate to major overall impacts during peak periods, the same overall levels as Alternative 1. It would contribute a negligible to minor adverse increment to cumulative effects. Aircraft overflights have an adverse, long-term, major cumulative effect on the park's natural soundscape. Even if all river-related noise including noise from boats and river-related helicopters was removed from the park, the park would still experience adverse, major effects from aircraft overflights independent of this river management plan. In the Quartermaster area, the Hualapai Tribe expects about the same number of flights independent of the river alternatives. Frequent overflights commonly reduce noise-free intervals to considerably less than an hour in many parts of the park. Given the history of aircraft overflights at Grand Canyon, mitigation is unlikely to be implemented that would reduce cumulative impacts on the natural soundscape to a minor or lower intensity level.

Conclusions. ***Modified*** Alternative 4 slightly increases impacts on the natural soundscape in Zone 2 and Zone 3. Compared to Alternative 1, it would have adverse, short- ***to long***-term, random, major impacts in Zone 2, which could be reasonably mitigated, but adverse, short- to long-term, frequent and periodic, major, impacts in Zone 3, especially in the Quartermaster area, which could not be reasonably mitigated to minor levels or less. Noise from boats in Zone 2 would be audible about ***276*** minutes/day (or ***38***% of the 12-hour day) without considering HRR overnight trips, and ***330*** minutes (***46***%) on busy days when HRR overnight trips operated. This would be an adverse, major impact in that zone. Noise-free intervals would average 1 to 1.5 hours in Zone 2 (an adverse, moderate impact), but less than an hour in Zone 3 (an adverse, major impact). Also, a motorboat would create regional impacts as it runs its motor for about three hours to travel the 35 miles through Zone 2.

Noise from boats and helicopters in Zone 3 would be audible from ***2,412 to 3,042*** minutes/day. Because this is more than 100% of the 12-hour day, there would be considerable overlap of noise events (i.e., more than one noise source audible much of the time). During peak-use days, there would be very little time for noise-free intervals in Zone 3. This would be an adverse, major impact in that zone, ***a greater impact than in Alternative 1.***

There would also be off-river noise and noise from upriver boats and tow-outs that is not quantifiable, and each motorized raft would run its motor up to 4 hours each in the course of its travels through all or part of the Lower Gorge, creating regional impacts over the area of travel (i.e., some rafts would travel the entire 53 miles from Diamond Creek to Lake Mead in a day, but others would travel shorter sections).

Modified Alternative 4 would not result in the impairment of the natural soundscape in Grand Canyon National Park.

The cumulative effects of ***Modified*** Alternative 4 would be regional, adverse, long-term, major impacts primarily due to extensive aircraft overflights, which could probably not be mitigated to minor intensity or less. ***Modified*** Alternative 4 would contribute a negligible to minor increment to the overall cumulative effects of noise on the park's natural soundscape, but even if all noise from all river recreation was eliminated from the park, the cumulative effects of aircraft noise would still be a major adverse impact. There would still be “significant adverse effects” on the natural soundscape due to frequent, periodic and noticeable noise from overflights, and “substantial restoration of natural quiet” would not be achieved as required by Public Law 100-91 and other mandates.

4.2.4.6.6 Alternative 5

Analysis. *Zone 2*—Management Zone 2 would be the same for Alternatives 4 and 5, except that upriver travel from Lake Mead would only be allowed to RM 273, so there would be no jetboats, tow-outs or pickups in Zone 2 for Alternative 5. So for Alternative 5, the totals for ***Modified*** Alternative 4 Zone 2 would be reduced by 72 minutes audibility for jetboat passenger pickups. See the more detailed analysis in ***Modified*** Alternative 4.

For Zone 2 the total time audible at a single point along the river from all of the above sources would be ***204*** minutes without the HRR Overnight trips (about ***28***% of the 12-hour day), and ***258*** minutes with the overnight trips (about ***36***% of the day audible), resulting in an adverse, major impact. In addition, each motorboat would create regional impacts as it runs its motor for about 3 hours to travel the 35 miles through this zone. The trips would create additional off-river noise, but this is not quantifiable. Noise-free intervals in Zone 2 would be expected to average 1 to 1.5 hours during peak days when considering only boats traveling in the zone (an adverse, short-term, moderate impact), even when considering that multiple boats would be audible at some times and no boats at other times. However, when cumulative effects are also considered (see below), such long noise free intervals would probably be rare in most places. Overall, Alternative 5 would have a localized and regional, adverse, short- to long-term, moderate to major impact in Zone 2.

The area of Zone 2 between Diamond Creek and Separation Canyon would be quieter than the area from Separation Canyon to RM 260, because jetboats and other boats from Lake Mead cannot travel past Separation Canyon.

Zone 3—In addition to all of the elements described above for Zone 2, the following additional elements present typical peak use under Alternative 5 for this zone and section of river:

- Pontoon boat trips:
  - Maximum 960 passengers/day divided by 6 passengers/boat = 160 boats
    - Average 160 boats/day × 2 passes (up and back) × 9 minutes/boat = 2,880 minutes audible/day
- Helicopter shuttles for pontoon boat passengers:
  - Maximum 960 passengers/day divided by 5 passengers/helicopter × 2 flights/helicopter × 3 minutes/flight = 1,152 minutes audible/day
- Helicopter shuttles for HRR passengers:
  - Day trips: 96 passengers/day divided by 5 passengers/helicopter × 2 flights/helicopter × 3 minutes/flight = 120 minutes audible/day
  - Overnight trips: 60 passengers divided by 5 passengers/helicopter × 2 flights/helicopter × 3 minutes/flight = 72 minutes audible/day

- Upriver boats from Lake Mead that stay only in Zone 3
  - Cannot be quantified as discussed above in "Methodology Considerations Specific to Lower Gorge Analysis." However, more upriver boats would be expected in Zone 3 than in Zone 2, due to time and distance considerations.

For Zone 3 the total time audible at a single point along the river from all of the above sources (including those coming into Zone 3 from Zone 2) varies from a low of ***4,356*** minutes (with no HRR Overnight trips), to a high of ***4,482*** minutes (with HRR overnight trips) (a major impact intensity level). Since there are only 720 minutes in a 12-hour day, multiple noise sources would be audible at the same time, and the natural soundscape would be essentially saturated by noise with very few noise-free intervals on a busy peak day.

The helicopter noise in combination with the boat noise would only occur in the Quartermaster area, and only during times when all boats were present (which would occur in the afternoons when HRR passengers were about ready to be picked up). The above totals would not include additional off-river noise because they are not quantifiable. In addition, each motorboat would create regional impacts as it runs its motor for about 1.5 hours to travel the 18 miles through this zone. Noise-free intervals would average less than one hour during peak days. Overall, Alternative 5 would have a localized and regional, adverse, frequent and periodic, short- to long-term, major impact in Zone 3.

Zone 4—Zone 4 does not have any plan-related helicopter or pontoon boat noise intrusions, but the continuing river activity (about the same as Zone 2) is added to by private watercraft on Lake Mead National Recreation Area, which may never enter Grand Canyon National Park.

Mitigation of Effects. Actions to mitigate effects would include ***a subset*** of the actions listed in Section 4.2.4.4.2. Compared to Alternative 1, Alternative 5 would reduce noise impacts in Zone 2 so less effort, staffing and funding would be needed to implement the mitigation actions. Therefore, it is likely that sufficient mitigation would be reasonably implemented in Zone 2 to reduce impacts to a minor level. However, the activity in the Quartermaster area in Zone 3 would make it unlikely that reasonable implementation of mitigation measures could reduce impacts to minor levels or less.

Cumulative Effects. Cumulative impacts would be similar to those discussed in Alternative A. Alternative 5 would have adverse, moderate to major overall impacts during peak periods, the same overall levels as Alternative 1. It would contribute an adverse, minor increment to cumulative effects, due primarily to increases in Quartermaster activity. Aircraft overflights have an adverse long-term, major cumulative effect on the park's natural soundscape. If all river-related noise (primarily from boats and helicopters) was removed from the park, the park would still experience adverse, major effects from aircraft overflights independent of this river management plan. Even in the Quartermaster area, the Hualapai Tribe expects about the same number of flights independent of the river alternatives. Frequent overflights commonly reduce noise-free intervals to considerably less than an hour in many parts of the park. Given the history of aircraft overflights at Grand Canyon, mitigation would be unlikely to reduce cumulative impacts on the natural soundscape to a minor or lower intensity level.

Conclusions. Alternative 5 slightly reduces impacts on the natural soundscape in Zone 2 compared to Alternative 1, but major increases in impacts occur in Zone 3. It would have adverse, short- ***to long***-term, random, moderate to major impacts in Zone 2, which could be reasonably mitigated, but adverse, short- to long-term, frequent, periodic, major impacts in Zone 3, especially in the Quartermaster area, which could not be reasonably mitigated to minor levels or less. Noise from boats in Zone 2 would be audible about ***204*** minutes/day (or ***28***% of the 12-hour day) without considering HRR overnight trips, and ***258*** minutes (***36***%) on busy days when HRR overnight trips operate, an adverse, short-term, ***major*** impact. Noise-free intervals would average 1 to 1.5 hours in Zone 2 (an adverse, moderate impact), but less than an hour in Zone 3 (an adverse, major impact). Also, each motorboat would create regional impacts as it runs its motor for about three hours to travel the 35 miles through Zone 2.

Noise from boats and helicopters in Zone 3 would be audible from ***4,356 to 4,482*** minutes. Because this would be more than 100% of the 12-hour use day, there would be multiple noise sources audible much of the time. During peak-use days, there would be very little time for noise-free intervals in Zone 3. This would be an adverse, long-term, major impact in this zone, and a large increase in noise compared to Alternative 1.

There would also be off-river noise. Upriver boats and tow-outs would only be allowed to RM 273, so it is not likely there would be much of that traffic, and such noise is not quantifiable as discussed above. Each motorized raft would run its motor up to 4 hours each in the course of its travels through all or part of the Lower Gorge, creating regional impacts over the area of travel (i.e., some rafts would travel the entire 53 miles from Diamond Creek to Lake Mead in a day, but others would travel shorter sections). Alternative 5 would not result in impairment of the natural soundscape at Grand Canyon National Park.

The cumulative effects of Alternative 5 would be major adverse, long-term regional impacts primarily due to extensive aircraft overflights of the park, and are not likely to be able to be mitigated to minor intensity or less. Alternative 5 would contribute a minor increment to the overall cumulative effects of noise on the park natural soundscape, but even if all noise from all river recreation was eliminated from the park, the cumulative effects of aircraft noise would still be an adverse, major impact. There would still be "significant adverse effects" on the natural soundscape due to frequent, periodic and noticeable noise from overflights, and "substantial restoration of natural quiet" would not be achieved as required by Public Law 100-91 and other mandates.

4.2.5 CAVE AND PALEONTOLOGICAL RESOURCES

4.2.5.1 ISSUES

Cave and paleontological resources include atmospheric, geologic (i.e., mineralogical, lithologic, geomorphic, paleontological and hydrologic), biological, ecological, cultural, recreational, and educational/scientific resources within caves, as well as fossil resources found outside caves. Impacts from visitation pose a serious threat to these resources, given that they are generally irreplaceable and nonrenewable. Numerous issues have been identified regarding these resources, both in public scoping and in internal review. The primary issues are described below.

While access to all caves, excluding Cave of the Domes, has been restricted by the "Superintendent's Compendium of Closures," several caves are accessible from the river and are thus vulnerable to impacts from unauthorized visitation by river runners. While the majority of visitors are conscientious about protecting cave and paleontological resources, a small percentage ignore park regulations and engage in acts that are destructive to the resource. Impacts to Grand Canyon caves by visitors (including researchers and managers) have been well documented.

Public education and appreciation for paleontological resources can have unintended consequences. Visitors have expressed a desire for increased information and access to paleontological resources; some visitors, however, have suggested that access to sensitive paleontological resources be restricted.

4.2.5.2 Guiding Regulations and Policies

The Federal Cave Resources Protection Act of 1988 requires the U. S. Departments of Agriculture and the Interior federal agencies to identify "significant caves" on federal lands, to regulate or restrict use of those caves as appropriate, and to include significant caves in land management planning efforts. It imposes civil and criminal penalties for harming a cave or cave resources and authorizes information to be withheld about the specific location of a significant cave from a requester under the Freedom of Information Act.

The National Parks Omnibus Management Act of 1998 allows the NPS to protect the confidentiality of the nature and specific location of paleontological objects.

NPS regulations prohibit possessing, destroying, or disturbing mineral resources, cave resources, and paleontological specimens in park units (36 CFR 2.1).

The NPS *Management Policies 2001* require the agency to allow natural geologic processes to proceed unimpeded (sec. 4.8.1). The Park Service can intervene in these processes only when required by Congress, when necessary for saving human lives, or when there is no other feasible way to protect other natural resources/ park facilities/historic properties. Cave and paleontological resources are to be managed in such a way that the integrity of these resources is protected, while maintaining confidentiality of sensitive site locations and encouraging scientific research.

Cultural resources located in caves are protected by the Antiquities Act, the Archeological Resources Protection Act, the National Historic Preservation Act, CEQ regulations, and NPS Director's Order 28. These policies and regulations are discussed in detail in Chapter 4, ***"Impacts on Cultural Resources".***

Under the current *Cave Management Plan,* all caves but the Cave of the Domes are closed to the public (NPS 1986b). In accordance with a revision of that plan, NPS staff at Grand Canyon are inventorying caves within the park and classifying them into five categories: Class 1 caves will be opened to the public without a permit; Class 2–5 caves will be restricted to use by permit only (NPS 2003a). Before entering any cave, individuals must determine the classification of the cave and apply for the requisite permit. With few exceptions, caving activity must be approved in advance through the Grand Canyon Science Center. Stanton's Cave has been gated to prevent unauthorized access by humans but still allow access for bats, other small mammals, and invertebrates.

4.2.5.3 MANAGEMENT OBJECTIVES FOR CAVE AND PALEONTOLOGICAL RESOURCES

Management objectives for cave and paleontological resources are included in Chapter 1. The objective for caves and paleontological resources as it relates to the management of recreational river use in the Grand Canyon is to provide for the protection of caves and paleontological resources from the impacts of visitation.

4.2.5.4 METHODOLOGY FOR ANALYZING EFFECTS TO CAVE AND PALEONTOLOGICAL RESOURCES

Effects specific to cave and paleontological resource were characterized for each alternative based on the impact thresholds presented below. Additionally, each alternative was evaluated to determine whether effects would be direct or indirect.

Intensity

Negligible—Any changes to cave resources, including mineral deposits, fossils, geologic features or human artifacts, that would not be measurable or perceptible.

Minor—Any changes to cave resources, including mineral deposits, fossils, geologic features, or human artifacts that would be measurable but slight, would not compromise the value of the feature, and would be possible to reverse or mitigate. Beneficial effects would be measurable but slight and would result in increased stability to individual cave and paleontological features.

Moderate—Any changes to cave resources, including mineral deposits, fossils, geologic features, or human artifacts, that would be measurable, perceptible, and of consequence to the value of the feature, but the impact might be possible to reverse or mitigate. Beneficial effects would be measurable and would contribute to an increase in the stability of resource features.

Major—Any changes to cave resources, including mineral deposits, fossils, geologic features, or human artifacts, that would be measurable, of severe consequence to the value of the feature, and impossible to reverse or expensive to mitigate. Beneficial effects would be measurable and would result in major stabilization of the resource.

Context

Localized—Impacts would be restricted to specific resource sites.

Regional—Impacts would occur to several specific resource sites within a management zone, Grand Canyon National Park, or the greater Grand Canyon region. This could also include impacts to a site that has regional significance in that it contains unique artifacts, species, or geologic formations.

Duration

Short-term—Impacts would last less than five years, if the human disturbance was not repeated, and permanent, if human disturbance continued without interruption. The effect would no longer be detected in five years, so that the resource was returned to its predisturbance condition (for example, trash and other items could be removed).

Long-term—Damage to paleontological, mineralogical, archeological, and historic resources would be permanent and irreversible. Archeological and historic materials that were rearranged, removed, or defaced would permanently lose their scientific value.

Timing

Impacts would vary depending on specific resource and their sensitivity to timing issues. For example, certain cave resources (bats) would be more susceptible to impacts during spring and summer months due to roosting, and fall and winter because of hibernation

4.2.5.4.1 Mitigation of Effects

Previous mitigation efforts indicate that specific measures can be effective in reducing impacts to air quality, if adequate funding, staffing, monitoring, and implementation of the measures are maintained. ***A list of possible mitigation measures to be considered singly or in combination, that are not already incorporated into the alternatives, but are judged likely to reduce impacts to cave and paleontological resources if implemented include the following***:

- ***Monitor cave and paleontological resources for visitor impacts and determine*** site-specific mitigation of visitor impacts
- Enhanced visitor education of park regulations and leave-no-trace ethics
- Revegetation and retrailing near cave entrances and paleontological sites
- Increased enforcement of site closures
- Increased patrols
- ***Where feasible, perform*** data recovery for resources facing eminent destruction
- Group size restrictions at sensitive sites
- Temporary or permanent closures of ***sites vulnerable to or experiencing resource damage***

4.2.5.4.2 Cumulative Impacts

Cumulative impacts on cave and paleontological resources were determined by combining the impacts of each alternative with other past, present, and reasonably foreseeable future actions, as described in ***"Cumulative Impacts"*** on page 249. The most significant past action that has impacted cave resources has been authorized visitation prior to the implementation of closures through the "Superintendent's Compendium" and the unauthorized visitation of caves since the closures. Research activities have also contributed to the effects from visitation. Since several types of cave resources are nonrenewable, even small incidents of visitation, authorized or unauthorized, can cumulatively diminish the resource. These losses are usually site-specific, but in cases where unique and diagnostic resources are present, the impact could be greater. Past visitation has resulted in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, cave and paleontological resources within the area of effect would continue to derive the benefit of protection from their location within Grand Canyon National Park, Lake Mead and Glen Canyon national recreation areas, and Hualapai tribal lands. Weighed against the impacts that come from visitation to these areas, this protection results in a beneficial, long-term, year-round, negligible to moderate effect.

4.2.5.4.3 Tools Used to Analyze Effects

In order to analyze the effect of each alternative, all available information on known cave and paleontological resources was compiled from NPS and Hualapai Tribe resource files. A map with locations of known caves, cultural and natural resources, and visitor stopping points (camps, lunch stops, and attractions), including data on use intensity, resulted in the identification of areas of resource concern, in which concentrations of sensitive resources overlapped with visitor use areas. Predictions about visitor impacts were based on predicted use levels from the Grand Canyon River Trip Simulator program.

4.2.5.4.4 Assumptions

In addition to general assumptions used for analysis of effects from each alternative (see page 246, assumptions that specifically relate to the alternatives presented in this document and their effects on cave and paleontological resources are presented below:

- Caves are attractive destinations during summer months for those seeking a reprieve from the heat of the day, although this visitation is generally restricted to caves close to the river. Very few caves are easily accessible from the river, and visitation is limited to those within a short hike, such as Stanton's Cave. Given that most true caves are found in the Redwall limestone layer of the canyon's strata, the accessibility of caves is further restricted by the canyon's geology. Caves and paleontological resources farther from the river corridor are actually more vulnerable during the shoulder seasons, when trip lengths and cooler weather are more conducive to exploration. The number of visitors who visit caves annually is a small percentage of those who travel the Colorado River, and most who do visit caves are generally conscientious about protecting cave and paleontological resources. As with all sensitive resources, a small percentage of visitors ignore park regulations and engage in acts that are destructive to the resource. Consequently, management variables that contribute to crowding, such as larger groups, more launches per day, and longer trips, can help to influence resource vulnerability.
- Variables that contribute to congestion (e.g., group size, trip length, number of passengers, user discretionary time, etc.) contribute to the vulnerability of cave and paleontological resources. However, all variables must be evaluated together.
- On longer trips visitors generally have more time to interact with the canyon environment, including sensitive cave and paleontological resources. This is particularly true for side canyons, as longer trips are designed to allow visitors opportunities to explore. Off-season hiking is also more conducive to exploring side canyons, as the extreme heat of the summer precludes hiking too far from the river itself.
- Increased visitor access to caves in the winter months adversely affects cave-dwelling bats. If hibernating bats are awakened, they can burn stored fat and might not be able to survive the winter (Thomas 1995). Population declines may be accelerated if numbers at maternity colonies are not sufficient to raise roost temperatures to the levels needed for healthy growth of young (Mohr 1972; Leslie, pers. comm. 2004a).

- The mode of travel (motor vs. oar) and trip type (commercial vs. noncommercial) are thought to have no effect on cave and paleontological resources. The assumption is that all individuals, whether on guided trips or noncommercial ones, could adversely interact with cave and/or paleontological resources.
- Impacts to cave and paleontological resources are generally long-term or permanent, although mitigation measures may be employed that can lessen these impacts. For example, while the gating of Stanton's cave has been effective in mitigating visitor impacts, it is considered a last resort mitigation, given the cost and the aesthetic consequence (see Photo 4-4). Impact thresholds for gated caves are always negligible for intensity regardless of alternative.

PHOTO 4- 4: GATE AT STANTON'S CAVE

- The number of pontoon boats and numbers of people on them will not directly affect cave and/or paleontological resources in the Lower Gorge because this type of trip does not offer visitors an opportunity to visit caves or paleontological resources.

4.2.5.5 Impact Analysis—Lees Ferry Alternatives

4.2.5.5.1 Alternative A (Existing Condition)

Analysis. Under Alternative A recreational river use would be managed to continue to allow large group sizes, lengthy trips, and spikes in the number of trips and people at one time, as well as daily launches (see Table 4- 1). User-days would remain capped at current levels, which would probably result in approximately the same number of total yearly passengers. Similarly, user discretionary time would remain similar to current levels.

The most noticeable effects on cave resources would be from continued unauthorized access to cave sites. While the number of caves accessible from the river is relatively small, sites that have sustained the most damage are those that are easily accessible to the river corridor. Several kinds of impacts have been documented. Impacts to fragile cave floor surfaces and soils include the rearrangement of natural and cultural material, footprints, trailing, soil compaction, and excavation. Impacts to cave formations (speleothems), rock and mineral resources, and paleontological resources include marks on surfaces, theft, vandalism, and inadvertent damage from trampling or excavating. Additional damage has occurred from the introduction of foreign objects and residues (oily residues from continuous touching, lint from clothing, wax from candles, smoke staining, toilet paper, odor, graffiti, etc.). Many of these impacts alter localized climate and hydrologic conditions that may alter or impede formation processes. Because cave and karst systems have a symbiotic relationship with local and regional hydrological systems, pollution or disruption of these natural systems can harm water supplies and water quality.

Biological resources that utilize caves are vulnerable to trampling and injury, as well as habitat destruction and damage that results in the abandonment of the cave. Human visitation in some caves may also disturb bats, not only through direct disturbance, but through changes in the micro-climate of the cave due to lights, increased humidity, gates, and other developments (Mann, Steidl, and Dalton 2002). Threatened species include but are not limited to several species of endangered bats and California condors, cave adapted invertebrates, and other small wildlife. Analyses of specific impacts to biological resources are detailed in specific sections of the natural resources impact analyses.

The integrity of cultural resources in caves have been compromised by the placement of fake split-twig figurines and other inappropriate material, as well as vandalism or theft of artifacts and other materials. Visitor access to cultural resources in caves has inadvertently disturbed significant features, thereby limiting the ability of some sites to convey their meaning. Analyses of specific impacts to cultural resources are detailed under “4.3 Impacts on Cultural Resources.” Human-caused fires have destroyed important natural and cultural artifacts, such as ground sloth and mountain goat dung, bones, hair, and other soft tissue that contain scientific material.

Impacts to paleontological resources outside of caves include polishing, marking, or removal of surfaces, rearrangement of material, theft, and damage to fossil material from attempted removal and/or vandalism.

Management variables such as group size, trip length, and launches per day affect crowding, congestion, and accessibility to cave and paleontological resources, and therefore they can contribute to increases or decreases in resource vulnerability to impacts such as those above (trampling, resource disturbance). Under Alternative A in the summer season these variables are at their highest levels of any alternatives. Similarly the number of trips and people at one time in the corridor are at their highest levels, particularly since up to nine groups can launch in a single day. The long trip lengths in this alternative increase the level of accessibility of all sites, but particularly those in the side canyons. Large group sizes and spikes in launches increase the probability of congestion at attraction sites. This exacerbates the effects of unauthorized visitation of caves by concentrating large levels of foot traffic and associated trampling, surface contact, and breath emissions into a confined space. These variables can directly and indirectly affect impacts to cave and paleontological resources along the river corridor and side canyons. Thus, summer use results in localized, adverse, long-term, minor to moderate effects that are dependent on accessibility from the river.

Overall use levels under this alternative, as measured by user-days, total passengers, and total user discretionary time in the winter and shoulder seasons, would be at or near the lowest levels for all alternatives (see Table 4- 2). While these variables indicate some of the lowest levels of off-season use, they would coincide with the highest allowable group sizes and trip lengths.

Longer trips under this alternative would increase the level of accessibility at all sites, but particularly those in the side canyons. Impacts, such as those discussed above, from winter and shoulder season use would be attributed primarily to the access afforded by these longer trips. Still, because use levels are low and off-season, impacts would be highly localized, adverse, long-term, minor to moderate. Regional impacts would be negligible.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed on page 407 (e.g., increased monitoring, patrols, education, etc.), but because current management of the river corridor allows substantial spikes in use, as well as the longest allowable trip lengths of any of the alternatives, it is unlikely that mitigations would be implemented at a level sufficient to reduce impacts to a minor intensity. Cave gating would be a last resort but might be considered to prevent or correct major impacts.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, past visitation, park management, and visitation by backcountry visitors and researchers results in measurable changes to localized cave and paleontological resources. This effect results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of Alternative A, when combined with other past, present, and reasonably foreseeable actions, would result in localized, adverse, long-term, minor to major effects to cave and paleontological resources. Alternative A would result in a localized, adverse, long-term, minor to moderate contribution to these cumulative effects.

Conclusion. The majority of paleontological and cave resources are nonrenewable, thus most of the effects from visitation would be direct, adverse, and irreversible. Intensity of impacts would remain minor to moderate. However, because very few caves and paleontological resources are accessible to river runners along the river corridor, effects would not occur to the majority of caves and paleontological resources. Therefore, effects would be extremely localized and highly dependent on accessibility. Effects would continue to occur year-round, with most impacts to resources adjacent to the river occurring during the summer months and most impacts to resources in less accessible areas occurring during the shoulder months when longer trips provide additional opportunities for side-canyon hiking. Because current management of the river corridor allows substantial spikes in use, as well as the longest allowable trip lengths of any of the alternatives, it is unlikely that mitigations would be implemented at a level sufficient to reduce impacts to a minor intensity. Alternative A would not result in the impairment of cave and paleontological resources in Grand Canyon National Park. Cumulatively, the effects of Alternative A, when combined with other past, present, and reasonably foreseeable actions, would result in adverse, localized, long-term, minor to major effects to cave and paleontological resources. Alternative A would have a localized, adverse, long-term, minor to moderate contribution to these cumulative effects.

4.2.5.5.2 Alternative B

Analysis. Under Alternative B recreational motor trips would be prohibited, and group sizes, maximum daily launches, and estimated total yearly passengers would be the lowest of any of the alternatives (see Table 4- 1). A launch-based system would eliminate spikes in use.

Summer use under this alternative in terms of total user-days would decrease to 107,418 (from 121,869 currently) and total passengers would go down to 8,492 (from 18,128 currently). These reduced use levels, along with reductions in group sizes, trip length, and maximum number of trips and people at one time, would help reduce crowding, thus decreasing the incidence of unintentional impacts to resources. Shorter trips, which would reduce the accessibility of side canyon resources, would be somewhat offset by an increase in user discretionary time (from 294,506 hours currently to 431,444 hours). As a result, access to all cave and paleontological resources, especially those in side canyons, could increase. While user discretionary time could represent an increase in sites per trip that river runners visited, it could also represent an increase the amount of time that visitors spent at fewer sites. Because few cave and paleontological resources along the river corridor are readily accessible (or recognizable) to river users, the majority of resources would not be affected. Effects such as those discussed above would continue to occur year-round, would be extremely localized, and would be highly dependent on accessibility, with most impacts to resources in and near the river occurring during the summer when visitors would have more time to explore sensitive resources. Overall, reductions in summer use would have beneficial, localized, long-term, negligible to minor effects compared to current use.

Under this alternative, overall use levels in the winter and shoulder seasons, as measured by user-days, total passengers, and user discretionary time, would increase above current levels, but would be much lower than the remainder of the alternatives. These levels of off-season use coincide with the lowest allowable group sizes and lower trip lengths. Compared to current use, these increases would potentially contribute to the accessibility and vulnerability of cave and paleontological resources, resulting in adverse, localized, long-term, negligible to minor effects.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed on page 407 (e.g., increased monitoring, patrols, education, etc.) and would be needed primarily to mitigate new use in the winter and shoulder seasons. Use levels would generally be lower in the summer months, with the exception of user discretionary time. A monitoring and treatment plan to determine and mitigate impacts from potential visitation would be needed and sufficient to reduce localized impacts to a minor intensity. Levels of additional education, patrols and site stabilization would be determined based on the results of the monitoring program.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, past visitation, park management, and visitation by backcountry visitors and researchers results in localized, measurable changes to cave and paleontological resources. This effect results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of Alternative B, when combined with other past, present, and reasonably foreseeable actions, would result in localized, adverse, long-term, minor to major effects to cave and paleontological resources. Alternative B would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

Conclusion. Based on the reduction of use from current conditions, Alternative B would directly contribute to the long-term protection and stabilization of individual cave and paleontological resource sites, especially those along the mainstem of the Colorado River. This would result in beneficial, localized, negligible to minor effects that would depend on site accessibility and vulnerability. Effects from visitation would continue to cause measurable change to localized resources, however, and impacts would be direct, adverse, localized, negligible to minor, and irreversible. Because few cave and paleontological resources along the river corridor are readily accessible (or recognizable) to river users, effects would not occur to the majority of resources. Therefore, effects would be extremely localized and highly dependent on accessibility. Effects would continue to occur year-round, with most impacts to resources in and near the river occurring during the summer when an increase in user discretionary time would give visitors more time to explore sensitive resources. Most impacts to resources farther from the river would occur in the shoulder and winter seasons. Impacts to cave and paleontological resources could be reduced to a minor intensity with reasonable mitigation. Alternative B would not result in the impairment of the cave and paleontological resources in Grand Canyon National Park. Cumulatively, the effects of Alternative B, when combined with other past, present, and reasonably foreseeable actions, would result in localized, adverse, long-term, minor to major effects to cave and paleontological resources. Alternative B would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

4.2.5.5.3 Alternative C

Analysis. Under Alternative C recreational motor trips would be prohibited. Group sizes and trip lengths would be at lower levels than now, but estimated total user-days and user discretionary time would be the highest of any alternative (see Table 4- 1). A launch-based system would eliminate spikes in use.

Lower summer use under this alternative in terms of user-days (down to 110,120 from 121,869 currently) and passengers (down to 11,252, from 18,128), along with moderate reductions in group sizes, trip lengths, and the maximum number of trips and people at one time, would help reduce crowding and incidences of unintentional impacts (such as trampling, resource disturbance) at attraction sites, including cave or paleontological resources. These variables would be somewhat offset, however, by an increase in user discretionary time from 294,506 hours currently to 335,089, which might result in increased accessibility to all cave and paleontological resources, especially those in side canyons. While user discretionary time could represent an increase in sites per trip that river runners visited, it could also represent more time spent at fewer sites. Because few cave and paleontological resources along the river corridor are readily accessible (or recognizable) to river users, the majority of resources would not be affected. Overall, reduced summer use would have localized, beneficial, long-term, negligible to minor effects compared to existing conditions.

Under this alternative, overall use levels in the winter and shoulder seasons, as measured by user-days, total passengers, and user discretionary time, would increase considerably above current levels (see Table 4- 2) and in most cases would be the highest use of all the alternatives. Allowable trip lengths would be reduced from 21 to 18 days in the shoulder season and from 30 to 21 days in the winter. Compared to current use, these off-season increases would potentially contribute to the accessibility and vulnerability of cave and paleontological resources, resulting in localized, adverse, long-term, minor to moderate effects.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed on page 407 (e.g., increased monitoring, patrols, education, etc.), and would be needed primarily to mitigate the considerable increases in winter and shoulder season use, as well as the highest yearly user-days and user discretionary time of any alternative. A monitoring and treatment plan to determine and mitigate impacts from potential visitation would be needed and would be sufficient to reduce localized impacts to a minor intensity. Levels of additional education, patrols, and site stabilization would be determined based on the results of the monitoring program.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, past visitation, park management, and visitation by backcountry visitors and researchers results in localized, measurable changes to cave and paleontological resources. This effect results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of Alternative C, when combined with other past, present, and reasonably foreseeable actions, would result in localized, adverse, long-term, minor to major effects to cave and paleontological resources. Alternative C would result in a localized, adverse, long-term, minor to moderate contribution to these cumulative effects.

Conclusion. Based on the projected changes in use patterns from existing conditions, Alternative C would directly contribute to the long-term protection and stabilization of individual cave and paleontological resources by reducing some variables and indicators of crowding in the peak season. This would be offset, however, by an increase in user-days and user discretionary time in each season, particularly in the off-season. Compared to current conditions, this alternative would have direct, adverse, local, long-term, minor to moderate impacts. Effects from visitation would continue to cause measurable change to localized resources, however, resulting in direct, adverse, local, moderate to major, and irreversible impacts at individual sites. Because few cave and paleontological resources along the river corridor are readily accessible (or recognizable) to river users, effects would not occur to the majority of resources. Therefore, long-term to permanent effects would be localized and highly dependent on accessibility. Effects would occur year-round, with the majority of new impacts occurring in the winter and shoulder seasons. Impacts to cave and paleontological resources could be reduced to a minor intensity with reasonable mitigation. Alternative C would not result in the impairment of cave and paleontological resources in Grand Canyon National Park. Cumulatively, the effects of Alternative C, when combined with other past, present, and reasonably foreseeable actions, would result in localized, adverse, long-term, minor to major effects to cave and paleontological resources. Alternative C would result in a localized, minor to moderate, long-term, adverse contribution to these cumulative effects.

4.2.5.5.4 Alternative D

Analysis. Under Alternative D recreational motor trips would be permitted two periods a year, from May to August and from December to February. Group sizes and trip lengths would be at lower levels than now, but user discretionary time would be among the highest of any of the alternatives (see Table 4- 1). A launch-based system would eliminate spikes in use.

There would be a small summer user-day increase under this alternative (from 121,869 user-days now to 122,739), and total passengers would decrease to 13,765 from 18,128 currently; however, there would be a large increase in total user discretionary time (from 294,506 hours now to 461,641). This means that fewer people would have more time to interact with the environment, which could result in increased accessibility to all resources, especially in side canyons. Reductions in group sizes, trip length, and the maximum number of trips and people at one time would help reduce crowding, thus decreasing the incidence of unintentional impacts to sensitive resources. Because few cave and paleontological resources along the river corridor are readily accessible (or recognizable) to river users, the majority of resources would not be affected. Overall, summer use would have an adverse, localized, negligible to minor effect compared to existing conditions.

Overall use levels in the winter and shoulder seasons, as measured by user-days and total passengers, would increase above current levels (see Table 4- 2). Allowable trip lengths would be reduced from current, with the exception of noncommercial oar trips, which remain at 30 days. Compared to current use, increased use would potentially contribute to the accessibility and vulnerability of cave and paleontological resources, resulting in adverse, localized, minor to moderate effects.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed on page 407 (e.g., increased monitoring, patrols, education, etc.) and would be needed primarily to mitigate considerable new use in the winter and shoulder seasons, as well as remarkably high user discretionary time levels. A monitoring and treatment plan to determine and mitigate impacts from potential visitation would be needed and would be sufficient to reduce localized impacts to a minor intensity. Levels of additional education, patrols and site stabilization would be determined based on the results of the monitoring program.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, past visitation, park management, and visitation by backcountry visitors and researchers results in localized, measurable changes to cave and paleontological resources. This effect results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of Alternative D, when combined with other past, present, and reasonably foreseeable actions, would result in localized, adverse, long-term, minor to major effects to cave and paleontological resources. Alternative D would result in a localized, adverse long-term, minor to moderate contribution to these cumulative effects.

Conclusion. Based on the projected changes in use patterns from current condition, Alternative D would directly contribute to the long-term protection and stabilization of individual cave and paleontological resource sites by reducing crowding. This would be offset, however, by a substantial increase in user discretionary time throughout the year and an increase in user-days in the off-season. Compared to current conditions, this alternative would have direct, adverse, local, long-term, negligible to minor effects. Effects from visitation would continue to cause measurable change to localized resources, however, resulting in direct, adverse, local, long-term to permanent, minor to moderate impacts at individual sites. Because few resources along the river corridor are readily accessible (or recognizable) to river users, effects would not occur to the majority of resources. Effects would occur year-round, with the greatest potential for new impacts occurring in the winter and shoulder seasons. Impacts to cave and paleontological resources could be reduced to a minor intensity with reasonable mitigation. Alternative D would not result in the impairment of the cave and paleontological resources of the Grand Canyon National Park. Cumulatively, the effects of Alternative D, when combined with other past, present, and reasonably foreseeable actions, would result in adverse, localized, long-term, minor to major effects to cave and paleontological resources. Alternative D would result in a localized, adverse, long-term, minor to moderate contribution to these cumulative effects.

4.2.5.5.5 Alternative E

Analysis. Under Alternative E recreational motor trips would be permitted April through September. Group sizes and trip lengths would be at lower levels than current, but user discretionary time would be among the highest (see Table 4- 1). A launch-based system would eliminate spikes in use.

Under Alternative E summer use would decrease slightly (total user-days would fall to 121,836 from 121,869 now, and total passengers would decrease to 15,230 from 18,128); however total user discretionary time would increase to 373,761 hours (from 294,506 hours now). So fewer people would have more time to interact with the environment, resulting in greater access and vulnerability of resources to impacts, especially in side canyons. However, reductions in group sizes, trip lengths, and the maximum number of trips and people at one time would reduce crowding, thus reducing incidences of unintentional impacts to resources. Because few cave and paleontological resources along the river corridor are readily accessible (or recognizable) to river users, the majority of resources would not be affected. Overall, summer use would have a localized, adverse, long-term, negligible to minor effect compared to current use.

Overall use levels in the winter and shoulder seasons would increase from existing (see Table 4-2), but would be relatively low compared to the rest of the alternatives. These increases would potentially contribute to impacts on resources from greater access. Because of the vulnerability of resources, impacts would be localized, adverse, long-term, and minor to moderate.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed on page 407 (e.g., increased monitoring, patrols, education, etc.), and would be needed primarily to mitigate new use in the winter and shoulder seasons. A monitoring and treatment plan to determine and mitigate impacts from visitation would be needed and would be sufficient to reduce localized impacts to a minor intensity. Levels of additional education, patrols, and site stabilization would be determined based on the results of the monitoring program.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, past visitation, park management, and visitation by backcountry visitors and researchers results in localized, measurable changes to cave and paleontological resources. This effect results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of Alternative E, when combined with other past, present, and reasonably foreseeable actions, would result in localized, adverse, long-term, minor to major effects to cave and paleontological resources. Alternative E would result in a localized, adverse long-term, minor to moderate contribution to these cumulative effects.

Conclusion. Based on the projected changes in use patterns from existing conditions, Alternative E would directly contribute to the long-term protection and stabilization of individual cave and paleontological resource sites by reducing crowding, especially in the peak summer season. This would be somewhat offset, however, by increases in user discretionary time throughout the year and an increase in user-days in the winter and shoulder seasons. Compared to current conditions, this alternative would have direct, adverse, local, long-term, negligible to minor effects. Effects from visitation would continue to cause measurable change to localized resources, however, resulting in direct, adverse, long-term to permanent, minor to moderate impacts at individual sites. Because few resources along the river corridor are readily accessible (or recognizable) to river users, effects would not occur to the majority of resources. Effects would occur year-round, with the greatest potential for new impacts in the winter and shoulder seasons. Impacts to cave and paleontological resources could be reduced to a minor intensity with reasonable mitigation. Alternative E would not result in the impairment of cave and paleontological resources in Grand Canyon National Park. Cumulatively, the effects of Alternative E, when combined with other past, present, and reasonably foreseeable actions, would result in localized, adverse, long-term, minor to major effects to cave and paleontological resources. Alternative E would result in a localized, adverse, long-term, minor to moderate contribution to these cumulative effects.

4.2.5.5.6 Alternative F

Analysis. Under Alternative F recreational motor trips would be permitted January through June. Group sizes and trip lengths would be lower than now. User discretionary time would be higher than existing conditions, but it would be relatively low compared to several other alternatives (see Table 4- 1).

Summer use under this alternative represents a considerable reduction in total user-days (a decrease of 19,578 days), in total user discretionary time (a decrease of 24,999 hours), and total projected passengers (a decrease of 4,174). As a result, lower summer use, along with reductions in group size, trip lengths, and maximum number of trips and people at one time, would help prevent crowding, thus reducing the incidence of unintentional impacts to resources. Because few cave and paleontological resources along the river corridor are readily accessible (or recognizable) to river users, the majority of resources would not be affected. Overall, summer use would have localized, beneficial, long-term, negligible to minor effects compared to current use.

Use levels in the winter and shoulder seasons, as measured by user-days, total passengers, and user discretionary time, would increase considerably above current levels (see Table 4- 2). These higher use levels could result in greater access to vulnerable cave and paleontological resources, with localized, adverse, long-term, minor to moderate effects.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed on page 407 (e.g., increased monitoring, patrols, education, etc.) and would be needed mitigate impacts from new use in the winter and shoulder seasons. A monitoring and treatment plan to determine and mitigate impacts from visitation would be needed and would be sufficient to reduce localized impacts to a minor intensity. Levels of additional education, patrols, and site stabilization would be determined based on the results of the monitoring program.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, past visitation, park management, and visitation by backcountry visitors and researchers results in localized, measurable changes to cave and paleontological resources. This effect results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of Alternative F, when combined with other past, present, and reasonably foreseeable actions, would result in localized, adverse, long-term, minor to major effects to cave and paleontological resources. Alternative F would result in a localized, adverse long-term, minor to moderate contribution to these cumulative effects.

Conclusion. Based on the projected changes in use patterns from existing conditions, Alternative F would directly contribute to the long-term protection and stabilization of individual cave and paleontological resource sites by reducing crowding, especially in the summer season. This would be somewhat offset, however, by an increase in user discretionary time, total projected passengers, and user-days in the winter and shoulder seasons. Compared to current conditions, this alternative would have a direct, adverse, local, long-term, and negligible to minor effect. Effects from visitation would continue to cause measurable change to localized resources, however, resulting in direct, adverse, long-term to permanent, minor to moderate impacts at individual sites. Because few resources along the river corridor are readily accessible (or recognizable) to river users, effects would not occur to the majority of resources. Therefore, these effects would be localized and highly dependent on accessibility. Effects would occur year-round, with the greatest potential for new impacts in the winter and shoulder seasons. Impacts to cave and paleontological resources could be reduced to a minor intensity with reasonable mitigation. Alternative F would not result in the impairment of cave and paleontological resources in Grand Canyon National Park. Cumulatively, the effects of Alternative F, when combined with other past, present, and reasonably foreseeable actions, would result in adverse, localized, long-term, minor to major effects to cave and paleontological resources. Alternative F would result in a localized, adverse, long-term, minor to moderate contribution to these cumulative effects.

4.2.5.5.7 Alternative G

Analysis. Under Alternative G recreational motor trips would be permitted January through August. Group sizes would be somewhat lower than what is permitted now, but they would be higher than under any other alternative. Trip lengths would generally be at their lowest levels of all the alternatives except for noncommercial winter oar trips, which would still be reduced to 21 days from 30 days now. Yearly user discretionary time would be higher than current conditions, but it would be the of all the action alternatives (see Table 4- 1). Estimated yearly passengers would increase from 22,461 to 28,680, and estimated total user-days would increase from 171,131 to 249,910. A launch-based system would eliminate spikes in use.

Summer use would decrease under this alternative. as indicated by total user-days (which would decrease to 101,984 from 121,869 now), total user discretionary time (down to 229,958 hours from 294,506), and total projected passengers (falling to 14,939 from 18,128). Lower summer use, particularly in the amount of user discretionary time that visitors would have to interact with the environment, would be lower in this alternative than in any other alternative. This would be offset, however, by the large group size (40) for commercial motor trips. Because these large groups would not have sufficient time to access side canyon sites, it is anticipated that the impacts would be generally restricted to the most easily accessible sites along the river. Because few cave and paleontological resources along the river corridor are readily accessible (or recognizable) to river users, the majority of resources would not be affected. Overall, summer use would have localized, beneficial, long-term, negligible to minor effects compared to current use.

Overall use levels in the winter and shoulder seasons, as measured by user-days and total passengers, would increase considerably above current levels and would be among the highest of all of the alternatives (see Table 4- 2). Additionally, winter launches would be twice those currently allowed, and shoulder season launches would be reduced from current levels but would still be higher than any other alternative. While overall use levels in the winter and shoulder seasons would increase considerably above current levels, reductions in trip lengths would result in relatively low user discretionary time, particularly in the shoulder seasons. Less daylight in the off-season would somewhat restrict access to side canyon resources, and impacts would generally be restricted to the most easily accessible sites along the river. Compared to current use, resulting impacts to cave and paleontological resources would be highly localized, adverse, long-term, and negligible to minor.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed on page 407 (e.g., increased monitoring, patrols, education, etc.) and would be needed to mitigate impacts from new use in the winter and shoulder seasons. Because trip lengths would be substantially reduced, adverse effects from visitation by large groups would be generally restricted to easily accessible river corridor sites. A monitoring and treatment plan to determine and mitigate impacts from visitation would be needed and would be sufficient to reduce localized impacts to a minor intensity. Levels of additional education, patrols, and site stabilization would be determined based on the results of the monitoring program.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, past visitation, park management, and visitation by backcountry visitors and researchers results in localized, measurable changes to cave and paleontological resources. This effect results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of Alternative G, when combined with other past, present, and reasonably foreseeable actions, would result in localized, adverse, long-term, minor to major effects to cave and paleontological resources. Alternative G would result in a localized, adverse long-term, minor to moderate contribution to these cumulative effects.

Conclusion. Based on the projected changes in use patterns from current condition, Alternative G would directly contribute to the long-term protection and stabilization of individual cave and paleontological resource sites by reducing passengers and trip lengths in the summer season. This would be somewhat offset, however, by relatively large group sizes and increases in off season use in terms of total projected passengers and user-days. Compared to current conditions, this alternative would have direct, adverse, local, long-term, and negligible to minor effects. Effects from visitation would continue to cause measurable change to localized resources, however, resulting in direct, adverse, long-term to permanent, minor to major effects at individual sites. Because few resources along the river corridor are readily accessible (or recognizable) to river users, effects would not occur to the majority of resources. Therefore, these effects would dependent on accessibility. Effects would occur year-round with the greatest potential for new impacts occurring in the winter and shoulder seasons. Impacts to cave and paleontological resources could be reduced to a minor intensity with reasonable mitigation. Alternative G would not result in the impairment of the cave and paleontological resources in Grand Canyon National Park. Cumulatively, the effects of Alternative G, when combined with other past, present, and reasonably foreseeable actions, would result in localized, adverse, long-term, minor to major effects to cave and paleontological resources. Alternative G would have a localized, adverse, long-term, minor to moderate contribution to these cumulative effects.

4.2.5.5.8 Modified Alternative H (NPS Preferred Alternative)

Analysis. ***Under Modified Alternative H, recreational motor trips would be permitted from April 1 to September 15. Group sizes would be lower than currently in the summer and considerably lower in the shoulder seasons. Trip lengths would be lower than current conditions, with some opportunities for longer trips in the winter. Yearly user discretionary time would be higher than current conditions, but lower than several other alternatives*** (see Table 4- 1). ***Estimated yearly passengers would increase to 24,657 from 22,461 currently, and estimated total user-days would increase to 228,986 from 171,131. A launch-based system would eliminate spikes in use.***

Summer use under this alternative would represent the highest level of user-days (124,316) of all the alternatives, including current conditions (121,869). Total projected passengers for this season (16,655) would decrease from current condition (18,128). User discretionary time would be relatively high (***393,513*** hours) compared to current conditions (294,506) and several other alternatives. An overall increase in summer user discretionary time would be offset by reductions in group sizes, trip lengths, and the maximum number of people and trips at one time, which would help reduce crowding and incidences of unintentional resource impacts. Because few cave and paleontological resources along the river corridor are readily accessible (or recognizable) to river users, the majority of resources would not be affected. Summer use would have adverse, localized, long-term, minor effects compared to existing conditions.

Use levels in the winter season, as measured by user-days and total passengers, would be higher than current levels but among the lowest of all the alternatives (see Table 4- 2). ***User-days and total passenger estimates would increase in the shoulder seasons, however much of this increase is the result of high use in September. Trip lengths would be somewhat decreased in the off-season and*** group sizes would be at the lowest level of all of the alternatives, with shoulder-season commercial trips reduced to 24 passengers and guides. With reduced daylight it is anticipated that accessibility to side canyon resources would be somewhat restricted; therefore, the potential for impacts would be highest at the most easily accessible sites along the river. Compared to current use, these factors indicate that the effect to cave and paleontological resources would be highly localized, adverse, long-term, and negligible to minor.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed on page 407 (e.g., increased monitoring, patrols, education, etc.) and would be needed mitigate impacts from new use in the winter and shoulder seasons. A monitoring and treatment plan to determine and mitigate impacts from visitation would be needed and would be sufficient to reduce localized impacts to a minor intensity. Levels of additional education, patrols, and site stabilization would be determined based on the results of the monitoring program.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, past visitation, park management, and visitation by backcountry visitors and researchers results in localized, measurable changes to cave and paleontological resources. This effect results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of ***Modified*** Alternative H, when combined with other past, present, and reasonably foreseeable actions, would result in localized, adverse, long-term, minor to major effects to cave and paleontological resources. ***Modified*** Alternative H would result in a localized, adverse long-term, minor to moderate contribution to these cumulative effects.

Conclusion. Based on the projected changes in use patterns from current conditions, ***Modified*** Alternative H would directly contribute to the long-term protection and stabilization of individual cave and paleontological resource sites by reducing crowding, particularly in the peak summer season. This would be somewhat offset, however, by an increase in summer user discretionary time and increases in off-season total projected passengers and user-days. Off season user discretionary time, however, would be relatively low as compared to ***the action alternatives***, and small group sizes would help reduce impacts from increased use. Compared to existing conditions, this alternative would have direct, adverse, long-term, negligible to minor effect. Effects from visitation would continue to cause measurable change to localized resources, however, resulting in direct, adverse, long-term to permanent, minor to moderate impacts at individual sites. Because few resources along the river corridor are readily accessible (or recognizable) to river users, effects would not occur to the majority of resources. Therefore, effects would be localized and highly dependent on accessibility. Effects would occur year-round, with the greatest potential for new impacts in the winter and shoulder seasons. Impacts to cave and paleontological resources could be reduced to a minor intensity with reasonable mitigation. ***Modified*** Alternative H would not result in the impairment of the cave and paleontological resources in Grand Canyon National Park. Cumulatively, the effects of ***Modified*** Alternative H, when combined with other past, present, and reasonably foreseeable actions, would result in localized, adverse, long-term, minor to major effects to cave and paleontological resources. ***Modified*** Alternative H would result in a localized, adverse, long-term, minor to moderate contribution to these cumulative effects.

4.2.5.6 IMPACT ANALYSIS—LOWER GORGE ALTERNATIVES

4.2.5.6.1 Methodology

Pontoon trips and HRR day and overnight trips under all Lower Gorge alternatives do not visit cave or paleontological sites, therefore these uses would have no effect on cave and paleontological resources.

4.2.5.6.2 Alternative 1 (Current Conditions)

Analysis. Caves and cave resources are more common in the Lower Gorge than in the upper portion of the Grand Canyon. Past disturbance of cave resources in the Lower Gorge are well documented, in particular the sloth caves such as Rampart and Muav. Rampart Cave was gated in the late 1990s to secure the remaining resources, but trespass into other caves in the Lower Gorge likely occurs.

Impacts to cave and paleontological resources would be essentially the same as those identified under Alternative A for Lees Ferry. They would consist primarily of damage to fragile resources, ranging from the inadvertent trampling and destruction of habitat, cultural resources, cave formations, and mineral and fossil resources to habitat abandonment and the deliberate theft and vandalism of nonrenewable resources. The intensity of the impacts would vary, however, since the Lower Gorge is a different use zone where the types and levels of use vary dramatically from what occurs in the Lees Ferry to Diamond Creek portion of the corridor.

Pontoon trips and HRR day and overnight trips do not visit cave or paleontological sites; therefore, this use has a negligible effect on cave and paleontological resources for all alternatives.

Depending on the surface elevation of Lake Mead, upriver recreational boating can vary. The amount of noncommercial upriver boating would not be regulated under this alternative (although personal watercraft or Jet skis would continue to be prohibited). Statistics on varying use levels are not available. Consequently, effects from noncommercial upriver trips are not included in this analysis.

Currently there are no time restrictions for noncommercial trips launching from Diamond Creek or for continuation trips launching from Lees Ferry. This allows recreationists relatively unlimited access to cave and paleontological resources in the Lower Gorge. Of particular concern is the access to side canyon resources. Currently, noncommercial groups are relatively small, which decreases the likelihood of crowding and its associated effects. Large commercial continuation trips generally do not visit cave and paleontological resources and only spend one night in the Lower Gorge. Thus, impacts to these resources are from noncommercial trips that take several days to explore side canyons. These impacts, as discussed above, would result in measurable changes in the resource and would continue to have direct, adverse, long-term, minor to moderate effects on localized resources. These effects would be highly dependent on accessibility from the river corridor.

Mitigation of Effects. Actions that would serve to mitigate localized effects would include an increase in monitoring of popular cave and paleontological sites, with stabilization and/or data recovery measures in place to mitigate any moderate to severe impacts. However, because current management of the river got unlimited trip lengths and because no management and treatment plan is in place for these resources, it is unlikely that mitigations could be implemented at a level sufficient to reduce impacts to a minor intensity.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, past visitation, park management, and visitation by backcountry visitors and researchers results in measurable changes to localized cave and paleontological resources. This effect results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of Alternative 1, when combined with other past, present, and reasonably foreseeable actions, would result in localized, adverse, long-term, minor to major effects to cave and paleontological resources. Alternative 1 would result in a localized, adverse, long-term, minor to moderate contribution to these cumulative effects.

Conclusion. Impacts to individual cave and paleontological resources under Alternative 1 would be direct, adverse, and minor to moderate, depending on accessibility from the river. Effects would be localized and year-round, with most impacts occurring to resources located in side canyons. For the most part, these impacts would be long-term to permanent. Because current management of the river corridor allows for unlimited trip lengths and because no management and treatment plan is in place for these resources, it is unlikely that mitigation could be implemented at a level sufficient to reduce impacts to a minor intensity. Alternative 1 would not result in the impairment of the cave and paleontological resources in Grand Canyon National Park. Cumulatively, the effects of Alternative 1, when combined with other past, present, and reasonably foreseeable actions, would result in localized, adverse, long-term, minor to major effects to cave and paleontological resources. Alternative 1 would result in a localized, adverse, long-term, minor to moderate contribution to these cumulative effects.

4.2.5.6.3 Alternative 2

Analysis. Under Alternative 2, group sizes, total number of daily passengers, and allowable upriver travel would be at the lowest levels of all of the alternatives (see Table 4- 1). Additionally, pontoon use and all associated operations and facilities, would be eliminated.

The number of noncommercial trips allowed to launch from Diamond Creek would remain unchanged, but trip lengths would be limited to four nights in the peak season and five nights in the non-peak season. Shorter trips would help limit access to sensitive side canyons and their attendant resources. Compared to current conditions, restrictions on trip length would have a direct, beneficial, long-term, negligible to moderate effect on cave and paleontological resources. Effects from visitation would still be measurable, however. Because few cave and paleontological resources along the river corridor are readily accessible (or recognizable) to river users, the majority of resources would not be affected. Therefore, effects would be adverse, long-term, and minor to moderate, but highly localized.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed on page 407 (e.g., increased monitoring, patrols, education, etc.). While use levels are relatively low in this alternative, a monitoring and treatment plan to determine and mitigate localized impacts from visitation, especially in high-use sites, would be needed and would be sufficient to reduce localized impacts to a minor intensity. Levels of additional education, patrols and site stabilization would be determined through the monitoring program. Installing gates on caves is always a last resort but could be considered to prevent or correct major impacts to caves.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, past visitation, park management, and visitation by backcountry visitors and researchers results in measurable changes to localized cave and paleontological resources. This effect results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of Alternative 2, when combined with other past, present, and reasonably foreseeable actions, would result in localized, adverse, long-term, minor to major effects to cave and paleontological resources. Alternative 2 would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

Conclusion. Under Alternative 2 limiting the length of trips launching from Diamond Creek would, compared to current conditions, directly contribute to the long-term protection and stabilization of individual cave and paleontological resources, especially sites in side canyons. This would result in a beneficial, localized, minor to moderate effect that would be highly dependent on site accessibility and vulnerability. However, effects from visitation to nonrenewable cave and paleontological resources would be direct, adverse, local, negligible to moderate, and irreversible. Because few cave and paleontological resources along the river corridor are readily accessible (or recognizable) to river users, the majority of resources would not be affected. Therefore, effects would be localized and highly dependent on accessibility. Impacts to cave and paleontological resources could be reduced to a minor intensity with reasonable mitigation. Alternative 2 would not result in the impairment of the cave and paleontological resources in Grand Canyon National Park. Cumulatively, the effects of Alternative 2, when combined with other past, present, and reasonably foreseeable actions, would result in localized, adverse, long-term, minor to major effects to cave and paleontological resources. Alternative 2 would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

4.2.5.6.4 Alternative 3

Analysis. Under Alternative 3 group sizes and trip lengths would be at substantially lower levels than currently. The total number of pontoon passengers, HRR passengers, and upriver trips would be at or above current levels (seeTable 4- 3). The number of noncommercial trips allowed to launch from Diamond Creek would remain unchanged, but trip length would be limited to five nights in the peak season and eight nights in the non-peak season.

Decreasing allowable trip lengths would limit access to sensitive cave and paleontological resources in side canyons. Compared to current condition, restrictions on trip length would have a direct, beneficial, long-term, and negligible to minor effect on cave and paleontological resources. Effects from visitation would still be measurable, however. Because few cave and paleontological resources along the river corridor are readily accessible (or recognizable) to river users, the majority of resources would not be affected. Therefore, effects would be adverse, long-term, and minor to moderate, but highly localized.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed on page 407 (e.g., increased monitoring, patrols, education, etc.). A monitoring and treatment plan to determine and mitigate localized impacts from visitation, especially at high-use sites, would be needed and would be sufficient to reduce localized impacts to a minor intensity. Levels of additional education, patrols, and site stabilization would be determined through the monitoring program. Installing gates on caves gating is always a last resort but could be considered to prevent or correct major impacts to caves.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, past visitation, park management, and visitation by backcountry visitors and researchers results in measurable changes to localized cave and paleontological resources. This effect results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of Alternative 3, when combined with other past, present, and reasonably foreseeable actions, would result in localized, adverse, long-term, minor to major effects to cave and paleontological resources. Alternative 3 would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

Conclusion. Compared to current conditions, reducing the number of days that trips could spend in the Lower Gorge would directly contribute to the long-term protection and stabilization of individual cave and paleontological resources, especially sites in side canyons. This would result in a beneficial, localized, negligible to minor effect that would be highly dependent on site accessibility and vulnerability. However, effects from visitation to nonrenewable cave and paleontological resources would be direct, adverse, negligible to moderate, and irreversible. These effects would be localized and highly dependent on accessibility. However, because not all cave and paleontological resources along the river corridor are readily accessible (or recognizable) to river users, the majority of resources would not be affected. Impacts to cave and paleontological resources could be reduced to a minor intensity with reasonable mitigation. Alternative 3 would not result in the impairment of cave or paleontological resources in Grand Canyon National Park. Cumulatively, the effects of Alternative 3, when combined with other past, present, and reasonably foreseeable actions, would result in adverse, localized, long-term, minor to major effects to cave and paleontological resources. Alternative 3 would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

4.2.5.6.5 Modified Alternative 4 (NPS Preferred Alternative)

Analysis. ***Modified*** Alternative 4 is characterized by a redistribution of HRR operations and represents a consensus between the NPS and the Hualapai Tribe on levels of HRR use and other uses originating at Diamond Creek. ***This alternative, however, presents the NPS's preference for lower levels of pontoon boat use in the Quartermaster area compared to levels proposed by the Hualapai Tribe. Pontoon use levels in this alternative allow for economic growth within the constraints of resource protection.*** Under ***Modified*** Alternative 4, HRR group sizes and trip lengths would be substantially lower than now, and upriver trips would be below current levels (seeTable 4- 3).

The number of noncommercial trips allowed to launch from Diamond Creek would remain unchanged, but overnight trips would be limited to three nights in the peak season and five nights in the non-peak season.

Decreasing the number of nights that noncommercial trips could spend in the canyon would limit access to sensitive side canyon resources. Compared to current conditions, restrictions on trip length would have a direct, beneficial, long-term, and minor to moderate effect on cave and paleontological resources. Effects from visitation would still be measurable, however. But because few cave and paleontological resources along the river corridor are readily accessible (or recognizable) to river users, the majority of resources would not be affected. Therefore, effects would be averse, long-term, and minor to moderate, but highly localized.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed on page 407 (e.g., increased monitoring, patrols, education, etc.). A monitoring and treatment plan to determine and mitigate localized impacts from visitation, especially in high-use sites, would be needed and would be sufficient to reduce localized impacts to a minor intensity. Levels of additional education, patrols and site stabilization would be determined through the monitoring program. Installing gates on caves is always a last resort but could be considered to prevent or correct major impacts to caves.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, past visitation, park management, and visitation by backcountry visitors and researchers results in measurable changes to localized cave and paleontological resources. This effect results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of ***Modified*** Alternative 4, when combined with other past, present, and reasonably foreseeable actions, would result in localized, adverse, long-term, minor to major effects to cave and paleontological resources. ***Modified*** Alternative 4 would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

Conclusion. Compared to current conditions, limiting the number of nights that trips traveling below Diamond Creek could spend in the canyon would directly contribute to the long-term protection and stabilization of individual cave and paleontological resources, especially sites in side canyons. This would result in beneficial, localized, minor to moderate effects that would be highly dependent on site accessibility and vulnerability. However, effects from visitation of nonrenewable cave and paleontological resources would be direct, adverse, negligible to moderate, and irreversible. However, effects would be localized and highly dependent on accessibility. Because not all cave and paleontological resources along the river corridor are readily accessible (or recognizable) to river users, the majority of resources would not be affected. Effects could continue year-round, with most impacts during summer when longer days offer visitors additional opportunities to access sensitive resources. Impacts to cave and paleontological resources could be reduced to a minor intensity with reasonable mitigation. ***Modified*** Alternative 4 would not result in the impairment of cave and paleontological resources in Grand Canyon National Park. Cumulatively, the effects of ***Modified*** Alternative 4, when combined with other past, present, and reasonably foreseeable actions, would result in adverse, localized, long-term, minor to major effects to cave and paleontological resources. ***Modified*** Alternative 4 would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

4.2.5.6.6 Alternative 5 (Hualapai Tribe Proposed Action)

Analysis. Alternative 5, similar to ***Modified*** Alternative 4, is characterized by a redistribution of HRR operations and represents a consensus between the NPS and the Hualapai Tribe on levels of HRR use and other uses originating at Diamond Creek. This alternative, however, represents the Hualapai Tribe's proposed higher levels of pontoon boat use than occur now. Under this ***Modified*** Alternative HRR group sizes and trip lengths would be substantially lower than under current conditions, and upriver trips would be below current levels (see Table 4- 3). The number of noncommercial trips allowed to launch from Diamond Creek would remain unchanged, but trip length is limited to three nights in the peak season and five nights in the non-peak season.

Decreasing the number of nights that noncommercial trips could spend in the canyon would limit access to sensitive resources in side canyons. Compared to current conditions, restrictions on trip length would have a direct, beneficial, long-term, and minor to moderate effect on cave and paleontological resources. Effects from visitation would still be measurable, however. But because few cave and paleontological resources along the river corridor are readily accessible (or recognizable) to river users, the majority of resources would not be affected. Therefore, effects would be adverse, long-term, and negligible to moderate, but highly localized.

Mitigation of Effects. Actions needed to mitigate effects would include ***a subset*** of those discussed on page 407 (e.g., increased monitoring, patrols, education, etc.). A monitoring and treatment plan to determine and mitigate localized impacts from visitation, especially in high-use sites, would be needed and would be sufficient to reduce localized impacts to a minor intensity. Levels of additional education, patrols, and site stabilization would be determined through the monitoring program. Installing gates on caves is always a last resort but could be considered to prevent or correct major impacts to caves.

Cumulative Effects. Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, past visitation, park management, and visitation by backcountry visitors and researchers results in measurable changes to localized cave and paleontological resources. This effect results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of Alternative 5, when combined with other past, present, and reasonably foreseeable actions, would result in localized, adverse, long-term, minor to major effects to cave and paleontological resources. Alternative 5 would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

Conclusion. Compared to current conditions, limiting the number of nights that trips below Diamond Creek could spend in the canyon would directly contribute to the long-term protection and stabilization of individual cave and paleontological resources, especially sites in side canyons. This would result in beneficial, localized, minor to moderate effects that would be highly dependent on site accessibility and vulnerability. However, effects from visitation to nonrenewable cave and paleontological resources would be direct, adverse, negligible to moderate, and irreversible. Because not all cave and paleontological resources along the river corridor are readily accessible (or recognizable) to river users, effects would not occur to the majority of resources, effects would be localized and highly dependent on accessibility. Effects could occur year-round, with most impacts during summer when more daylight offers visitors additional opportunities to explore sensitive resources. Impacts to cave and paleontological resources could be reduced to a minor intensity with reasonable mitigation. Alternative 5 would not result in the impairment of cave and paleontological resources in Grand Canyon National Park. Cumulatively, the effects of Alternative 5, when combined with other past, present, and reasonably foreseeable actions, would result in adverse, localized, long-term, minor to major effects to cave and paleontological resources. Alternative 5 would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

4.2.6 VEGETATION

4.2.6.1 ISSUES

Vegetation was identified as an impact topic during both internal and public scoping sessions. The comments about vegetation ***that*** were received ***included***:

- Protect ecological resources as the first priority
- Use an adaptive management approach and improve resource monitoring
- Consider closing areas experiencing excessive impacts
- Mark and maintain trails because social trailing is a problem and should be reduced
- Protect threatened and endangered species
- Protect vegetation, including the old high-water zone and side canyons
- Partially address the loss of camping beaches through the removal of invasive vegetation

- Manage invasive exotic species
- Restore natural conditions
- Protect near-river springs and seeps, and tributaries, because they are valuable resources

The vegetation resources throughout much of Grand Canyon National Park's remote backcountry are minimally impacted, with natural processes intact and functioning ***except for in local areas such as campsites and along trails. Similarly, at localized sites*** throughout the river corridor and ***in*** some side canyons, human impacts have directly and indirectly altered vegetation on individual plant and community levels, often disrupting the interactions between physical and biological processes. Activities related to recreation on the Colorado River that have contributed to vegetation impacts include trampling, damage, and the spread of exotic plant species. The variables within the alternatives that have the greatest potential to impact vegetation are group size, trip length, user discretionary time, launch schedule (including seasonal use levels), user-days, and the total number of yearly passengers.

River recreation impacts to vegetation are evident in three roughly parallel bands of riverside vegetation (the new and old high-water zones, and upland/desert scrub), and at attraction sites, which often ***contain*** riparian vegetation. The trampling of vegetation has three initial effects: abrasion of vegetation (plants are crushed, sheared off, or uprooted), abrasion of soil organic layers, and compaction of soil (Hendee, Stankey, and Lucas 1990). Since soils and vegetation are highly interconnected, an impact to one often leads to an impact to the other. For plants, trampling leads to reduced vigor, cover and reproduction, and changes in species composition (Liddle 1975). Trampling of and damage to vegetation occurs in the new and old high-water zones as well as upland and riparian areas when hikers use campsites and attraction areas and create new trails (social trailing). Much of this damage is a result of river runners moving about campsites, establishing sleeping or kitchen areas, exploring beyond campsite margins, finding comfortable (usually shady) areas to eat or rest during lunch breaks, hiking, and enjoying the attraction sites. In the early 1970's researchers noted that the lack of marked and well-maintained trails caused hikers to create new trails, damaging vegetation and increasing topsoil erosion (Tomko and Karpiscak 1974). In a 1980 report, researchers stated humans directly influence the stability of the old high-water zone and upland areas through the destruction of plants, with impacts evident at attraction sites in addition to camping areas (Turner and Karpiscak 1980). In 1974, recommendations were made to establish a single trail and to obliterate superfluous trails.

The compaction and disturbance of soils by humans can lead to erosion and loss of organic matter, indirectly affecting native vegetation and soil microbiota and thereby diminishing plant growth potential and the health and survival of vegetation resources (Hendee, Stankey, and Lucas 1990; Cole 1986). Impacts to vegetation in turn relate to the ability of plant roots and microbiota to help create ***nutrient rich*** soils in this arid environment. Researchers have described the relationship between the amount of use and the amount of impact, with low levels of use often causing large impacts and vegetation loss (Cole and Monz 2003). The ability of a particular area to sustain human impacts often depends on the condition and sustainability of the biological environment, and within the geographic extent of this analysis, the old high-water zone and upland areas are most susceptible to damage. In general, social trail impacts include the direct and indirect ***impacts*** described above, and most often lead to the complete loss of the vegetation that existed prior to trail creation.

Higher numbers of total visitors present more opportunities for damage to vegetation and noncompliance with the park's current boating regulations. Larger groups are also more likely to disturb larger areas (Hendee, Stankey, and Lucas 1990). In Grand Canyon, vegetation loss has been found to be equally severe in high- and low-use core areas, leading to rapid mineral soil exposure; vegetation loss is less pronounced on the perimeters of campsites (Cole 1986). Researchers have observed that parties that stay longer at sites are more likely to develop the site (Washburne and Cole 1983). Along the river corridor, site modification generally occurs in the new high-water zone, with rocks moved and vegetation altered in an intentional effort to enlarge or modify camp space or to create trails. Plants in the new high-water zone, ***a zone that can*** accommodate high***er levels of use***, are often able to recover quickly from these impacts and other disturbances (Kearsley et al. 2003; Jackson Kennedy, and Phillips 2001). Damage to plants in the old high-water zone and upland areas have a greater effect because these plants require ***a*** longer recovery time than those in the new zone. When large groups use medium or small sized camping beaches, people searching for privacy denude native vegetation in the old high-water zone to establish new tent sites, thereby expanding the campsite. Research in 1986 found that core campsite areas were devoid of vegetation (0% cover) compared to 60% cover in undisturbed areas (Cole 1986). Although camping is prohibited in most of the old high-water zone, campsite expansion into this area and the associated loss of vegetation has been exacerbated by the ongoing reduction in the size of camping beaches due to ***soil*** erosion and plant encroachment.

Recreationists on longer trips that layover at sites have more time to explore the old high-water zone and upland areas and to hike to nearby attractions, increasing both the area of possible impact and the probability of impacts. Many attraction sites are near water and contain riparian vegetation, which is sensitive to human impacts but is also extremely variable and influenced by many environmental variables (Grand Canyon Wildlands Council 2003). One researcher stated that one of the most urgent threats to the biota of springs is current and future recreational activity (Spence 2004). Human impacts at springs include trampling and swimming, which damages vegetation, ***increases*** erosion, and allows exotic species to invade.

The spread of nonnative or exotic plant species directly affects native vegetation, causing changes in the composition of vegetative communities. The spread of exotics can be intentional (e.g. planting) or unintentional (e.g. humans unknowingly transporting seeds or propagules on their shoes, clothing, or equipment). The removal or damage of plants and soils in the new and old high-water zones and in upland areas provides an opportunity for exotic and invasive plant species, often with competitive advantages, to move in and occupy the sites. Uprooting invasive plants, such as the offensive camelthorn, can actually stimulate bud growth on the rhizome, spread seeds, and encourage the spread of exotics in some areas. When control actions are taken without direction of park management, the results can lead to an increase in exotic plant distribution. In addition, continual trampling can favor the most resilient species, which in Grand Canyon are often the invasive exotic plants.

Vegetation resources at Grand Canyon are typically more sensitive during the spring and early summer months, because they are reproducing or germinating and flowering (Hammitt and Cole 1987). Ephemeral annuals often complete their life cycle in a relatively short period. Desert adaptations like thorns and thick, succulent leaves appear to promote resistance to trampling (Cole 1986). However, once recreationists trample or damage vegetation in the old high-water zone and upland areas, resilience becomes very low.

Throughout much of the Colorado River corridor, boaters tie their rafts around vegetation. Tamarisk is the species most often tied to, due to its abundance and distribution. However, on some beaches with few to no tamarisk, boaters may tie to native vegetation such as seep willow, desert broom, and coyote willow rather than using a sand stake. Successive use can damage the vegetation. While this is typically an impact to individual plants, cumulatively over time and also combined with other vegetation impacts, this can be an issue. A good example of this potential is the damage that the large Gooding willow tree at Granite Park (RM 209 R) has suffered over the years (see Photo 4-5). For years, the tree was the primary object to which boaters tied, causing damage from girdling. The tree also provides good shade, leading recreationists to gather beneath it. Human use, combined with shoreline erosion, has caused root injury, leading to severe declines in the tree's health. At 200 years old, the tree is not only historic, but also an important cultural and ethnobotanical resource to the Hualapai Tribe (HDCR 2002).

PHOTO 4- 5: GOODING WILLOW AT GRANITE PARK USED TO TIE UP BOATS

Colorado River "Commercial Operating Requirements" permit the collection of driftwood between October 1 and April 30 and prohibit the collection of wood from standing or fallen trees, dead or alive, native or exotic (NPS 2003e). Driftwood occurs primarily along beaches, but it can also be found in side canyons. Currently, only a small percentage of river use takes place during these colder months, but even with limited use, supplies of driftwood can be substantially reduced (Brown 2003). The loss of large quantities of driftwood could be detrimental to wildlife and macroinvertebrates that utilize it for habitat, but it would not directly affect the vegetation communities along the river (Haden et al. 1999; Maser and Sedell 1994). However, as limited driftwood supplies diminish, the use of standing or fallen trees near campsites may increase (Brown 2003). Decaying wood plays an important role in ecosystems, and the collection of standing or fallen dead material can lead to declines in site productivity, particularly on drought stricken and infertile soils, and it can also impact invertebrates, small mammals, and birds that utilize it for food and shelter (Hendee, Stankey, and Lucas 1990).

Lack of data, challenges with restoration in desert environments, and limitations in staff and funding contribute to the inability of park staff to mitigate current levels of impacts. Current mitigation measures are re-initiated annually; yet for many areas, the levels of impacts remain unacceptable for resource protection and preservation.

4.2.6.2 GUIDING REGULATIONS AND POLICIES

Overarching laws, including the NPS Organic Act of 1916, the National Environmental Policy Act of 1969 and the National Parks Omnibus Management Act of 1998, are described in the ***Section 4.1***. ***Laws relating to Arizona Department of Agriculture salvage restricted plant species and GRCA Species of Concern*** are addressed separately ***under the "Special Status Species" section***.

The Organic Act directs parks to conserve scenery and natural objects unimpaired for future generations. The NPS interprets this to mean that native vegetation, ecosystems, and watersheds should be protected and perpetuated as part of Grand Canyon National Park's legacy for current and future generations.

The NPS *Management Policies 2001* (NPS 2000a) direct park managers to understand, maintain, restore, and protect the inherent integrity of natural resources, processes, systems, and values of the park. To the extent possible, the NPS shall allow natural processes, including the evolution of species, to control landscape and population level dynamics, assuming that all components of the natural systems remain intact. The preservation of fundamental physical and biological processes, as well as individual species, plant communities, and other components of naturally evolving ecosystems, is inherent in management direction. The *Management Policies* state that the Park Service will maintain as parts of the natural ecosystems of parks all native plants and animals by:

- Preserving and restoring the natural abundance, diversities, dynamics, distributions, genetic and ecological integrity, and behaviors of native plant populations and the communities and ecosystems in which they occur
- Restoring native plant populations in parks when they have been extirpated by past human-caused actions
- Initiating the return of human-disturbed areas to natural conditions (or the natural trajectory), including the processes characteristic of the ecology zone
- Minimizing human impacts on native plants, communities, and ecosystems, and the processes that sustain them
- Preventing the introduction of exotic species and removing established populations
- Monitoring natural systems and human influences upon them to detect change and developing appropriate management actions
- Protecting watersheds as complete hydrologic systems, primarily by avoiding impacts to watershed and riparian vegetation, and by allowing natural fluvial processes to proceed unimpeded
- Preserving, enhancing, and restoring the natural and beneficial values of wetlands

Executive Order 13112, “Invasive Species,” states that any federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law, subject to budgetary limitations:

- Prevent the introduction of invasive species
- Detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner
- Monitor invasive species populations accurately and reliably
- Provide for restoration of native species and habitat conditions in ecosystems that have been invaded
- Conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species
- Promote public education on invasive species and the means to address them

Section IV of Grand Canyon’s “Commercial Operating Requirements” outline specific actions regarding multiple trailing, campsite impacts, and campfires (NPS 2003e). River guides must stress to passengers the need to stay on established trails to minimize multiple trailing and associated impacts to vegetation and soils. Group hikes must be led by guides who are knowledgeable about the trails and areas in order to ensure compliance. To minimize damage in the old high-water zone and pre-dam riparian plant communities, guides must conduct camp activities in post-dam sandbar areas (i.e., in the shoreline and new high-water zone) and should ensure that no one creates new routes or sleeping areas in the fragile desert environments (i.e. old high-water zone and upland areas). As previously stated, the operating requirements allow for the collection of driftwood from October 1 to April 30, but prohibit the gathering of wood from standing or fall trees, dead or alive, native or exotic.

4.2.6.3 Management Objectives for Vegetation

As stated in Chapter 1, the management objective for vegetation as it relates to management of recreational river use in the Grand Canyon, is to manage river recreational activities to minimize human-caused impacts to native vegetation, reduce the spread of exotic plant species, and preserve fundamental biological and physical processes.

4.2.6.4 Methodology for Analyzing Effects to Vegetation Resources

The general process for assessing impacts is discussed in Section 4.1. To analyze the effect of each alternative on vegetation resources, staff compiled all available information on the vegetation in the river corridor and side canyons (NPS, GCMRC, Hualapai Tribe resource files and personal communication with resource specialists) and used the best available data for species locations, past documentation and studies of impacts, and the most recent research for species in the park. A map with locations of known cultural and natural resources and visitor stopping points (camp, lunch stops, and attraction sites), including data on use intensity, resulted in the identification of areas of resource concern, in which concentrations of sensitive resources overlapped with visitor use areas. The impact analysis was based on the interaction of context, duration, timing, and intensity of visitor impacts, which were defined using resource-specific impact thresholds.

4.2.6.4.1 Impact Thresholds

The general process for assessing impacts to the environment is discussed in Section 4.1 of Chapter 4. Effects specific to vegetation are characterized for each alternative based on the impact thresholds presented below. Additionally, each alternative was evaluated to determine whether effects would be direct or indirect. For intensity, the impacts to vegetation could be negligible, minor, moderate, or major, and they could be beneficial or adverse. Context, duration, and timing are resource based and are generally similar for each alternative. Impact intensity is more likely to vary by alternative. Impacts were measured against pre-established thresholds to determine the impact intensity.

Intensity

Negligible—Impacts to individual plants or plant communities would have no measurable or perceptible effect on size, viability, integrity, interrelationships, or function of the plant community. There would be no increase in or introduction of exotic plant species. No mitigation would be necessary.

Minor—Impacts to individual plants or plant communities would be measurable or perceptible but would not affect the size, viability, integrity, interrelationships, or function of the plant community. There could be slight and barely perceptible changes in number, density, or cover of exotic plants. Any mitigation necessary to offset adverse impacts would be minimal and effective.

Moderate—Impacts to plant communities would be measurable and perceptible and would affect the overall size, viability, integrity, interrelationships, or function of the plant community. There would be apparent and measurable changes in number, density, or cover of exotic plants. Mitigation to offset adverse impacts would be extensive, but most likely successful. The impacted area would require more than one year for recovery.

Major—Impacts to plant communities would be substantial, highly noticeable, and have the potential of becoming permanent. They would affect the overall size, viability, integrity, interrelationships and/or function of the plant community. Exotic plants would outnumber native plants. Mitigation to offset adverse impacts would be extensive, and success would not be guaranteed.

Context

Localized—Impacts would be considered localized if they occurred only in areas where people congregate (campsites, attraction sites) and affected individual plants or small patches within plant communities.

Regional—Impacts could be considered regional if they were spread along the entire reach of a resource management zone and into the adjacent vegetation zones (new and old high-water zones, and uplands). Regional impacts would affect the entire range of the population or species within Grand Canyon National Park, the mainstem of the Colorado River, or all side canyons along the river.

Duration

Short-term—Impacts to an individual plant or community would last less than one year.

Long-term—Impacts to an individual plant or community would last more than one year or result in permanent change.

Timing

Impacts to vegetation could occur year-round, but the plants are most sensitive ***in the*** spring when there is the most germination and emergence. ***Impacts to old high- water zone vegetation are more likely to occur during high flows (experimental flows above 20,000cfs) when a portion of the new high water zone is submerged.***

The ***area of analysis*** includes the Colorado River corridor from Lees Ferry through Grand Canyon National Park and adjacent tribal lands to Lake Mead. The analysis area includes areas commonly visited by river runners hiking off the river. Except for the cumulative impact analysis or as specifically stated in the text, the analysis area does not include areas upstream from Lees Ferry (including Glen Canyon Dam), Lees Ferry itself (which is part of Glen Canyon National Recreation Area), or areas in Lake Mead National Recreation Area (including Pearce Ferry and South Cove).

4.2.6.4.2 Mitigation of Effects

Common to all alternatives is the development of a monitoring and ***mitigation*** plan as part of an adaptive management program to monitor and evaluate resources and identify mitigation actions. Within the plan, indicators of the limits of acceptable change (as defined in the 1989 *Colorado River Management Plan)* will be ***expounded upon*** in accordance with the revised river management plan evaluated in this environmental impact statement. ***A list of possible*** mitigation measures ***to be considered singly or in combination, that are*** not already incorporated into the alternatives, ***but*** are judged likely to reduce impacts to vegetation ***if implemented*** include the following:

- Provide a map of small, medium, and large campsites to river runners and ***encourage*** parties of 12 or less to use small campsites, 13–24 to use medium campsites, and 24 or more to use large campsites
- Implement a site-specific multi-resource monitoring program (i.e., one that takes into account soils, water quality, vegetation, wildlife, and archeological resources) to identify at-risk areas and to prioritize mitigation efforts; compare indicator species abundance, richness, and diversity in and near camping and attraction sites with areas seldom visited by recreationists
- Identify protocols for hardening, resting, or rehabilitating campsites or attraction sites and link them to the systematic monitoring program
- Delineate and stabilize campsites and trails, harden selected sites, and clear native and nonnative vegetation to ***maintain*** campsites in the new high-water zone

- Maintain or construct trails in desirable areas (i.e., where they mitigate impacts or protect sensitive areas), move or obliterate trails in undesirable areas (e.g., social trailing, or trails over cultural/sensitive sites), and initiate closures when necessary
- Build and/or maintain erosion control structures as needed to protect sensitive resources and stabilize soils. Recontour ground surfaces to promote drainage to appropriate areas
- Actively revegetate impacted areas, restore biological and physical components, and accelerate the recovery of the biological community's structure and function
- Conduct additional research into restoration methods and techniques for desert environments
- Remove invasive exotic plant species and monitor removal efforts. ***Actively manage native and nonnative vegetation to impede encroachment into historically used campsites and help preserve campsite capacities***
- ***Consider a ban on the collection of driftwood for winter campfire use if driftwood supplies diminish significantly due to increased winter use***

4.2.6.4.3 Cumulative Impacts

Cumulative impacts on vegetation were determined by combining the impacts of each alternative with other past, present, and reasonably foreseeable future action, as described in Section 4.1 of Chapter 4. The most significant action that has affected, and will continue to affect, vegetation resources in the river corridor is the operation of Glen Canyon Dam. Flow ***levels*** in the mainstem of the Colorado River directly affect the health, vigor, and composition of plant communities along the river corridor, and indirectly in side canyons. The increased distribution of invasive exotic plant species in the river corridor provides an ample seed source for their continued spread throughout the corridor, and it also paves the way for colonization of side canyons. Similarly, the presence of exotic plant species upstream from Lees Ferry, including on private and non-NPS administered lands, provides a seed source for the spread of exotic plant species in the park. The Glen Canyon Dam and the spread of exotic plant species have localized to regional, adverse, long-term, year-round, moderate to major effects on vegetation.

Researchers documented vegetation impacts from feral burros as early as 1974, noting vegetation destruction and decreases in species diversity. These impacts, along with impacts to soils, remain visible on the landscape today with very little vegetation recovery (Leslie 2004a). Past feral burro impacts on vegetation are localized, adverse, long-term, year-round, and moderate to major.

In addition to feral burros, backcountry hikers and anglers, have created trails and added to the loss of vegetation in upland and old high-water zone areas. ***Administrative use such as tamarisk eradication projects and archaeological site monitoring programs can also contribute to vegetation impacts.*** The intentional or unintentional spread of exotic plant species by humans coming into the area of effect contributes to the current levels of impacts along ***the Colorado River corridor.*** This can have localized, adverse, short- to long-term, year-round, minor to major effects on vegetation.

Natural events, such as floods in side canyons and rockfalls, denude vegetation, which can add to the loss of diverse and intact native vegetation and contribute to the spread of invasive, exotic plant species. Cumulatively, impacts to vegetation would be adverse, localized to regional, short- to long-term, and minor to major.

Natural events, such as floods in side canyons and rockfalls, denude vegetation, which can add to the loss of diverse and intact native vegetation and contribute to the spread of invasive, exotic plant species. Cumulatively, impacts to vegetation would be adverse, localized to regional, short- to long-term, and minor to major.

4.2.6.4.4 Assumptions

General assumptions used to analyze the impacts of each alternative are discussed in Section 4.1 of Chapter 4. Assumptions that specifically relate to the alternatives in this document and their effect on vegetation are presented below:

- The geographic area evaluated for vegetation impacts includes the river corridor from Lees Ferry to Lake Mead, the three vegetation zones (new and old high-water zones and the upland zone) at campsites, and areas accessible to river users for a distance of 2 miles from the river corridor, including off-river attraction sites, side canyons, and uplands.
- ***Noncommercial and commercial groups are considered to behave similarly at campsites; however impacts to vegetation from small groups as compared to large groups are different. Large groups tend to spread out more and affect old high water zone native vegetation, especially on smaller beaches.***
- The mode of travel (i.e., motor vs. oar) has no direct impact on vegetation; however, on a daily basis motor trips spend less time on the river and have more time at campsites, which will be evaluated through user discretionary time.
- Longer trips have, by their nature, increased amounts of time (i.e., user discretionary time) for visitors to interact with the canyon environment. This increased time has the potential to allow greater access to sensitive vegetation resources. This is particularly true for side canyons, as longer trips are designed to allow visitors opportunities to hike the many side canyons of the Colorado River. Off-season hiking (in the shoulder and winter months) is more conducive to exploring side canyons, as the extreme heat of the summer precludes hiking too far from the Colorado River.
- Not all visitor impacts to vegetation resources in and accessible to the river corridor are from river runners; other backcountry users contribute to impacts in areas that offer reasonable access. While the effect from river runners to sites in these areas would be additive, it would be indistinguishable from damage caused by visitors using other means of access.
- Mitigation measures to achieve ecological restoration in some areas, particularly the old high-water zone and uplands, might not be attainable, and the goal of the mitigation measures may be to simply disguise the impacts or to revegetate areas, possibly not achieving the true restoration of the biological and physical properties present prior to impact.

- Wetlands and dense thickets or riparian vegetation in the Colorado River corridor are rarely visited or disturbed by river runners. Recreation impacts on these types of vegetation would be negligible because they would have no measurable effect on the plant community and would not contribute to the expansion of exotic species. Wetlands in the corridor would more likely be impacted by fluctuating river levels than river runners because their dense vegetation and muddy soils make the areas unattractive to visitors. Wetlands and riparian areas in side canyons, however, show signs of impacts from recreationists.
- Water quality contamination is most common in side canyons and along the river where personal care products and human waste are disposed of in the water. While changes in the water quality of the tributaries could adversely affect vegetation along the streams, there is no quantitative data to support this conclusion, and the overall impact to vegetation is thought to be inconsequential.
- ***Regional impacts to vegetation are negligible in all Lees Ferry alternatives.***

4.2.6.5 IMPACT ANALYSIS—LEES FERRY ALTERNATIVES

The potential for impacts for the eight Lees Ferry alternatives are based on a comparison to Alternative A, which describes the impacts of existing conditions.

4.2.6.5.1 Alternative A (Existing Condition)

Analysis. Under Alternative A large group sizes (43 for commercial motor, 39 commercial oar), lengthy trips, and spikes in the number of trips and people at one time, and daily launches would continue (***see Table 4-*** 1). User-days would remain capped at current levels, which would probably result in approximately the same number of total yearly passengers. ***User discretionary time would be the lowest annually of all of the alternatives, with the greatest number of hours in the summer season. Winter use would remain very low and shoulder season user-days and user discretionary time would be the lowest of all the alternatives.***

The 1989 *Colorado River Management Plan* defined limits of acceptable change as standards that indicate the change in resource conditions that would instigate action. The limits of acceptable change for vegetation analysis are:

- *New high-water zone*—There should be no long-term modification of plant community development as a result of recreational use in areas outside campsites and trails; no more than one primary trail from a mooring location to a destination site; no more than 10% encroachment of the camping area into vegetation as a result of visitor related uses.
- *Old high-water zone*—There should be no disturbance exceeding 225 square feet at any site; no loss of trees due to human activity; no destruction of dead, standing vegetation; no less than a 20% decline in mature age classes between high activity areas and control sites; and no campsites.
- *Upland/Desert Scrub*—There should be no disturbance exceeding 225 square feet at any site; no long-term modification of natural succession; no more than one trail to an attraction site; and no campsites.

Grand Canyon National Park's "Commercial Operating Requirements" (NPS 2003e) set forth the following guidelines to protect vegetation resources:

- River guides should stress the need to stay on established trails.
- Removal of wood from standing or fallen trees, dead or alive, is prohibited.
- Passengers should be instructed not to blaze new hiking routes or sleeping areas in fragile desert zones (old high-water zone and upland areas).
- Camp activities should be conducted in the more resistant post-dam sandbar areas (new high-water zone).
- Special use requirements for the Nankoweap area were designed to minimize multiple trailing, crowding, and campsite competition.

Despite the above regulations, current enforcement levels, visitor education, and mitigation measures, impacts to vegetation under current conditions exceed the limits of acceptable change and have led to damaged vegetation. This damage can also impact soils, wildlife, and cultural resources since these resources are interconnected.

The Colorado River Human Impact Monitoring Program provides managers with baseline data with which to make informed management decisions (Brown and Jalbert 2003). The data provide a view of resource conditions under current use levels and can be used to describe current levels of vegetation impacts. The monitoring program, based on the limits of acceptable change, uses quantifiable biophysical indicators to document resource conditions and changes at sites along the Colorado River through the Grand Canyon.

Although there are 47 total sites in the monitoring program, site inventory occurs on an annual rotating basis. Data on 25 sites collected in July and October 2003 provide the most current data set. Under current conditions 96% of the 25 campsites monitored had more than 10 social trails per campsite (***see Table 4-*** 4 ***on page 259***); one campsite had 88 social trails. The 1989 *Colorado River Management Plan* set a limit of one trail from mooring, through the campsite, and into the old high-water zone.

The study also demonstrated a relationship between beach size and vegetation impacts; as beach size decreases, impacts to soils and vegetation in the old high-water zone increase. The campsite in the study with the fewest social trails (RM 118 camp) had a beach area that could accommodate large trip sizes, but even that site had nine social trails under current use levels. At this time, the monitoring program does not provide quantitative data on the amount of ground area that has been disturbed solely by the social trails; however, the creation of social trails causes direct trampling of vegetation, most often resulting in complete loss of plant life, and indirect impacts to vegetation from soil compaction and disturbance.

Under current conditions, the Grand Canyon National Park Science Center has data on mitigation efforts in the river corridor that conservatively show that social trails need to be obliterated at 60% of the 148 sites that have been part of the mitigation program over the past two decades. The impacts are severe enough to require native plant revegetation at 46% of the sites, and just blocking access to the trail is insufficient to begin the process of natural recovery.

Despite NPS efforts to obliterate and revegetate unnecessary trails over the past two decades, efforts have been minimally successful. Current mitigation measures for soils and vegetation combined have not accomplished the ultimate goal of restoration; rather they have served as short-term efforts to prevent further damage to resources pending the start of long-term natural recovery. The limited success of the treatments is partially due to lack of funding and resources, but also indicates that current use levels exceed the ability of NPS staff to mitigate the impacts.

Recreation-caused impacts to vegetation in both the new and old high-water zones ***have*** been documented (Brown and Jalbert 2003). While the upland, wetland, and seep/spring areas are not specifically included in the current program, these areas (particularly those near attraction sites) display damage under current use levels. Of 25 campsites studied in 2003, only 8% did not have trails entering the old high-water zone, and 75% had more than one trail into the old high-water zone. Under current conditions, 38% of the overall sites surveyed in the program (47 total sites) had more than 225 square feet of disturbance, exceeding the limit of acceptable change standard set in the 1989 *Colorado River Management Plan*.

During evaluations of Hualapai traditional cultural properties, heavy to severe human impacts were found (HDCR 2002; Jackson et al. 2001). One example is Granite Park, where evaluators noted that trails into the old high-water zone that had been obliterated by park staff were still being heavily used, with the brush and revegetation being bypassed and ignored. Researchers noted that there was still heavy on-site camping in the old high-water zone in some areas, leading to further clearing of and damage to vegetation (Jackson et al. 2002). Of the 18 traditional cultural properties between Lees Ferry and Diamond Creek, only two did not have any human impacts.

Based on the 25 sites surveyed in 2003, 63% had campsites in the old high-water zone, with a maximum of 16 campsites (Brown and Jalbert, 2003). There is a correlation between the number of vegetation islands and the number of campsites and social trails. Researchers documented as many as 53 vegetation islands at one site, with 96% of the 25 sites having vegetation islands (Brown and Jalbert 2003). While the vegetation in the islands may be intact, the surrounding perimeters of the islands are devoid of vegetation, contributing to the overall loss of vegetation at campsites in the river corridor. Current Colorado River boating regulations prohibit camping activities in the old high-water zone (NPS 2003e), yet impacts in the old high-water zone from camping activities are widespread under current use levels.

Some of the indicators measured by Brown and Jalbert (2003) define site quality, but present marginal value regarding the ecological integrity of the site. For example, the monitoring program records damage to tamarisk (occurring at 100% of the sites with tamarisk presence), which may create an aesthetic impact, but would not adversely affect the health and vigor of native vegetation. Of the 25 sites surveyed in 2003, all had damage to native woody vegetation in the new high-water zone, and 65% of the sites had more than 50 individual fractures. In the old high-water zone, 52% had damage to native woody vegetation (mesquite and acacia), with a maximum of 147 fractures. Under current management, these impacts are primarily restricted to campsites and along trails, contributing to vegetation damage, but overall they present more of a quality or aesthetic impact rather than a larger scale ecological impact. Nevertheless, woody vegetation in the old high-water zone is a non-renewing resource in the short-term, and possibly the long-term, and damage to trees could lead to declines in long-term health and vigor. In addition to woody vegetation damage, 35% of the sites with cactus displayed human-caused damage from campsite expansion and social trailing.

Exotic vegetation is present at 52% of the 25 sites surveyed in 2003 (Brown and Jalbert 2003). This percentage is likely very low because observers only looked for camelthorn, Bermuda grass, and Russian thistle, the species that are easiest to identify. There are currently 120 known exotic plant species in the inner canyon, and with more extensive documentation, the number of sites with exotic plants present would very likely increase. Some of these species (e.g., red brome and Bermuda grass) have been present in the Colorado River corridor and at campsites for decades, with human impacts in addition to dam-related impacts aiding in their spread (Tomko and Karpiscak 1974). Under current conditions people unintentionally distribute seeds from one location to another, exacerbating the spread of these species. Recreationists also manually remove certain species (e.g., camelthorn), typically to improve campsite quality, but often they exacerbate the problem since pulling this species stimulates the growth buds and spreads seeds. In addition, the removal of both native and exotic plants, whether intentional or not, provides an opportunity for exotic and invasive plant species to move into the vacated seedbed without competition.

Driftwood supplies are currently limited in certain portions of the river corridor. At some campsites, despite current regulations prohibiting these actions, woody material from standing vegetation, both native and exotic, is collected for firewood. In 2003, 59% of the campsites with firewood piles had locally collected vegetation in them, despite the current prohibition on collecting any non-driftwood material (Brown and Jalbert 2003).

Mitigation of Effects. Actions required to mitigate effects would include ***a subset*** of the mitigation measures defined on page ***435***. To attempt to reduce impacts to minor levels, the following measures would be required:

- an increase in the number of NPS staff to educate users about vegetation impacts
- an increase in NPS patrols at campsites to ensure that river runners do not camp in the old high-water zone or otherwise damage vegetation
- an increase in full-time science center and trail maintenance staff to revegetate barren areas, block undesirable social trails, and initiate restoration actions.

These measures would be reasonable and attainable in the new high-water zone, but they would require additional funding and staff. It is unlikely that mitigation would be implemented at a level sufficient to reduce impacts in the old high-water zone to a minor level due to the spikes in use, high user discretionary time levels, long trip lengths, and large group sizes.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Effects to Vegetation Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative A on vegetation, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative A would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

Conclusion. Under Alternative A adverse impacts to vegetation in the new high-water zone would be perceptible and measurable at the majority of campsites and attractions. Impacts would occur year-round, with the most extensive impacts during the summer due to the high-use levels. Current levels of mitigation have been shown to be insufficient to reduce the impacts. Overall, impacts would be considered adverse, localized, short-term, seasonal to year-round, and minor to moderate in intensity.

In the old high-water zone, including uplands and side canyons, vegetation impacts are often long-term. Direct and indirect impacts occur year-round, but are specific to campsites, attractions, and trails leading into side canyons. Although year-round impacts are perceptible, the majority of user discretionary time under present levels of use is spent in the late spring and summer, when plants are most susceptible to damage. Long trips under this alternative would increase the level of accessibility to attraction sites and side canyons. Vegetation trampling, injury, and loss, combined with the spread of exotic plant species and indirect impacts, have changed the character and health of vegetation. Damage to woody vegetation, the number of social trails, and the number of campsites all exceed levels prescribed in the 1989 *Colorado River Management Plan.* Given the steady reduction in the number and size of beaches, the large group sizes in this alternative would pose the greatest threat to vegetation resources in the old high-water zone, where visitors camp when beach areas are limited. Current levels of mitigation are insufficient to repair these impacts, and even with additional mitigation, the damage is considered long-term and may be irreversible in some areas. Therefore, vegetation impacts in the old high-water zone would be considered adverse, localized, long-term, year-round, and moderate to major in intensity.

Under Alternative A, the addition of mitigation measures would create beneficial, localized, short-term effects; however, under current levels of funding and staffing, adverse impacts would not be reduced to negligible levels in the new high-water zone, or negligible to minor in the old high-water zone, or upland areas.

In summary, the overall impacts to vegetation without additional mitigations under Alternative A would be adverse, localized, seasonal to year-round, short- to long-term, and minor to major in intensity. Alternative A would not result in the impairment of vegetation resources in Grand Canyon National Park. Cumulative effects of Alternative A on vegetation, when combined with other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative A would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.2.6.5.2 Alternative B

Analysis. Under Alternative B recreational motor trips would be prohibited and group sizes, trips and people at one time, daily launches, and estimated total yearly passengers would be at their lowest levels (***see Table 4-*** 1***).*** Trip lengths would be reduced, and maximum commercial group sizes would be reduced from 43 to 25 people. An eight-person noncommercial trip would be added. Total user discretionary time would increase ***over current*** in all seasons due to the lack of shorter motor trips. Total user-days would be about the same as current; however, the total number of passengers per year would decrease by about 10,000.

Under this alternative launches per day would be capped at four during the summer, two during the shoulder seasons, and one in the winter. This would reduce crowding at attraction sites and the likelihood of new social trails being developed. Total user-days and yearly passengers would be at their lowest under this alternative, resulting in the lowest level of potential impacts to vegetation from visitor use impacts and the spread of invasive exotic species. In addition, smaller groups would likely benefit the preservation, protection, and restoration of vegetation resources in all three vegetation zones. Small private trips with a group size of eight could use small beaches, and the reduction from maximum group size from 43 to 25 would decrease the likelihood of impacts from social trailing and campsite expansion in the old high-water zone and upland areas. Together these actions have localized, beneficial, short- to long-term, seasonal to year-round, minor to moderate effects on vegetation from current conditions.

Management actions aimed at keeping use levels on individual campsites low would likely be beneficial to the resources (Cole 1986). However, under Alternative B use levels would be higher in the spring, when vegetation resources are most susceptible to impacts. Shorter trips would require that trips move through the canyon faster, with less time for layover days and hikes in side canyons and to attraction sites, ***bu***t overall user discretionary time would increase due to the absence of short motor trips, resulting in an increase in the opportunity for recreationists to damage vegetation resources as discussed in Alternative A. However, when balanced with the reductions in the maximum number of trips and people at one time, total yearly passengers, launches, and user-days, vegetation impacts would likely be reduced, and Alternative B would have localized, beneficial, short- to long-term, seasonal to year-round, minor to moderate effects on vegetation from current conditions.

Mitigation of Effects. Mitigation measures would be the same as Alternative A. These measures would require additional funding and staff, but it is unlikely they would be implemented at a level sufficient to reduce impacts to a sustainable negligible ***to minor*** intensity. Impacts to individual plants or plant communities would still have a measurable effect on the size, viability, integrity, interrelationships, or function of the plant community.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in “Methodology for Analyzing Effects to Vegetation Resources: Cumulative Impacts.” The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative B on vegetation, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative B would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. Under Alternative B a beneficial change from current conditions would be expected in all three vegetation zones—the new high-water zone, the old high-water zone, and upland areas. Vegetative conditions in the river corridor and side canyons could improve, but they would not return to pre-use conditions. Smaller groups, fewer launches, shorter trips, and reduced numbers of trips and people at one time would all be beneficial for the protection of vegetation resources. While use would still be highest in the summer, use in the shoulder and winter seasons would increase; nevertheless, coupled with the other reductions, vegetation conditions would likely improve. Direct and indirect adverse impacts to vegetation would remain. Mitigation would still be required, with increases in staff and funding necessary to implement the measures. Even with these increases, it is unlikely that mitigation measures would be able to reduce the adverse impacts from recreational use to negligible levels in any of the vegetation zones.

In summary, Alternative B ***overall and without mitigations*** would have beneficial, localized, short- to long-term, seasonal to year-round, minor to moderate effects compared to current conditions. However, this alternative would still have adverse, localized, short- to long-term, seasonal to year-round, minor to moderate impacts to vegetation resources. Alternative B would not result in the impairment of vegetation resources in Grand Canyon National Park. Cumulative effects of Alternative B on vegetation, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative B would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.6.5.3 Alternative C

Analysis. Under Alternative C motor boats would be eliminated, but total annual user discretionary time would more than double, the highest level of all alternatives. Winter user discretionary time would increase ***substantially and*** user discretionary time in early spring would increase fourfold. Maximum group size would be reduced to 30 people and maximum trip length to 21 days. User-day levels would double in the shoulder seasons. Daily launches would be reduced to four in the summer, three in the shoulder seasons, but would increase to two in the winter months. There would be approximately 3,000 more passengers per year, but group sizes and the maximum number of trips and people at one time would decrease.

Smaller groups and shorter trips would benefit vegetation in all three zones, similar to Alternative B. This would decrease the potential for trampling, social trailing, and campsite expansion, thereby resulting in less damage to vegetation in all three vegetation zones, including riparian areas in side canyons and near attraction sites. Reducing group sizes and trip lengths would have localized, beneficial, short- to long-term, seasonal to year-round, minor to moderate effects on vegetation from current conditions. However, user-day levels would double in the shoulder seasons, including spring when plants are most susceptible to damage. The annual increase in user-days and total passengers would result in more use of the limited number of campsites, with direct and indirect impacts to vegetation resources. The increase in total passengers per year would also increase the likelihood of exotic plant species being spread, the use of wood for campfires that was not driftwood (in violation of the park's current boating requirements), and the potential for damage to vegetation. Increased use in critical months would have localized, adverse, short- to long-term, seasonal, moderate impacts to vegetation.

This alternative would double annual user discretionary time, the highest of any alternative. As a result, there would be a greater potential for direct and indirect adverse impacts to vegetation, particularly in the old high-water zone and upland areas, as a result of social trail creation and general exploration of side canyons and attraction sites. The increase in user discretionary time would have localized, adverse, year-round, short- to long-term, minor to moderate effects from current conditions. The large increase in winter user discretionary time would likely result in the depletion of driftwood supplies during that season. As previously discussed, as driftwood supplies diminish, campers use standing or fallen trees near campsites, although this is prohibited in the “Commercial Operating Requirements”; these impacts would likely increase and have localized, adverse, short-term, seasonal, minor impacts.

Mitigation of Effects. Mitigation measures would be the same as Alternative A. One additional measure to mitigate impacts to vegetation would be to further reduce the season in which fires are permitted ***or require boaters to use charcoal or carry in firewood***. These measures ***would*** be beyond a level that would be reasonable and attainable and could not be implemented at a level sufficient to reduce impacts to a sustainable negligible intensity. Impacts to individual plants or plant communities would still have a measurable effect on the size, viability, integrity, interrelationships, or function of the plant community.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in “Methodology for Analyzing Effects to Vegetation Resources: Cumulative Impacts.” The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative C on vegetation, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative C would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

Conclusion. Similar to Alternative B, vegetation conditions in the new high-water zone, old high-water zone and uplands areas in the river corridor and side canyons could improve, but none would return to pre-use conditions. Smaller group sizes, shorter trips, and reductions in trips and people at one time would be beneficial for short- and long-term protection and restoration of vegetation resources. However, use levels would increase in the spring, leading to additional vegetation damage during the most susceptible season and also when mitigation measures are usually implemented. The increase in total numbers of users and user discretionary time would have direct and indirect, adverse, short- and long-term effects on vegetation. Mitigation would be required, with large increases in staff and funding necessary to implement the measures. Even with these increases, mitigation measures would be unable to reduce the adverse impacts from recreational use to negligible or minor levels in the river vegetation zones.

In summary, this alternative would overall ***and without additional mitigations*** have adverse, localized, short- to long-term, year-round, moderate effects on vegetation resources. The beneficial aspects of this alternative would be offset by the tremendous increase in user discretionary time and total number of users. Alternative C would not result in the impairment of vegetation resources in Grand Canyon National Park. Cumulative effects of Alternative C on vegetation, when combined with other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative C would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

4.2.6.5.4 Alternative D

Analysis. Alternative D is a mixed-use alternative, with two periods of no-motor use—March and April and September and October. Commercial group sizes would decrease to a maximum of 25, while noncommercial groups would remain at 16. The maximum trip length would be 30 days, and trip lengths would be reduced from current levels in the summer and shoulder seasons. An eight-person noncommercial trip would be added. Total annual user-days would increase ***by around 50,000 and this*** alternative would have the second highest total user discretionary time, double the present level. There would be a substantial increase in user discretionary time in ***the*** spring, as well as winter. The maximum number of trips and people at one time, as well as total passengers, would be reduced from current levels. Commercial motor and oar trips would be allowed in the winter.

Similar to Alternatives B and C, the reduction in group sizes and trip lengths would have localized, beneficial, short- to long-term, seasonal to year-round, minor to moderate effects on vegetation from current conditions in all three river corridor zones by decreasing the potential for trampling, social trailing, and campsite expansion. Potential damage to vegetation would be reduced in all three vegetation zones, including riparian areas in side canyons and near attraction sites. Shorter trips in the shoulder seasons, especially in spring, would benefit vegetation during the critical reproductive months by reducing layover days and opportunities for hiking into the old high-water zone and side canyons. However, there would be an overall increase in spring user discretionary time, reducing some of the beneficial effects from shorter trips. Longer trips would continue in some seasons, with increased layovers and hiking opportunities and associated damage to vegetation. Allowing five launches per day in the summer, three in the shoulder seasons, and one in the winter would result in more launches per day than under Alternative B, but crowding and subsequent impacts at attraction sites would still be reduced ***from current***. The increase in total annual user-days would result in more use of the limited number of campsites, with more overall direct and indirect, localized, adverse, short- to long-term, year-round, minor to moderate impacts to vegetation. The reduction in total passengers per year would decrease the likelihood of the spread of exotic plant species, and the potential for damage to vegetation, having localized, beneficial, short-term, seasonal, minor effects.

This alternative would have the second highest total user discretionary time, increasing the potential for direct and indirect impacts to vegetation, particularly in the old high-water zone and upland areas, through social trail creation and general exploration of side canyons and attraction sites. The increase in winter use, although only half that of Alternative C, would likely result in the depletion of driftwood supplies during that season. As described in the "Issues," as driftwood supplies diminish, the use of standing or fallen trees near campsites, although prohibited, would likely increase. Together these actions would have localized, adverse, short- to long-term, seasonal to year-round, minor to moderate effects.

Mitigation of Effects. Mitigation measures would be the same as Alternative B. These measures would require additional funding and staff, and it is unlikely they would be implemented at a level sufficient to reduce impact to a sustainable negligible intensity. Impacts to individual plants or plant communities would still have a measurable effect on the size, viability, integrity, interrelationships, or function of the communities.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Effects to Vegetation Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative D on vegetation, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative D would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. Similar to Alternatives B and C, vegetation conditions in the new high-water zone, old high-water zone, and uplands areas of the river corridor and side canyons might improve, but no areas would return to pre-use conditions. Smaller groups, shorter trips, and reduced numbers of trips and people at one time would be beneficial for short- and long-term protection and restoration of vegetation resources. However, increased user discretionary time levels in the spring would likely result in additional vegetation damage during the most susceptible season and also when mitigation measures are usually implemented. While the reduction in total passengers each year would have direct and indirect, beneficial, short- and long-term effects on vegetation, these impacts which would be offset by adverse, short- and long-term, minor to moderate impacts from increases in total user discretionary time. Mitigation would be required, with large increases in staff and funding necessary to implement the measures. Even with these increases, mitigation measures would be unable to reduce the adverse impacts from recreational use to negligible levels in the new high-water zone, old high-water zone, or upland areas.

Overall ***and without additional mitigations***, this alternative would have adverse, localized, short- to long-term, year-round, minor to moderate effects on vegetation resources. The beneficial aspects of this alternative would be offset by the tremendous increase in user discretionary time. Alternative D would not result in the impairment of vegetation resources in Grand Canyon National Park. Cumulative effects of Alternative D on vegetation, when combined with other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative D would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.6.5.5 Alternative E

Analysis. Alternative E is also a mixed-use alternative, equal motor and no-motor seasons (October through March). Maximum commercial group sizes would be reduced to 30 people for motor trips and 25 for oar trips. An eight-person noncommercial trip would be added. Maximum trip lengths in all seasons would be reduced from current levels, as would the maximum number of trips and people at one time. Total annual user-days increase by approximately 60,000. The total number of yearly passengers would be slightly higher than now. The maximum number of launches per day would be reduced, with six launches in the summer, three in the shoulder seasons, and two in winter. Overall user discretionary time would increase ***significantly.*** However, rises in spring user discretionary time hours would be more moderate than in the previous two alternatives, as would the increase in summer and winter user discretionary time.

Similar to the previous three alternatives, smaller groups and shorter trips would benefit vegetation in all three river corridor zones. These reductions would decrease the potential for trampling, social trailing, campsite expansion and damage to vegetation in all three vegetation zones, including riparian areas in side canyons and near attraction sites. Shorter trips in the shoulder seasons, particularly in spring, would benefit vegetation during the critical reproductive months by reducing layover days and opportunities for hiking into the old high-water zone and side canyons. These actions would have localized, beneficial, short- to long-term, seasonal to year-round, minor to moderate effects on vegetation from current conditions. However, there would be an overall, but more moderate, increase in spring user discretionary time, reducing some of the beneficial effects associated with shorter trips. The launch pattern would allow for a greater number of launches per day than Alternative B, but would still reduce crowding and subsequent impacts at attraction sites from current levels, having localized, beneficial, short- to long-term, seasonal to year-round, minor to moderate effects. The increase in total annual user-days would result in more use of the limited number of campsites, increasing overall direct and indirect impacts on vegetation. The increase in total passengers per year would increase the likelihood of the spread of exotic plant species and the potential for damage to vegetation.

The overall increase in user discretionary time would raise the potential for direct and indirect adverse impacts to vegetation resources (as discussed in Alternative A), particularly in the old high-water zone and upland areas, through social trail creation and general exploration of side canyons and attraction sites. The increase in winter use could likely result in the depletion of driftwood supplies during that season. Together these actions would have localized, adverse, short- to long-term, seasonal to year-round, minor to moderate effects.

Mitigation of Effects. Mitigation measures would be the same as Alternative B. These measures would require additional funding and staff, and it is unlikely they would be implemented at a level sufficient to reduce impact to a sustainable negligible intensity. Impacts to individual plants or plant communities would still have a measurable effect on the size, viability, integrity, interrelationships, or function of the communities.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in “Methodology for Analyzing Effects to Vegetation Resources: Cumulative Impacts.” The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative E on vegetation, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative E would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. Similar to Alternatives B, C, and D, vegetation conditions in zones along the river corridor and in side canyons might improve, but none would return to pre-use conditions. Smaller groups, shorter trips, and fewer trips and people at one time would be beneficial for the short- and long-term protection and restoration of vegetation resources. However, more user discretionary time in the spring would likely result in additional vegetation damage during the most susceptible season and also when mitigation measures are usually implemented. The annual increase in total passengers and total user discretionary time would have direct and indirect, adverse, short- and long-term, moderate effects on vegetation. Mitigation would be required, with large increases in staff and funding necessary to implement the measures. Even with these increases, mitigation measures would be unable to reduce the adverse impacts from recreational use to negligible or minor levels in the new high-water zone, old high-water zone, or upland areas.

In summary, this alternative overall ***and without additional mitigations*** would have adverse, localized, short- to long-term, year-round, minor to moderate effects on vegetation resources. Alternative E would not result in the impairment of vegetation resources in Grand Canyon National Park. Cumulative effects of Alternative E on vegetation, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative E would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.6.5.6 Alternative F

Analysis. Alternative F would also have equal motor and no-motor seasons, with no motors allowed from July through December. Maximum trip sizes would be decreased to 30 people, and trip lengths would be reduced in all seasons. The maximum number of trips at one time would drop from 70 to 54, and the maximum number of people at one time would drop ***by about one hundred***. Six launches per day would be allowed in the summer, four in the shoulder seasons, and two in the winter. An eight-person noncommercial trip would be added. Total annual user discretionary time would increase ***by about 150,000 hours, but*** the second lowest for the action alternatives. Early spring user discretionary time would increase substantially, but late spring and summer time would actually decrease. Total yearly passengers would increase by about 3,000.

The effects of this alternative would be similar to those described in Alternative E in terms of smaller groups, shorter trips, and fewer launches per day, as well as increased user-days and total user discretionary time. An increase in spring user discretionary time would raise the probability of vegetation impacts during the critical time for plant reproduction, having localized, adverse, short- to long-term, seasonal, moderate effects from current conditions.

Mitigation of Effects. Mitigation measures would be the same as Alternative B. These measures would require additional funding and staff, and it is unlikely they would be implemented at a level sufficient to reduce impact to a sustainable negligible intensity. Impacts to individual plants or plant communities would still have a measurable effect on the size, viability, integrity, interrelationships, or function of the communities.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Effects to Vegetation Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative F on vegetation, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative F would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

Conclusion. Similar to the previous alternatives, vegetation conditions in the new high-water zone, old high-water zone and uplands areas in the river corridor and side canyons might improve, but none would return to pre-use conditions. Smaller groups, shorter trips, fewer trips and people at one time would be beneficial for short- and long-term protection and restoration of vegetation resources. However, increased user discretionary time levels in the early spring would likely lead to additional vegetation damage during the most susceptible season and also when mitigation measures are usually implemented. More annual total passengers and total user discretionary time would have a direct and indirect, adverse, short- and long-term, moderate effect on vegetation resources; however, total annual user discretionary time hours would be the second lowest for the new alternatives. Mitigation would be required, with large increases in staff and funding necessary to implement the measures. Even with these increases, mitigation measures would be unable to reduce the adverse impacts from recreational use to negligible or minor levels in the new high-water zone, old high-water zone, or upland areas.

In summary, this alternative overall ***and without additional mitigations*** would have adverse, localized, short- to long-term, year-round, minor to moderate effects on vegetation resources. Alternative F would not result in impairment of the vegetation resources of the Grand Canyon National Park. Cumulative effects of Alternative F on vegetation, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative F would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.2.6.5.7 Alternative G

Analysis. Alternative G would allow an eight-month motor season and a four-month no-motor season (September to December). The maximum group size for commercial motor trips would be 40 people, similar to current conditions. Commercial oar trips would have a maximum of 30 people. Maximum trip lengths would be reduced from the current level in all seasons. Six launches per day would be allowed in the summer, five in the shoulder months (the highest of any alternative other than A), and two in the winter. Total annual user-days would increase by about 78,000, with a slight decrease during the summer, doubling in the spring and a tenfold increase in the winter. The maximum number of trips at one time would decrease substantially, with a modest reduction in people at one time from current levels. User discretionary time would be the lowest of all ***action*** alternatives, with an increase of only about 66,000 hours from current levels. Late spring and summer user discretionary time would decrease. Total annual passengers would increase by 6,000.

Adverse effects on vegetation due to large group sizes would be similar to those described in Alternative A, localized, adverse, short- to long-term, seasonal to year-round, and minor to major. They would occur in all three vegetation zones, with short-term impacts in the new high-water zone and long-term impacts in the old high-water zone and upland areas. With less user discretionary time there would be less time for recreationists to layover and hike to attraction sites and side canyons. Combined with the decreases in the maximum number of trips and people at one time, this would help reduce the adverse impacts to vegetation; however, impacts to vegetation at and around campsites would remain high. Only 25% of the campsites along the river can accommodate group of 36 or larger. When large groups utilize the more abundant medium size beaches, impacts extend into the old high-water zone, creating direct and indirect, long-term, adverse impacts to vegetation. The increase in total annual user-days would also result in more use of the limited number of campsites, increasing the overall vegetation impacts. Reductions in trip lengths, particularly in spring, would have localized, beneficial, short- to long-term, seasonal, minor to moderate effect on vegetation during the critical reproductive months by reducing layover days and opportunities for hiking into the old high-water zone and side canyons. However, there would be an increase in early spring user discretionary time and launches, thereby reducing some of the beneficial effects of the shorter trips. More launches per day would be allowed than under Alternative B, but crowding and subsequent impacts at attraction sites would still be reduced compared to current levels. The increase in total passengers per year would increase the likelihood of the spread of exotic plant species and the potential for damage to vegetation. Together these actions would have localized, adverse, short- to long-term, seasonal to year-round, minor to moderate effects.

Mitigation of Effects. Mitigation measures would be the same as Alternative B. These measures would require ***higher levels of*** additional funding and staff, and it is unlikely they would be implemented at a level sufficient to reduce impact to a sustainable negligible intensity. Impacts to individual plants or plant communities would still have a measurable effect on the size, viability, integrity, interrelationships, or function of the communities.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in “Methodology for Analyzing Effects to Vegetation Resources: Cumulative Impacts.” The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative G on vegetation, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative G would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

Conclusion. Under Alternative G adverse impacts to vegetation would be similar to Alternative A, with impacts to new high-water zone, old high-water zone and upland vegetation perceptible and measurable at the majority of campsites and attractions. Impacts in the new high-water zone would be localized, short-term, and of minor to moderate intensity. In the old high-water zone and upland areas, large groups would lead to adverse, long-term, moderate to major impacts to vegetation. A comparatively low amount of user discretionary time, along with decreases in the maximum number of trips and people at one time, would decrease the potential for vegetation damage and loss, but the increase in spring user discretionary time would raise increase the overall potential for damage during the critical reproductive time for many plants. The increase in total passengers and total user discretionary time each year would have direct and indirect, adverse, short- and long-term, moderate to major effects on vegetation resources, even though total annual user discretionary time hours would be the lowest for the new alternatives. Mitigation would be required, with large increases in staff and funding necessary to implement the measures, but measures might not be able to reduce the adverse impacts from recreational use to negligible or minor levels in the new high-water zone, old high-water zone, or upland areas.

In summary, this alternative overall ***and without additional mitigations*** would have adverse, localized, short- to long-term, year-round, minor to major effects on vegetation resources. Alternative G would not result in the impairment of vegetation resources in Grand Canyon National Park. Cumulative effects of Alternative G on vegetation, when combined with other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative G would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects

4.2.6.5.8 Modified Alternative H (NPS Preferred Alternative)

Analysis. Under the ***Modified*** Alternative H, there would ***be 5.5 mixed use months and 6.5 no-motor months***. Total annual user discretionary time would increase by about 200,000 hours. ***User discretionary time would increase by 50,000 hours in the shoulder season, have a 10-fold increase in the winter, and increase by 100,000 hours in the summer.*** Trip sizes would decrease for commercial groups and would remain the same for noncommercial trips, with fewer trips and people at one time and fewer launches per day. ***Commercial group sizes would be further reduced in the shoulder seasons.*** Total yearly passengers, user-days, ***and launches*** would increase over current levels. Trip length in ***the summer season*** would decrease.

Similar to previous alternatives, smaller groups and shorter trips would benefit vegetation in all three river corridor vegetation zones, with a decreased potential for trampling, social trailing, and campsite expansion. The potential for damage to vegetation in all three vegetation zones would be reduced, including riparian areas in side canyons and near attraction sites. Shorter trips in the shoulder seasons, particularly in spring, would benefit vegetation during the critical reproductive months by reducing layover days and opportunities for hiking into the old high-water zone and side canyons. These actions would have localized, beneficial, short- to long-term, seasonal to year-round, minor to moderate effects on vegetation from current conditions. However, there would be an overall, but more moderate, increase in spring user discretionary time, reducing some of the beneficial effects of shorter trips. Fewer launches per day would be allowed than under Alternative A, which would reduce crowding and subsequent impacts at attraction sites from current levels. This would have localized, beneficial, short- to long-term, seasonal to year-round, minor to moderate effects. ***Smaller commercial group sizes in the shoulder season as well as no large commercial motor trips in March would have localized, beneficial, short- to long-term, seasonal, minor to moderate effects.*** The increase in total annual user-days and total passengers per year would result in more use of the limited number of campsites, increasing overall direct and indirect adverse impacts to vegetation, the likelihood of the spread of exotic plant species, and the potential for damage to vegetation. Together these actions would have localized, adverse, short- to long-term, seasonal to year-round, minor to moderate effects.

The increase in overall user discretionary time over current conditions would increase the potential for direct and indirect adverse impacts to vegetation, particularly in the old high-water zone and upland areas, as a result of social trail creation and general exploration of side canyons and attraction sites. Increased winter use could likely result in the depletion of driftwood supplies during that season, likely resulting in the use of standing or fallen trees near campsites for firewood, in violation of regulations.

Mitigation of Effects. Mitigation measures would be the same as Alternative B. These measures would require additional funding and staff, and it is unlikely they would be implemented at a level sufficient to reduce impacts to a sustainable negligible intensity. Impacts to individual plants or plant communities would still have a measurable effect on the size, viability, integrity, interrelationships, or function of the communities.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Effects to Vegetation Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of ***Modified*** Alternative H on vegetation, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. ***Modified*** Alternative H would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. Under this alternative, conditions in the new high-water zone, old high-water zone, and upland areas in the river corridor and side canyons might improve, but none would return to pre-use conditions. Smaller groups, shorter trips, and fewer trips and people at one time would be beneficial for the short- and long-term protection and restoration of vegetation resources. The increase in total passengers and total user discretionary time each year would have direct and indirect, adverse, short- and long-term, moderate effects on vegetation resources. Mitigation would be required, with large increases in staff and funding necessary to implement the measures. Even with these increases, mitigation measures would be unable to reduce the adverse impacts from recreational use to negligible levels in the new high-water zone, old high-water zone, or upland areas.

In summary, this alternative overall ***and without additional mitigations,*** would have adverse, localized, short- to long-term, seasonal to year-round, minor to moderate effects on vegetation resources. ***Modified*** Alternative H would not result in the impairment of vegetation resources in Grand Canyon National Park. Cumulative effects of ***Modified*** Alternative H on vegetation, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. ***Modified*** Alternative H would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.6.6 IMPACT ANALYSIS—LOWER GORGE ALTERNATIVES

4.2.6.6.1 Alternative 1 (Existing Condition)

Analysis. Alternative 1 represents the current diverse mix of recreational activities on the Colorado River from Diamond Creek to Lake Mead within the Grand Canyon. Uses include private and commercial trips, pontoon boat tours, and upriver takeouts. Current maximum group size for HRR day trips is 100, with an average launch of one per day of up to 10 boats at a time. Overnight trips average one launch per week, with a maximum group size of 34. The current number of 15 campsites would remain, and no new ones would be added. The two small floating docks at Quartermaster would also remain, with no additional docks proposed. For the pontoon operations, a maximum of 188 passengers would continue to be allowed during the peak season and ***130*** during the off-season. Upriver travel would be unlimited below Separation Canyon (RM ***240***).

Recreational impacts to vegetation between Diamond Creek and Lake Mead are similar to those discussed under Alternative A for the Lees Ferry to Diamond Creek reach—localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Vegetation trampling, injury, and loss, combined with the spread of exotic plant species and the indirect impacts discussed under "Issues," have changed the character and health of vegetation. The variables that would have the greatest potential to impact vegetation are group size, number of launches, and the number of total passengers for the various uses.

The vegetation data for the Lower Gorge are more limited than those for the Lees Ferry to Diamond Creek reach. The NPS currently does not implement actions to mitigate damage to the vegetation resources in this reach; however, under current use levels extensive impacts have been documented. At Bridge Canyon the human impacts are reported to be heavy, with modification of the campsite area (HDCR 2002). Traditional cultural property evaluators also noted increased trailing and moderate to heavy vegetation clearing and on-site camping in the upper portions of the site, heavily impacting vegetation, which is a traditional cultural property. Similarly at Spencer Canyon, evaluators observed moderate to heavy human impacts from trailing in the new high-water zone and old high-water zone areas, especially around a portable toilet (Jackson et al. 2002). At Travertine Falls there were also moderate to heavy impacts from trailing along the spring and up to the ledge, and also on the upstream side of the spring and in front of the falls. They also noted broken and damaged vegetation along the trail. In 2002 the recommendation was to obliterate the social trails to protect resources.

Adverse effects on vegetation, similar to those described under Alternative A, would continue to occur in all three vegetation zones, with short-term impacts in the new high-water zone and long-term impacts in the old high-water zone and upland areas. Current campsites would not be able to accommodate large groups. When the number of people exceeded the capacity of a site, the impacts would extend into the old high-water zone, creating adverse, direct and indirect, long-term, moderate to major impacts to vegetation. Large numbers of passengers participating in day trips under this alternative (up to 100 people) would continue to have localized, adverse, short- to long-term, year-round, moderate to major effects on vegetation at attraction sites. The number of passengers would also increase the likelihood of the spread of exotic plant species, and the potential for damage to vegetation.

Mitigation of Effects. Actions required to mitigate effects would include ***a subset*** of the mitigation measures defined on page ***435***. To attempt to reduce impacts to minor levels, the following measures would be required:

- ***Work with the Hualapai Tribe to increase visitor education*** about vegetation impacts
- ***Increase NPS patrols at campsites to ensure that river runners do not camp in the old high-water zone or otherwise damage native vegetation***
- ***Increase the revegetation of barren areas***, block undesirable social trails, and initiate restoration actions

It is unlikely that mitigation would be implemented at a level sufficient to reduce overall vegetation impacts to a minor or negligible intensity due to the number of passengers and group size.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Effects to Vegetation Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative 1 on vegetation, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 1 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

Conclusion. Under this alternative vegetation in the new high-water zone, old high-water zone, and upland areas in the river corridor and side canyons would continue to be adversely impacted. The number of passengers and group sizes would continue to have direct and indirect, adverse, short- and long-term, moderate to major effects on vegetation. Mitigation would be required, with large increases in staff and funding necessary to implement the measures. Even with these increases, mitigation measures would be unable to reduce the adverse impacts from recreational use to minor or negligible levels.

In summary, this alternative overall ***and without additional mitigations*** would have adverse, localized, short- to long-term, seasonal to year-round, moderate to major effects on vegetation resources. Alternative 1 would not result in the impairment of vegetation resources in Grand Canyon National Park. Cumulative effects of Alternative 1 on vegetation, when combined with other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 1 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

4.2.6.6.2 Alternative 2

Analysis. Under Alternative 2 recreational use of the Lower Gorge would be reduced from current levels. The maximum group size for HRR day trips would be 30 (down from the current maximum of 100), with two launches per day during the peak season (instead of one currently) and one launch per day during the non-peak season. Overnight trips would have a slightly smaller group size than under current conditions, down to 30 from 34. One additional campsite would be created, requiring vegetation removal. There would be no change in the docks at Quartermaster. Pontoon boat tours and their associated helicopter shuttles would be eliminated. Jetboats would be used for commercial takeouts, but at reduced levels compared to Alternative 1. Upriver travel would be restricted to below RM 262.

Reducing the size of day trips to 30 people would reduce the number of people at attraction sites at one time, minimizing the damage to vegetation as a result of social trailing. The group size for overnight trips would be reduced, producing a lower level of potential impacts to vegetation from campsite expansion and social trailing. The decrease in group sizes would likely produce small benefits for the preservation, protection, and restoration of vegetation resources in all three vegetation zones. Capping the total numbers of daily passengers would also reduce the potential for spreading exotic plant species. These actions would have localized, beneficial, short- to long-term, seasonal to year-round, minor to moderate effects on vegetation from current conditions.

Creating one additional campsite would result in the direct loss of vegetation in the new high-water zone and possibly the old high-water zone; however, this vegetation would likely by comprised of nonnative species, such as tamarisk, or extensively distributed native species. Impacts would be adverse, short and long-term, and minor to moderate.

The lack of pontoon boat operations would have a beneficial effect on the vegetation resources by reducing foot traffic in the vicinity of the Quartermaster launch site. This would have localized, beneficial, long-term, year-round, minor to moderate effects on vegetation from current conditions.

Mitigation of Effects. Mitigation measures would the same as Alternative 1. Increased funding and staff would be needed. Mitigation could be implemented at a level sufficient to reduce overall vegetation impacts to minor.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Effects to Vegetation Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative 2 on vegetation, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 2 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. Under Alternative 2 lower levels of use would benefit vegetation in all three zones along the river. Vegetation conditions in the new high-water zone, old high-water zone, and upland areas in the river corridor and side canyons might improve, but none would return to preuse conditions. Direct and indirect adverse impacts to vegetation would remain. Mitigation would still be required, with increases in staff and funding necessary to implement the measures. Even with these increases, it is unlikely that mitigation measures would be able to reduce the adverse impacts from recreational use to negligible levels.

In summary, Alternative 2 would have beneficial, localized, short- to long-term, seasonal to year-round, minor to moderate effects compared to current conditions. However, this alternative ***without additional mitigations*** would still have adverse, localized, short- to long-term, seasonal to year-round, minor to moderate impacts to vegetation resources. Alternative 2 would not result in the impairment of vegetation resources in Grand Canyon National Park. Cumulative effects of Alternative 2 on vegetation, when combined with other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 2 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.6.6.3 Alternative 3

Analysis. Alternative 3 would allow the same mix of recreational opportunities as current conditions, but at different levels. The maximum group size for HRR day trips would be 30 (down from a maximum of 100 currently), with three launches per day during the peak season and two per day during the non-peak season. Group sizes for overnight trips would be slightly smaller than now, down to 30 from 34, but one additional launch would be added each day. Two additional campsites with supply storage would be created, requiring vegetation removal. A small floating dock would be constructed added at RM 263. Pontoon tours in the Quartermaster area would increase, as would commercial takeouts. A new use under Alternative 3 would be jetboat tours of the Lower Gorge.

Similar to Alternative 2, decreasing the maximum number of people on HRR day trips under this alternative would reduce the number of people at attraction sites at one time, minimizing damage to vegetation from social trailing. However, this would be somewhat offset by having two additional day trip launches. The slight reduction in overnight group sizes would somewhat lower the level of potential impacts to vegetation from campsite expansion and social trailing; however, one additional overnight launch per day would slightly increase the opportunity for vegetation damage. The decrease in group sizes would likely produce small benefits to the preservation, protection, and restoration of vegetation resources in all three vegetation zones. The total numbers of daily passengers would also reduce the potential for spreading exotic plant species. These actions would have localized, beneficial, short- to long-term, seasonal to year-round, minor to moderate effects on vegetation from current conditions.

Providing two additional campsites would result in the loss of new high-water zone and possibly some old high-water zone vegetation; however, this vegetation would likely be comprised of nonnative species, such as tamarisk, or extensively distributed native species. Impacts would be adverse, short and long-term, and moderate. The creation of supply storage would also directly contribute to vegetation loss.

The continuation of pontoon boat operations and more than doubling of maximum daily passengers, combined with the addition of upriver jetboat tours, would have adverse, direct and indirect, short and long-term, seasonal to year-round, moderate effects on the vegetation resources by increasing foot traffic in the pontoon launch area and at resting sites.

Mitigation of Effects. Mitigation measures would be the same as Alternative 1. Increased funding and staff would be needed. Mitigation could be implemented at a level sufficient to reduce overall vegetation impacts to minor.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Effects to Vegetation Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative 3 on vegetation, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 3 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. Under Alternative 3 a small beneficial change from current conditions would be expected in all three vegetation zones due to reductions in group sizes; however, the increase in pontoon operations and an increase in overnight trips would offset the beneficial changes at localized sites. Adding two new campsites would cause direct, adverse, long-term, year-round, moderate impacts to the vegetation in those areas. Direct and indirect, adverse, short- to long-term, localized, moderate impacts to vegetation would remain due to the number of recreationists in the area of analysis. Mitigation would still be required, with increases in staff and funding necessary to implement the measures. Even with these increases, it is unlikely that adverse impacts from recreational use would be reduced to negligible levels.

In summary, Alternative 3 ***without additional mitigations*** would have adverse, localized, short- to long-term, seasonal to year-round, moderate impacts to vegetation resources. Alternative 3 would not result in the impairment of vegetation resources in Grand Canyon National Park. Cumulative effects of Alternative 3 on vegetation, when combined with other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 3 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.6.6.4 Modified Alternative 4 (NPS Preferred Alternative)

Analysis. Under ***Modified*** Alternative 4 HRR trips (both day and overnight) would be redistributed throughout the year. The maximum group size for day trips would be 40 people during the peak season with up to 96 passengers per day (compared to the current maximum of 100), and 35 people during non-peak with two launches per day. Overnight trips would have a smaller group size than under current conditions, down to 20 from 34 during peak season, and 20 during the non-peak season. There would be three overnight launches per day during the peak season and one during the non-peak season. Three campsites would be added, requiring vegetation. A floating dock ***large enough to safely accommodate HRR and pontoon use*** would be provided at RM 262.5. Pontoon tours in the Quartermaster area would ***increase to 480 passengers with an increase to 600 based upon favorable review of concession operations and resource monitoring data.***

Under this alternative there would be no limit on day trip launches during the peak season, but there would be a limit of two launches per day in the non-peak season. Reducing group sizes would reduce the number of people at attraction sites at one time, minimizing the damage to vegetation through social trailing; however, 40 people at one site at one time would still exceed the capacity of most sites, but HRR trips would be using designated sites. The effect from current conditions would be negligible to minor. Reducing the group size for overnight trips, as well as total trip length, would decrease potential impacts to vegetation from campsite expansion and social trailing. The decrease in overnight and day trip group sizes would likely produce benefits to the preservation, protection, and restoration of vegetation resources in all three vegetation zones. The total numbers of daily passengers would also reduce the potential for spreading exotic plant species. These actions would have localized, beneficial, short- to long-term, seasonal to year-round, minor to moderate effects on vegetation from current conditions.

Adding three campsites would result in the loss of vegetation in the new high-water zone and possibly the old high-water zone; however, the vegetation would likely by comprised of non-native species, such as tamarisk, or extensively distributed native species. Impacts would be direct, adverse, long-term, and moderate.

The continuation of pontoon boat operations, with ***an increase in numbers of passengers over current*** would have adverse, direct and indirect, short and long-term, seasonal to year-round, moderate effects on the vegetation ***resources at the localized area around RM 262.***

Mitigation of Effects. Mitigating measures would be the same as Alternative 1. Increased funding and staff would be needed. Mitigation could ***not*** be implemented at a level sufficient to reduce overall vegetation impacts to ***negligible or*** minor.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Effects to Vegetation Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of ***Modified*** Alternative 4 on vegetation, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. ***Modified*** Alternative 4 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

Conclusion. Under ***Modified*** Alternative 4 a small beneficial change from current conditions would be expected in all three vegetation zones due to reductions in ***HRR*** group sizes. Adding three new campsites would cause direct, localized adverse, long-term, year-round, moderate impacts to the vegetation in those areas. Direct and indirect adverse impacts to vegetation would remain under this alternative. ***Additional*** mitigation ***measures*** would be required, with increases in staff and funding necessary to implement the measures. Even with these increases, it is unlikely that mitigation measures would be able to reduce the adverse impacts from recreational use to negligible ***or minor*** levels.

In summary, ***Modified*** Alternative 4 ***without additional mitigations*** would have adverse, localized, short- to long-term, seasonal to year-round, moderate impacts to vegetation resources.

Modified Alternative 4 would not result in the impairment of vegetation resources in Grand Canyon National Park. Cumulative effects of ***Modified*** Alternative 4 on vegetation, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. ***Modified*** Alternative 4 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.2.6.6.5 Alternative 5 (Hualapai Tribe Proposed Action)

Analysis. Alternative 5 would include the same group sizes, launches, and campsite additions as ***Modified*** Alternative 4. A large floating dock would be added at RM 263. Pontoon tours in the Quartermaster area would increase to 960 passengers per day.

As described for ***Modified*** Alternative 4, reducing group sizes for day and overnight trips would reduce the number of people at attraction sites at one time, minimizing the damage to vegetation from social trailing; however, 40 people at one site at one time would still exceed the capacity of most sites, but HRR trips would be using designated sites. The effect would be negligible to minor from current conditions. Smaller overnight groups would reduce the level of potential impacts to vegetation from campsite expansion and social trailing. The decreases in overnight and day trip group sizes would likely have localized, beneficial, year-round, short- to long-term, minor to moderate effects to the preservation, protection, and restoration of vegetation resources in all three vegetation zones.

Adding three campsites would result in the direct, adverse, long-term, moderate loss of vegetation in the new high-water zone and possibly the old high-water zone; however, the vegetation would likely by comprised of nonnative species, such as tamarisk, or extensively distributed native species.

Increasing daily passengers for pontoon boat operations from 188 to 960 would increase the potential for adverse, direct and indirect, short- and long-term, seasonal to year-round, moderate effects on the vegetation resources ***specifically at the localized area around RM 262.5***.

Mitigation of Effects. Mitigation measures would be the same as Alternative 1. Increased funding and staff would be needed. It is unlikely that mitigation would be implemented at a level sufficient to reduce overall vegetation impacts to a minor or negligible intensity due to the increase in the number of passengers.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Effects to Vegetation Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative 5 on vegetation, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 5 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

Conclusion. Similar to ***Modified*** Alternative 4, Alternative 5 would have a small beneficial effect compared to current conditions in all three vegetation zones due to reductions in group sizes. Adding three new campsites would cause direct, localized adverse, long-term, year-round, moderate impacts to the vegetation in those areas. A fivefold increase in daily passengers for pontoon boat operations would increase the potential for adverse, direct and indirect, short- and long-term, seasonal to year-round, moderate effects on vegetation at the launch site. Mitigation would still be required, with increases in staff and funding necessary to implement the measures. Even with these increases, it is unlikely that mitigation measures would be able to reduce the adverse impacts from recreational use to negligible levels.

Alternative 5 ***without additional mitigations*** would have adverse, localized, short- to long-term, seasonal to year-round, moderate impacts to vegetation resources. Alternative 5 would not result in the impairment of the vegetation resources in Grand Canyon National Park. Cumulative effects of Alternative 5 on vegetation, when combined with other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 5 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.2.7 TERRESTRIAL WILDLIFE

4.2.7.1 ISSUES

Internal and external scoping meetings identified a number of issues that pertain to biological resources:

- Protection of ecological resources should be the NPS's first priority
- Resources should be monitored for impacts
- The NPS should consider closing areas experiencing excessive impacts
- Social trailing is a problem and should be reduced; the NPS should mark and maintain trails
- Vegetation, including in the old high-water zone and side canyons, should be protected
- Reduce visitor impacts resulting in behavioral modification of wildlife species
- Dam impacts as they relate to cumulative effects (both Glen Canyon Dam and Hoover Dam)
- Wildlife habitat degradation/enhancement/restoration
- Invasive species spread (loss of habitat and exotic fauna)
- Noise impacts (helicopter, motor and visitor's vocalizations)
- Pollution
- Restore natural conditions

Potential human-caused impacts to terrestrial wildlife and wildlife habitat associated with boating and recreational use include habitat degradation or modification, introduction of pollutants and contaminants into the environment, and disturbances to individuals or groups of wildlife. These potential impacts are described briefly below.

Habitat modification indirectly affects terrestrial wildlife. Recreational use can result in the direct destruction of vegetation through uprooting or crushing of plants, causing reduction of plant cover, leaf biomass, carbohydrate reserves, and reductions of seed and flower production (Liddle 1975). Soil compaction on sites and on maintained or social trails reduces populations of soil invertebrates (Chappell et al. 1971; Duffey 1975). Removal of native vegetation and low trophic level organisms at and near campsites decreases natural food supply and can result in a trophic cascade throughout an animal community. Reduction of driftwood piles by river runners for use as firewood eliminates cover and shelter for a variety of smaller wildlife species.

Pollutants introduced into the environment by river runners can lead to direct and indirect impacts to terrestrial wildlife. In this case, human food is considered a pollutant, and intentional feeding of wildlife or unintentional littering of food scraps and trash attract wildlife to campsites and attraction areas, creating a food base for lizards and rodents by attracting invertebrates. This increased food base indirectly affects populations of small carnivores, such as coyotes, gray foxes, ringtails, and spotted skunks, by increasing rodents as a food source. Large ungulates have been known to ingest food wrappers and other trash left at camps (***see Photo 4-*** 6***; Valdez et al. 1998***). Ingestion of trash, such as pop-tops and aluminum foil, can cause injury or death.

PHOTO 4- 6: TRASH ON BEACH AT RM 24

Disturbances by humans can directly and indirectly affect terrestrial wildlife. The impacts associated with disturbances include:

- Avoidance of an area
- Abandonment of a nest or den site
- Flushing of animals

- Behavior modifications and habituation to humans
- Injury or possibly mortality
- Exposure to predation

Disturbances tend to be a direct result of the presence of humans, especially when they attempt to photograph or view wildlife or cross through an animal's territory (Knight and Cole 1991). The presence of boats on the river, hikers in the side canyons, swimmers in tributaries, river runners on the beaches, and helicopters in the air can disturb nearby wildlife. Most wildlife will disperse if they sense humans nearby. This can disrupt the behavior of wildlife and cause animals to temporarily stop foraging, abandon nest or den sites, and abandon protective cover, thereby increasing the risk of predation and disrupting breeding efforts.

4.2.7.2 Guiding Regulations and Policies

The NPS Organic Act (16 U.S.C. 1 et seq.) directs parks to conserve wildlife unimpaired for future generations. The NPS *Management Policies 2001* (NPS 2000a, sec. 4.4.1) state that "the NPS will maintain as parts of the natural ecosystems of parks all native plants and animals." The service will achieve this through:

- Preserving and restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and the communities and ecosystems in which they occur.
- Restoring native plant and animal populations in parks when they have been extirpated by past human-caused actions.
- Minimizing human impacts on native plants, animal populations, communities, and ecosystems, and the processes that sustain them.

Natural processes are relied on to control populations of native species to the greatest extent possible. Native species are protected from harvest, harassment, or harm by human activities.

Threatened and endangered species and their designated critical habitats are addressed beginning on page ***502.***

4.2.7.3 Management Objectives for Terrestrial Wildlife Resources

Management objectives for the *General Management Plan* and the *Colorado River Management Plan* are included in Table 2 in Chapter 1. The objective for terrestrial wildlife as it relates to management of recreational river use in the Grand Canyon is to manage river recreational use in a manner that protects native terrestrial wildlife and their habitats, and preserves wildlife populations by minimizing human caused wildlife disturbance and reducing habitat alteration.

4.2.7.4 METHODOLOGY FOR ANALYZING EFFECTS TO TERRESTRIAL WILDLIFE RESOURCES

The general process for assessing impacts to the environment is discussed in Section 4.1 of Chapter 4. Effects specific to terrestrial wildlife and habitat are characterized for each alternative based on the impact thresholds presented below.

Because ***hundreds of*** vertebrate species occur in Grand Canyon National Park, information gathering and analysis was focused on wildlife groups, species, and habitats that would most likely be affected by river recreational use. Impacts on terrestrial wildlife were analyzed using the best site-specific data available for species locations and distributions within the park. This information included, but was not limited to, inventories and research conducted by park biologists, personal communications with resource specialists, Arizona Game and Fish Department data, Hualapai tribal data, and Grand Canyon Monitoring and Research Center studies. Species information was then compared with campsite use intensity tables and the Human Impacts Monitoring Database (Brown and Jalbert 2003). It should be noted that there is a distinct lack of recreational disturbance and habitat alteration impact research specific to the Grand Canyon river corridor. Therefore, considerable use was made of research conducted in other areas and extrapolated to the present conditions in the Grand Canyon. This technical literature was used to determine the most susceptible aspects of a particular species' or group of species' life cycle and habitat use areas. This information was then used to direct the collection of quantitative and qualitative data regarding the presence and status of these features within the park. In the absence of hard data, best professional judgment was utilized after consulting with technical experts.

4.2.7.4.1 Impact Thresholds

The analysis of an impact to a particular species or group of species involves a complex examination of the interaction of the context, duration, timing, and intensity of each identified impact. These measures are defined below.

Intensity

Negligible—Impacts to wildlife and/or habitat would not be perceptible or measurable; impacts would not be of any measurable or perceptible consequence to wildlife populations or the ecosystems supporting them.

Minor—Impacts to wildlife and/or habitat would be perceptible or measurable, but the severity and timing of changes to parameter measurements would not be expected to be outside the natural variability and would not be expected to have effects on wildlife populations or ecosystems. Population numbers, population structure, genetic variability, and other demographic factors for species might have slight changes, but characteristics would remain stable. Key ecosystem processes might have slight disruptions that would be within natural variability, and habitat for all species would remain functional.

Moderate—Breeding animals of concern are present and would be impacted; animals are present during particularly vulnerable life stages. Impacts to wildlife and/or habitat would be perceptible and measurable, and the severity and timing of changes to parameter measurements would be expected to be sometimes outside of natural variability, and changes within natural variability might be long-term. Population numbers, population structure, genetic variability, and other demographic factors for species would have measurable changes creating declines, which could be from displacement, but would be expected to rebound to pre-impact numbers. No species would be at risk of being extirpated from the park, key ecosystem processes might have slight disruptions that would be outside natural variability (but would be expected to return to natural variability) and habitat for all species would remain functional.

Major—Impacts to wildlife and/or habitat would be perceptible and measurable, and the severity and timing of changes to parameter measurements would be outside of natural variability for long time periods, and changes within natural variability might be long-term or permanent. Population numbers, population structure, genetic variability, and other demographic factors for species might have large, short-term declines with long-term population numbers considerably depressed. In extreme cases, species might be extirpated from the park, key ecosystem processes like nutrient cycling might be disrupted, or habitat for any species might be rendered not functional.

Context

Regional—Regional impacts would affect a widespread area of suitable habitats or the range of the population or species within Grand Canyon National Park, such as the entire mainstem of the river, or would be widespread among suitable tributaries or side canyons along the river.

Localized—Localized impacts would be confined to a small part of the population or to a small part of a habitat or range, such as a single campsite, spring, or side canyon.

Duration

Short-term—Short-term impacts to an individual or habitat area would be one day up to one year; long-term impacts would be greater than one year. Short-term impacts to a population would last up to five years.

Long-term—Long-term impacts would be greater than five years.

Timing

Impacts could occur year-round, but wildlife resources would be most sensitive during the spring and summer when mating (spawning), birthing, and hatching occur.

4.2.7.4.2 Mitigation of Effects

Mitigation of Effects. Previous mitigation efforts indicate that specific measures can be effective in reducing impacts to terrestrial wildlife, if adequate funding, staffing, monitoring, and implementation of the measures are maintained. ***A list of possible*** mitigation measures ***to be considered singly or in combination, that are*** not already incorporated into the alternatives, ***but*** are judged likely to reduce impacts to terrestrial wildlife ***if implemented*** include the following:

- Conduct a regularly scheduled monitoring program.

- Increase the number of patrol trips and the level of resource protection enforcement activities.
- Increase the level of resource education that each river recreation participant receives.
- Compare indicator species abundance, richness, and diversity in and near camping and attraction sites with areas seldom visited by recreationists.
- Measure vegetation change through time by means of remote sensing imagery, as a less expensive, but less precise, surrogate for direct monitoring of populations.
- Institute site closures of sensitive and impacted areas.
- Actively manage impacted areas through revegetation efforts.
- Construct official trails and aggressively close and rehabilitate all other trails.
- Limit or prohibit use of down woody material including driftwood for firewood.

4.2.7.4.3 Cumulative Impacts

Cumulative impacts on terrestrial wildlife were determined by combining the impacts of each alternative with other past, present, and reasonably foreseeable future actions (see Section 4.1 of Chapter 4 for a detailed list of such actions).

Cumulative Effects for Lees Ferry to Diamond Creek. The major factor affecting terrestrial wildlife resources in the river corridor is the operation of Glen Canyon Dam. The dam's effects far outweigh the effects of river recreationists on the vegetation, and consequently the wildlife, of the river corridor. The dam has created a new vegetative structure that should remain relatively stable under current operations. ***However,*** the ongoing erosion of beaches under current operating parameters can result in additional impacts to terrestrial wildlife resources. As beaches erode, river recreationists are forced into vegetated areas ***and into the old high-water zone*** to accommodate camping needs, resulting in additional wildlife habitat degradation. The dam has localized to regional, adverse, long-term, year-round, moderate to major effects in the new high-water zone.

Other cumulative effects include the additive nature of impacts generated by recreational hikers who visit the river and the effects of researchers who study various aspects of the canyon's physical and biological nature. These users have localized, adverse, short- to long-term, year-round, moderate effects in all hydrologic zones and up side canyons.

4.2.7.4.4 Assumptions

General assumptions used to analyze the effects of each alternative are discussed in Section 4.1 of Chapter 4. Assumptions that specifically relate to the alternatives considered in this document and their effect on terrestrial wildlife are as follows:

- As there are no data to empirically support or refute the position that guided trips are better controlled and result in less resource damage, this analysis assumes that all individuals, whether on guided tours or noncommercial trips, would have an equal chance of adversely interacting with wildlife and its habitat.

- User discretionary time provides an indicator of the opportunity for a certain proportion of river recreationists to adversely interact with individual animals and their habitat.
- Hunting is illegal. Fishing requires compliance with Arizona ***Game and Fish Department*** regulations.
- Present conditions in the river corridor are significantly different from historical conditions. Ecosystem conditions have changed because of anthropogenic influences (Fradkin 1981; Pacey and Marsh 1998). The introduction of nonnative plants has ***Modified*** the riparian community and its wildlife habitat quality. ***Tamarisk***, which was introduced into the United States as an ornamental tree, escaped cultivation by the late 1800s. It appeared along the mainstem of the Colorado River in 1920 (Hunter et al. 1988), though rapid expansion of its range along the river did not occur until 1935 to 1955 (DeLoach 1989). ***Tamarisk*** is well suited to the changed riverine ecosystem and displaced native riparian species throughout the river corridor. Important wildlife habitats, including cottonwood-willow gallery forests, all but disappeared from the Lower Colorado River and were replaced by this less desirable invader (Anderson and Ohmart 1984a).
- Overall, Glen Canyon Dam has provided the most significant effects on Grand Canyon biota. For the most part, the dam has controlled high volume, beach-scouring floods, and the riparian area throughout the corridor has increased at a relatively rapid rate. The increase in vegetation growth and habitat brings with it a concomitant increase in the density and diversity of animal life. It is unknown how the recent lowering of Lake Mead influences the riparian ecosystem in lower Grand Canyon in the long-term.
- The impacts of river runners are generally concentrated in a very small unit area at the campsites, except when they are involved in side canyon or special interest hikes. These side-canyon hikes probably result in the greatest impacts in terms of vegetation trampling and disturbance to sensitive biological resources.
- All caves are currently closed to visitation except through a permitting process. Rampart Cave and Stanton's Cave are closed and gated.

4.2.7.5 Impact Analysis—Lees Ferry Alternatives

4.2.7.5.1 Alternative A (Existing Condition)

Analysis. Alternative A would continue the current river management practices, which allow large group sizes (43 for commercial motor, 39 commercial oar) lengthy trips, and spikes in trips at one time, people at one time, and daily launches (see ***Table 4-*** 1). User-days would remain capped at current levels, which would result in approximately the same number of total yearly passengers. Similarly, user discretionary time would remain at current levels. The greatest amount of user discretionary time would continue to be available in the summer, while winter use would remain very low *(*see Table 4- 2).

Reptiles and Amphibians—Impacts to reptiles and amphibians generally take the form of occasional opportunistic collecting or harassment by river recreationists. Direct human contact, especially handling, can result in stress, injury, or mortality of an individual. Rattlesnakes are occasionally relocated to prevent potentially dangerous confrontations, which can result in disturbance of a population's genetic integrity. Removed individuals suffer a loss of home range, increased competition, and increased potential for predation. Tadpoles and juvenile amphibians in springs and tributaries may be trampled by recreationists during the spring and summer, and aquatic habitat may be permanently disrupted. Much of this sporadic damage is offset at individual camping beaches by increased invertebrate prey sources created by food sources left by recreationists.

In 2003 researchers found 16 species of reptiles and amphibians in the old high-water zone, 15 in the new high-water zone, and 10 in the shore zone (Kearsley et al. 2003). They also noted that the seven most common species in the river corridor occurred in all three zones, but different species were using the zones in different proportions. The two toad species were most common in the new high-water zone, but also occupied the shore zone; they were seldom trapped in the old high-water zone. Sideblotched and spiney lizards are common in both the old and new high-water zones, but whiptails were most abundant in the new zone. At the present level of recreational use, herpetofauna in the river corridor appears to be abundant, but increases in recreational activity that lead to habitat modification and disturbance would have an adverse effect on these species.

In summary, impacts to reptiles and amphibians from the current use level and pattern would be adverse, short-term, and negligible to minor.

Birds—Prior to Glen Canyon Dam, the riparian vegetation along the Colorado River was extremely limited due to frequent flooding (Turner and Karpiscak 1980). Since the completion of Glen Canyon Dam, substantial amounts of new riparian vegetation have become established in the river corridor, and bird densities have increased (Brown, Carothers, and Johnson 1987). However, the removal or modification of the newly created riparian vegetation by recreationists is an ongoing source of impacts to birdlife in the corridor. Habitat modification occurs in both the vegetation of the new and old high-water zones (see Appendix C).

The importance of old high-water zone vegetation to bird species in the canyon has been well documented in recent years (Yard 1996; Yard and Cobb 2001), especially for the production of prey items for this species group. Removal or disturbance of vegetation in this zone by river recreationists would therefore result in the loss of habitat substrate for birds' prey base.

Research also confirmed a particular nonnative leaf-hopper in the diets of several of the bird species investigated (Yard 1996). This species is associated only with tamarisk of the new high-water zone (Stevens 1985), and its presence in the diet of all six species studied illustrates the importance of the vegetation in this zone. Yard et al. (2004) determined that the diet of Lucy's warbler, a species that has expanded its population after construction of the dam, consisted of 49% of the tamarisk-associated leaf-hopper.

Sogge (1998) studied the relationship between riparian vegetation/habitat characteristics and measures of the resident breeding bird community in the river corridor, and determined that covariants associated with large vegetation structures (tree area and volume, new high-water area) and tamarisk area and volume were the best predictors of bird community response variables (abundance, richness and diversity index). Other research indicates that there is a strong positive correlation between breeding bird density and vegetation density as measured by total vegetative volume along the river corridor (Kearsley et al. 2003). Disturbance or destruction of vegetation in either the old or new high-water zone would therefore adversely affect avian species.

In the analysis of 42 frequently used campsites in the river corridor associated with vegetation in the old high-water zone (Brown and Jalbert 2003), only ***six*** did not have trails into th***is*** zone. The vast majority had more than two trails into this area of high importance to breeding bird species. Of the 30 commonly used river stops, individual sites in the old high-water zone ranged from 1 to 30, with an average of 6.4 sites. At the current level of use all but ***two*** sites had human-caused tree damage in both zones, with 30 sites having over 100 trees damaged. A large portion of the tree damage was minor, but disturbance to shrubs and the removal of vegetation ***during the creation of*** trails and campsites ***destroys*** potential habitat for breeding birds. If each of the approximately 200 river campsites between Lees Ferry and Diamond Creek had an average of only 0.5 acre of habitat removed for campsites and social trails, then 100 acres of vegetation in the new high-water zone has been removed from avian habitat. This is 8% of the approximately 1,235 acres of new habitat created since the construction of Glen Canyon Dam (Brown and Trosset 1989). Direct removal of that amount of potential habitat ***has*** a measurable negative impact on avian species abundance, richness, and diversity.

Direct disturbance to avian species from noise and the presence of humans at the present level of river use is an ongoing adverse, short-term, moderate impact. This conclusion is based primarily on a review of the literature as no studies have been undertaken in Grand Canyon to measure the disturbance effects on avian species in the canyon environment. The effect of noise on avian species other than waterfowl and raptors has been given little research attention. Waterfowl are demonstrably more overtly responsive to noise than other species (Edwards et al. 1979), but reports of impacts on raptors are somewhat more ambiguous. A limited number of studies have evaluated the effects of human-induced disturbance and noise on raptors. Predictably, raptor responses to noise and disturbance in these studies have varied. Most studies reported relatively minor impacts and many of these found effects to be temporary (e.g., Lamp 1987). In the few cases where reproductive success was evaluated, reproductive parameters were sometimes affected, but not to a large degree. Researchers have reported that nesting raptors were more sensitive to ground-based activities than to aircraft (Frazer, Franzel, and Mathisen 1985; Grubb and King 1991). But researchers also reported that animals showed a greater response to helicopters than to fixed-wing aircraft (Grubb and King 1991).

Most research has involved helicopters or other aircraft, and the decibel levels tested are substantially greater than those generated by current state-of-the-art, four-stroke outboard motors used in the Grand Canyon. One researcher compared flushing responses in brent geese and determined that noisy outboards induced flight at 1–2 kilometers, but quieter boats would not induce flight outside of 500 meters (Owens 1977). In a river corridor environment like the Grand Canyon it is not unusual to observe waterfowl and shorebirds repeatedly disrupted by the approach of boats, but no studies have been undertaken to empirically determine the difference in responses to oar-powered and motor-powered craft in the Grand Canyon. It is obvious, however, that the flushing of birds along the river can result in several direct impacts. These include the expenditure of energy as they fly from the crafts, an increase in the vulnerability to predation, and reduced foraging efficiency. Wakes from motorized rafts may also drown young birds or flood nests in riparian thickets along the river.

Human presence in breeding areas of various birds can alter species richness, abundance and composition. In a 1984 study it was determined that the abundance of 11 of 12 bird species was lower in areas of high recreation intensity than in areas less frequented by visitors (Van der Zande et al. 1984). The areas of high visitor use were those where 8 to 37 people per hectare were present at one time. This density of people would frequently be present on most camping beaches in the summer throughout the river corridor.

Changes in species richness and community composition can be brought about by the activity of recreationists. In campgrounds environmental structure and complexity are usually reduced, which can decrease species diversity (Hammitt and Cole 1987). Researchers found seven bird species positively associated with campgrounds and another seven species associated with non-campground areas (Blakesley and Reese 1988). Changes in habitat structure (tree and shrub density, volume of down woody vegetation) provided likely explanations for differential species response.

In summary, impacts to birds generated by the current use pattern would be adverse, long-term, and moderate.

Mammals—Ungulates and Carnivores. Many bighorn concentration areas do not contain significant camp or attraction sites, and the few that do occur in these areas are used by humans in the low to moderate intensity range, resulting in low human impact ratings (see Appendix C). A few areas such as Kanab Creek and Nankoweap, however, do contain concentrations of bighorn, deer, and their associated predators, and habitat disturbance can be observed that is directly related to human utilization levels in the moderate to high range (see Appendix C). The major physical modification of habitat associated with these campsites has already occurred, and continued degradation (removal of forage plants, creation of new social trails) would continue to occur, but the rate is not expected to accelerate under current use levels. Despite degradation of habitat immediately adjacent to camping areas and attractions, these highly mobile large mammals are capable of dispersing to undisturbed areas and spend relatively little time in the vicinity of camps. The presence of humans in these camps for extended periods effectively eliminates them as suitable habitat during those periods, but large mammals generally make use of these areas shortly after the departure of humans (Van Dyke et al. 1986; Edge et al. 1985; Edge and Marcum 1985). These disruptions would occasionally reach the moderate threshold of measurable declines in population numbers, but the mobility and fecundity of these species should result in rebounds to pre-impact levels.

Direct disturbance to large mammals from noise and the presence of humans would also result in minor to moderate, short-term, adverse impacts. Anecdotal observations (GRCA wildlife files) indicate that adult bighorn and deer seldom react to observations of boats on the river, but young-of-the-year react vigorously and unpredictably. Research conducted with simulated low-level aircraft on these species indicate that noise levels have to be significant to induce flight responses (Krausmen et al. 1998), but the mere presence of humans on shore will produce the same effect as high-decibel noise. Researchers studied the reaction of mountain sheep approached by humans and noted increased heart rates and flight responses (MacArthur, Geist, and Johnston 1982). The reaction to humans on foot was greater than reactions to road traffic, helicopters, or fixed-wing aircraft.

A variety of studies on ungulates have shown that this group is relatively flexible with respect to habitat use when confronted with noise disturbance. When regularly presented with a disturbance on a scheduled basis deer, elk and sheep avoid areas when noise is present and return when the disturbance subsides (Van Dyke et al. 1986; Edge and Marcum 1985; Leslie and Douglas 1980). When exposure is brief or if sufficient hiding cover is available, changes in home range size have been undetectable (Eckstein et al. 1979; Edge et al 1985). At the current level of operations, it is anticipated that daily exposure to noise from motors would consist of brief, repeated bouts in the summer, and that ungulates would occasionally be subject to stress, but would, for the most part, continue to adapt and habituate to the present level of disturbance.

In the Whitmore area, where helicopter exchanges are made, disturbance effects are anticipated to be at least in the moderate range. Researchers studied the effects of helicopters on bighorn sheep in Grand Canyon National Park and found that helicopter activity reduced the foraging efficiency of adult sheep by 43% (Stockwell, Bateman, and Berger 1991). Foraging efficiency has been suggested as a factor in determining physical condition and reproductive success in bighorn sheep (Bleich et al. 1994). Helicopter activity has been shown to alter the movement and habitat use of wild sheep, and low-flying helicopters (270 to 750 feet above the ground) increased the heart rate in ewes 2.5 to 3 times above normal (Bleich et al. 1994; MacArthur, Geist, and Johnston 1982). While bighorn sheep can become habituated to some types of repeated human disturbance, researchers found that they do not habituate or become desensitized to repeated helicopter flights (Bleich et al. 1994).

The effect on large mammals from the introduction of contaminants and pollutants into the corridor environment is expected to be an adverse, short-term, negligible impact. Several reasons support this conclusion. Of primary importance is the fact that the enormous volume of the Colorado River will dilute the contaminant concentrations to a very low level. Fuel discharges from motorized boats will be diluted well below the toxicity threshold for most mammalian species, which are typically in the tens of thousands of parts per million (ppm). The ingestion of human food items can be a problem in localized areas.

In summary, present levels of river recreational use would result in adverse, short-term, ***negligible*** to moderate impacts to larger mammals such as bighorn sheep, mule deer, and coyote in the area of analysis.

<u>Small Mammals</u>. By serving as a major prey base for bird, reptile, and mammal predators, as well as fulfilling an important role in soil aeration and seed dispersal, rodents and their population dynamics can serve as a tool for making assessments of general ecosystem health.

Within the riparian zone of the river corridor, rodents are the most common small mammals, with at least 14 species representing seven genera (Carothers and Aitchison 1976; GRCA wildlife files). The deer mouse is the only rodent that depends directly on the riparian zone for its existence (BOR 1995). The removal or modification of riparian vegetation by recreationists is an ongoing source of impacts to small mammals throughout the corridor. The modification of habitats occurs in both the vegetation of the new and old high-water zones (Brown and Jalbert 2003).

Of the 219 camping areas monitored by the NPS staff in the river corridor down to Diamond Creek, 58% have human impacts in the moderate to high range. A more detailed analysis of 47 frequently used campsites in the river corridor determined that of the 42 sites associated with vegetation in the old high-water zone, only 6 did not have trails into that zone (Brown and Jalbert 2003). This habitat supports the majority of breeding small mammals encountered in the corridor (Kearsley et al. 2003). Of these commonly used river stops, 30 had campsites in the old high-water zone with from 1 to 30 individual sites. All but 2 sites had human-caused tree damage in both zones, and 30 sites had over 100 trees damaged or removed. Much of the tree damage is minor, but disturbance to understory shrubs and large down woody debris is a major component of habitat modification. The removal of vegetation for campfires, campsite grooming, and social trail restoration reduces potential habitat for small mammals.

Disturbance impacts on small mammals by recreationists include injury, mortality, and stress resulting from handling, removal or displacement of habitat, or displacement of young or nursing females from nursery areas. Small mammals that use driftwood piles and understory for shelter and forage areas may be negatively affected when river runners remove wood to make fires or when woody debris is removed for trail restoration and campsite grooming. Indirect impacts on small mammal populations are likely to be more substantial than direct impacts. Negative effects of recreational activity on small mammals have been documented in the literature (Knight and Cole 1995; GRCA wildlife files). These include:

- Disruption of foraging or breeding behavior
- Reduced parental attentiveness to young
- Soil compaction at campsites and trails affecting burrows of some small mammals
- Use of driftwood for campfires, temporarily reducing habitat for small mammals at some locations
- Feeding unsuitable food to animals, particularly rock squirrels, resulting in individual animals habituating to frequently used camp and attraction sites

In 2003 studies more small mammals were captured in the old high-water zone, which is often associated with the steeper sides of the canyons that afford more structure for small mammals, than in other zones (Kearsley et al. 2003). In addition, two rare species *(Perognathus formosus, Dipodomys ordii*) have only been captured in this zone. Researchers determined that spring abundance of small mammals in the river corridor was relatively constant for the three years studied (Kearsley et al. 2003)). Annual abundance did, however, differ. The annual difference in total numbers of small mammals captured from 2001 to 2003 was primarily due to annual variations in recruitment during the growing season. Fall relative abundance across the three years was significantly different and all were higher than during the preceding spring. The old high-water zone has the highest abundance and richness of mammals; some species have only been detected in this zone. Increases in recreational disturbance or loss of habitat during the growing season, particularly in the old high-water zone, could result in decreases in small mammal population numbers and species richness.

In summary, current use patterns would result adverse, long-term, moderate impacts to small mammals in the area of analysis.

Bats. Habitat modification from river recreationists visiting bat roosting areas would produce negligible to minor adverse impacts to crack and crevice dwelling bat species for a short duration until new roost sites have been located and occupied. Grand Canyon National Park provides abundant habitat for crack and crevice dwelling bats. However, habitat modification to caves where bats are present in maternity colonies or are hibernating can have adverse, long-term, moderate ***and in some cases*** major impacts. Some bat species (cave myotis and Arizona myotis) have declined or disappeared from areas along the Lower Colorado River where habitat conversion and flooding due to dam construction have occurred over the past 60 years (Leslie, pers. comm. 2004a).

Human disturbance is probably the biggest threat to roosting bats. While vandalism and direct aggression toward roosting bats definitely occur and can cause large amounts of damage, even "responsible" cave visitors may unknowingly cause harm to roosting bats simply by being present (GRCA wildlife files). Repeated disturbance at a roost site may cause bats to abandon the roost and move into a less favorable (but less disturbed) alternative roost (Leslie, pers. comm. 2004a). Disturbance during hibernation may wake the bats, causing them to burn stored fat and perhaps preventing them from being able to survive the winter (Thomas 1995). Population declines may be accelerated if numbers at maternity colonies are not sufficient to raise roost temperatures to the levels needed for healthy growth of young (Mohr 1972; Leslie, pers. comm. 2004a).

Human visitation in some caves may also cause changes in the micro-climate of the cave due to lights, increased humidity, gates and other developments (Mann, Steidl, and Dalton 2002). These direct and indirect disturbances by human visitors have been well documented in Stanton's Cave (RM 30.5) and Bat Cave (RM 266.5), and in cave research in Marble Canyon (Chambers et al. 2004). ***The installation of bat gates at Stanton's Cave and Rampart Cave has successfully reduced visitor impacts to bats.*** Human visitation impacts on crack and crevice dwelling species would be less than those of cave-dwelling species because the former are more diffuse throughout the environment.

The effect on bat species from the introduction of contaminants and pollutants is expected to be an adverse, short-term, negligible impact. Of primary importance is the fact that the enormous volume of the Colorado River will dilute the contaminant concentrations to a very low level. Fuel discharges from motorized boats will be diluted well below the toxicity threshold for most terrestrial species (typically in the tens of thousands ppm). Invertebrate insects are more susceptible, however, because bats glean from the wing and would rarely if ever forage on insect carcasses.

In summary, river recreation at the present level would result in adverse, long-term, moderate impacts to bat species in the area of analysis.

Mitigation of Effects. Previous mitigation efforts indicate that specific measures can be effective in reducing impacts to terrestrial wildlife, if adequate funding, staffing, monitoring, and implementation of the measures are maintained. Reasonable mitigation actions are listed on ***page 465.***

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Effects to Terrestrial Wildlife Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and moderate to major. Cumulatively, the effects of Alternative A on terrestrial wildlife, when combined with other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and moderate to major. Alternative A would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. The majority of river recreational access occurs in the late spring, when breeding and brooding for a variety of species is still underway, and summer. Fortunately, the early spring breeding season experiences less recreational access, and disturbance impacts during this period are probably at a low level. Overall, however, most terrestrial species would continue to experience adverse, long-term, moderate impacts. Under some conditions impacts from habitat modification at campsites, disturbance from boats and individuals on shore, and ingestion of pollutants would be observable and measurable and would occur when breeding animals were present. Population numbers and structure, genetic variability, and other demographic factors for species could have measurable changes resulting in declines, which could be from displacement, but eventually a rebound would be expected. Despite the population declines, no species would be at risk of being extirpated from the park; key ecosystem processes might have slight disruptions that would be outside natural variability (but would be expected to return to natural variability), and habitat for all species would remain functional.

Under Alternative A the impacts to terrestrial wildlife ***without additional mitigations*** would be adverse, regional and local, short and long-term, and negligible to moderate. Alternative A result in the impairment of terrestrial wildlife resources in Grand Canyon National Park. Cumulative effects would be adverse, regional to localized, long-term, year-round, and moderate to major. Alternative A would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.7.5.2 Alternative B

Analysis. Under Alternative B, recreational motor trips would be prohibited and group sizes, the maximum number of trips and people at one time, daily launches, user-days, and estimated total yearly passengers would be at their lowest (***see Table 4-*** 1). Trip lengths would be substantially reduced from current conditions, but user discretionary time would increase from current levels (see Table 4- 2).

Reptiles and Amphibians—Greater access would increase the occurrence of adverse interactions with reptiles and amphibians, providing additional opportunities for habitat damage, but it is doubtful that the impacts would rise to a level beyond an adverse, short-term, negligible to minor level.

Birds—Increased use levels in early and late spring (e.g., as indicated by greater user discretionary time) would increase disturbance impacts to breeding birds, but not to such an extent that impacts would rise beyond adverse, long-term, and moderate. Increased access in winter would result in additional impacts to wintering waterfowl. Increased user discretionary time could indicate more opportunities for recreationists to adversely impact critical habitat components as discussed under Alternative A. Eliminating helicopter exchanges would benefit raptors in the Whitmore area.

Mammals—User discretionary time would increase in all seasons, resulting in more potential for adverse habitat modification and disturbance of mammals, but this would be partially offset by the substantial decrease in the maximum number of trips and people at one time. Smaller group sizes might result in a reduction of camping sites in the old high-water zone, which would benefit all species groups. Large mammals would be able to return more quickly to areas from which they had been dispersed, and it is likely that the interval to the next trip passing a given point or arriving for camping would be increased. Eliminating helicopter exchanges would benefit large mammals in the Whitmore area. Prohibiting motorized uses would decrease noise impacts; however, it is unknown whether animals are responding to noise or visual cues from the presence of any type of boat on the river. Alternative B impacts to large mammals would be minor to moderate, adverse, and short-term.

Increased winter use levels could result in adverse, long-term, moderate impacts, particularly to cave-dwelling bats. Disturbance at hibernacula might wake hibernating bats, causing them to burn stored fat and perhaps preventing them from being able to survive the winter (Thomas 1995). Population declines could be accelerated if numbers at maternity colonies were not sufficient to raise roost temperatures to the levels needed for healthy growth of young (Mohr 1972; Leslie, pers. comm. 2004a). An increase in user discretionary time along the river corridor would likely allow recreationists to increase their exploration of the canyon. Generally, visitors are attracted to caves and shelters that also provide critical bat habitat for roosting, hibernating, and rearing young.

For all mammal species, under some conditions impacts from habitat modification at campsites, disturbance from boats and individuals on shore, and ingestion of pollutants would be observable and measurable and would occur when breeding animals were present. Population numbers, population structure, genetic variability, and other demographic factors for species would have measurable changes creating declines, which could be from displacement, but eventually a rebound would be expected. Despite the population declines, no species would be at risk of being extirpated from the park. Key ecosystem processes might have slight disruptions that would be outside natural variability (but would be expected to return to natural variability), and habitat for all species would remain functional.

Mitigation of Effects. Previous mitigation efforts indicate that specific measures can be effective in reducing impacts to terrestrial wildlife, if adequate funding, staffing, monitoring, and implementation of the measures are maintained. Reasonable mitigation actions are listed on page ***465***.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in “Methodology for Analyzing Effects to Terrestrial

Wildlife Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and moderate to major. Cumulatively, the effects of Alternative B on terrestrial wildlife, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and moderate to major. Alternative B would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

Conclusion. Under Alternative B recreational use would increase throughout the entirety of spring and summer. In late spring, breeding and brooding for a variety of species is still under way. Disturbances as a result of greater user discretionary time would increase during critical periods in spring and summer, but noise levels would decrease and most mammal species would benefit from the reduced trip size and a lower number of trips at one time. Increased winter use would result in greater disturbance to wintering waterfowl. Overall, most terrestrial species would experience adverse, long-term, moderate impacts. Some wildlife populations could decline due to habitat modification at campsites, disturbance from boats and individuals on shore, ingestion of pollutants, and displacement; but under this alternative a rebound would be expected. No species would be at risk of being extirpated from the park. Habitat for all species would remain functional.

In summary, under Alternative B impacts to terrestrial wildlife would be adverse, regional and local, short and long-term, and negligible to ***moderate.*** Alternative B would not result in the impairment of terrestrial wildlife resources in Grand Canyon National Park. Cumulative effects would be adverse, regional to localized, long-term, year-round, and moderate to major. Alternative B would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.2.7.5.3 Alternative C

Analysis. Under Alternative C motorized river use would be eliminated. Total annual user discretionary time would increase greatly in all seasons compared to existing conditions ***(the highest of all alternatives)***, while user-days and passengers would increase greatly in all seasons except summer (see Table 4- 2). Group sizes would decrease, as would the maximum number of trips and people at one time.

Reptiles and Amphibians—Doubling user discretionary time would substantially increase potential adverse impacts to reptilian habitat. As described for mammals, increased winter use would likely result in the rapid depletion of driftwood, which provides habitat and food sources for reptiles and amphibians. This increased use would result in adverse, short-term, moderate impacts to herpetofauna.

Birds—A fourfold increase in early spring user discretionary time would increase opportunities for disturbance pressure on nesting avian species during a very critical life stage. Simply walking near a nest can attract predators to an area (e.g., Keith 1961). The level of spring visitation under Alternative C could result in major population disruptions that would exceed the normal range of variability. Certain species that must nest in riparian area could be extirpated from the river corridor. The huge increase in winter use would have a major adverse effect on wintering waterfowl. These factors indicated that this level of recreational use would likely cause adverse, long-term, major impacts to bird species.

Mammals—A doubling of the annual user discretionary time would substantially increase the potential for adverse impacts to mammalian habitat by recreational users of campsites and hiking and social trails. The increase in winter use would likely result in a rapid depletion of driftwood fuel supplies. Users would then turn to local down, woody vegetation and eventually live vegetation for winter fuel wood. A general deterioration of mammalian habitat would result in impacts increasing to at least the adverse, long-term, moderate level.

Increased use ***and the highest user discretionary time*** in winter could result in adverse, long-term, moderate to major impacts to bat species, particularly to cave-dwelling bats. Disturbance of hibernating bats would likely wake them, causing them to burn stored fat and perhaps preventing them from being able to survive the winter (Thomas 1995). Population declines might be accelerated if numbers at maternity colonies were not sufficient to raise roost temperatures to the levels needed for healthy growth of young (Mohr 1972; Leslie, pers. comm. 2004a). An increase in user discretionary time would likely allow recreationists to explore more of the canyon, including caves and shelters that also provide critical habitat for roosting, hibernating, and rearing young. Even a small group disturbing cave bats could have adverse, long-term, major, and often irreversible impacts.

For all terrestrial wildlife, changes in wildlife population parameters could approach the limits of the range of natural variability. Population numbers of certain species groups could show large declines at this level of river use. Given enough habitat degradation and virtually constant direct disturbance, population numbers and diversity could decrease significantly and could remain depressed for the long-term.

Mitigation of Effects. Previous mitigation efforts indicate that specific measures can be effective in reducing impacts to terrestrial wildlife, if adequate funding, staffing, monitoring, and implementation of the measures are maintained. Reasonable mitigation actions are listed on page ***465.***

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Effects to Terrestrial Wildlife Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and moderate to major. Cumulatively, the effects of Alternative C on terrestrial wildlife, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, and moderate to major. Alternative C would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

Conclusion. The great increase in early spring use (and associated user discretionary time) would lead to increased opportunities for disturbance of a majority of mammalian and avian species at critical stages in their life cycles, which can lead to adverse impacts on population numbers and species diversity. Any gain resulting to wildlife from decreased levels of motor noise would be more or less offset by the increase in human presence in limited habitat areas throughout the breeding season. Recreational use under Alternative C would result in the potential for adverse, long-term, moderate to major impacts to terrestrial wildlife species in the entire river corridor. The changes in wildlife population parameters could approach the limits of the range of natural variability, and population numbers of certain species groups could show large declines at this level of river use. Given enough habitat degradation and virtually constant direct disturbance, population numbers and diversity would decrease significantly and could remain depressed for the long-term. Present species that must nest in riparian areas could be extirpated from the river corridor.

In summary, under Alternative C the impacts to terrestrial wildlife would be adverse, regional and local, short and long-term, and moderate to major without ***additional mitigations***. Alternative C would not result in the impairment of terrestrial wildlife resources in Grand Canyon National Park. Cumulative effects would be adverse, regional to localized, long-term, year-round, and moderate to major. Alternative C would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

4.2.7.5.4 Alternative D

Analysis. Under Alternative D, there would be two periods of no-motor use, March and April, and September and October. Annual user discretionary time ***increases*** from the present level (see Table 4- 2), but group sizes would decrease. There would be a substantial increase in early and late spring user discretionary time, as well as in the winter.

Reptiles and Amphibians—***An increase in*** user discretionary time would substantially increase the potential for adverse impacts to reptilian habitat as a result of the recreational use of campsites and hiking and social trails. Increase winter use would likely result in the rapid depletion of driftwood fuel supplies that also provide habitat and food sources for reptiles and amphibians. Greater user discretionary time would result in adverse, short-term, moderate impacts to herpetofauna.

Birds—Greater use in early and late spring would increase the potential for disturbance of nesting avian species during a very critical life stage. This level of spring visitation could result in major population disruptions that would approach the limits of the normal range of variability. Certain uncommon species associated with the new high-water zone could be extirpated in the river corridor. The increase in winter use would have a major adverse effect on wintering waterfowl. Consequently, recreational use under Alternative D would cause adverse, long-term, moderate to major impacts.

Mammals—Similar to Alternative C, ***the increase in*** user discretionary time would vastly increase the opportunity for adverse impacts to mammalian habitat by recreational users of campsites and hiking and social trails. The increase in winter use, although only half that of Alternative C, would result in increased use of driftwood supplies, which provide important habitat for small mammals. A general depletion of mammalian habitat would result in impacts increasing to at least the adverse, long-term, moderate range.

Increased winter use could result in adverse, long-term, moderate to major impacts to bat species, particularly to cave dwelling bats. Disturbance at hibernacula could wake hibernating bats, causing them to burn stored fat and perhaps preventing them from being able to survive the winter (Thomas 1995). Population declines could be accelerated if numbers at maternity colonies were not sufficient to raise roost temperatures to the levels needed for healthy growth of young (Mohr 1972; Leslie, pers. comm. 2004a). An increase in user discretionary time would likely allow recreationists to more thoroughly explore the canyon, including caves and shelters that also provide critical habitat for roosting, hibernating, and rearing young. Even a small group disturbing cave bats could have adverse, long-term, major, and often irreversible impacts.

Similar to Alternative C for all terrestrial wildlife, changes in wildlife population parameters could approach the limits of the range of natural variability, and population numbers of certain species groups could show large declines. Given enough habitat degradation and virtually constant direct disturbance, population numbers and diversity could decrease significantly and remain depressed for the long-term.

Mitigation of Effects. Previous mitigation efforts indicate that specific measures can be effective in reducing impacts to terrestrial wildlife, if adequate funding, staffing, monitoring, and implementation of the measures are maintained. Reasonable mitigation actions are listed on page ***465.***

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Effects to Terrestrial Wildlife Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and moderate to major. Cumulatively, the effects of Alternative D on terrestrial wildlife, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and moderate to major. Alternative D would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

Conclusion. A substantial increase in early spring use would lead to an increased potential for disturbance of a majority of mammalian and avian species at critical stages in their life cycles, which can substantially impact population numbers and species diversity. Eliminating motors in March and April might have some beneficial impacts to breeding species, but recreational use would still have adverse, long-term, moderate to major impacts to terrestrial wildlife species in the entire river corridor. Similar to Alternative C, changes in wildlife population parameters could approach the limits of the range of natural variability, and population numbers of certain species groups could show large declines. Given enough habitat degradation and virtually constant direct disturbance, population numbers and diversity could decrease significantly and remain depressed for the long-term. Present uncommon species that must nest in riparian areas could become extirpated from the river corridor.

In summary Alternative D would have adverse, regional and local, short- and long-term, moderate to major impacts on terrestrial wildlife ***without additional mitigations***. Alternative D would not result in the impairment of the terrestrial wildlife resources in Grand Canyon National Park. Cumulative effects would be adverse, regional to localized, long-term, year-round, and moderate to major. Alternative D would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

4.2.7.5.5 Alternative E

Analysis. Under Alternative E there would be a no-motor season from October through March, and group sizes would decrease. Increases in spring user discretionary time would be moderate compared to the previous two alternatives, as would the increase in summer and winter user discretionary time (see Table 4- 2).

Reptiles and Amphibians—Greater use would increase opportunities for adverse interactions with reptiles and amphibians and provide additional opportunities for habitat damage, but adverse impacts would likely remain in the short-term, negligible to minor range.

Birds—Higher use levels in early and late spring would increase opportunities for disturbance impacts to breeding birds, but not to such an extent as to rise beyond an adverse, long-term, moderate impact. Increased winter use would result in additional impacts to wintering waterfowl. Not allowing motorized use in March would have a somewhat beneficial effect on nesting birds. More user discretionary time would allow recreationists more time to explore and possibly damage critical habitat components, as discussed in Alternative A. Reduction of helicopter exchanges would benefit raptors in the Whitmore area.

Mammals—More user discretionary time would increase the potential for adverse habitat modification and disturbance of mammals, but this would be partially offset by substantial decreases in the maximum number of trips and people at one time. Reducing group size might reduce the expansion of campsites in the old high-water zone. Large mammals would be able to return more quickly to areas from which they had been dispersed, and it is likely there would be longer intervals between trips passing a given point or arriving at a specific site to camp. Small mammals would experience habitat degradation as fuel wood ***is*** used by an increased number of winter visitors. Additional use would result in opportunities for recreationists to spend more time in the old high-water zone, resulting in more damage and disturbance in this important area for rodents. Reduction of helicopter exchanges would benefit large mammals in the Whitmore area. A six-month no-motor season would decrease noise impacts. However, it is unknown whether animals are responding to noise or simply to visual cues from the presence of any type of boat on the river. Under Alternative E impacts to large and small mammals would be adverse, short-term, and minor to moderate.

Moderate increases in winter user discretionary time could result in adverse, long-term, minor to moderate impacts to bat species, particularly to cave-dwelling bats. Disturbance at hibernacula could wake hibernating bats, causing them to burn stored fat and perhaps preventing them from being able to survive the winter (Thomas 1995). An increase in user discretionary time would likely allow recreationists to more thoroughly explore the canyon, including caves and shelters that also provide critical habitat for roosting, hibernating, and rearing young.

For all terrestrial wildlife in the impact area, under some conditions impacts from habitat modification at campsites, disturbance from boats and individuals on shore, and ingestion of pollutants would be observable and measurable and would occur when breeding animals were present. Population numbers, population structure, genetic variability, and other demographic factors for species would have measurable changes, resulting in declines, which could be from displacement, but eventually a rebound would be expected. Despite population declines, no species would be at risk of being extirpated from the park. Key ecosystem processes might have slight disruptions that would be outside natural variability (but would be expected to return to natural variability). Habitat for all species would remain functional.

Mitigation of Effects. Previous mitigation efforts indicate that specific measures can be effective in reducing impacts to terrestrial wildlife, if adequate funding, staffing, monitoring, and implementation of the measures are maintained. Reasonable mitigation actions are listed on page ***465.***

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Effects to Terrestrial Wildlife Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and moderate to major. Cumulatively, the effects of Alternative E on terrestrial wildlife, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and moderate to major. Alternative E would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. Under Alternative E increased river recreational use through the spring and summer would result in adverse impacts to various wildlife species. Nesting birds could be especially affected during early spring, when decreased noise levels during March would be somewhat beneficial, but use would likely increase in late spring when breeding and brooding are still underway for various species. Most mammal species would benefit from reduced trip sizes and lower numbers of trips at one time. Increased winter use would result in greater disturbance to wintering waterfowl. Overall, most terrestrial species would experience adverse, long-term, moderate impacts. Some wildlife populations could decline due to habitat modification at campsites, disturbance from boats and individuals on shore, ingestion of pollutants, and displacement; but under this alternative a rebound would be expected. No species would be at risk of being extirpated from the park. Habitat for all species would remain functional.

In summary, under Alternative E the impacts to terrestrial wildlife would be adverse, regional and local, short and long-term, and ***negligible*** to moderate ***without additional mitigations***. Alternative E would not result in the impairment of the terrestrial resources in Grand Canyon National Park. Cumulative effects would be adverse, regional to localized, long-term, year-round, and moderate to major. Alternative E would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.7.5.6 Alternative F

Analysis. Under Alternative F the no-motor season would be from July through December, maximum trip sizes would decrease, and the maximum number of trips and people at one time would drop (see ***Table 4-*** 1). Annual user discretionary time would increase, but it would be the second lowest ***annually*** for the new alternatives. Early spring user discretionary time, passengers, and user-days would increase substantially, but all use indicators for May through August would decrease, due to the change to no-motors and fewer launches in July and August (see Table 4- 2***). All parameters would increase significantly in the winter.***

Reptiles and Amphibians—Greater use would increase the occurrence of adverse interactions with reptiles and amphibians, with additional opportunities for habitat damage. It is likely that impacts would continue to be adverse, negligible to minor, and short-term.

Birds—More use in the early spring use would increase opportunities for disturbance impacts to breeding birds, but not to such an extent that the impact would be more than an adverse, long-term, moderate impact. Reduced user discretionary time in the late spring and summer suggest fewer recreational use impacts during this critical time period. More winter use would result in additional impacts to wintering waterfowl. Overall increased annual user discretionary time would result in more opportunities for recreationists to damage critical habitat components as discussed in Alternative A. Reducing helicopter exchanges would benefit raptors in the Whitmore area.

Mammals—The increase in overall use would increase the potential for adverse habitat modification and disturbance of mammals, but this would be partially offset by substantial decreases in the maximum number of trips and people at one time. Reduced trip sizes could result in less camping in the new high-water zone. Large mammals would be able to return more quickly to areas from which they had been dispersed, and it is likely intervals would be longer between the next trip passing a given point or arriving at a site to camp. The use of fuel wood by campers would degrade habitat for small mammals. More user discretionary time would give recreationists more opportunities to explore areas in the old high-water zone, increasing damage and disturbance in this area of importance to rodents. Reducing helicopter exchanges would benefit large mammals in the Whitmore area. A six-months no-motor season would decrease noise impacts, but it is unknown whether animals respond to noise or simply to visual cues from the presence of any type of boat on the river. Under Alternative F impacts to large and small mammals would be adverse, short-term, and minor to moderate.

Increased winter use ***(user-days, passengers and user discretionary time)*** could result in adverse, long-term, moderate ***to major*** impacts to bat species, particularly to cave dwelling bats. Disturbance at hibernacula could wake hibernating bats, causing them to burn stored fat and perhaps preventing them from being able to survive the winter (Thomas 1995). An increase in user discretionary time would likely allow recreationists to more thoroughly explore the canyon, including caves and shelters that also provide critical habitat for roosting, hibernating, and rearing young. Even a small group disturbing cave bats could have adverse, long-term, ***major*** and often irreversible impacts.

For all terrestrial wildlife species in the impact area, under some conditions impacts from habitat modification at campsites, disturbance from boats and individuals on shore, and ingestion of pollutants would be observable and measurable and would occur when breeding animals were present. Population numbers and structure, genetic variability, and other demographic factors for species would have measurable changes, resulting in declines, which could be from displacement, but eventually a rebound would be expected. Despite population declines, no species would be at risk of being extirpated from the park. Key ecosystem processes might have slight disruptions that would be outside natural variability, but they would be expected to return to natural variability. Habitat for all species would remain functional.

Mitigation of Effects. Previous mitigation efforts indicate that specific measures can be effective in reducing impacts to terrestrial wildlife, if adequate funding, staffing, monitoring, and implementation of the measures are maintained. Reasonable mitigation actions are listed on page ***465***.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Effects to Terrestrial Wildlife Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and moderate to major. Cumulatively, the effects of Alternative F on terrestrial wildlife, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and moderate to major. Alternative F would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. Recreational use levels under Alternative F would be about equal to current levels in the spring and would be reduced in the summer. In late spring, breeding and brooding for a variety of species is still underway, and disturbance impacts to birds during this critical time period would increase. Noise levels would decrease from July through December, along with reduced trip sizes and fewer trips at one time, would benefit most bird and mammal species. Increased winter use would result in greater disturbance to wintering waterfowl. Overall, most terrestrial species would experience adverse, long-term, moderate impacts. Some wildlife populations could decline due to habitat modification at campsites, disturbance from boats and individuals on shore, ingestion of pollutants, and displacement; but under this alternative a rebound would be expected. No species would be at risk of being extirpated from the park. Habitat for all species would remain functional.

In summary, Alternative F would have adverse, regional and local, short- and long-term, negligible to ***major*** impacts to terrestrial wildlife ***without additional mitigations***. Alternative F would not result in the impairment of terrestrial resources in Grand Canyon National Park. Cumulative effects would be adverse, regional to localized, long-term, year-round, and moderate to major. Alternative F would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.7.5.7 Alternative G

Analysis. Under Alternative G generally larger, shorter trips would occur, with all indicators of access increased ***substantially over current*** in winter and shoulder seasons, but decreased in summer (see Table 4- 1).

Reptiles and Amphibians—More user discretionary time would increase the occurrence of adverse interactions with reptiles and amphibians and provide additional opportunities for habitat damage, but it is likely that adverse impacts would remain in negligible to minor.

Birds—The substantial decrease in late spring and summer user discretionary time would decrease disturbance impacts to breeding birds, and that combined with only modest increases in early spring use could result in adverse, long-term, minor to moderate impacts to avian species. Increased user discretionary time in winter would result in additional impacts to wintering waterfowl. The comparatively small increase in annual user discretionary time would slightly increase opportunities for recreationists to damage critical habitat components as discussed in Alternative A.

Mammals—More annual use would slightly increase the potential for adverse habitat modification and disturbance of mammals, but this would be partially offset by substantial decreases in the maximum number of trips and people at one time. Large mammals would be able to return more quickly to areas from which they had been dispersed, and the interval between trips passing a given point or arriving at a site to camp would be increased. Small mammals would experience habitat degradation as fuel wood was used by the increased number of winter visitors. Additional user discretionary time suggests that recreationists would have more time to explore the canyon, including the old high-water zone, with increased damage and disturbance in this important area for rodents. Under Alternative G impacts to large and small mammals would be adverse, short-term, minor to moderate.

Increased winter use (***user-days, passengers and user discretionary time)*** could result in adverse, long-term, moderate ***to major*** impacts to bat species, particularly to cave dwelling bats. Disturbance at hibernacula could wake hibernating bats, causing them to burn stored fat and perhaps preventing them from being able to survive the winter (Thomas 1995). An increase in user discretionary time would likely allow recreationists to more thoroughly explore the canyon, including caves and shelters that also provide critical habitat for roosting, hibernating, and rearing young. Even a small group disturbing cave bats could have adverse, long-term, ***major*** and often irreversible impacts.

For all terrestrial wildlife in the impact area, under some conditions impacts from habitat modification at campsites, disturbance from boats and individuals on shore, and ingestion of pollutants would be observable and measurable and would occur when breeding animals were present. Population numbers and structure, genetic variability, and other demographic factors for species could have measurable changes creating declines, which could be from displacement, but eventually a rebound would be expected. Despite the population declines, no species would be at risk of being extirpated from the park. Key ecosystem processes might have slight disruptions that would be outside natural variability, but would be expected to return to natural variability. Habitat for all species would remain functional.

Mitigation of Effects. Previous mitigation efforts indicate that specific measures can be effective in reducing impacts to terrestrial wildlife, if adequate funding, staffing, monitoring, and implementation of the measures are maintained. Reasonable mitigation actions are listed on page ***465***.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in “Methodology for Analyzing Effects to Terrestrial Wildlife Resources: Cumulative Impacts.” The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and moderate to major. Cumulatively, the effects of Alternative G on terrestrial wildlife, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and moderate to major. Alternative G would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. Under Alternative G slightly increased access in March and April, but reduced access from May through August would benefit a variety of species who breed and raise their young in the late spring. Disturbance impacts to birds during the critical time period in the March-April period would increase slightly, but the decrease in the May-June period should off-set this. Fewer trips at one time should benefit most species. The increase in winter access would result in greater opportunities for disturbance to wintering waterfowl. Overall, most terrestrial species would experience adverse, long-term, minor to moderate impacts. Some wildlife populations could decline due to habitat modification at campsites, disturbance from boats and individuals on shore, ingestion of pollutants, and displacement; but under this alternative a rebound would be expected. No species would be at risk of being extirpated from the park. Habitat for all species would remain functional.

In summary, under Alternative G impacts to terrestrial wildlife would be adverse, regional and local, short and long-term, and negligible to ***major without additional mitigations***. Alternative G would not result in the impairment of terrestrial wildlife resources in Grand Canyon National Park. Cumulative effects would be adverse, regional to localized, long-term, year-round, and moderate to major. Alternative G would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.7.5.8 Modified Alternative H (NPS Preferred Alternative)

Analysis. Under ***Modified*** Alternative H a ***five and a half month mixed use season and a six and a half*** month no-motor season would occur. Total annual user discretionary time would increase substantially ***over current***. Compared to the other alternatives, winter user discretionary time would increase by a moderate amount (see Table 4- 2). Trip sizes would decrease for commercial groups ***to 32 in the summer and 24 in the shoulder seasons*** and the maximum number of trips and people at one time would decrease.

Reptiles and Amphibians—Increased user discretionary time would provide additional opportunities for adverse interactions with reptiles and amphibians and resulting habitat damage, but it is likely that adverse, short-term impacts would remain in the negligible to minor range.

Birds—The substantial increase in user discretionary time from May through August would increase opportunities for disturbance impacts to breeding birds, and that combined with more modest use increases in ***the shoulder seasons*** could result in adverse, long-term, moderate impacts to avian species. ***No motors and small group sizes in March will have minor to moderate beneficial effects on birds.*** Increased winter use would result in additional potential for impacts to wintering waterfowl. The increased annual user discretionary time would increase opportunities for recreationists to damage critical habitat components, as discussed in Alternative A.

Mammals—More user discretionary time would increase the potential for adverse habitat modification and disturbance of mammals, but this would be partially offset by the substantial decreases in the maximum number of trips and people at one time. Reduced trip sizes might result in less camping in the ***old*** high-water zone. ***No motors and smaller group sizes in the spring will be beneficial to young of the year.*** Large mammals would be able to return more quickly to areas from which they had been dispersed, and it is likely that there would be longer intervals between trips passing a given point or arriving at a certain site to camp. Small mammals would experience habitat degradation with the greater use of driftwood as fuel wood by more winter visitors. With additional user discretionary time, recreationists could spend more time exploring the old high-water zone, increasing damage and disturbance in this important area for rodents. Under this alternative impacts to large and small mammals would be adverse, short-term, and minor to moderate.

Increased winter use could result in adverse, long-term, minor to moderate impacts to bat species, particularly to cave dwelling bats. Disturbance at hibernacula could wake hibernating bats, causing them to burn stored fat and perhaps preventing them from being able to survive the winter (Thomas 1995). An increase in user discretionary time would likely allow recreationists to more thoroughly explore the canyon, including caves and shelters that also provide critical habitat for roosting, hibernating, and rearing young.

For all terrestrial wildlife in the area of impact, under some conditions impacts from habitat modification at campsites, disturbance from boats and individuals on shore, and ingestion of pollutants would be observable and measurable and would occur when breeding animals are present. Population numbers and structure, genetic variability, and other demographic factors for species would have measurable changes creating declines, which could be from displacement, but eventually a rebound would be expected. Despite the population declines, no species would be at risk of being extirpated from the park. Key ecosystem processes may have slight disruptions that would be outside natural variability, but would be expected to return to natural variability. Habitat for all species would remain functional.

Mitigation of Effects. Previous mitigation efforts indicate that specific measures can be effective in reducing impacts to terrestrial wildlife, if adequate funding, staffing, monitoring, and implementation of the measures are maintained. Reasonable mitigation actions are listed on page ***465***.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Effects to Terrestrial Wildlife Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and moderate to major. Cumulatively, the effects of ***Modified*** Alternative H on terrestrial wildlife, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and moderate to major. ***Modified*** Alternative H would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. Under ***Modified*** Alternative H recreational use ***stays low*** in March and ***increases incrementally*** in April***, which*** would ***benefit*** a variety of wildlife species. In late spring breeding and brooding is still underway for numerous species, and ***early*** summer is an important phase in many species' breeding cycles. Reduced trip sizes and fewer trips at one time should benefit some species, but increased winter use would result in greater opportunities for disturbance to wintering waterfowl ***and bats***. Overall, most terrestrial species would experience adverse, long-term, moderate impacts. Some wildlife populations could decline due to habitat modification at campsites, disturbance from boats and individuals on shore, ingestion of pollutants, and displacement; but under this alternative a rebound would be expected. No species would be at risk of being extirpated from the park. Habitat for all species would remain functional.

In summary, under ***Modified*** Alternative H impacts to terrestrial wildlife would be adverse, regional and local, short and long-term, and negligible to moderate. ***Modified*** Alternative H would not result in the impairment of the terrestrial resources in Grand Canyon National Park. Cumulative effects would be adverse, regional to localized, long-term, year-round, and moderate to major. ***Modified*** Alternative H would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.7.6 Impact Analysis—Lower Gorge Alternatives

4.2.7.6.1 Methodology and Assumptions

In addition to the assumptions listed for all alternatives on page 466, assumptions specific to the Lower Gorge include the following:

- Personal watercraft from Lake Mead National Recreation Area are prohibited upstream of the Grand Canyon National Park boundary buoy. There are no restrictions on upriver travel below Separation Canyon at the present time.
- The Lower Gorge ecosystem is delicate and fragile, and the Colorado River supports some of the most abundant and diverse riparian vegetation and wildlife communities in the southwestern United States (Christensen 1997). Consequently, habitat loss, the proximity of other disturbing activities (areas typically avoided by wildlife, particularly large mammals), the limited availability of undisturbed habitat nearby, and the degree of restoration after construction must all be taken into account in the analysis.

Impacts on Special Status species (including the southwest river otter, the bald eagle, the California condor, and the American peregrine falcon) are discussed ***in Chapter 4.2.9 Environmental Consequences: Special Status Species.***

4.2.7.6.2 Alternative 1 (Existing Condition)

Analysis. Recreational use of the Lower Gorge under Alternative 1 would continue to be unregulated except noncommercial launches would be limited to two per day, with a maximum of 16 people each (including guides). There are an average 100 trips per year (including educational and administrative trips) and generally last only a few days. HRR would continue to offer one day trip per day during the March-October season, with up to 10 boats (100 people) launching at the same time, and three overnight trips per month. No additional campsites would be developed.

The pontoon boat operation at Quartermaster would continue with seven boats in continuous operation throughout the day from May through September, with an average of 188 passengers per day. Pontoon passengers arrive and leave by helicopter, while passengers arriving for HRR day and overnight trips only leave by helicopter.

Invertebrates—Terrestrial riparian insect, which serve as a critical terrestrial food base for many wildlife species, were probably not as diverse and abundant before the construction of Glen Canyon Dam due to the scouring effects of floods and the limited amount of beach vegetation. Riparian vegetation has grown substantially in the Lower Gorge in the last decade, which has likely increased the invertebrate diversity and abundance. The Colorado River in Lower Grand Canyon supports some of the most abundant and diverse riparian vegetation and wildlife communities in the southwestern United States (Christensen 1997). This may be the very reason for the diversity of birds and bats documented in recent years within the park (GRCA wildlife files; Christensen 2002), as described in Chapter 3 under "Terrestrial Wildlife."

Several specific insect problems are occurring along the Colorado River corridor and in the Lower Gorge region. Harvester ants, also known as red ants, usually occur in low densities along the beach and terrace interfaces near the river. However, on the few heavily used beaches in the Lower Gorge, ant densities are much higher than at relatively unused beach areas. Investigations indicate that this problem is directly relates to human activity and improper organic garbage disposal. Because of their increasing numbers and painful sting, this presents a health hazard to particularly to persons sensitive to the toxins.

The flesh fly and blow fly populations have also shown an increase in density at heavily used campsites. These populations are generally linked with sanitation problems, particularly in regards to fecal and organic waste disposal. These insects could definitely be the source of some fly-vectored health issues in the Lower Gorge, as many of the boats traveling upriver do not have sanitation facilities.

With the continued high levels of use in the area of analysis and the increase in established campsites, woody riparian vegetation can be expected to decrease. In addition, driftwood serving as habitat would likely decrease, slightly impacting terrestrial invertebrate species and over time possibly bird and bat species occupying the area.

Direct impacts to invertebrate species from river recreation at the present level would result in adverse, local, short-term, minor impacts. Indirect impacts to invertebrate species from disturbance at current use patterns would likely result in adverse, local, short-term, minor to moderate impacts.

Reptiles and Amphibians—Amphibians are not well represented in the Lower Gorge due to generally arid surface conditions (NPS 1979c), although toads such as the Woodhouse's toad and red-spotted toad have been documented (GRCA wildlife files). Tree frogs are common in warmer tributaries. (The leopard frog is discussed under "***4.2.9 Special Status*** Species.") No impacts are expected on the Sonoran desert tortoise population in Grand Canyon National Park because it occurs in the upland habitat in the Lower Gorge. The park is currently undertaking comprehensive studies to further document presence of Mohave desert tortoise within the park boundaries.

Sixteen species of reptiles have been identified along the Colorado River (Carpenter 2001) as described further in Chapter 3. Direct impacts to reptiles are brought about through changes in the available food at the most impacted campsites. Ants, flies, and gnats make up a large portion of lizards' diets. These insects thrive on organic garbage and fecal waste products. Where these insects are present in unusually high densities, there is a corresponding increase in lizard densities. Many species of lizards use dwindling supplies of available driftwood for foraging, display, basking areas, and cover, particularly the spiny lizard; these areas are scarcer along the Lower Gorge than in the upper reaches of the river corridor.

At the present level of recreational use, there appears to be minimal impact to reptiles in the Lower Gorge, but substantial impacts to amphibians. An increase in recreational activity that leads to habitat modification and disturbance would have moderate adverse effects on these species.

Birds—Based on surveys in 2001 and 2002 (Christensen 2002), the most common bird species in the Lower Gorge include the yellow-breasted chat, Bell's vireo, song sparrow, yellow warbler, blue-gray gnatcatcher, and Bewick's wren. Song sparrows appear to be increasing in the Lower Gorge (Christensen 2002). At Burnt Springs, Bat Cave, and Spencer Creek (RM 264.0) appreciable numbers of birds are supported relative to Surprise Creek and the Quartermaster area. These areas resemble stream riparian and stream communities, with vegetation such as willows, cottonwood, sedges, and rushes that provide excellent habitat to a variety of bird species, including the endangered Southwestern willow flycatcher and several species of shorebirds, herons, and egrets. Peregrine falcons were once numerous in the area of analysis, but declines have been documented. A survey of this area in 2002 indicated that the mean number of birds observed was extremely low compared to previous years' survey data (Christensen 2002). One explanation would be that the habitat is deteriorating due to a lack of water and that the number of birds that can be supported has declined.

Many impacts on wildlife from the continued use of helicopters and motorized vessels throughout the river corridor have been documented. Such species as migratory hawks, peregrine falcons, and California condors are disturbed by helicopter noise and proximity to use (Olson 2003). (Impacts on condors and falcons are discussed under "4.2.9 Special Status Species.") Park biologists have noted through field observations that bird species can be disturbed by the operation of motorized vessels because they create noise that flushes the birds and create wakes that disrupt nests. Motorized vessel noise can also flush birds from their nests, which can be harmful or fatal to unfledged chicks. Keeping adults away from the nest can disrupt proper development of the young and prevent them from defending the nest against predators.

The nesting season for neotropical migrants is from May to September. However, many birds, like the herons and some species using the lower elevation of the Lower Gorge, start nesting earlier. Therefore, the primary nesting season directly correlates to the high-visitor-use season. While motorized boat use can disturb bird species, there have been conflicting reports on how this use most impacts birds. In general, boats can create a large wake that can damage nest sites and create noise that can flush birds from their nests. However, most boaters tend to avoid shoreline and vegetated areas or decrease speed when in these areas except when off-loading for side canyon hikes.

Overall, impacts on birds from motorized vessels would be considered a major impact because use occurs at critical periods during nesting season and migration periods. Habitat in this area is limited, and there could be an increase in mortality of these species based on greater use of motorized vessels in the inflow areas and around important nesting areas. In particular, grebes, including Clark's grebes, build floating nests that could be damaged or flooded by the wake of a motorized vessel. Clark's grebes have been documented in the Pearce Ferry delta. Studies have shown that high recreational use can disturb wintering waterfowl and some raptors (Stalmaster and Kaiser 1997).

In heavily used camping areas, three species of birds—the starling, common raven, and the house sparrow—are affected by human activities along the river corridor. At every major campsite, habituated ravens have been documented. Organic garbage left intentionally (specifically for the purpose of feeding wildlife) and unintentionally generally most influence ravens. All indications are that ravens and starlings are in higher densities along the river corridor in the Lower Gorge than they would be normally if not fed.

The effect on bird species from the introduction of contaminants and pollutants is expected to be an adverse, short-term, negligible impact. Visitation and recreation along the Lower Gorge have steadily increased in the past, a trend that is likely to continue. Future increases in the use of motorized vehicles could result in increased spills of petroleum products and other contaminants, adversely affecting water quality. Decreases in water quality could affect bird species that use marsh and backwater vegetation types (e.g., the western least bittern and Yuma clapper rail) to forage on invertebrates.

Direct disturbance and impacts to avian species from noise (helicopter and motorized watercraft) and the presence of humans at the present level of use would be adverse, short- and long-term, and major.

Mammals—By serving as a major prey base for bird, reptile, and mammal predators, as well as fulfilling an important role in soil aeration and seed dispersal, nocturnal rodents and their population dynamics can serve as a tool for making assessments of general ecosystem health. Small mammal species in the lower gorge are typical of those in the upper reaches of the river corridor (Christensen 2001, 1997; Kearsley, Cobb, and Yard 2001; GRCA wildlife files, unpublished data 2004) as further described in Chapter 3. Upland studies in Burnt, Spencer, and Quartermaster Canyons indicate a higher number of species and individuals compared to the riparian transects (Christensen 2002; GRCA wildlife files, unpublished data 2004). These results are similar to those found previously (Christensen 2001, 1997) and to those reported by Yard (2001).

In 1977, researchers affiliated with the Arizona Academy of Science noted that coyotes were preying on predominantly desert cottontails and pocket mice, as well as foraging on woodrats and various *Peromyscus* spp. These studies indicated that these species were more plentiful at sampling sites on the north side of the river.

Firewood collection can affect small mammal populations by altering food sources and living places and eliminating protected sites. Organic trash around campsites also attracts animals, ranging from invertebrates to small rodents, certain birds, and small mammals. Although such changes in habitat, including removal or modification of riparian vegetation, are the major source of impact on smaller wildlife species, most of these changes are highly localized, with the exception of pest species. The modification of habitats occurs in both the vegetation of the new high and old high-water zones (GRCA campsite monitoring database 2003). The most heavily used sites by visitors include Bridge (RM 243) and the Quartermaster area. Inventories and monitoring at these sites have shown a recent decline in species diversity and abundance (Christensen 2003, 1997; Kearsley, Cobb, and Yard 2001; GRCA wildlife files, unpublished data 2004).

The removal of vegetation for campfires, campsite establishment, and grooming reduces potential habitat for small mammals. Impacts on small mammals include injury, mortality, and stress resulting from handling; changes in living spaces and food sources; removal or displacement of habitat; or displacement of young or nursing female from nursery areas.

Direct impacts on mammals from current use patterns would result in adverse, regional and local, short- and long-term, major impacts. Indirect impacts on small mammal populations would likely be more substantial than those of direct impacts but on a localized level.

Aquatic Furbearers—Relatively little is known about the historic semi-aquatic furbearers in the Grand Canyon (i.e., beavers, river otters, and muskrats). Sighting records prior to the construction of Glen Canyon Dam indicate that river otters and beavers were present, but that their occurrence was sporadic and their densities low (Hoffmeister and Durham 1971; Hoffmeister 1986). Since the completion of the dam in 1963, muskrats have rarely been observed along the river corridor (GRCA wildlife files; Breck and Kellett 2000), and may be extirpated from the park. The southwestern river otter, a species of concern, is thought to be extirpated from the park.

According to Carothers and Brown (1991), beaver populations within the Grand Canyon began to expand after the completion of Glen Canyon Dam. They attributed the increase to the cessation of spring floods and the post-dam development of extensive riparian vegetation. The 2000 inventory conducted by Breck and Kellet recorded beaver signs at 23 sites from RM 0.8 to RM 208.5. Five of these sites were identified as river runner campsites. NPS surveys during the same year indicated that beavers are evenly distributed along the river in suitable habitat (Leslie 2000a). Beavers have an important effect on the riparian ecosystem, as described in Chapter 3.

The harassment of wildlife by recreationists produces excitement or stress in animals. This may lead to panic, exertion, and disruption of essential functions such as breeding, displacement, and sometimes death. Animals that are healthy and have ample food and places to escape are more capable of withstanding harassment than animals that harassment than animals that are underfed, parasitized, or lacking secure areas for escape (Ream 1979). It is difficult to make generalizations about harassment are because of the considerable variability between and within species. Beavers in the Lower Gorge have been documented as slapping tails and being “pushed” downriver. Disturbance and loss of woody vegetation at the current levels may have minor to moderate impacts on the Lower Gorge beaver population. Due to a direct correlation between beaver and otter habitat, this could impact future river otter restoration efforts.

Mammals—Ungulates and Carnivores. Bighorn sheep use has been documented on both the north and south sides of the river corridor in the Lower Gorge. On the Hualapai tribal lands, bighorns are hunted generally along the rim areas, likely pushing them seasonally down onto the river corridor. There are few campsites in this area. However, pontoon and jetboat use, as well as helicopter traffic, likely impact large mammal distribution and, consequently, their predators.

Direct disturbance to large mammals from noise and the presence of humans can result in moderate to major adverse impacts. Limited research on these species conducted using simulated low-level aircraft indicate that noise levels have to be significant to induce flight responses (Krausmen et al. 1998), but the mere presence of humans on shore will produce the same effect as high decibel noise. Researchers studied the reaction of mountain sheep approached by humans and noted increased heart rates and flight responses (MacArthur, Geist, and Johnston 1982). The reaction to humans on foot was greater than reactions to road traffic, helicopters, or fixed-wing aircraft in some circumstances.

Wild ungulates and carnivores change their movement patterns in response to aircraft over-flights, construction noise, and walking park visitors (e.g. Krausman et al. 1998; Eckstein et al 1979; Edge and Marcum 1985; Richens and Lavigne 1978). All of these sounds are associated with approaches or human activity. The authors concluded that frequent alerting affected food intake of bighorn sheep.

Helicopter activity has been shown to alter the movement and use of habitat by wild sheep, and low-flying helicopters (270 to 750 feet above the ground) increased the heart rate in ewes 2.5 to 3 times above normal (Bleich et al. 1994; MacArthur, Geist, and Johnston 1982). While bighorn sheep can become habituated to some types of repeated human disturbance, researchers found that they do not habituate or become desensitized to repeated helicopter flights (Bleich et al. 1994).

Noise is suspected to cause stress-related illness in both humans and animals, but the causal link has been difficult to prove (Federal Interagency Committee on Noise 1992). High noise levels may cause wild animals to become irritable, affecting feeding intake, energy expenditure, social interactions, and parenting and nurturing. All of these effects can result in population declines. Even if populations are unaffected, genetically determined differences in susceptibility might exert subtle selection that could eventually affect fitness.

If animals respond as soon as they detect a sound, then noisy vehicles will affect them at a much greater distance than humans. However, if they are habituated to vehicle noise (motors, including pontoon boats and jetboats, and helicopters in the Lower Gorge) at levels that are not aversive, then humans laughing and yelling can arouse response at greater ranges than vehicle noise. The potential effect of noise on animals along the river corridor has not been well studied; however, many of these impacts have been anecdotally noted in bighorn sheep (GRCA wildlife files) and some bird species along the river.

Wildlife, in general, move away from disturbances such as approaching motorized vessels. However, the NPS has observed unpredictable responses from bighorn sheep near the shoreline (NPS 2002b). At times they will move away when a vessel is approaching and return when it moves away. At other times they will ignore the approaching vessel and not move. This indicates that effects on bighorn sheep of motorized watercraft at present levels is minimal.

The effect on large mammals from the introduction of contaminants and pollutants into the corridor environment is expected to be an adverse, short-term, negligible impact. Several reasons support this conclusion. Of primary importance is the fact that the enormous volume of the Colorado River will dilute contaminant concentrations to a very low level. Fuel discharges from motorized boats will be diluted well below the toxicity threshold for most mammalian species (typically in the tens of thousands ppm).

Ingestion of human food items or litter can be a problem, particularly in areas where human visitation is frequent, in high numbers, and poorly regulated (e.g., Carothers and Aitchison 1976; GRCA wildlife files). Litter may affect vertebrate populations by being eaten and causing injury or mortality or through indirect impacts by producing higher densities of insects. Some litter articles may be used as improper nesting materials. It is likely that river runners, visitors helicoptering in, and upstream travelers all contribute to this problem, particularly in the high-use campsites and attraction sites, resulting in moderate short-term impacts on a localized level.

Bats. Habitat modification and human disturbance are probably the greatest threat to roosting bats. Human visitation in Lower Gorge caves disturbs bat species not only through direct disturbance, but also through changes in the microclimate of caves they inhabit due to noise disturbance, lights, and increase in humidity (Mann, Steidl, and Dalton 2002). Also, hikers can disturb the cave floor, which provides habitat for the protected Grand Canyon cave pseudoscorpion and other invertebrate species, also disrupting the food base for small mammals such as ringtail cats. These direct and indirect disturbances by human visitors have been well-documented Rampart, Stanton's, and Bat caves (Leslie, pers. comm. 2004a).

Disturbance of roosting bats in Bat Cave, a very important habitat for Mexican free-tailed bats, as described in Chapter 3*,* continues to be a management concern. Although the cave is officially closed, visitors have easy access to the point of roosting by means of a short technical climb and a long boardwalk. Multiple social trailing along the slope first appeared in 1996 and has steadily increased even with the closure in place. Prior to that, one trail directly south of the cave on a steep talus slope was the only visible trail to the towers.

Use of motorized vehicles on the river may result in increased spills of petroleum products and other contaminants, adversely affecting water quality. Decreases in water quality could affect bird and mammal species that use marsh and backwater vegetation types (e.g., California leaf-nosed bat, pale Townsend's big-eared bat, western red bat) to forage on invertebrates. The effect on bat species from contaminants and pollutants is expected to be an adverse, short-term, negligible impact.

As human activity in riparian zones along the Lower Gorge increases, fire frequency is also likely to increase (Busch 1995). As fire frequency increases, and as tamarisk and arrowweed continue to dominate areas after fires, more disturbances of species that use riparian vegetation types for forage (e.g., pale Townsend's big-eared bat, western red bat, Mexican and pocket free-tailed bats) would likely occur.

Human disturbance at current use levels would have localized, adverse, short- to long-term, year-round, moderate impacts on bat species.

Mitigation of Effects. Previous mitigation efforts indicate that specific measures could be effective in reducing impacts to terrestrial wildlife, if adequate funding, staffing, monitoring, and implementation of the measures were maintained. Reasonable mitigation actions would be the same as those listed on page 465. In addition, the following mitigations ***may be considered singly or in combination, to reduce impacts to terrestrial wildlife from implementation of*** the Lower Gorge alternatives:

- Conduct surveys and research, as appropriate, to collect information necessary to better define the species habitat requirements
- Design and implement inventory and monitoring plans for ungulates and their habitats
- Maintain existing important yellow-billed cuckoo habitat areas
- Avoid disturbance of bird species during the breeding season
- Conduct surveys to determine the distribution of bat species
- ***Continue*** existing leopard frog surveys and monitoring and protection efforts
- Design and implement monitoring protocols and ***resources*** database ***that are compatible*** with other conservation planning efforts (e.g., databases developed ***and maintained by*** the Glen Canyon Dam Adaptive Management Program and the ***Lower*** Colorado River Multi-Species Conservation Program)
- As data gaps are identified, design and implement monitoring actions directed toward ***little known*** species ***in*** the Lower Gorge (i.e., mammals, amphibians, insects)
- Develop and use consistent monitoring and research protocols

Cumulative Effects. In addition to the cumulative actions described above in "Methodology for Analyzing Effects to Terrestrial Wildlife: Cumulative Effects," two additional effects are applicable in the Lower Gorge. Development on Hualapai tribal lands in the Quartermaster area would continue to have moderate to major adverse impacts on use of the area as wildlife habitat, and some species and individuals have likely already been displaced from the area. However, based on the amount of available habitat adjacent to or near the developed area, it is unlikely that there are more than localized, adverse, short- to long-term, year-round, moderate effects and regional, adverse, short- to long-term, year-round, minor effects on wildlife and wildlife habitat.

Extensive helicopter and motorized boat use in the Quartermaster area could cause localized, adverse, short- to long-term, seasonal to year-round, major impacts to wildlife populations in this area because bird and ungulate species could abandon this habitat due to the increased disturbance, resulting in a loss of bird species diversity within the area. However, helicopter use in this area, which is under Hualapai tribal control, is expected to continue at current or increased levels independent of the alternatives analyzed in this document.

The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of alternative 1 on terrestrial wildlife, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 1 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

Conclusion. Under Alternative 1 the majority of visitor access would continue to occur in the spring and summer. Overall, most terrestrial species would continue to experience adverse, long-term, moderate to major impacts. Under some conditions impacts from habitat modification at campsites, disturbance from boats and helicopter traffic, and ingestion of pollutants would be observable and measurable. There could be moderate to major impacts on nesting bird habitat from the continued unregulated use of motorized vessels within sensitive roosting and nesting areas in the area.

In summary, Alternative 1 ***without additional mitigations*** would result in continued adverse, regional and local, short- and long-term, moderate to major impacts to invertebrates, mammals (ungulates, beavers, and bats), reptiles and amphibians, and birds in the area of analysis. Alternative 1 would not result in the impairment of terrestrial wildlife resources of Grand Canyon National Park. Cumulative effects would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 1 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

4.2.7.6.3 Alternative 2

Analysis. This alternative would eliminate the use of the pontoon operation in the Quartermaster area and associated helicopter flights. HRR would be restricted to two day trips per day in the peak season, with a maximum of 30 people each, and one trip per day in the non-peak season. One additional campsite would be constructed (requiring vegetation clearing) on Hualapai tribal land for HRR use. HRR overnight trips would be increased to one per day, with a maximum group size of 30 people.

Invertebrates—On the few heavily used beaches in the Lower Gorge ant densities would continue to persist at the levels described in Alternative 1. As this problem is directly related to human activity and improper organic garbage disposal, the increase in HRR overnight trips would increase potential for higher ant densities.

Reptiles and Amphibians/Mammals—Habitat modification, as discussed in Alternative 1, and human disturbance would probably be the greatest threats to mammals in the Lower Gorge. With the increase in HRR overnight trips there would be a parallel increase in remote side canyon hiking and possible trampling of amphibian habitat and young. There would also be an increase in the displacement of woody material due to campfire fuel use, campsite establishment, and grooming that would likely further affect small mammal and reptile local populations.

There would likely continue to be minor impacts to reptiles in the Lower Gorge but major impacts to amphibians. An increase in recreational activity that leads to habitat modification and disturbance would have adverse effects on these species.

Birds—Eliminating pontoon boat operations and associated helicopter flights could benefit certain bird species, such as migratory hawks, in the Quartermaster and Burnt Springs area.

This alternative would reduce recreation-related impacts on migratory hawks, as well as peregrine falcons, to the minor level. Recreational use impacts to neotropicals are primarily due to habitat destruction and nesting disturbance but would be greatly reduced under this alternative.

Overall, the impact on birds from an increase in motorized vessels would meet the major impact threshold. Motorized use would occur at critical times during nesting season and migration periods. Habitat in this area is limited, and there could be an increase in mortality of these species based on the increasing use of motorized vessels in the inflow areas and around important nesting areas. However, the decrease in helicopter traffic would likely benefit most raptor species. The benefits associated with the elimination of helicopter flights and pontoon boats would likely be negated by continued helicopter use outside the park.

Mitigation of Effects. As described for Alternative 1, previous mitigation efforts indicate that specific measures could be effective in reducing impacts to terrestrial wildlife, if adequate funding, staffing, monitoring, and implementation of the measures were maintained. Reasonable mitigation actions would be the same as those listed on pages 465 and 494.

Cumulative Effects. Under Alternative 2 it is expected that the overall number of helicopter flights in the Quartermaster area would remain at about the same levels as now, even though they would not be transporting pontoon boat passengers under this alternative. Compared to Alternative 1 there would be little or no change in the cumulative effect on bird species from helicopters. This would result in adverse, localized, short- to long-term, major cumulative impacts in the Quartermaster area on lands adjacent to the park in the river corridor.

As described for Alternative 1, development on Hualapai tribal lands in the Quartermaster area would continue to have moderate to major adverse impacts on use of the area as wildlife habitat, and some species and individuals have likely already been displaced from the area. Based on the amount of available habitat nearby, it is unlikely that there would be more than localized, adverse, short- to long-term, year-round, moderate effects and regional, adverse, short- to long-term, year-round, minor effects on wildlife and wildlife habitat.

The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major. Cumulatively, the effects of Alternative 2 on terrestrial wildlife, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 2 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

Conclusion. Due to the construction of a campsite, surface compaction, and human disturbance, additional nesting habitat would be lost, resulting in adverse, minor to moderate impacts to birds. Adverse impacts to mammals would remain at the moderate to major levels for cave-dwelling bats and small mammals. The increase in overnight passenger launches could increase adverse impacts from disturbance to such species as beaver, ungulates, and carnivores.

In summary, Alternative 2 ***without additional mitigations*** would result in adverse, regional and local, short- and long-term, minor to major impacts to terrestrial wildlife species. Alternative 2 would not result in the impairment of terrestrial wildlife resources in Grand Canyon National

Park. Cumulative effects would be regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects. Alternative 2 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.2.7.6.4 Alternative 3

Analysis. Alternative 3 is characterized by a slight decrease in average daily HRR use (from one day trip of 100 people to three day trips with 30 people each), but up to 400 pontoon boat passengers per day. Upriver trip takeouts would be allowed based on continuation of trip takeout needs. An additional commercial use, jetboat tours, would be allowed, with a maximum of two tours per day. A floating, formal dock would be allowed at RM ***262.5***, contingent on environmental compliance and removal of the "informal" docks at RM 262 and 263.

Invertebrates—Increased HRR overnight use, and a possible increase in day use by jetboat tours at beaches and campsites, would likely increase organic attractants to some invertebrate species such as ants, causing a nuisance. Increased activity at these sites would likely have localized, adverse, short-term, year-round, minor effects on invertebrate species.

Amphibians and Reptiles/Mammals—As discussed in Alternative 1, habitat modification and human disturbance would continue to be the greatest threats to amphibians, reptiles, and mammals. Due to an increase in HRR overnight trips, there would also be a greater loss of woody material being used for campfires, as well as displacement for campsite establishment and grooming, which would likely further affect small mammal and reptile local populations. Noise from motorized vessels would also cause disturbance. There would be an increase in remote side canyon hiking and possible trampling of amphibian habitat and young if closures were not established and enforced during the critical breeding and rearing periods.

An increase in interactions between humans and wildlife would be expected from increased visitation at he picnic and pontoon sites, as well as by the addition of jetboats and visitors to previously less impacted sites.

The effect on large mammals from contaminants, pollutants, and noise in the corridor environment would likely increase with the addition of jetboat tours. Although the enormous volume of the Colorado River would dilute the contaminant concentrations to a very low level, fuel discharges from motorized boats and the potential for accidents involving oil and fuel spills would be greater.

Aquatic mammal species have been documented as not only being disturbed by watercraft, but also subject to mortalities (Serfass, pers. comm. 2002). The addition of jetboats, which typically operate at much higher speeds that pontoon craft, could be expected to injure or kill beavers utilizing the Lower Gorge.

Birds—As described for Alternative 1, motorized use would occur at critical times during nesting season and migration periods. Habitat in this area is limited, and there could be an increase in mortality of these species as a result of more motorized vessels in the inflow areas and around important nesting areas. An increase of winter passengers on pontoon boats to 400 per day would substantially increase the flushing of overwintering and migratory birds, resulting in an adverse, moderate impact. Ravens and starlings would likely expand their range of habituation to more sites where attractants were available. Overall, the impact on birds from increased motor vessel use would be considered an adverse, major impact.

Mitigation of Effects. As described for Alternative 1, previous mitigation efforts indicate that specific measures could be effective in reducing impacts to terrestrial wildlife, if adequate funding, staffing, monitoring, and implementation of the measures were maintained. Reasonable mitigation actions would be the same as those listed on pages 465 and 494.

Cumulative Effects. As described for Alternative 1, development on Hualapai tribal lands in the Quartermaster area would continue to have moderate to major adverse impacts on use of the area as wildlife habitat, and some species and individuals have likely already been displaced from the area. Based on the amount of available habitat nearby, it is unlikely that there would be more than localized, adverse, short- to long-term, year-round, moderate effects and regional, adverse, short- to long-term, year-round, minor effects on wildlife and wildlife habitat.

The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major. Cumulatively, the effects of Alternative 3 on terrestrial wildlife, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 3 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

Conclusion. An increase in HRR overnight trips would result in more adverse human/wildlife interactions. An increase of winter passengers on pontoon boats to 400 per day would substantially increase the flushing of overwintering and migratory birds, resulting in an adverse, moderate impact. The addition of jetboat tours would adversely impact bird and mammal species. An increase in visitation into remote side canyons would likely impact amphibians, ungulates, and carnivores due to increased disturbance to wildlife utilizing these once-remote side canyon areas and secluded shorelines. More visitors flying in by helicopter and the addition of jetboat tours would increase the potential for impacts on species such as ravens, starlings, some invertebrate ant species, and perhaps even coyotes, as experienced elsewhere in the park, particularly at picnic areas. Impacts would be adverse and major for migratory raptors.

In summary, Alternative 3 ***without mitigations*** would have regional and local, adverse, short- and long-term, minor to major impacts on wildlife species. Alternative 3 would not result in the impairment of terrestrial wildlife resources in Grand Canyon National Park. Cumulative effects would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 3 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

4.2.7.6.5 Modified Alternative 4 (NPS Preferred Alternative)

Analysis. ***Modified*** Alternative 4 would have a variable number of trips per day, with up to 40 people (including guides) per trip during the peak season and a variable number of trips per day with up to 35 people during the non-peak season. For pontoon operations there would be a ***maximum daily capacity of 480 passengers, possibly increasing up to 600*** plus associated helicopter operations. Four upriver trip takeouts per day would be allowed, plus tow-outs. A floating, formal dock would be allowed at RM 262.5.

Invertebrates—A large increase in overnight HRR use at beach and campsites would likely result in organic attractants to some invertebrate species such as ants, causing a nuisance. Habitat modification would likely result in a reduction in species diversity and breeding habitat. The level of activity proposed in this alternative would have an adverse, minor effect on invertebrate species.

Amphibians and Reptiles/Mammals—As discussed in Alternative 1, habitat modification and human disturbance would continue to be the greatest threat to mammals at campsites and in remote side canyons in the Lower Gorge. With an increase in HRR overnight trips, there would continue to be an adverse effect on woody material being used for campfires, as well as being displaced for campsite establishment and grooming, which would likely further adversely affect local small mammal and reptile populations. Increased disturbance from motorized vessels might also affect some ungulate species and aquatic mammals using the shoreline due to longer trips. There would likely be an increase in remote side canyon hiking, resulting in the possible trampling of amphibian habitat and young if closures were not set in place and enforced during critical breeding and rearing periods.

Interactions between humans and wildlife would likely increase at campsites, the helipad, and picnic area sites.

The effect on large mammals from the introduction of contaminants and pollutants into the corridor environment could be expected to remain adverse, short-term, minor, the same as Alternative 1.

Birds—Bird species would continue to be affected by the use of motorized vessels during nesting and migration periods. Habitat in the Lower Gorge is limited, and there could be adverse impacts to breeding birds based on increased use of motorized vessels in the inflow areas and around important nesting areas. Overall, the impact on birds would be considered adverse and major.

Mitigation of Effects. As described for Alternative 1, previous mitigation efforts indicate that specific measures could be effective in reducing impacts to terrestrial wildlife, if adequate funding, staffing, monitoring, and implementation of the measures were maintained. Reasonable mitigation actions would be the same as those listed on pages 465 and 494.

Cumulative Effects. As described for Alternative 1, development on Hualapai tribal lands in the Quartermaster area would continue to have moderate to major adverse impacts on use of the area as wildlife habitat, and some species and individuals have likely already been displaced from the area. Based on the amount of available habitat nearby, it is unlikely that there would be more than localized, adverse, short- to long-term, year-round, moderate effects and regional, adverse, short- to long-term, year-round, minor effects on wildlife and wildlife habitat.

The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major. Cumulatively, the effects of ***Modified*** Alternative 4 on terrestrial wildlife, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. ***Modified*** Alternative 4 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

Conclusion. ***Modified*** Alternative 4 ***without additional mitigations*** would have adverse, short- and long-term, moderate to major impacts to wildlife species both regionally and locally. ***Modified*** Alternative 4 would not result in the impairment of terrestrial wildlife resources in Grand Canyon National Park. Cumulative effects would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. ***Modified*** Alternative 4 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

4.2.7.6.6 Alternative 5 (Hualapai Tribe Proposed Action)

Analysis. Alternative 5 would be the same as ***Modified*** Alternative 4 except for pontoon boat operations and upriver travel. Under Alternative 5 there would be a dramatic increase in pontoon operations, with a maximum of seven boats carrying a maximum of 960 passengers each day in the Quartermaster area, plus associated helicopter flights. Upriver travel would be allowed only below RM 273, and no jetboat tours would be allowed.

Invertebrates—Insect problems would likely increase substantially because of proposed use levels under this alternative. Ant densities would be much higher on heavily used beaches than at relatively unused beach areas because of human activity and improper organic garbage disposal. Flesh and blow fly populations would also show an increase in density at heavily used campsites, particularly at sites with improper fecal and organic waste disposal, as many vessels traveling upriver from Lake Mead do not have sanitation facilities. With high levels of use and the increase in established campsites, woody riparian vegetation, which provides habitat for invertebrate species would be expected to decrease. Impacts to invertebrates would likely be adverse, short-term, and minor to moderate.

Amphibians and Reptiles/Mammals—As discussed in Alternative 1, habitat modification and human disturbance would continue to be the greatest threat to mammals at campsites and in remote side canyons in the Lower Gorge. With an increase in HRR overnight trips, there would continue to be an adverse effect on woody material being used for campfires, as well as being displaced for campsite establishment and grooming, which would likely further adversely affect local small mammal and reptile populations. Increased disturbance from motorized vessels might also affect some ungulate species and aquatic mammals using the shoreline due to longer trips. There would likely be an increase in remote side canyon hiking, resulting in the possible trampling of amphibian habitat and young if closures were not set in place and enforced during critical breeding and rearing periods.

Under Alternative 5 the increase in pontoon and associated helicopter traffic would likely have an increased adverse impact on large mammal distribution and, consequently, their predators. As described for Alternative 1, ungulates and carnivores would likely change their movement patterns in response to increased aircraft overflights, construction noise, and park visitors. With the large number of helicopter flights per day in the Quartermaster area, large mammal could be completely displaced for several surrounding miles.

It is likely that Alternative 5 would substantially increase the interactions between humans and wildlife, possibly resulting in management actions to minimize conflicts. These management actions could result in the direct reduction of some wildlife species such as coyotes, squirrels, and deer (GRCA wildlife files).

The effect on large mammals from the introduction of contaminants and pollutants into the corridor environment could be expected to remain adverse, short-term, minor, the same as Alternative 1.

Overall impacts on reptiles, amphibians, and mammals at the proposed level of use would be adverse, long-term, and major.

Birds—Bird species would continue to be affected by the use of motorized vessels during nesting and migration periods. Habitat in the Lower Gorge is limited, and there could be adverse impacts to breeding birds based on increased use of motorized vessels in the inflow areas and around important nesting areas. Overall, the impact on birds would be considered adverse and major.

Mitigation of Effects. As described for Alternative 1, previous mitigation efforts indicate that specific measures could be effective in reducing impacts to terrestrial wildlife, if adequate funding, staffing, monitoring, and implementation of the measures were maintained. Reasonable mitigation actions would be the same as those listed on pages 465 and 494.

Cumulative Effects. As described for Alternative 1, development on Hualapai tribal lands in the Quartermaster area would continue to have moderate to major adverse impacts on use of the area as wildlife habitat, and some species and individuals have likely already been displaced from the area. Based on the amount of available habitat nearby, it is unlikely that there would be more than localized, adverse, short- to long-term, year-round, moderate effects and regional, adverse, short- to long-term, year-round, minor effects on wildlife and wildlife habitat.

The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major. Cumulatively, the effects of Alternative 5 on terrestrial wildlife, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 5 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate to major contribution to these cumulative effects.

Conclusion. Under alternative 5 the large number of helicopter flights in the Quartermaster area would greatly impact and likely displace migratory raptors and large mammals, causing adverse, major impacts. Impacts to amphibians and reptiles would likely remain at a major level under this alternative. The impacts of recreational use on neotropical migrants due to disturbance by the large number of motorized boats passing nesting areas could result in adverse and moderate impacts. Winter use of pontoons and the constant flushing and harassment of over wintering raptors and waterfowl would be an adverse, major impact.

In summary, Alternative 5 ***without additional mitigations*** would have regional and local, minor to major, adverse, long-term impacts to wildlife species. Alternative 5 would not result in the impairment of the terrestrial wildlife resources in Grand Canyon National Park. Cumulative effects would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 5 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate to major contribution to these cumulative effects.

4.2.8 AQUATIC RESOURCES

4.2.8.1 ISSUES

The following resource comments were received during public scoping:

- Protect ecological resources is the NPS's first priority
- Protect near-river springs and seeps, and tributaries, because they are valuable resources
- Protect threatened and endangered species
- Close off areas experiencing excessive impacts
- Use an adaptive management approach and improve resource monitoring
- Manage invasive exotic species
- Restore natural conditions
- Eliminate motor use to protect aquatic resources

Aquatic resources occur in both the Colorado River mainstem and in the numerous side canyon streams and springs that make up the river system. Although Glen Canyon Dam fundamentally changed the character of the Colorado River in Grand Canyon from a flood-prone river with a wide range of water temperatures and sediment loads to dam-controlled flows with a narrow range of water temperatures and reduced sediment loads, the system does retain important elements of the predam river.

Four native fish species occur in the Colorado River in Grand Canyon National Park: the humpback chub (an endangered species), the flannelmouth sucker (a candidate species), the bluehead sucker, and the speckled dace. ***As Grand Canyon National Park shares a boundary with Lake Mead, razorback sucker (an endangered species), may exist in the Lower Gorge.*** The tributaries in the Grand Canyon are vital for the persistence of native fish populations; the tributaries are spawning grounds for adult fish and rearing areas for juveniles.

Protection of the ecological resources of the canyon, particularly the near river springs, seeps, and tributaries are an important aspect of NPS management of the river corridor. Side canyon tributaries and springs are attraction sites for river runners throughout the year, although most ***wading and swimming*** occurs during the summer. Minimizing visitor impacts to fragile aquatic resources is necessary to ensure the continued success of the resource.

Recreational impacts on aquatic resources are well documented in many national parks. Recreational impacts on streams have been documented in Great Smoky Mountains National Park (Larson and Hammitt, 1981) and in springs in Death Valley National Park, where areas have been closed to recreationists due to impacts (USFWS 1980). Wright and Li (1998) reported that river runners reduced aquatic insect abundance in an Oregon stream of similar size to Bright Angel Creek. Aquatic communities are relatively resilient and generally recover in 30 days after most types of disturbance (flooding, road construction, etc.) end (Yount and Niemi 1990); however, park streams and springs can have sustained, repetitive seasonal impacts that to date have not been evaluated. Sappington (1998) found that recreational activities in the Virgin River in Zion National Park reduced fish abundance of native fishes, particularly young fish. Gorman and Gorman and Stone (1999) reported a reduction in catch rates over the past decade in the Little Colorado River near the confluence with the Colorado River; recreational activity is a suspected cause.

PHOTO 4- 7: RECREATIONISTS ROIL SUBSTRATES

Although more field experiments are needed, outboard engine exhaust (Tjarnlund et al. 1995) and noise (Schoilk and Yan 2002) are deleterious to fish health and alter behavioral patterns. The New Zealand mudsnail, an exotic pest species, has recently been found in several tributaries that are popular river runner attractions. These visitors may be inadvertently spreading these snails up tributaries (Shannon et al. 2003). Trailing across established trails along stream banks and bottoms increases impacts of erosion and sedimentation. Disturbance of substrates by walking in streams through fish, amphibian, and invertebrate egg masses can affect these resources, as does the creation of dams and channels with rocks. Dams disturb aquatic habitat and impede stream flow, and can block migrating fishes. Recreational activities such as playing in tributaries can alter fish behavior (spawning, rearing, and feeding) and alter water quality from lotions and bug spray. Wakes from motorized boats can create bank erosion and dislodge riparian vegetation that provides shade and an abundance of insect life for aquatic species. Native fish can be caught during recreational angling. Pollution from camp and lunch stop waste (primarily food scraps) and human fecal waste that wash into tributaries, mainstem backwaters, and springs can affect water quality and the aquatic resources that depend on them. Recreationists have indirect impacts on aquatic resources by adversely affecting water quality (see the "Water Quality" section), water discharge, physical substratum, trophic biomass, and community composition.

4.2.8.2 GUIDING REGULATIONS AND POLICIES

The aquatic resources in Grand Canyon National Park are protected and managed in a manner according to the mandates established by the following; The NPS Organic Act of 1916, the Clean Water Act of 1948, the Wilderness Act of 1964, the Wild and Scenic Rivers Act of 1968, the National Environmental Policy Act of 1969, the Endangered Species Act of 1973, Exotic Organisms Act of 1977, Protection of Wetlands Act of 1977, Federal Compliance with Pollution Control Standards Act of 1978, Pollution Prevention Act of 1990, Grand Canyon Protection Act of 1994, and Executive Order 13112, "Invasive Species."

NPS *Management Policies 2001* (NPS 2000a) direct park management to understand, maintain, restore, and protect the inherent integrity of natural resources, processes, systems and values of the park. To the extent possible, the NPS allows natural processes, including the evolution of species, to control landscape and population level dynamics, assuming that all of the components of the natural systems remain intact. The preservation of fundamental physical and biological processes, as well as individual species, plant communities, and other components of naturally evolving ecosystems, is inherent in management direction. The NPS will maintain as parts of the natural ecosystems of parks all native plants and animals through:

PHOTO 4- 8: STREAM AT DEER CREEK

- Preserving and restoring the natural abundance, diversities, dynamics, distributions, genetic and ecological integrity, and behaviors of native species and the communities and ecosystems in which they occur.
- Restoring native species in parks when they have been extirpated by past human-caused actions.
- Initiating the return of human-disturbed areas to natural conditions (or the natural trajectory), including the processes characteristic of the ecology zone.
- Minimizing human impacts on native species, communities, and ecosystems, and the processes that sustain them.
- Preventing the introduction of exotic species and removing established populations.
- Monitoring natural systems and human influences upon them to detect change and developing appropriate management actions.
- Protecting watersheds, as complete hydrologic systems, primarily by avoiding impacts to watershed and riparian vegetation, and by allowing natural fluvial processes to proceed unimpeded.
- Preserving, enhancing and restoring the natural and beneficial values of wetlands.

"Grand Canyon National Park 2004 Commercial Operating Requirements IV":

A. 1. Cans, rubbish and other refuse may not be discarded in the water or along the shore of the river, in side canyon, on trials, along escape routes, or in any other portions of the canyon. All refuse material must be carried out.

2. The use of soap is restricted to the mainstem of the Colorado River only. Use of soap in side streams or within 100 yards of the confluence of any side stream and the main river is prohibited.

B. Each boat party must carry a washable/reusable toilet system capable of containing and removing solid human waste from the canyon. A washable/reusable toilet must be accessible during the day.

"Superintendent's Compendium": Areas restricted to day-use only include the following tributaries, springs and seeps

- Little Colorado River confluence (RM left 60–65)
- Shinumo Creek (RM 109)
- Elves Chasm (RM 116.5)
- Deer Creek confluence (1/2 mile upstream or downstream on the north side of the river at RM 136)
- Columbine Falls (within 200 yards of the bay at RM 274.3)

4.2.8.3 Management Objective for Aquatic Resources

The management objective for aquatic resources, as stated in Chapter 1, is to manage river recreation use in a manner that protects native aquatic organisms, reduces aquatic habitat alteration, and minimizes the spread of exotic species.

4.2.8.4 Methodology for Analyzing Impacts to Aquatic Resources

The general process for assessing impacts to the environment is discussed in Section 4.1 of Chapter 4. Effects specific to aquatic resources are characterized for each alternative based on the impact thresholds presented below. The overall impact rating depends upon the interaction of context, duration, timing, and intensity of each identified impact. Impacts on aquatic resources were analyzed using the best available data for species locations, past aquatic monitoring reports, and the most recent published research on aquatic communities in Grand Canyon National Park and similar streams in the region. Impacts to aquatic resources could be negligible, minor, moderate, and major. Context, duration, and timing are resource based and are generally similar for each of the alternatives. Intensity is more likely to vary by alternative.

4.2.8.4.1 Impact Thresholds

Intensity

Negligible—Impacts to the aquatic environment would not result in detectable effects to aquatic organisms or populations in the Colorado River, tributaries, or springs.

Minor—Adverse: Impacts to the aquatic environment would result in detectable effects to aquatic organisms or populations in the Colorado River, tributaries, or springs. These changes would be temporary and the resource would return to pre-impact condition within a few days.

Beneficial: Impacts would result in short-term improvements in the aquatic habitat.

Moderate—Adverse: Impacts to the aquatic environment would result in detectable effects to aquatic organisms or populations in the Colorado River, tributaries, or springs. These changes would not be permanent, and the resource would rebound to pre-impact numbers after one season.

Beneficial: Impacts would result in habitat improvement and a reduction in invasive species.

Major—Adverse: Impacts to the aquatic environment would result in detectable effects to aquatic organisms or populations in the Colorado River, tributaries, or springs, which would likely result in long-term to permanent changes. In extreme cases, species may be extirpated from the park.

Beneficial: Impact that would result in the restoration of native species and elimination of invasive species.

Context

Localized—Impacts would occur to aquatic resources at attraction sites with aquatic features, in tributaries, or at seeps or springs.

Regional—Impacts would occur in the mainstem Colorado River within a management zone.

Duration

Short-term—Impacts would occur to an individual, population, or habitat and would range from one day to a season, with no lingering results.

Long-term—Impacts would occur to an individual, population, or habitat and would last longer than one season and longer than the life span of an individual animal.

Timing

Impacts to aquatic resources can be time sensitive. There is no dormant period in aquatic ecosystems. Mainstem impacts would likely be more pronounced during low-volume discharge months (such as May and October) than high volume months (July and January). Spawning and growth of young-of-the-year fish in tributaries are also sensitive periods. Summer is a period of low discharge, peak water temperatures, and the lowest dissolved oxygen levels, so fish are more easily stressed. ***Recreational impacts to aquatic resources are more likely in the summer due to the high air temperatures and the increased desire of visitors to interact with water to cool off, especially in side streams.*** Monsoon storms (summer-fall) can cause flooding that impacts aquatic resources.

4.2.8.4.2 Mitigation of Effects

Previous mitigation efforts indicate that specific measures can be effective in reducing impacts to terrestrial wildlife, if adequate funding, staffing, monitoring, and implementation of the measures are maintained. ***A list of possible*** mitigation measures ***to be considered singly or in combination, that are*** not already incorporated into the alternatives, ***but*** are judged likely to reduce impacts to aquatic resources ***if implemented*** include the following:

- Increase visitor education and awareness
- Develop baseline data for impact detection and restoration
- Develop and implement aquatic resource monitoring program to access impacts

- ***Consider closing*** sensitive sites and impacted areas ***or limiting access to aquatic attractions to fewer groups at one time***
- Consistent with the 1989 *Colorado River Management Plan* Limits of Acceptable Change standards: restrict activities in known humpback chub habitat. This includes the mouth of the Little Colorado River during critical time periods
- Restrict river runner use of Tapeats and Kanab creeks to day use only; no camping at the mouths of these creeks
- Use limited site closures to assess impacts of visitation
- Construct and maintain trails along tributaries and springs getting ***hiking*** out of the streambeds
- Prohibit the construction of man-made rock obstructions (dams) and actively remove them ***from sensitive tributaries***
- ***Consider reducing*** swimming and wading ***in sensitive tributaries***
- Restrict angling in areas inhabited by sensitive, threatened, or endangered fishes
- Remove exotic aquatic species where feasible and monitor recovery
- Enforce Commercial Operating Regulations regarding sanitation procedures, camp kitchen waste disposal and use of the day tripper. ***Study the effects of pharmaceuticals and personal care products on aquatic resources***

Current NPS management efforts to mitigate impacts to aquatic resources include restricting recreational angling within 1 mile of the Little Colorado River, removal of trout from Bright Angel Creek, and surveys of native and introduced fishes in several side canyon tributaries. The effectiveness of management actions in Bright Angel Creek will be evaluated over the next several years by monitoring the native fish populations in the creek and through estimates of trends in the brown trout population in the mainstem by the Glen Canyon Dam Adaptive Management Program, ***Grand Canyon Monitoring and Research Center. The NPS will continue to allow angling of nonnative fish to reduce predation on and competition with native fish.*** Lack of scientific data, challenges with working in remote desert environments, the need to balance access with protection of species, and limitations in park staff and funding contribute to the difficulty park staff have in mitigating current levels of impacts to aquatic resources. ***See the Biological Assessment Appendix F for a description of aquatic studies to be included in the CRMP Implementation Plan.***

NPS has analyzed the alternatives without specific mitigation measures because without appropriate baseline data on the effects of recreational activities on aquatic resources, it would be difficult to determine exactly which mitigation measures should be employed. Also, mitigation measures for aquatic resources may cause adverse effects to other resources including visitor use and experience. Specific mitigation measures will be described in the CRMP implementation plan. The type and levels of mitigation will be based upon the results of the monitoring program.

4.2.8.4.3 Cumulative Impacts

Cumulative impacts on aquatic resources were determined by combining the impacts within each alternative with other past, present, and reasonably foreseeable future action (see Section 4.1 of Chapter 4 for a detailed list of all actions).

Mainstem. Impacts on native fishes from angling are caused primarily by backcountry users in the Marble Canyon area and near Bright Angel Creek. Angling has a cumulative adverse, minor to moderate, short-term, effect. The major factor affecting aquatic resources in the mainstem and wetlands along the Colorado River is the existence and operation of Glen Canyon Dam. The effects of the dam far outweigh the effects of river recreationists on aquatic resources in the river corridor. The dam has favored the formation of new cold-water aquatic habitats that should remain relatively stable under current operating conditions. Federal and state agencies have introduced non-native cool-water, invertebrates and fishes, which compete with and prey on native species. Cumulative impacts from Glen Canyon Dam and the introduction of exotic species are adverse, regional, long-term, year-round and major.

Regional drought, which could result in reduced base flow of tributaries, could intensify the negative impacts of recreational activity at attraction sites. ***Reduced spring and seep flow can stress aquatic flora and fauna.*** Regional drought can also affect the level of Lake Mead and reduce the level of the mainstem Colorado River in the Lower Gorge. Regional drought has regional, adverse, short-term, year round, ***negligible to moderate*** effects on aquatic resources.

Tributaries and Springs. Federal and state agencies have introduced non-native fishes, primarily trout, into several tributaries. Trout compete with and prey on native fishes. Recreational angling ***(an activity more common to backcountry users) can help reduce nonnative fish populations, but anglers may accidentally catch and remove native fish.*** In addition to river runner use, the major factors affecting aquatic resources in side canyon tributaries are backcountry hikers and researchers. The lower reaches of most tributaries are more heavily impacted by river runners while the upper reaches are more heavily impacted by backcountry hikers. Backcountry hikers and commercial mule riders probably dominate the use of Bright Angel Creek. ***Impacts to water quality from stock use are discussed in Chapter 4: Environmental Consequences "Water Quality."*** Watershed management plans, such as tributary flow regulation, ground water pumping, and controlled burns, could also alter tributary water quality and flows ***and indirectly affect aquatic resources. Cumulative impacts to aquatic resources in tributaries and springs are adverse, moderate to major, short- to long-term, seasonal and localized.***

4.2.8.4.4 Assumptions

General assumptions used in the analysis of effects for each alternative are discussed in Section 4.1 of Chapter 4. Assumptions that specifically relate to alternatives presented in this document and their effect on aquatic resources are presented below.

- The existence and operation of Glen Canyon Dam and the elevation of Lake Mead are the dominant impacts on aquatic resources in the mainstem Colorado River in Grand Canyon National Park.

- The influence of Lake Mead extends 36 miles up into the Lower Gorge at full pool.
- Regionally, recreational impacts to aquatic resources are generally negligible to minor due to the large area of the mainstem Colorado River and short-term nature of the effects.
- Aquatic resources in tributaries and springs are more sensitive and prone to recreational impacts than the mainstem.
- At least 62 of 261 recreational sites in Grand Canyon National Park have an aquatic feature (Appendix C, Table 1), and are visited on a daily basis during summer months.
- The probability of impacts to aquatic resources occurring in tributaries and springs increases as the level of visitation increases.
- Decreasing trip lengths and group size and shifting use to the fall and winter can mitigate increasing visitor access (total estimated user-days).
- Longer trips have ***more opportunity for layover days that provide*** increased amounts of time for visitors to interact with the canyon environment. This increased time has the potential to allow greater interaction with aquatic resources. This is particularly true for side canyon hiking during spring and fall, and shelter seeking and the desire to cool off in water during hot summer months. Off-season hiking (shoulder and winter months) are more conducive to exploring side canyons, as the extreme heat of the summer precludes hiking too far from the river itself, but users are less likely to get into the water to swim.
- Backcountry users contribute to visitor impacts in the backwaters and wetlands along the mainstem and in side canyon tributaries and springs. Their effects would be additive.
- Contamination by ***pharmaceuticals and*** personal care products ***(PPCPs) as well as*** human waste occurs along the river and in side canyons. Changes in water quality from ***the introduction of PPCPs most likely*** adversely ***impacts*** aquatic resources, ***but additional research is needed.***
- An increase in numbers of motor boats operating within a localized area increases motor related impacts to aquatic resources.

4.2.8.5 IMPACT ANALYSIS—LEES FERRY ALTERNATIVES

4.2.8.5.1 Alternative A (Existing Condition)

Analysis. Under Alternative A, management of recreational use would continue to allow large group sizes with a maximum commercial group size of 43, long trips with a maximum winter trip length of 30 days, and spikes in trips and people at one time, and daily launches (see Table 4- 1). User-days would remain capped at current levels, which would result in approximately 22,500 passengers per year. Highest use occurs in the summer months and lowest use in the winter months. ***Annual*** user discretionary time would ***be at*** the lowest ***level*** of all the alternatives. Whitmore exchanges would occur year-round and there would be a three-month no-motor season in the fall. Both motor and oar commercial trips would be allowed in the winter.

Erratic launch patterns (with a maximum of nine launches per day in summer) and the highest number of trips and people at one time create crowding at attraction sites. The major attraction sites with aquatic features would continue to experience many 100+ and 150+ visitor days in the summer (Table 4- 21). Large numbers of visitors per day repeatedly using tributaries and seeps and springs in the late spring and summer months can have significant impacts on aquatic resources and habitat during critical months of the year. This has localized, adverse, seasonal, short- to long-term, moderate to major effects on aquatic resources.

TABLE 4- 21: PREDICTED VISITATION LEVELS AT MAJOR ATTRACTION SITES WITH AQUATIC FEATURES (MAY–AUGUST)

	Alternatives							
	A	B	C	D	E	F	G	Modified H
Days with 100+ Visitors								
Little Colorado River	28	0	1	11	0	0	0	0
Shinumo Creek	53	0	5	86	0	2	3	0
Elves Chasm	75	0	80	98	2	11	5	0
Deer Creek	66	1	64	109	12	4	8	0
Matkatamiba	4	0	48	3	0	0	0	0
Havasu Creek	79	0	73	102	11	0	4	0
Days with 150+ Visitors								
Little Colorado River	11	0	0	0	0	0	0	0
Shinumo Creek	14	0	2	11	0	0	0	0
Elves Chasm	18	0	8	30	0	1	0	0
Deer Creek	24	0	27	32	0	0	0	0
Matkatamiba	0	0	9	0	0	0	0	0
Havasu Creek	36	0	39	31	0	0	0	0

Note: Based on data from the Grand Canyon River Trip Simulator.

This alternative also allows for large group sizes up to 43 people, which increases the probability that a larger surface area of the tributary streambed would be impacted. Larger groups are more likely to disturb larger areas (Hendee, Stankey, and Lucas 1990). When several large groups visit attraction sites at the same time, the probability of impacting aquatic resources magnifies and impacts such as roiling substrates, bank erosion, trampling of riparian vegetation, disturbing food sources and egg masses, dam building, polluting water with personal care products and creating multiple trailing are more likely to occur. This has localized, adverse, seasonal, short- to long-term, moderate to major effects on aquatic resources.

Many campsites are located near tributaries, and camp and lunch waste (primarily food scraps) and human fecal waste can wash into tributaries, mainstem backwaters, and springs, affecting water quality and the aquatic resources that depend on them. Under current condition, results from the Colorado River Human Impact Monitoring Program (Brown and Jalbert 2003) showed evidence of human waste at 18 of the 25 sites monitored during July and October 2003. Although all river trips are required to carry out all solid human waste, these regulations do not have 100% compliance. Camp-related pollution has localized, adverse, seasonal, short-term, negligible to minor effects.

Low user discretionary time and low use in the spring are beneficial to aquatic resources, but longer trip lengths that encourage layover days and allow people more time to hike further up tributaries, make sensitive side canyon resources more vulnerable to impacts. The probability of spreading exotic species farther up into side canyons increases with larger groups of people with more time to hike further up tributaries. Longer trip lengths have localized, adverse, short- to long-term, seasonal to year-round, moderate effects on aquatic resources.

Under this alternative, there is a three-month no-motor season in the fall. The benefits of a no-motor season are a reduction in pollution from motor fuel and exhaust and the removal of disturbance to fish from motor noise. These benefits are not likely to significantly improve aquatic resource conditions, since fish spawn in the spring and young-of-the-year need protection in early to mid summer. A motor season in the spring and summer adversely affects aquatic resources in the mainstem. Motor pollution and noise has regional to localized, adverse, short- to long-term, seasonal, negligible to minor effects.

Mainstem (Regional)—Recreational impacts to aquatic resources in the Colorado River are negligible to minor, short-term, and seasonal. Research in other parks indicates that noise and petroleum contaminants from motor boats adversely affect aquatic resources at detectable levels, but are short-term. Recreational impacts to native fishes in the mainstem could result from anglers inadvertently catching native fishes while angling for trout; however there are no recreational fishing river trips along this stretch of river and angling is not a common river running activity.

Tributaries and Springs (Localized)—Recreational impacts to aquatic resources in tributaries and springs (roiling substrates, disturbing bank sediments and vegetation, dislodging fish eggs, etc.) are adverse and ***minor*** to major. Impacts would be detectable and in some cases, aquatic resources would not return to pre-impact conditions within one season. High use in the summer season when river runners seek shade and cool water in side canyons during the summer heat adversely affects aquatic resources during critical summer months. These impacts would be localized to attractions with aquatic features, short-term, and seasonal (summer). Repeated annual heavy use of sensitive side canyon tributaries or springs could lead to long-term impacts on species abundances and diversity. The low number of users in the spring helps protect fish during the spawning season.

Mitigation of Effects. Actions required to mitigate effects in an attempt to reduce impacts to minor, would include ***a subset*** of the mitigation measures identified in the ***"Mitigation of Effects"*** section above. An increase in funding and staff over current levels would be needed year-round. The increase in mitigations would be at a reasonable and attainable level.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Impacts to Aquatic Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short-term to long-term, seasonal to year-round, and ***negligible*** to major. Cumulatively, the effects of Alternative A on aquatic resources, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative A would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

Conclusion. Alternative A would have adverse, regional to localized, short-term to long-term, seasonal, negligible to major effects on aquatic resources. There would be negligible effects from current conditions. Alternative A would not result in the impairment of aquatic resources in Grand Canyon National Park. Cumulatively, the effects of Alternative A on aquatic resources, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative A would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

4.2.8.5.2 Alternative B

Analysis. Under Alternative B recreational motor trips would be prohibited and group sizes, people at one time, daily launches, user-days, and estimated total yearly passengers at the lowest ***of all the action alternatives*** (see Table 4- 1). Maximum trip length would be substantially reduced from current condition down to 18 days and maximum commercial group size would be reduced from 43 to 25 people. An eight person noncommercial trip would be added. Total user discretionary time increases in all seasons due to the lack of shorter motor trips. There would be no Whitmore Helicopter exchanges. Total user-days would be about the same as current; however total number of passengers per year decreases by around 10,000. No commercial trips would be allowed in the winter.

Controlling the number and types of trips that can launch each day helps reduce trips at one time and people at one time and thereby reduces crowding and congestion at attraction sites in the summer (Table 4- 21). By reducing group sizes, fewer people would be recreating in streams at one time and the area of impact would occur over a smaller area. This alternative reduces the number of passengers in the spring and summer, protecting aquatic resources during critical months. This would have localized, beneficial, short- to long-term, seasonal, minor to moderate effects on aquatic resources from current conditions.

Although user discretionary time goes up, reducing total user-days and total number of feet in the streams would have beneficial effects to aquatic resources. Reducing trip length would minimize the number of days users can layover at sites, as well as time to impact sensitive sites up side canyons. The reduced trip lengths in conjunction with the increased user discretionary time would mean that users would be spending much of their time at sites along the river corridor, thereby protecting tributary sites. Users would be less likely to spread exotic species farther up into side canyons. Reducing trip length would have localized, beneficial, short- to long-term, seasonal to year-round, minor to moderate effects on aquatic resources from current conditions.

Under this alternative, there would be no motors year-round. This would have localized to regional, beneficial, short- to long-term, seasonal, negligible to minor effects on aquatic resources from current conditions by reducing pollution from fuel and exhaust, as well as lowering disturbance to aquatic life from motor noise.

Mainstem (Regional)—Same as Alternative A, except pollution from motor fuel and noise from motor boats would not be an issue, reducing impacts to negligible.

Tributaries and Springs (Localized)—Reduced number of launches per day, consistent launch patterns, a reduction in trips at one time and people at one time, and reduced group size and trip length would all be beneficial to aquatic resources and improve conditions over current. ***User discretionary time would increase and*** allowing public access to aquatic attraction sites even at the reduced numbers proposed under Alternative B would still cause adverse, seasonal, short-term to long-term, minor to moderate effects on tributary and spring aquatic resources. Impacts would be detectable, but resources would likely return to pre-impact conditions after one season.

Mitigation of Effects. Actions required to mitigate effects in an attempt to reduce impacts to minor, would include ***a subset*** of the mitigation measures identified in the ***"Mitigation of Effects"*** section above. An increase in funding and staff over current levels would be needed year-round. The increase in mitigations would be at a reasonable and attainable level.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Impacts to Aquatic Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and ***negligible*** to major. Cumulatively, the effects of Alternative B on aquatic resources, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major. Alternative B would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. Alternative B ***without mitigations*** would have adverse, regional to localized, short-term to long-term, seasonal, and negligible to moderate effects on aquatic resources. There would be beneficial, regional to localized, short-term, year-round, minor to moderate effects on aquatic resources from current conditions**.** Alternative B would not result in the impairment of aquatic resources in Grand Canyon National Park. Cumulatively, the effects of Alternative B on aquatic resources, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major. Alternative B would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.8.5.3 Alternative C

Analysis. Under Alternative C, motors would be eliminated, maximum group size would be reduced to 30 people and maximum trip length to 21 days. Trips at one time and people at one time would be reduced, while total annual user-days would increase by around 100,000 (see Table 4- 1). User-day levels double in the shoulder seasons. Total user discretionary time would also double, with the greatest increase in winter and shoulder seasons. Launches per day would be reduced to four in the summer, three in the shoulder seasons, but increased to two in the winter months. There would be approximately 3,000 more passengers per year. Commercial oar trips would be allowed in the winter.

Controlling the number of trips that could launch each day would help reduce trips at one time and people at one time and could relieve crowding and congestion at attraction sites. However under the high-use levels proposed in Alternative C and with all trips moving at about the same pace, the numbers of people visiting attraction sites per day in the summer would still be about as high as under current condition (Table 4- 21). So the new launch pattern would have a negligible effect on aquatic resources from current conditions. By reducing group sizes, fewer people would be recreating in streams at one time and the area of impact would occur over a smaller area. Reducing trip length would minimize the number of days users would be laying over at sites, as well as time to impact sensitive sites up side canyons. Users would less likely to spread exotic species farther up into side canyons. Reducing group size and trip length would have localized, beneficial, short- to long-term, seasonal to year-round, minor to moderate effects on aquatic resources from current conditions.

Unlike Alternative B, this alternative doubles the number of passengers in the spring, which would make aquatic resources more vulnerable during this critical time, ***but does reduce summer use, which would benefit aquatic resources.*** Annual user discretionary time would substantially increase, as would total number of user-days and total number of passengers. ***Together these*** would have localized, adverse, short- to long-term, seasonal, ***minor*** to major effects on aquatic resources. A large increase in user-days, people at one time, and user discretionary time in the winter would represent new use at a time of year when aquatic resources are probably less sensitive to disturbance and when river runners are not playing in the water. This new winter use would probably have negligible effects on aquatic resources.

Under this alternative there would be no motors year-round. This would be beneficial to aquatic resources by reducing amount of petroleum contamination, as well as disturbance to aquatic life from motor noise.

Mainstem (Regional)—Same as Alternative A with the benefits of no motors year-round

Tributaries and Springs (Localized)—Recreational impacts to aquatic resources in tributaries and springs would be adverse and ***minor*** to major because of the large increases in spring and summer user discretionary time as well as the high numbers of trips all traveling at the same speed ***stopping at attraction sites at the same time***. Changes to aquatic resources would be detectable. In some instances, aquatic resources would return to pre-impact condition within a season, but in other cases, impacts would be long-term and permanent. Summer is the peak river running season when visitors swim in tributaries. This alternative ***has high user discretionary time in the summer*** during ***a*** critical season, which would have adverse effects. Impacts would be localized to attractions with aquatic features, short-term, and seasonal (spring and summer). Repeated heavy annual use of sensitive side canyon tributaries and springs would lead to long-term adverse impacts on species abundances and diversity.

Mitigation of Effects. Actions required to mitigate effects in an attempt to reduce impacts to minor, would include ***a subset*** of the mitigation measures identified in the ***"Mitigation of Effects"*** section above. An increase in funding and staff over current levels would be needed year-round. The increase in mitigations would be at a reasonable and attainable level.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Impacts to Aquatic Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and ***negligible*** to major. Cumulatively, the effects of Alternative C on aquatic resources, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major. Alternative C would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

Conclusion. Alternative C ***without mitigations*** would have adverse, regional to localized, short-term to long-term, seasonal, and negligible to major effects on aquatic resources. There would be beneficial, regional to localized, short-term, year-round, negligible to moderate effects on aquatic resources from current conditions**.** Alternative C would not result in impairment of the aquatic resources of Grand Canyon National Park. Cumulatively, the effects of Alternative C on aquatic resources, when combined with other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major. Alternative C would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

4.2.8.5.4 Alternative D

Analysis. Alternative D is a mixed use alternative. Under this alternative, maximum commercial group size is 25. Trip lengths are reduced from current in the summer and shoulder seasons, but a maximum trip length of 30 days is allowed in the winter. An eight person noncommercial trip would be added. Total annual user-days increase by about 50,000 (see Table 4- 1). This alternative has the highest total user discretionary time. There are four no-motor months that occur in the shoulder seasons to coincide with the high backcountry use season. Trips at one time and people at one time and total passengers are reduced from current. Motor trips are allowed in the winter. There would be no Whitmore helicopter exchanges. Commercial motor and oar trips are allowed in the winter.

Controlling the number of trips that can launch each day helps reduce trips at one time and people at one time and can relieve crowding and congestion at attraction sites. However under the particular mix of trip types numbers of people visiting aquatic attraction sites per day in the summer is higher than current at some sites (Table 4- 21). This would have localized, adverse, short- to long-term, seasonal, negligible to minor effects on aquatic resources from current conditions. Similar to Alternatives B and C, by reducing group sizes, fewer people would be recreating in streams at one time and the area of impact would occur over a smaller area. The reduction in group size would have localized, beneficial, short- to long-term, seasonal, minor to moderate effects on aquatic resources from current conditions.

Reducing trip length would minimize the number of days users can layover at sites, as well as time to impact sensitive sites up side canyons. Although user discretionary time increases, users would most likely spend more time at sites adjacent to the river since trip lengths are shorter. Users are less likely to spread exotic species farther up into side canyons. Shorter trip lengths would have localized, beneficial, short- to long-term, seasonal, minor to moderate effects on aquatic resources from current conditions. Noncommercial winter trip lengths would still be 30 days, but aquatic resources are less vulnerable in the winter months and fewer people play in the water due to colder temperatures, thus having negligible effects.

The number of passengers in the spring would remain relatively low, and no motors would be allowed in the spring. These actions would protect aquatic resources during this critical season. This would have localized to regional, beneficial, short- to long-term, seasonal, moderate effects.

Mainstem (Regional)—Same as Alternative A, except the no-motor season in the spring would be beneficial over current conditions.

Tributaries and Springs (Localized)—Recreational impacts to aquatic resources in tributaries and springs would be adverse and moderate because there would be detectable changes but not permanent. Adverse impacts would occur due to the increases in user discretionary time and the number of days that major attraction sites with aquatic features would experience an increase in the number visitors. Summer continues to have high use and is the peak river running season and river runners seek shade and cool water in side canyons during the summer heat. However, in the spring season, aquatic resources are protected with low numbers of passengers and small group sizes. Impacts would be localized to attraction sites with aquatic features, short-term to long-term, and seasonal (spring and summer).

Mitigation of Effects. Actions required to mitigate effects in an attempt to reduce impacts to minor, would include ***a subset*** of the mitigation measures identified in the ***"Mitigation of Effects"*** section above. An increase in funding and staff over current levels would be needed year-round. The increase in mitigations would be at a reasonable and attainable level.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Impacts to Aquatic Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and ***negligible*** to major. Cumulatively, the effects of Alternative D on aquatic resources, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major. Alternative D would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

Conclusion. Alternative D ***without mitigations*** would have adverse, regional to localized, short-term to long-term, seasonal, and negligible to moderate effects on aquatic resources. There would be beneficial, minor to moderate effects from current conditions. Alternative D would not result in impairment of the aquatic resources of Grand Canyon National Park. Cumulatively, the effects of Alternative D on aquatic resources, when combined with other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major. Alternative D would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.2.8.5.5 Alternative E

Analysis. Alternative E is a mixed use alternative. Under this alternative, maximum commercial group sizes are reduced to 30 people for motor trips and 25 people for oar trips. An eight person noncommercial trip would be added. Maximum trip lengths in all seasons are reduced from current. There is a six month no-motor season from October to March (see Table 4- 1).

Helicopters at Whitmore only operate from April to September. Maximum trips at one time and people at one time are reduced from current, while total annual user-days increases by approximately 60,000. Launch patterns allow six launches in the summer, three during shoulder seasons and two in the winter. There are no commercial trips allowed in the winter.

Under the mix of use types and launch pattern proposed in Alternative E, there is a reduction in trips at one time and people at one time and numbers of people visiting aquatic attractions per day in summer (Table 4- 21). This helps to relieve crowding and congestion at attraction sites and would indirectly reduce impacts to aquatic resources, having localized, beneficial, short- to long-term, seasonal, minor to moderate effects from current conditions. By reducing group sizes, fewer people would be recreating in streams at one time and the area of impact would occur over a smaller area. Reducing trip length would minimize the number of days users can layover at sites, as well as time to impact sensitive sites up side canyons. Users would be less likely to spread exotic species farther up into side canyons. Reducing group size and trip length would have localized, beneficial, short- to long-term, seasonal to year-round, minor to moderate effects on aquatic resources from current conditions.

User-days and user discretionary time in the spring increase, but total number of passengers during the shoulder season remains low and trip lengths are the shortest of all alternatives. Although river recreationists may have more user discretionary time, the use would likely occur within the river corridor and not up side canyons because they would not be staying as long at river stops. This would have localized, beneficial, short- to long-term, seasonal to year-round, minor to moderate effects on aquatic resources from current conditions. An increase in user-days, passengers, and user discretionary time in the winter represents new use at a time of year when aquatic resources are probably less sensitive to disturbance and when river runners are not playing in the water and intentionally seeking out side canyon tributaries to escape high air temperatures, would have a negligible effect on aquatic resources.

The no-motor season would be October to March. Eliminating motor boat noise and fuel contaminants in March would benefit aquatic species at the beginning of the spawning season. In April, motor trips would be limited to one launch per day. This would have localized to regional, beneficial, short- to long-term, seasonal, negligible to minor effects.

Mainstem (Regional)—Same as Alternative A, with some benefit to aquatic resources having the no-motor season in March.

Tributaries and Springs (Localized)—Recreational impacts to aquatic resources in tributaries and springs would be adverse and ***minor to*** moderate because there would be detectable changes but not permanent. The new launch pattern, group size and trip length reduction would benefit aquatic resources over current condition since fewer people at one time would be visiting aquatic attractions. Summer continues to have high use and is the peak river running season and river runners seek shade and cool water in side canyons during the summer heat. Impacts would be localized to attraction sites with aquatic features. Impacts would be long-term when impacts affect species abundances and diversity.

Mitigation of Effects. Actions required to mitigate effects in an attempt to reduce impacts to minor, would include ***a subset*** of the mitigation measures identified in the ***"Mitigation of***

Effects" section above. An increase in funding and staff over current levels would be needed year-round. The increase in mitigations would be at a reasonable and attainable level.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Impacts to Aquatic Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and ***negligible*** to major. Cumulatively, the effects of Alternative E on aquatic resources, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major. Alternative E would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. Alternative E ***without mitigations*** would have adverse, regional to localized, short-term to long-term, seasonal, and negligible to moderate effects on aquatic. There would be negligible to moderate effects from current conditions. Alternative E would not result in impairment of the aquatic resources of Grand Canyon National Park. Cumulatively, the effects of Alternative E on aquatic resources, when combined with other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major. Alternative E would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.8.5.6 Alternative F

Analysis. Alternative F is a mixed-use alternative with six months of mixed use ***of mixed use and six months of nonmotorized use.*** The no-motor season would occur July through December (see Table 4- 1). Daily launch patterns would allow a maximum of six trips per day in the summer, four in the shoulder seasons and two in the winter. Helicopter exchanges at Whitmore would occur only during the January to June motor season. Commercial winter trips would be allowed. Maximum commercial group size would be 30 people and trip lengths would be reduced in all seasons. An eight person noncommercial trip would be added. Trips at one time and people at one time are reduced, while annual user discretionary time increases and number of total passengers per year rises by around 3,000.

Similar to Alternative E, the mix of use types and launch pattern proposed would reduce trips and people at one time and numbers of people visiting aquatic attractions per day in summer (Table 4- 21). This would help relieve crowding and congestion at attraction sites and would indirectly reduce impacts to aquatic resources. By reducing commercial group size to 30, fewer people would be recreating in streams at one time and the area of impact would occur over a smaller area. These actions would have localized, beneficial, short- to long-term, seasonal to year-round, minor to moderate effects on aquatic resources from current conditions.

Reducing trip length would minimize the number of days users can layover at sites, as well as time to impact sensitive sites up side canyons. Although user discretionary time would increase, users would most likely spend more time at sites adjacent to the river because of shorter trips. Users would be less likely to spread exotic species farther up into side canyons. Reducing trip length would have localized, beneficial, short- to long-term, seasonal to year-round, minor to moderate effects on aquatic resources from current conditions.

Under this alternative, user-days and number passengers would double in the spring, and five motorboat launches per day would occur in May and June. Together these actions would have localized to regional, adverse, short- to long-term, seasonal, minor to moderate effects on aquatic resources, especially fish.

Mainstem (Regional)—Increased spring/early summer use would have greater adverse effects on aquatic resources than in Alternative A, making regional impacts negligible to moderate.

Tributaries and Springs (Local)—Recreational impacts to aquatic resources in tributaries and springs would be adverse and ***minor*** to major because there would be detectable and possible permanent changes to the resource. Large increases in spring user discretionary time and shoulder season passengers adversely affect aquatic resources during a critical time period. Summer use is still high during the season when aquatic resources are vulnerable and visitors are most likely to swim in the water. Impacts would be localized to attractions with aquatic features, short-term to long-term, and seasonal (spring and summer).

Mitigation of Effects. Actions required to mitigate effects in an attempt to reduce impacts to minor, would include ***a subset*** of the mitigation measures identified in the ***"Mitigation of Effects"*** section above. An increase in funding and staff over current levels would be needed year-round. The increase in mitigations would be at a reasonable and attainable level.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Impacts to Aquatic Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and ***negligible*** to major. Cumulatively, the effects of Alternative F on aquatic resources, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major. Alternative F would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

Conclusion. Alternative F ***without mitigations*** would have adverse, regional to localized, short-term to long-term, seasonal, and negligible to major effects on aquatic resources in tributaries and springs. There would be negligible to moderate effects from current conditions. Alternative F would not result in impairment of the aquatic resources of Grand Canyon National Park. Cumulatively, the effects of Alternative F on aquatic resources, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major. Alternative F would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.2.8.5.7 Alternative G

Analysis. Alternative G is a mixed-use alternative. Maximum group size for commercial motor trips would be large, similar to current, at 40 people. Commercial oar trips would have a maximum group size of 30 people. Maximum trip lengths would be reduced from current in all seasons. Launch patterns would allow for six trips to launch in the summer, five in the shoulder months and two in the winter. Shoulder month launches are the highest of all alternatives aside from Alternative A. There would be a four month nonmotor season that would occur from September to December. Total annual user-days would increase by around 78,000 with a slight decrease during summer, doubling in the spring and a ten fold increase in the winter. Trips at one time would decrease significantly with a modest reduction in people at one time from current. User discretionary time is the second lowest. This alternative allows for around a 6,000 increase in number of passengers annually. Winter commercial use is not allowed and Whitmore helicopter exchanges occur from January to August.

Under the mix of use types and launch pattern proposed in Alternative G, trips and people at one time would be reduced, along with the number of people visiting aquatic attractions per day in summer (Table 4- 21). This would help relieve crowding and congestion at attraction sites and would indirectly reduce impacts to aquatic resources, having localized, beneficial, short- to long-term, seasonal to year-round, minor to moderate effects on aquatic resources from current conditions.

This alternative would preserve the large group sizes similar to current conditions. Large groups have greater adverse effects on aquatic resources in tributaries and at springs because people spread out more, disturb larger areas, create more access trails, and increase the level of pollutants. This would have localized, adverse, short- to long-term, seasonal to year-round, moderate to major effects on aquatic resources similar to current conditions.

Alternative G would have a low summer user discretionary time combined with shorter trip lengths, so use would likely be concentrated at sites along the river and not up side canyons. This would have localized, beneficial, short- to long-term, seasonal to year-round, minor to moderate effects on aquatic life in tributaries, affording sensitive, off-river sites some protection.

A doubling of user-days, an increase in the number of passengers by 6,000 people, and five launches per day (the highest of all alternatives) would have localized, adverse, short- to long-term, seasonal, moderate to major effects to aquatic resources in the critical spring months.

There would only be a four month no-motor season that would occur in the fall affording negligible benefits to aquatic resources.

Mainstem (Regional)—Same as Alternative A, but with all motor use in spring and summer and significantly greater number of passengers in the spring. Impact level would be elevated to negligible to moderate.

Tributaries and Springs (Localized)—Recreational impacts to aquatic resources in tributaries and springs would be adverse and ***minor*** to major because there would be detectable and possible permanent changes to the resource. A large increase in shoulder season passengers, in conjunction with a doubling of spring user-days and large group sizes, adversely affect aquatic resources during a critical time period. Summer use is still high during the season when aquatic resources are vulnerable and visitors are most likely to swim in the water. Impacts would be localized to attractions with aquatic features, short-term to long-term, and seasonal (spring and summer).

Mitigation of Effects. Actions required to mitigate effects in an attempt to reduce impacts to minor, would include ***a subset*** of the mitigation measures identified in the ***"Mitigation of Effects"*** section above. An increase in funding and staff over current levels would be needed year-round. The increase in mitigations would be at a reasonable and attainable level.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Impacts to Aquatic Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and ***negligible*** to major. Cumulatively, the effects of Alternative G on aquatic resources, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative G would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

Conclusion. Alternative G ***without mitigations*** would have adverse, regional to localized, short-term, seasonal, and negligible to major effects on aquatic resources. There would be negligible to moderate effects from current conditions. Alternative G would not result in impairment of the aquatic resources of Grand Canyon National Park. Cumulative effects of Alternative G on aquatic resources, when combined with other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative G would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

4.2.8.5.8 Modified Alternative H (NPS Preferred Alternative)

Analysis. ***Modified*** Alternative H is a mixed use alternative, with a ***six and a half month*** no-motor season. This alternative would allow daily launches of six trips in the summer ***first two weeks of September***, three in the shoulder seasons ***except from April 16-30 when there would be four***, and one in the winter. Summer maximum commercial group size would be 32 people and shoulder seasons 24. No commercial trips would be allowed in the winter. An 8-person noncommercial trip would be added. Trip lengths would be reduced from current levels in all seasons. Whitmore ***passenger*** exchanges (***helicopter*** and hiking) would occur ***from April to September. Total annual user-days would increase by 58,000***, with noncommercial user-days almost doubling. Total number of passengers would increase by around ***1,500***, and user discretionary time would increase in all seasons.

Under the mix of use types and launch pattern proposed in ***Modified*** Alternative H, trips and people at one time would be reduced, along with numbers of people visiting aquatic attractions per day in summer (Table 4- 21). No aquatic attractions would receive more than 100 people per day. The proposed launch pattern would be effective in relieving crowding and congestion at attraction sites and would indirectly reduce impacts to aquatic resources, having localized, beneficial, short- to long-term, seasonal, moderate effects from current conditions. Group size is reduced to 32 in the peak season and 24 in the shoulder seasons, to help minimize impacts. Fewer people would be recreating in streams at one time and the area of impact would occur over a smaller area. Reduced group size, especially in the spring, would have localized, beneficial, short- to long-term, seasonal to year-round, moderate effects from current conditions.

Reducing trip length in the high-use season would minimize the number of days users can layover at sites, as well as time to impact sensitive sites up side canyons. Although user discretionary time would increase, users would most likely spend more time at sites adjacent to the river since trip lengths are shorter. They would be less likely to spread exotic species farther up into side canyons. Shorter trip lengths would have localized, beneficial, short- to long-term, seasonal, minor to moderate effects from current condition. Noncommercial winter trip lengths would still be long at 25 days, but aquatic resources would be less vulnerable in the winter because fewer people play in the water due to colder temperatures.

Under this alternative there would be a modest increase in the number of passengers and user-days in the spring. Motor use would ***not*** be allowed in ***March and would ramp up in April, which could have beneficial effects on aquatic resources in*** the spring. These actions would have localized to regional, adverse, seasonal, short- to long-term, negligible to minor effects to aquatic resources.

Mainstem (Regional)—Same as Alternative A, but motor use is limited to one launch per day in the spring.

Tributaries and Springs (Localized)—Recreational impacts to aquatic resources in tributaries and springs would be adverse and ***minor to*** moderate because there would be detectable changes but not permanent. The new launch pattern, group size and trip length reduction would benefit aquatic resources over current condition since fewer people at one time would be visiting aquatic attractions. Summer continues to have high use and is the peak river running season and river runners seek shade and cool water in side canyons during the summer heat. Impacts would be localized to attraction sites with aquatic features. Impacts would be long-term when impacts affect species abundances and diversity.

Mitigation of Effects. Actions required to mitigate effects in an attempt to reduce impacts to minor, would include ***a subset*** of the mitigation measures identified in the ***"Mitigation of Effects"*** section above. An increase in funding and staff over current levels would be needed year-round. The increase in mitigations would be at a reasonable and attainable level.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Impacts to Aquatic Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and ***negligible*** to major. Cumulatively, the effects of ***Modified*** Alternative H on aquatic resources, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. ***Modified*** Alternative H would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

Conclusion. ***Modified*** Alternative H ***without mitigations*** would have adverse, regional to localized, short-term to long-term, seasonal, and negligible to moderate effects on aquatic resources. There would be beneficial, short-term, seasonal, negligible to moderate effects from current conditions. ***Modified*** Alternative H would not result in impairment of the aquatic resources of Grand Canyon National Park. Cumulative effects of ***Modified*** Alternative H, when combined with other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. ***Modified*** Alternative H would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.2.8.6 Impact Analysis—Lower Gorge Alternatives

Aquatic resource data for the Lower Gorge are more limited than for Lees Ferry to Diamond Creek. Grand Canyon National Park does not have aquatic resource monitoring or mitigation programs in this reach. Some work on aquatic resources is being conducted by the Hualapai Tribe and the Grand Canyon Monitoring and Research Center.

4.2.8.6.1 Alternative 1 (Existing Condition)

Analysis. River recreational use below Diamond Creek includes commercial and noncommercial oar and motor downriver trips continuing to Lake Mead from Lees Ferry, noncommercial and HRR trips launching from Diamond Creek, private boaters traveling upriver from Lake Mead, Hualapai/ Oriental Tour pontoon boats operating in the Quartermaster area, and jetboats that run upriver for passenger take outs, and noncommercial boat tow-outs. The maximum group size for HRR day trips is 100 people year-round; on average, one trip launches per day. Overnight trips average one launch per week and have a maximum group size of 34. Pontoon operations average 188 passengers per day during peak season and ***130*** during non-peak season. Commercial downriver trips continuing on to Lake Mead have a maximum group size of 43. There are two small floating docks in the Quartermaster area for pontoon boat and HRR operations. Upriver travel is unlimited below Separation Canyon. There are no restrictions on the length of stay for commercial or noncommercial users.

Very little recreational impact research has been conducted by park staff between Diamond Creek and Lake Mead; however the Hualapai Division of Cultural Resources (HDCR) documented recreational impacts to various Traditional Cultural Properties (TCPs) in 2001 and 2002. At five of the properties evaluated in 2001 (Whitmore Canyon, Granite Park, Pumpkin Springs, Three Springs Canyon and RM 223), impacts from trailing and on-site camping were observed to be heavy to severe (Jackson et al. 2002).

At Spencer Canyon and Travertine Falls the resource staff observed moderate to heavy human impacts from trailing. Trailing impacts at Travertine were located along the spring and up to the ledge, and also on the upstream side of the spring and in front of the falls. In 2002, the recommendation was to obliterate the social trails to protect resources.

Alternative 1 would continue to allow group sizes up to 100 people. Larger groups are more likely to disturb larger areas (Hendee, Stankey, and Lucas 1990) and the probability is high that a larger surface area of tributary stream beds would be impacted. When several large groups visit attraction sites at the same time (HRR trips and continuing commercial trips), the probability of impacting aquatic resources magnifies and impacts such as roiling substrates, bank erosion, trampling of riparian vegetation, disturbing food sources and egg masses, dam building and creating multiple trailing are more likely to occur. Large numbers of visitors per day repeatedly using aquatic attraction sites (such as Travertine) in the late spring and early summer months can have significant impacts on aquatic resources and habitat during critical months of the year. Repeated annual heavy use of aquatic attractions could lead to long-term impacts on species abundances and diversity. Large group sizes have localized, adverse, year-round, short- to long-term, moderate to major effects on aquatic resources.

Pollution from camp and lunch waste (primarily food scraps) and human fecal waste can wash into tributaries, mainstem backwaters, and springs, affecting water quality and the aquatic resources that depend on them. Under current conditions larger groups and longer trips would increase the chance for pollution from ***pharmaceuticals and*** personal care products. Although silt and thick nonnative vegetation make access to side canyons more difficult, unrestricted trip lengths allow visitors more opportunity to hike up tributaries and access sensitive sites. Pollution and unrestricted trip lengths would have localized, adverse, seasonal to year-round, short- to long-term, minor to moderate effects on aquatic resources.

Use zones in the Lower Gorge (Zones 2 and 3) are considered semi-primitive and rural natural respectively. These zones allow for an increase in total use over Zone 1 in the upper canyon, as well as different types of use, including upriver jetboats, pontoon boat tours, and private boaters using two-stroke motors. Because the temperatures are milder at the west end of the Grand Canyon, use occurs year-round. Jetboat and private boat use is unrestricted. Pontoon boat use currently can reach up to 500 passengers per day, but averages 188 per day. Pontoon boats average 10 people per boat, so there is currently up to 50 pontoon boat trips per day running in a two mile stretch between RM 262.5 and RM 260. Impacts to aquatic life from outboard engine exhaust (Tjarnlund et al. 1995) and noise (Schoilk and Yan 2002) are deleterious to fish health and alter behavioral patterns, and have localized to regional, adverse, short- to long-term, year-round, negligible to minor effects on aquatic resources.

With the drop in Lake Mead water levels, silt banks and mud flats have become prevalent along the river's edge. Wakes from all motor and jetboats contribute to erosion of these newly exposed deposits, changing gentle slopes to sharply cut banks Figure 4.1.1-1 (Mengel pers comm. 2003b). The Hualapai Tribe is especially concerned about impacts to aquatic habitat from wakes from the 40-foot-long jetboats equipped with engines generating up to 1,050 horsepower per boat, and traveling at high speeds (Christensen, pers. comm. 2003). Motorboat and jetboat wakes have localized, adverse, short- to long-term, year-round, minor to moderate effects on aquatic habitat.

Mainstem (Regional)—Recreational impacts to the mainstem would be adverse, short-term, year-round, and negligible to moderate because changes to aquatic resources would be detectable. Due to a lack of data it is unknown whether this impact is permanent. Research in other parks indicates that noise and petroleum contaminants from motor boats adversely affect aquatic resources at detectable levels, but are short-term.

Tributaries and Springs (Localized)—Recreational impacts to aquatic resources in tributaries and springs would be adverse and minor to major because changes to the resource would be detectable and possibly permanent due to large groups and longer trips. Repeated annual heavy use of sensitive side canyon tributaries or springs could lead to long-term impacts on species abundances and diversity.

Mitigation of Effects. Actions required to mitigate effects in an attempt to reduce impacts to minor, would include ***a subset*** of the mitigation measures identified in the ***"Mitigation of Effects"*** section above. An increase in funding and staff over current levels would be needed year-round. The increase in mitigations would be at a reasonable and attainable level.

To attempt to reduce impacts to minor levels, a significant increase in the number of NPS staff to educate users about impacts to aquatic resources, NPS patrols at day use sites to ensure that river runners do not camp there, and several more full time Science Center staff to monitor the effects of recreational use on aquatic resources would be needed. This would take a significant increase in funding specifically designed for these purposes. This increase would not be reasonable or attainable.

In addition, the Hualapai Tribe has considered creating a Visitor Management Plan to address use patterns at heavily used sites, such as Diamond Creek, Quartermaster and Travertine Falls. In cooperation with the Hualapai Tribe, Grand Canyon National Park should develop Limits of Acceptable Change thresholds that would trigger mitigations and management actions at all Lower Gorge aquatic sites. A cooperative monitoring and site rehabilitation program should be initiated. The Hualapai Tribe is considering plans to regulate human waste disposal and employ use restrictions at Travertine Canyon. They have also proposed that HRR boatman monitor client activities so that natural resources are not impacted by visitors. ***Work with the*** Hualapai Tribe ***to implement*** EPA regulations and develop a hazardous material containment plan ***to*** properly ***store*** pontoon boat fuel ***and to develop*** procedures to follow in the event of a fuel spill at RM 262.5.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Impacts to Aquatic Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and ***negligible*** to major. Cumulatively, the effects of Alternative 1 on aquatic resources, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 1 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

Conclusion. Alternative 1 ***without mitigations*** would have adverse, regional to localized, short-term to long-term, seasonal to year-round, and negligible to major effects on aquatic resources. There would be negligible effects from current conditions. Alternative 1 would not result in impairment of the aquatic resources of Grand Canyon National Park. Cumulative effects of alternative 1 on aquatic resources, when combined with other past, present and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 1 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

4.2.8.6.2 Alternative 2

Analysis. Recreational use would be at the lowest levels under Alternative 2. Maximum group size for HRR day trips would be reduced from 100 to 30. There would be two HRR day trip launches per day during peak season and one per day during non-peak season. Maximum group size for overnight trips would be reduced from 34 to 30, and one trip would launch per day. Total number of HRR passengers per day would be 48 in the peak season and 24 in the non-peak season, compared to 100 passengers per day throughout the year. There would be no docks at Quartermaster and no pontoon boat tours. Two jetboats would be allowed to travel upstream to RM 262 to pick up commercial passengers. Trip lengths for all users would be reduced to four days.

A reduction in group size to 30 people and a cap on the number of launches from Diamond Creek per day would have would have localized, beneficial, short- to long-term, year-round, moderate effects on aquatic resources from current conditions, especially in the tributaries and springs, the primary attraction sites. The number of HRR day trips would increase to two in the peak season, but these would be much smaller groups with a substantial reduction in total number of daily passengers per day. HRR overnight trips would be limited to one per day with a group size of 30 and one campsite on river left would be designated for this use. Fuel pollutants and noise from pontoon boats would be eliminated, having a localized, beneficial, long-term, year-round, minor to moderate effect from current conditions. Jetboats would be limited to two commercial pick ups per day during the peak season and none during the non-peak season, limiting adverse effects from jetboats and having regional to localized, short- to long-term, seasonal, negligible to minor benefits from current conditions. Upriver travel including jetboats and private motor boats would only be allowed to travel up to RM 262, which could provide some benefit to aquatic resources in Zone 3.

All groups would be limited to a maximum trip length of four days. Reducing trip length would minimize the number of days users can layover at sites, as well as time to impact sensitive sites up side canyons. Users would be less likely to spread exotic species farther up into side canyons. Limiting trip length would have localized, beneficial, short- to long-term, seasonal to year-round, moderate effects from current conditions.

Mainstem (Regional)—Recreational impacts to aquatic resources in the Colorado River would be reduced from current and adverse effects would likely be short-term, year-round and negligible to minor primarily due to the elimination of pontoon boats.

Tributaries and Springs—Recreational impacts to aquatic resources in tributaries and springs would be adverse and minor to moderate. River running occurs throughout the year in the Lower Gorge and river runners seek shade and cool water in side canyons on hot days. Impacts would be localized at attraction sites with aquatic features, but would be short- to long-term if continued daily use lead to adverse impacts on species abundances and diversity. There would be beneficial, minor to moderate impacts to tributaries and springs relative to current conditions because of smaller groups and less overall use.

Mitigation of Effects. Since impacts would not be higher than minor, mitigation ***measures*** could continue at current levels. Mitigations may be any of the mitigation measures identified in the "Mitigation of Effects" section above.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Impacts to Aquatic Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and ***negligible*** to major. Cumulatively, the effects of Alternative 2 on aquatic resources, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 2 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. Alternative 2 ***without mitigations*** would have adverse, regional to localized, short-term to long-term, seasonal to year-round, and negligible to moderate effects on aquatic resources. There would be beneficial, localized, short-term, minor to moderate effects on aquatic resources from current conditions. Alternative 2 would not result in impairment of the aquatic resources of Grand Canyon National Park. Cumulatively, the effects of Alternative 2 on aquatic resources, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 2 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.8.6.3 Alternative 3

Analysis. The mix of recreational use in Alternative 3 would be similar to current conditions. Maximum group size for HRR day trips would be reduced from 100 to 30. There would be three HRR day trip launches per day during peak season and two per day during non-peak season. Maximum group size for overnight trips would be reduced to 30 from 34 and two trips would launch per day. There would be one dock at Quartermaster and pontoon boat tours would carry up to 400 passengers per day. Four jetboats would be allowed to travel upstream to Separation Rapids to pick up commercial passengers.

A reduction in group size to 30 people and a cap on the number of launches from Diamond Creek per day would have beneficial effects on aquatic resources, especially in the tributaries and springs, the primary attraction sites. The number of HRR day trips would increase to three in the peak season, but these would be much smaller groups with a total number of daily passengers reduced slightly. HRR overnight trips would be increased to two per day with a group size of 30, but these groups would be utilizing two campsites on river left designated for this use. Reduced group size would have localized, beneficial, short- to long-term, year-round, moderate effects on aquatic resources from current conditions. All groups would be limited to a maximum trip length of eight days. Reducing trip length would minimize the number of days users can layover at sites, as well as time to impact sensitive sites up side canyons. Users would be less likely to spread exotic species farther up into side canyons. Limiting trip lengths would have localized, beneficial, short- to long-term, seasonal to year-round, moderate effects from current conditions.

Fuel pollutants and noise from pontoon boats, as well as boat wakes, would double since the number of passengers per day would go from 188 to 400. This would adversely affect aquatic resources in the mainstem. Along with the increase in number of boats there would be an increase in the amount of pontoon boat fuel stored at RM 262. Currently, this fuel is sling-loaded into the Quartermaster area and stored in gasoline containers in the tamarisk below the old high water mark. The increase in the number of fuel storage containers would increase the possibility of a fuel spill, further adding contaminants to the water and indirectly affecting aquatic resources. Impacts from pollutants and boat wakes would be localized, adverse, short- to long-term, year-round, and moderate.

Four jetboats would be allowed to pick up commercial passengers all the way up to Separation. Impacts from jetboats would be adverse and similar to Alternative 1. There would continue to be no restrictions on private day users coming up from Lake Mead, so impacts from private users would be similar to Alternative 1.

The Hualapai Tribe believes that the creation of a new dock at RM 262.5 would have localized, beneficial, year-round, long-term, minor effects to fish by providing shade.

Mainstem—Same as Alternative 1 with a benefit over current due to smaller group sizes, which is offset by a doubling of pontoon boats.

Tributaries and Springs—Recreational impacts to aquatic resources in tributaries and springs would be adverse and ***minor to*** moderate because there would be detectable, but not likely permanent changes to the resource. Smaller group sizes would be beneficial, but the total number of day use passengers per day would be about the same as Alternative 1. Overnight use would double. Repeated annual heavy use of sensitive side canyon tributaries or springs (such as Travertine) could lead to long-term impacts on species abundances and diversity.

Mitigation of Effects. Same as Alternative 1; however the level of mitigation needed would likely be reasonable and attainable.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Impacts to Aquatic Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and ***negligible*** to major. Cumulatively, the effects of Alternative 3 on aquatic resources, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 3 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. Alternative 3 ***without mitigations*** would have adverse, regional to localized, short-term to long-term, seasonal to year-round, and ***negligible*** to moderate effects on aquatic resources. There would be localized, beneficial, year-round, short- to long-term minor to moderate effects from current conditions. Alternative 3 would not result in impairment of the aquatic resources of Grand Canyon National Park. Cumulatively, the effects of Alternative 3 on aquatic resources, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 3 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.8.6.4 Modified Alternative 4 (NPS Preferred Alternative)

Analysis. ***Modified*** Alternative 4 is a consensus between Grand Canyon National Park and the Hualapai Tribe on levels of HRR use in the Lower Gorge and would be similar to current conditions. ***This alternative represents the NPS's compromise on levels of pontoon boat use based upon all Lower Gorge operations coming under a concessions contract.*** Maximum group size for HRR day trips would be reduced from 100 to 40 during peak season. There would be a variable number of HRR day trip launching each day during peak season and they could carry a maximum of 96 passengers per day. There would be two HRR day trip launches per day during non-peak season with a maximum group size of 35. Group size for overnight trips would be reduced from 34 to 20; three trips would launch per day in the peak season and one in the non-peak season. There would be one small floating dock ***at Quartermaster that would be large enough to accommodate pontoon and HRR boats. Pontoon boat tours would carry up to 480 passengers per day with an increase to 600 upon favorable concessions evaluations and resource monitoring data.*** Four jetboats would be allowed to travel upstream to Separation Rapids to pick up commercial passengers.

The ***increase*** in pontoon boat use to ***480 and possibly 600*** passengers per day would ***increase*** the amount of erosion created by pontoon boat wakes as well as fuel pollutants and noise. This would have a localized, ***adverse***, short- to long-term, year-round, minor to moderate effect on aquatic resources in the mainstem. The increase in the total number of HRR passengers and overnight use would ***have adverse***, year-round, short- to long-term, minor to moderate effects but reducing group size from 100 people to 40 will have ***beneficial, year-round, short- to long-term minor to moderate effects over current condition.*** This group size is higher than what has been proposed as appropriate in the Lees Ferry ***Modified*** Alternative H, but this higher use would be more appropriate in Zone 3. The creation of specific designated camps for HRR overnight trips may help limit impacts to aquatic species, if these camps are not located near the mouths of tributaries.

Trip lengths would be reduced to three nights. This would reduce crowding and congestion and would minimize the number of days users can layover at sites, as well as time to impact sensitive sites up side canyons. Users would be less likely to spread exotic species farther up into side canyons. Limiting trip length would have localized, beneficial, short- to long-term, seasonal to year-round, moderate effects from current conditions.

Four jetboats would be allowed to pick up commercial passengers all the way up to ***RM 240***. Impacts from jetboats would still be adverse and similar to Alternative 1. There would continue to be no restrictions on private day users coming up from Lake Mead, so impacts from private users would be similar to Alternative 1.

The Hualapai Tribe believes that the creation of a new dock at RM 262.5 would have localized, beneficial, year-round, long-term, minor effects to fish by providing shade.

Mainstem (Regional)—Recreational impacts to aquatic resources in the Colorado River would be reduced from current and adverse effects would likely be short-term, year-round and negligible to minor.

Tributaries and Springs—Recreational impacts to aquatic resources in tributaries and springs would be adverse and ***minor to*** moderate because of the ***increase in trips, passengers and a relatively large*** group size of 40 ***for HRR trips***. River running occurs throughout the year in the Lower Gorge and river runners seek shade and cool water in side canyons on hot days. Impacts would be localized to attraction sites with aquatic features, but would be short-term to long-term if continued daily use lead to adverse impacts on species abundances and diversity. There would be minor beneficial impacts to tributaries and springs relative to current conditions because of smaller group sizes and shorter trip lengths.

Mitigation of Effects. Same as Alternative 1; however the level of mitigation needed would be higher due to increased HRR use, but it would likely be reasonable and attainable.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Impacts to Aquatic Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and ***negligible*** to major. Cumulatively, the effects of ***Modified*** Alternative 4 on aquatic resources, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. ***Modified*** Alternative 4 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. ***Modified*** Alternative 4 ***without mitigations*** would have adverse, regional to localized, short-term to long-term, seasonal to year-round, and negligible to moderate effects on aquatic resources. There would be localized, beneficial, year-round, short- to long-term, minor to moderate effects from current conditions. ***Modified*** Alternative 4 would not result in impairment of the aquatic resources of Grand Canyon National Park. Cumulatively, the effects of ***Modified*** Alternative 4 on aquatic resources, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. ***Modified*** Alternative 4 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.8.6.5 Alternative 5 (Hualapai Tribe Proposed Action)

Analysis. Alternative 5 is a consensus between Grand Canyon National Park and the Hualapai Tribe on levels of HRR use in the Lower Gorge and would be similar to current conditions. This alternative is the Hualapai Tribe's proposed alternative for pontoon and jetboat use. Alternative 5 would have the same level of HRR use described in ***Modified*** Alternative 4. There would be one large floating dock at Quartermaster and pontoon boat tours would carry up to 960 passengers per day. Jetboat pick ups would not be allowed and noncommercial tow-outs could only travel upriver to RM 273. There would be no kayak/canoe upriver delivery.

HRR use is exactly the same as in ***Modified*** Alternative 4, so impacts to aquatic resources would be similar to those described in ***Modified*** Alternative 4. This includes beneficial effects from a reduction in group size and trip length, but adverse effects from the total increase in use ***and overnight trips***.

Substantially increasing the number and level of pontoon boat use to 960 passengers per day would increase the amount of erosion created by pontoon boat wakes as well as pollution from fuel and disturbance due to motor noise. This use is concentrated in a two mile stretch and under this alternative would occur constantly for a period of six to eight hours. This high use would have an increased level of adverse impact on aquatic resources in the mainstem. This level may be high enough to displace or affect the health of populations of native fish, but minimal research exists especially at lowering lake levels. Along with this increase in pontoon boat use would be an increase in fuel storage at RM 262.5 that increases the probability of a fuel spill. Impacts to aquatic resources from a large increase in pontoon boat use would be localized, adverse, short- to long-term, year-round, and ***minor to*** moderate.

Commercial jetboat pickups would be eliminated, which would eliminate the effects of jetboat wakes on aquatic habitat along the riverbanks. This would have localized to regional, beneficial, short- to long-term, seasonal, minor to moderate effects on aquatic resources from current conditions.

The Hualapai Tribe believes that the creation of a new dock at RM 262.5 would have localized, beneficial, long-term, year-round, minor effects to fish by providing shade.

Mainstem—Impacts to the main stem would increase under this alternative and be adverse short-term, year-round, ***minor to*** moderate.

Tributaries and Springs—Recreational impacts to aquatic resources in tributaries and springs would be adverse and ***minor to*** moderate because of the ***increase in number of trips and*** group size of 40, but with reduced trip length, passengers would have less time to hike up into side canyons. River running occurs throughout the year in the Lower Gorge and river runners seek shade and cool water in side canyons on hot days. Impacts would be localized to attraction sites with aquatic features, but would be short-term to long-term if continued daily use lead to adverse impacts on species abundances and diversity. Some beneficial effects to tributaries and springs may occur over current condition because of smaller group sizes and shorter trip lengths.

Mitigation of Effects. Same as Alternative 1: Mitigations to reduce impacts to minor would be extensive and at levels that are not reasonable or attainable.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Impacts to Aquatic Resources: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and ***negligible*** to major. Cumulatively, the effects of Alternative 5 on aquatic resources, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 5 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

Conclusion. Alternative 5 ***without mitigation*** would have adverse, regional to localized, short-term to long-term, seasonal to year-round, and ***minor to*** moderate effects on aquatic resources. There would be localized, beneficial, short- to long-term, year-round, minor to moderate effects from current conditions. Alternative 5 would not result in impairment of the aquatic resources of Grand Canyon National Park. Cumulative effects of Alternative 5 on aquatic resources, when combined with these other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 5 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

4.2.9 SPECIAL STATUS SPECIES

4.2.9.1 ISSUES

The issues identified during internal and external scoping meetings pertaining to ***special status*** species include all the issues identified for terrestrial wildlife and vegetation, plus the following:

- Threatened, endangered, ***proposed and candidate species of concern*** should be protected.
- Human-caused impacts to ***special status wildlife*** species associated with boating and recreational use include habitat degradation or modification, introduction of pollutants and contaminants into the environment, and disturbances to individuals or groups of wildlife as described for terrestrial wildlife.

4.2.9.2 GUIDING REGULATIONS AND POLICIES

The guiding regulations and policies for ***special status*** species and their habitats are the same as those for terrestrial wildlife and vegetation with the following addition.

The Endangered Species Act (16 U.S.C. 1531 et seq.) defines the terms and conditions of the federal status of species in a park and requires an examination of impacts on all species federally listed or proposed for listing, and designated ***or proposed*** critical habitats for threatened or endangered species. ***In June 2005,*** the park ***submitted a biological assessment for formal consultation on the effects of the preferred alternatives on threatened and endangered species and their habitats to*** the U. S. Fish and Wildlife Service in compliance with section 7 of the Endangered Species Act. That document makes the Park's official determination of effects on species and is incorporated by reference into the final environmental impact statement for the revised Colorado River management plan ***in Appendix F*** when completed.

The NPS *Management Policies 2001* state that the agency would consider potential effects of actions on state or locally listed species (NPS 2000a). The service is required to perpetuate the natural distribution and abundance of these species and the ecosystems on which they depend. ***Former species of concern to the US Fish and Wildlife Service (former C2 species Fed Reg.***

2/28/96) for which there is no legal status and are not listed by the Arizona Game and Fish Department as Arizona wildlife of special concern, are considered Grand Canyon National Park species of concern by NPS biologists. These species are listed in the table in Chapter 3, but are not analyzed in this chapter due to their lack of legal status.

Arizona does not have a threatened or endangered fish and wildlife statute, but the state does list wildlife species of special concern (ADGF ***1996, AGFD 2003***). State ***species of special concern*** within the park were determined from this ***database***. ***The Arizona Native Plant Law (Arizona revised statutes, Title 3 Agriculture, Chapter 7, Article 1, 3-903) describes Arizona native plants that are protected and require specific permits to collect. There are five salvage restricted plants located in the area of analysis; however none are known to be adversely affected by recreational activities in the river corridor.***

4.2.9.3 Management Objectives

As stated in Chapter 1, the management objectives for ***special status*** species in relation to recreational river use is

- Protect all ***special status*** species and their habitats from impacts associated with river recreational activities.

4.2.9.4 Methodology for Analyzing Effects

4.2.9.4.1 Impact Thresholds

The process for assessing impacts to ***special status*** species is essentially the same as that described for terrestrial wildlife, except it is focused on ***federally threatened, endangered, candidate and Arizona wildlife species of special concern*** listed in Chapter 3.

The analysis of an impact to a particular species or group of species involves examination of the interaction of the context, duration, timing, and intensity of each identified impact, as defined below.

Intensity

Negligible—***Special status*** species would not be affected, or the effects would be at or below the level of detection.

A negligible effect would equate with a “no effect” determination under section 7 of the Endangered Species Act regulations for threatened, endangered, ***or candidate*** species.

Minor—Impacts to ***special status*** species would be perceptible or measurable, but the severity and timing of changes to parameter measurements are not expected to be outside natural variability and are not expected to have effects on populations of sensitive species. Impacts would be outside critical periods.

A minor effect would equate with a determination of “likely to adversely affect” or “not likely to adversely affect” under section 7 of the Endangered Species Act regulations for threatened, endangered, ***or candidate*** species.

Moderate—Impacts to ***special status*** species would be perceptible and measurable, and the severity and timing of changes to parameter measurements are expected to be sometimes outside natural variability, and changes within natural variability might be long-term. Populations of sensitive species might have small to moderate declines, but they are expected to rebound to pre-impact numbers. No species would be at risk of being extirpated from the park. Some impacts might occur during key time periods.

A moderate effect would in most cases equate with a determination of "likely to adversely effect" under section 7 of the Endangered Species Act regulations for threatened, endangered, ***or candidate*** species.

Major—Impacts to ***special status*** species would be measurable, and the severity and timing of changes to parameter measurements are expected to be outside natural variability for long periods of time or even be permanent; changes within natural variability might be long-term or permanent. Populations of sensitive species might have large declines, with population numbers significantly depressed. In extreme cases, a species might be at risk of being extirpated from the park, key ecosystem processes like nutrient cycling might be disrupted, or habitat for any species might be rendered not functional. Substantive impacts would occur during key time periods. Impacts would be long-term to permanent.

A major effect would equate with an "adversely affect with/without a jeopardy opinion" under section 7 of the Endangered Species Act regulations.

Context

Localized—Impacts would occur in a small part of a habitat or range, such as a single campsite, spring, or side canyon.

Regional—Impacts would affect a widespread area of suitable habitats or the range of the population or species within Grand Canyon National Park, such as the entire mainstem of the Colorado River, or widespread among suitable tributaries or side canyons along the river.

Duration

Short-term—Impacts to an individual or habitat area would last from one day up to one year. Short-term impacts to a population would last up to one year.

Long-term—Impacts would be greater than one year. Long-term impacts to a population would be longer than one year.

Timing

Impacts could occur year-round, but generally resources are most sensitive during the spring and summer, when mating (spawning), birthing, and hatching occur.

4.2.9.4.2 Mitigation of Effects

Previous mitigation efforts indicate that specific measures can be effective in reducing impacts to ***special status*** species, if adequate funding, staffing, monitoring, and implementation of the measures are maintained. Reasonable mitigations to consider ***singly or in combination*** for reducing or eliminating impacts to ***special status*** species include ***a subset*** of those listed under

"Terrestrial Wildlife," ***"Aquatic Resources,"*** and "Vegetation," ***which are all contingent upon the availability of funding:***

- Develop and implement monitoring programs for threatened, endangered, ***and candidate*** species
- Close southwestern will flycatcher nest ***sites that are impacted by recreational activities (with 0.5 mile buffer) between May 1 and July 15***
- ***Encourage river running trips (commercial, private, and science) to avoid stopping near Nankoweap Creek (RM 52) in March if eagles are observed in the area. Monitor roosting eagles in the vicinity of Phantom Ranch for three years***
- ***Distribute educational information about condors and brown pelicans to river runners to educate users on how to avoid inappropriate interactions with these birds***
- ***Restrict river access to PACs located up side canyons occupied by Mexican spotted owls during the breeding season (March 1–August 31), where feasible as determined by the Park's wildlife biologist***
- ***If funding is available, monitor impacts of recreational use on vegetation in side canyons occupied by Mexican spotted owls and the impacts of human disturbance on this species within the Park***
- ***If Yuma clapper rails are found in GRCA during the breeding season or if nests are located and these sites are determined by the Park's wildlife biologist to be impacted by recreational activities, then GRCA will establish a closure of suitable breeding habitat, at specific sites with an appropriate buffer, during the length of the breeding season***
- ***Educate river recreationists using the Whitmore Canyon area to not handle or otherwise disturb any desert tortoises they may encounter. Require recreationists to pack their trash out of the area***
- ***Implement the final Conservation Agreement and Rangewide Conservation Assessment and Strategy for the Relict Leopard Frog (Rana onca)***
- ***Conduct surveys of potential nesting habitat for the western yellow-billed cuckoo prior to any new construction or vegetation management; close nesting areas (and a 0.5 mile buffer) during the breeding season if sites are impacted by recreational activities***
- ***Restrict use of the Little Colorado River to protect humpback chub: No boats will be allowed to enter or park in the Little Colorado River. To stop in the vicinity of the Little Colorado River, boats that launched from Lees Ferry may park upstream or downstream of the confluence. Swimming and wading in the Little Colorado River will be allowed year round in the northern half of the river. The southern half of the river from the confluence to the park boundary (located approximately two miles upstream) will be closed to river runner swimming and wading from March 1st to November 30th. River runners hiking the Little Colorado River who need to cross between the north and south sides will be allowed to wade and cross at the established crossing (marked by cairns), approximately 0.2 miles upstream of the confluence. Camping and fishing bans will remain in place. The purpose of these restrictions is to protect native fish habitat (including phragmites along the south bank of the Little Colorado River) and spawning and young of the year humpback chub (an endangered species).***

- ***Fund a study to examine behavioral changes of humpback chub in response to recreation in the LCR (feeding, avoidance of predators, etc.). Determine the levels of pharmaceuticals and personal care products (PPCPs) in the Colorado River and sensitive tributaries, and study the effects of PPCPs on aquatic biota. Implement a study to determine recreational impacts to native fish habitat in tributaries such as Shinumo.***

- ***Conduct surveys in cooperation with Lake Mead NRA of backwaters and side channels in the Lower Gorge-Lake Mead interface, and that portion of Lake Mead NRA where project activities extend, for spawning razorback suckers (use of light traps to catch larvae may be an appropriate means of surveying). Require river runners to avoid recreational use of areas found to be used by razorback suckers during the spawning period.***

- Close ***Upper*** Elves Chasm ***during the peak river runner season, March through October of each year; initiate an educational program for river runners about protecting the Kanab ambersnail at Vaseys Paradise and Upper Elves Chasm. Implement a study to determine recreational impacts to Kanab ambersnail at Vasey's paradise.***
- ***Conduct inventory of bats and bat caves along the river corridor and take management actions to mitigate the impacts of visitors where necessary***
- ***GRCA will work cooperatively with other condor recovery partners and the Hualapai Tribe to determine patterns of condor use (e.g., flight routes) of the Whitmore Canyon and Quartermaster Canyon areas***
- ***GRCA will make condor information available to pilots (including helicopter) at FAA-sponsored pilot safety meetings. GRCA will distribute brochures and make graphics of summer and winter flight routes available to the pilots. Pilots will be asked to actively watch for condors and to maintain safe distances between aircraft and condors.***
- ***In consultation with the Hualapai Tribe, GRCA will work to determine the feasibility of surveying MSO habitat under helicopter flights associated with CRMP in the Quartermaster Canyon area. Contingent upon availability of funding, and if the Hualapai Tribe agrees, GRCA will work with the Tribe to conduct these MSO surveys***
- ***If MSO are found as a result of the surveys, GRCA, in consultation with the Hualapai Tribe and the FAA, will work to determine the necessity and feasibility (i.e., economically, safety-wise) of adjusting helicopter flight routes to avoid resident MSO. If adjustments are deemed to be appropriate and feasible and the parties agree, they will work cooperatively to determine flight route adjustments***
- ***Water Quality mitigations for the preferred Alternative 4 from CRMP FEIS Chapter 4 "Environmental Consequences: Water Quality" would be implemented***

4.2.9.4.3 Cumulative Impacts

Cumulative impacts on ***special status*** species were determined by combining the impacts of each alternative with other past, present, and reasonably foreseeable future actions, as described in Section 4.1 of this chapter.

Because the Colorado River corridor is managed as recommended wilderness, there are few anthropogenic factors that would combine to increase the cumulative effects of river recreation. The major factor cumulatively affecting ***special status*** species in the river corridor is the operation of Glen Canyon Dam. The effects of the dam far outweigh the effects of river recreationists on aquatic and terrestrial habitats, and consequently fish and wildlife, in the river corridor. The dam has created a new vegetative structure that should remain relatively stable under current operations. However, the ongoing erosion of beaches under current operating parameters could result in additional impacts to fish and wildlife resources. As beaches erode, river recreationists tend to move into vegetated areas ***in the old high-water zone*** to accommodate camping needs, resulting in additional wildlife habitat degradation. The impacts to ***special status*** species would be increased as the loss or degradation of habitat accelerated. The effects of habitat alteration and increasing populations of exotic fishes could result in significant impacts on the humpback chub, possibly leading to its extirpation from Grand Canyon National Park. The dam has localized to regional, adverse, long-term, year-round, moderate to major effects on ***special status*** species.

Numerous aircraft overflights occur in flight corridors between Lees Ferry and Diamond Creek (see "Natural Soundscapes"). Because the flight corridors are several thousand feet above the river corridor, the main cumulative effect is the potential for aircraft to collide with a protected bird species, such as a condor ***or brown pelican***. In addition, the high level of helicopter traffic at Whitmore and Quartermaster could cumulatively affect bird species because of noise and potential collisions. This could have localized to regional, adverse, short- to long-term, seasonal to year-round, minor to moderate effects.

Other cumulative effects include the additive nature of impacts generated by recreational hikers who visit the river and the effects of researchers who study various aspects of the canyon's physical and biological nature. These users have localized, adverse, short- to long-term, year-round, moderate effects in all hydrologic zones and up side canyons.

Together, cumulative effects would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major.

4.2.9.4.4 Assumptions

General assumptions used for the analysis of effects of each alternative are discussed in Section 4.1 of Chapter 4. Specific assumptions related to the alternatives and their effect on ***special status*** species include all those listed under the "Terrestrial Wildlife" section, plus the following:

- Alternatives for Diamond Creek to Lake Mead are analyzed for the maximum limits presented in the alternatives.
- There are no threatened, endangered, ***or candidate*** plant species in the area of analysis. Impacts to rare plants are discussed in the "Vegetation" section.

4.2.9.5 IMPACT ANALYSIS—LEES FERRY ALTERNATIVES

Impact ratings for individual ***special status*** species are summarized in Table 4- 22; species not likely to be affected by the ***Lees Ferry*** alternatives are listed in Table 4- 23. The Lees Ferry alternatives are not compared to the Lower Gorge alternatives due to differences in management, density of users, and the length of the river (226 miles from Lees Ferry to Diamond Creek and 50 miles from Diamond Creek to Lake Mead).

TABLE 4- 22: SUMMARY IMPACT RATINGS FOR INDIVIDUAL SPECIAL STATUS **SPECIES—LEES FERRY ALTERNATIVES**

Common Name	Alternatives							
	A	B	C	D	E	F	G	*Modified* H
Kanab Ambersnail	Moderate	Moderate	Major	Major	Moderate	Moderate	Moderate	Moderate
Humpback Chub	Moderate	Moderate	Major	Major	Moderate	Major	Major	Moderate
American Peregrine Falcon	Minor	Moderate	Moderate	Moderate	Minor	Minor	Minor	Minor
Bald Eagle	Minor	Minor	Major	Major	Moderate	Major	Moderate	Moderate
California Condor	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Mexican Spotted Owl	Minor	Moderate	Moderate	Moderate	Minor	Minor	Minor	Moderate
Southwestern Willow Flycatcher	Moderate	Major	Major	Major	Moderate	Moderate	Moderate	***Moderate***
California brown pelican	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***
Desert tortoise (Mohave population)	***Moderate***	***Negligible***	***Minor***	***Moderate***	***Moderate***	***Moderate***	***Moderate***	***Moderate***
Mexican Long-tongued Bat	Moderate	Moderate	Major	Major	Moderate	Moderate	Moderate	Major
Pale Townsend's Big-eared Bat	Moderate	Moderate	Major	Major	Moderate	Moderate	Moderate	Major
Spotted Bat	Moderate	Moderate	Major	Major	Moderate	Moderate	Moderate	Major

TABLE 4- 23: LISTED AND SPECIAL STATUS SPECIES NOT LIKELY TO BE AFFECTED—LEES FERRY ALTERNATIVES

Common Name	Reason Not Likely to be Affected
Wildlife	
Razorback Sucker	Presumed extirpated between Lees Ferry and Diamond Creek; last collected in the Lower Gorge in the early 1990s.
Lowland Leopard Frog	***Presence not confirmed above Diamond Creek.***
Northern Leopard Frog	Although potential habitat is present, a historic population has not been confirmed between Lees Ferry and Diamond Creek.
Relict Leopard Frog	Presence not confirmed above Diamond Creek.
Desert Tortoise ***(Sonoran population)***	Known only to occur in upland habitats in the Lower Gorge, which are rarely visited.
Yellow-billed Cuckoo	Not known to occur from Lees Ferry to Diamond Creek; suitable habitat occurs below Diamond Creek.
Yuma Clapper Rail	Not known to occur from Lees Ferry to Diamond Creek.
Western Red Bat	Occurs in areas where river-based human visitation is rare.
Southwest River Otter	Extirpated from the Grand Canyon.

4.2.9.5.1 Alternative A (Existing Condition)

Analysis. Under Alternative A management of recreational use would continue to allow large group sizes, lengthy trips, and spikes in the numbers of trips and people at one time, as well as daily launches (see Table 4- 1). User-days would remain capped at current levels, which would probably result in approximately the same number of total yearly passengers. Annual user discretionary time would ***be the lowest of all the alternatives***.

All of the impacts discussed in the "Terrestrial Wildlife" section (habitat modification, disturbances, and pollutants/contaminants) could affect ***special status*** species in the same ways they would affect species ***without special status***. However, these impacts could be greater for ***special status*** species due to their smaller and sometimes localized populations and specialized habitat requirements. Most of these impacts could result in a "take" of a federally listed species.* In some cases, an entire Grand Canyon population might be affected because the species only occurs at a few sites along the river.

Impacts to Grand Canyon populations of the Kanab ambersnail, southwestern willow flycatcher, and humpback chub would be regional because those species are concentrated in localized areas and any effects in these areas would affect the entire Grand Canyon population.

Impacts on localized populations and individuals would vary by season. ***Rare*** plants and ***special status*** wildlife are most vulnerable during the spring and summer, so the loss or alteration of habitat and disturbances of individuals during these times would be detectable and could be significant. Some ***special status*** species, such as the southwestern willow flycatcher and ***western yellow-billed cuckoo***, do not occur in the Grand Canyon in fall and winter. Others, such as the bald eagle, are present only in winter.

Kanab Ambersnail—The Kanab ambersnail is vulnerable to trampling and incidental molestation, particularly from April through August at Vasey's Paradise and Elves Chasm, both of which are popular attractions for river recreationists. Although lush growths of poison ivy discourage use of most of the Vasey's site, river runners often stop to draw water from the spring or fish in the eddy. At upper Elves Chasm the snails were originally purposefully released in areas that were not likely to be affected by foot traffic, but the snails are mobile, and the site receives moderate visitation. The ambersnail habitat itself may also be impacted, resulting in population declines during higher visitor use months. Impacts to the Kanab ambersnail would be adverse, regional, short-term, and moderate.

Humpback Chub—Impacts to the humpback chub would occur spring through fall due to the high potential for people to visit and swim in the lower reaches of the Little Colorado River, which is the primary spawning and nursery area in the Grand canyon and in the Colorado River below Glen Canyon Dam. Recent population estimates for the humpback chub in and near the Little Colorado River indicate a significant decline in numbers over the last decade (Van Haverbeke and Coggins 2003; Van Haverbeke 2003; GCMRC 2003a) due to habitat modification by the dam and predation and competition from nonnative fishes. The effect of river running on humpback chub is unknown; however, recreationists make heavy use of the lower Little Colorado River from mid-April through mid-October, with the heaviest use from May to September. This coincides with spawning activity and the presence of young-of-the-year chub in the Little Colorado. Recreationists could directly affect chub eggs, fry, and young by roiling substrates and altering feeding and shelter-seeking behaviors, and indirectly by disturbing nearshore habitats and introducing suntan lotion into the water. Humpback chub display ***modified*** behavior patterns in the Little Colorado River; they are not captured as frequently in the lower 2 kilometers of the

* The Endangered Species Act defines the term "take" to mean "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."

reach as they were historically (Minckley 1989, 1990). Chub might avoid this area because of human disturbances. In the Virgin River in Zion National Park, recreational activities (boating, tubing, wading, and swimming) increased the patchiness of native fishes, reduced the diversity of their assemblages, and reduced the abundance of young native fishes (Sappington 1998). Additional impacts may result from the fact that popular camps occur within known mainstream humpback chub aggregation sites, and anglers fishing for trout accidentally catch this species. Currently, the park does not allow angling in the Colorado River within 1 mile of the confluence with the Little Colorado River. Impacts to the humpback chub would be adverse, regional, long-term, and moderate.

American Peregrine Falcon—Peregrine falcon populations in the Grand Canyon have remained stable or increased slightly from 1988 to 1999 (Ward 2000). Direct interaction between peregrine falcons and river recreationists would be unlikely. Noise levels could indirectly affect peregrines, causing them to temporarily leave an area. Falcons may be disturbed by helicopters or river runners while nesting or foraging, but they would be able to return to the activity once the disturbance was gone, or they would relocate to a less disturbed area. Helicopter exchanges in the Whitmore area could impact peregrine falcons. Ritchie (1987) reported that peregrine falcon responses varied from no response to flushing when helicopters were within 2,000 feet of the birds. Craig and Craig (1984) reported that prairie falcons, red-tailed hawks, and golden eagles exhibited varied responses when helicopters passed nearby. As helicopters approach, individual bird responses range from no response to abandonment of perches. Impacts to the American peregrine falcon would be adverse, localized, short-term, and minor.

Bald Eagle—Researchers who studied the effects of nonmotorized recreational boating on non-breeding bald eagles in Alaska noted that 58% flushed in response to rafts approaching (Steidl and Anthony 1995). The flush distance was related to the distance that the boats were first sighted—only 23% flushed at distances greater than 100 meters. Other researchers studied bald eagle distribution in relation to human activity in Grand Canyon National Park and determined that eagle distribution was negatively correlated with the amount of activity (Brown and Stevens 1997). Eagles are flushed in the Grand Canyon as boats pass hunting perches and roosts, but at the low level of present winter use, the effects on the eagle population are probably within the range of natural variability. Researchers also found that people camping near nesting eagles caused significant behavior modifications, such as declines in feeding and reduced attentiveness to young (Steidl and Anthony 1995). Although eagles do not nest in the Grand Canyon, it is estimated that camping near roosting bald eagles in the canyon results in behavioral changes. A strong negative correlation has been found between eagle distribution and human activity, even at low levels of winter use (Brown and Stevens 1997). Noise also impacts eagles. Since the motor season currently begins December 15 and wintering eagles are present into March, eagles are subject to boat motor noise (GRCA wildlife files). With the present low level of winter use, impacts to the bald eagle would be adverse, localized, short-term, and minor.

California Condor—Numerous encounters between river runners and hikers and California condors have been reported since condors were released in 1996. Condor/human conflicts have occurred in Marble Canyon, especially at the Badger campsite. Impacts occur when humans approach, feed, or harass these curious birds. This species is extremely vulnerable throughout the year because of its small population size. Each reproductive season is key to establishing the population. Although their preferred roosting habitat is rock cliffs, snags, and stands of live conifers, condors scavenge and roost along the Colorado River and its tributaries (Osborn 2003). They are attracted to trash left behind by river runners, such as pop-tops and pieces of aluminum foil, and can be harmed if they ingest these items. Condors scavenging in occupied campsites have come into conflict with river runners (Leslie, pers. comm. 2003). These interactions can increase habituation to humans. Recreationists would be more likely to encounter or attempt to interact with condors during the higher use months, but adverse encounters have occurred in winter (GRCA wildlife files). Impacts to the California condor would be adverse, localized, short-term, and moderate.

Mexican Spotted Owl—Recent surveys have located approximately 40 Mexican spotted owl protected activity centers within Grand Canyon National Park (Willey, Ward, and Spotskey 2002; Willey and Ward 2003). Five protection activity centers are within 3 miles of the river. Day hikers could reach these areas, but the areas are not in frequently traveled canyons. Mexican spotted owls are relatively tolerant of hikers. Researchers tested owls in narrow canyon habitat similar to that encountered in Grand Canyon and determined that birds rarely flushed at distances of greater than 24 meters (Swarthout and Steidl 2001). Beyond 55 meters birds were unlikely to alter their behavior when hikers approached. It is estimated that some owls would be flushed by day hikers, but this impact is not expected to cause a decline in population numbers as it would be short-term and would rarely occur. Impacts to the Mexican spotted owl would be adverse, localized, short-term, and minor.

Southwestern Willow Flycatcher—Surveys in June 2003 found two pairs of flycatchers at different locations along the river in the upper canyon (Yard, pers. comm. 2003a). Nesting or breeding birds may be disturbed by river runners as they create trails through, or expand camps into, dense stands of tamarisk. This impact could cause a decline in the population and result in a moderate impact. Impacts would not occur during the fall and winter because the flycatcher is not present in the Grand Canyon at that time. Impacts to the southwestern willow flycatcher would be adverse, regional, short-term, and moderate during the spring and summer when visitor use is highest.

Brown Pelican—While pelicans are rare along the river corridor in GRCA, they are present and in some years are present in higher than usual numbers. From reports in 2004 of an aggressive pelican at Phantom Ranch near the boat docking area and of pelicans approaching boats out of curiosity around Hermit, it appears that interactions with river runners are possible when pelicans are within the corridor. These interactions may consist of interruptions to fishing efforts caused by river rafts passing and flushing the birds downstream. Given river rafts relatively slow speed, collisions with boats are unlikely although possible; this likelihood may increase if fish are present in the boat or if the pelican is excessively curious. Sport fishing within the river corridor may impact pelicans if monofilament and hooks are not disposed of properly. Additional threats to the species include water pollution including contaminants such as oil and fuel. Impacts to brown pelican under Alternative A would be adverse, regional, short-term and minor to moderate.

Desert Tortoise (Mohave population)—Potential threats to desert tortoise from recreational use in the river corridor include the presence of humans using the well-established trail at Whitmore Canyon. Although hiking exchange rates at Whitmore Canyon are relatively low under Alternative A, human presence brings threats to the tortoise in the form of harassment

and the reptile eating refuse or discarded items left by hikers. Such objects can become lodged in the gastrointestinal tract or entangle heads and legs causing death. Such refuse deposition can easily occur in remote areas and is likely, or at least possible, wherever humans are present, even on foot trails. Impacts from hiking under Alternative A would be adverse, localized, short-term and minor.

Tortoise may also be affected by helicopter use in the Whitmore Wash area. Desert tortoises are one of several species of tortoises that have acoustic social signals and are known to react to meaningful sounds in their environments (Bowles et al. 1998a). The masking effect of human-induced sources of noise such as that created by helicopters that correspond closely to the frequency bandwidth of tortoise vocalizations, may damage hearing or significantly alter an individual's ability to effectively communicate or respond in appropriate ways; this includes the awareness of incidental sounds made by approaching predators which may decrease the ability of tortoise to avoid capture by a predator (Bowles et al. 1998b; Bowles 1995; USFWS 1994). Species-typical defensive responses of tortoise to the approach of danger include startling, running, diving underwater, wedging the shell into a crevice, urinating and defecating on an attacker, producing threatening sounds, freezing, and withdrawing into the shell (Bowles et al. 1998a). Loud noises and associated vibrations may damage the hearing apparatus of desert tortoise and ground vibrations can cause desert tortoise to emerge from their burrows (USFWS 1994). Impacts to desert tortoise under Alternative A would be adverse, localized, short- to long-term, and moderate.

Bats—Local populations of the spotted bat, Mexican long-tongued bat, and pale Townsend's big-eared bat within a cave or series of caves could be ***minor to*** moderately impacted and might experience population declines if reproductive success was reduced. However, habitat modification to caves that contain maternity colonies or hibernacula could have moderate (***and possibly*** major) adverse and long-term impacts. Populations of some bat species have declined or disappeared along the Colorado River ***due to disturbance by recreationists. Impacts to special status bats under Alternative A would be adverse, localized, long-term and moderate.*** Also see the discussion of human-caused impacts on bats under "Terrestrial Wildlife" for Alternative A.

Mitigation of Effects. Previous mitigation efforts indicate that specific measures can be effective in reducing impacts to ***special status*** species, if adequate funding, staffing, monitoring, and implementation of the measures are maintained. Reasonable mitigations to consider ***singly or in combination*** for reducing or eliminating impacts to ***special status*** species include ***a subset*** of those listed under "Terrestrial Wildlife", "Aquatic Resources", and "Vegetation," plus those listed on page 534.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Effects: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative A, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on ***special status*** wildlife species. Alternative A would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. Impacts to populations of Kanab ambersnail, humpback chub, and southwestern willow flycatcher are likely to be regional because they are concentrated in localized areas and any effects in those areas would affect the entire population of these species. Any amount of use during the reproductive season could affect a local population of ***special status*** species due to their small populations and specific habitat preferences. Impacts on other ***special status*** species would be localized. Helicopter exchanges in the Whitmore area could impact peregrine falcons, with adverse, localized, short-term, minor effects***, but affect Mohave desert tortoise with adverse, localized, short- to long-term moderate effects***. Low levels of winter use could have adverse, localized, short-term, minor effects on the bald eagle. The California condor is extremely vulnerable throughout the year because of its small population size. Impacts, which occur when humans approach, feed, or harass these curious birds, would be adverse, localized, short-term, and moderate. ***Similar impacts can occur to the brown pelican.*** Some Mexican spotted owls would be flushed by day hikers, but this would be a short-term, rare occurrence, and impacts would be adverse, localized, short-term, and minor. Impacts on bats would range from minor to moderate if caves that contain maternity colonies or hibernacula were ***Modified***.

In summary, impacts to ***special status*** species under Alternative A ***without additional mitigations*** would be adverse, short and long-term, regional and localized, seasonal to year-round, and minor to moderate. Alternative A would not result in the impairment of ***any special status*** species in Grand Canyon National Park. Cumulative effects would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative A would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.9.5.2 Alternative B

Analysis. Under Alternative B recreational motor trips would be prohibited, and group sizes, people at one time, daily launches, user-days, and estimated total yearly passengers would be the lowest of any ***action*** alternative (see Table 4- 1). Trip lengths would be substantially reduced from current conditions, although user discretionary time would increase from current levels. ***There would be no hiking or helicopter exchanges at Whitmore.***

The types of impacts described under Alternative A would be similar under Alternative B. Increases in annual user discretionary time indicate increased potential opportunities for adverse impacts on the Kanab ambersnail (possibly exceeding the moderate threshold), but that increase would likely be offset by reductions in access.

The increase in user discretionary time in March and April could increase the potential for recreationists to interrupt humpback chub reproductive activities at the Little Colorado River, but probably not to the extent it would exceed the moderate impact threshold.

A large increase in summer user discretionary time could result in substantially more foot traffic in side canyons. Such activity could increase flushing occurrences of Mexican spotted owls, with resulting decreases in production of young and moderate impacts to this species. As the southwestern willow flycatcher is a late nester, the increase in late spring and early summer user discretionary time could increase the potential for impacts that might begin to approach the major impact level if mitigation measures such as closures or restrictions on access to nesting areas were not instituted. More winter use would increase impacts to the bald eagle, but not beyond the minor threshold. ***California condor and brown pelican impacts would be similar to Alternative A.*** No impacts from motorboat or helicopter use would occur under this alternative***, reducing impacts to the Mohave desert tortoise to negligible***. Peregrine falcon would benefit from the decrease in helicopter activity.

The increased summer ***and winter*** user discretionary time could also increase opportunities for disturbance impacts to bat species in maternity colonies, but probably not beyond the moderate threshold.

Mitigation of Effects. As discussed for Alternative A, reasonable mitigations to consider ***singly or in combination*** for reducing or eliminating impacts to ***special status*** species include ***a subset of*** those listed under "Terrestrial Wildlife", "Aquatic Resources", and "Vegetation," plus those listed on page 534.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Effects: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major. Cumulatively, the effects of Alternative B, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on ***special status*** wildlife species. Alternative B would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

Conclusion. Similar to Alternative A, impacts to populations of Kanab ambersnail, southwestern willow flycatcher, and humpback chub are likely to be regional because they are concentrated in localized areas and any effects in those areas would affect the entire population of these species. Impacts on localized populations and sensitive individuals would be similar to Alternative A. Any amount of use during the reproductive season could affect a local population of sensitive species due to their small populations and specific habitat preferences. Even though helicopters and motorboats would not be used under this alternative, river use would increase during the winter, but impacts to bald eagles would still be minor. Impacts to peregrine falcons ***from reduction in motor noise and helicopters*** would be beneficial and negligible throughout the year. There might be increased potential for disturbance to several species during the summer, but probably not beyond the moderate threshold.

In summary, the impacts to ***special status*** species under Alternative B ***without additional mitigations*** would be adverse, regional and local, seasonal to year-round, short and long-term, and ***negligible to major*** if mitigation measures were not instituted. Alternative B would not result in the impairment of ***special status*** species in Grand Canyon National Park. Cumulative effects, when combined with other past, present, and reasonably foreseeable actions, would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative B would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.2.9.5.3 Alternatives C and D

Analysis. Under Alternative C motorized use would be eliminated; however, total annual user discretionary time would increase greatly in all seasons compared to Alternative A. User-days and passengers would increase greatly in all seasons but summer, where those indicators of use would decrease. Group sizes would decrease, as would maximum numbers of trips and people at one time.

Under Alternative D, there would be two periods of no-motor use—March–April and September–October. Annual user discretionary time would double from the present level, but group sizes would decrease. There would be a substantial increase in user discretionary time during early and late spring, as well as a large increase in winter.

The type of impacts under Alternative C would be similar to Alternatives A and B, but the intensity would be much greater. A doubling of annual user discretionary time suggests vastly increased potential for adverse impacts to habitat by recreational users of campsites and hiking trails, including the potential to adversely affect Kanab ambersnail habitat at Vasey's Paradise. If this area was not closed or closely monitored, impacts could reach the major threshold.

A substantial increase in user discretionary time in March and April ***in both alternatives*** could increase opportunities for recreationists to interrupt humpback chub reproductive activities in the Little Colorado River, possibly to the major threshold as the present population continues to decline and additional disruption of reproductive activity, destruction of eggs and fry, and disturbance of young-of-the-year may further depress the population.

A fourfold increase in early spring user discretionary time ***in Alternative C and threefold in Alternative D*** also suggests increased opportunities for disturbance pressure on nesting avian species, such as the peregrine falcon and southwestern willow flycatcher, during a critical life stage. There could be major population disruptions to willow flycatcher that would exceed the normal range of variability if mitigation measures (closures or restrictions on access to nesting areas) were not instituted. The peregrine falcon would probably not be impacted beyond the moderate threshold, but if bird and bat prey species were severely impacted this could change. The large increase in summer user discretionary time suggests potential for increased foot traffic in side canyons, which could increase flushing occurrences of Mexican spotted owls, reaching the moderate impact threshold.

California condor and brown pelican impacts primarily in the high use summer season would be adverse, regional, short-term, and moderate similar to Alternative A. Although the absence of motors and helicopters in Alternative C would be beneficial to many species, hiking exchanges would be allowed at Whitmore having an adverse localized, short- to long-term, minor effect on Mohave desert tortoise. Alternative D, which allows both hiking and helicopter exchanges would have adverse, localized, short- to long-term, moderate effects on Mohave desert tortoise.

A substantial increase in winter use ***in both alternatives*** would result in adverse, long-term, moderate to major impacts to the bald eagles and various bat species, particularly cave dwelling bats, due to the same type of impacts discussed for bats in Alternative A.

Mitigation of Effects. As discussed for Alternative A, reasonable mitigations to consider ***singly or in combination*** for reducing or eliminating impacts to ***special status*** species include ***a subset of*** those listed under "Terrestrial Wildlife", "Aquatic Resources", and "Vegetation," plus those listed on page 534.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Effects: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major. Cumulatively, the effects of Alternatives C and D, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, moderate to major effects on ***special status*** wildlife species. Alternatives C and D would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

Conclusion. Under Alternative C, ***without additional mitigations*** the impacts to ***special status*** species ***would be adverse ranging from regional to local, minor to major, seasonal to year-round and short-term and long-term from regional to local, moderate to major, seasonal to year-round and short-term and long-term. Under Alternative D, without additional mitigations, the impacts to special status species would be adverse regional and local, short- and long-term, moderate to major effects.*** Neither Alternative C nor Alternative D would result in impairment of ***special status*** species in Grand Canyon National Park. Cumulative effects would be regional to localized, adverse, short- to long-term, seasonal to year-round, and moderate to major. Alternatives C and D would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

4.2.9.5.4 Alternative E

Analysis. Under Alternative E there would be a no-motor season from October through March, and group sizes would decrease. Increases in spring user discretionary time would be more moderate than in the previous alternatives, as would increases in summer and winter user discretionary time.

Alternative E would have similar types of impacts as those described under Alternative A, but the intensities would differ. Increases in user discretionary time suggest the potential for greater impacts on the Kanab ambersnail, but they would not exceed the moderate threshold.

The increase in user discretionary time during the March–April period suggests increased opportunities for recreationists to interrupt humpback chub reproductive activities in the Little Colorado River, but impacts would probably not exceed the moderate threshold.

California condor and brown pelican impacts primarily in the high use summer season would be adverse, regional, short-term, and moderate similar to Alternative A.

No impacts from motor use for six months in fall and winter would benefit American peregrine falcon prey species. Reducing helicopter activity in the Whitmore area would benefit falcons in the area, and impacts overall to the population should remain minor. ***Continued helicopter and***

hiking exchanges at Whitmore would cause adverse, short- to long-term, localized, moderate effects to Mohave desert tortoise, but the impacts would be seasonal.

Increased winter use would increase opportunities for impacts to the bald eagle, but this might be partially offset by the no-motor season extending into March. The impacts would probably still reach the moderate threshold if bald eagle distributions were disrupted through increased human activity on the river and in camps near roosting areas. Increased foot traffic in canyons brought about by the moderate increase in summer access could increase flushing occurrences of Mexican spotted owls, but below the moderate impact threshold because the protected activity centers are 3 miles from the river and it would take a large increase in several indicators of use to increase the potential for adverse interactions. Since the southwestern willow flycatcher is a late nester, the more modest increase in late spring and early summer use would maintain impacts at the moderate threshold level. This would be assured if mitigation measures (closures or restrictions to nesting areas) were instituted. Increased summer use ***and winter use*** would increase potential for impacts to bat species in maternity colonies, but probably not beyond the moderate threshold.

Impacts to populations of Kanab ambersnail, humpback chub, and southwestern willow flycatcher would be regional because those species are concentrated in localized areas, and any effects in that area would affect the entire population.

Mitigation of Effects. As discussed for Alternative A, reasonable mitigations to consider ***singly or in combination*** for reducing or eliminating impacts to ***special status*** species include ***a subset of*** those listed under “Terrestrial Wildlife”, “Aquatic Resources”, and “Vegetation,” plus those listed on page 534.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in “Methodology for Analyzing Effects: Cumulative Impacts.” The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major. Cumulatively, the effects of Alternative E, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on ***special status*** wildlife species. Alternative E would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

Conclusion. In summary, impacts to ***special status*** species under Alternative E ***without additional mitigations*** would be adverse, regional and local, seasonal to year-round, short and long-term, and minor to moderate. Alternative E would not result in the impairment of ***special status*** species in Grand Canyon National Park. Cumulative effects would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative E would result in a localized, adverse, short- to long-term, seasonal to year-round, minor contribution to these cumulative effects.

4.2.9.5.5 Alternative F

Analysis. Under Alternative F the no-motor season would extend from July through December, maximum trip sizes would be decreased, the maximum number of trips at one time would drop from 70 to 54, and the maximum number of people at one time would drop from 1,095 to 972. Annual user discretionary time would increase, but it would be the second lowest of the alternatives. All indicators of access would increase in the March-April period but would decrease in the May–August period compared to Alternative A as a result of prohibiting motors and allowing fewer launches in July and August.

Alternative F would have the same types of impacts as those described under Alternative A; however, intensities would differ. Increases in user discretionary time suggest the potential for greater impacts on the Kanab ambersnail, but they would not exceed the moderate threshold, and overall summer use decreases would lower the potential for impacts during this period.

The increase in access during March and April suggests a greater potential for recreationists to interrupt humpback chub reproductive activities at the Little Colorado River. Impacts could be adverse and major if the present population continued to decline; additional disruption of reproductive activity, destruction of eggs and fry, and disturbance of young-of-the-year could further depress the population.

No impacts from motor use would occur for a six-month July to December period and this would benefit a variety of prey species for the American peregrine falcon. Reducing helicopter activity in the Whitmore area would also benefit peregrine falcons, and overall impacts to the population should remain minor. ***Continued helicopter and hiking exchanges at Whitmore would cause adverse, short- to long-term, localized, moderate effects to Mohave desert tortoise, but the impacts would be seasonal.*** Increased winter use and the no-motor season ending in December would increase the potential for impacts on bald eagles. The impacts could reach the major threshold if eagle distributions were disrupted through increased human activity on the river and in camps near roosting areas. Decreased foot traffic in canyons resulting from the decrease in summer use could decrease flushing occurrences of Mexican spotted owls, but not below the minor impact threshold. Since the southwestern willow flycatcher is a late nester, use patterns in Alternative F would reduce opportunities for impacts, but not below the moderate threshold level. Decreased summer use would decrease the potential for impacts to bat species in maternity colonies, but probably not below the moderate threshold. ***California condor and brown pelican impacts primarily in the early summer season would be adverse, regional, short-term, and moderate similar to Alternative A.***

Impacts to populations of Kanab ambersnail, humpback chub, and southwestern willow flycatcher would affect the entire Grand Canyon population because they are concentrated in localized areas.

Impacts on localized populations and sensitive individuals would be similar to Alternative A. Any amount of use during the reproductive season could affect a local population of sensitive species due to their small populations and usually specific habitat preferences.

Mitigation of Effects. As discussed for Alternative A, reasonable mitigations to consider ***singly or in combination*** for reducing or eliminating impacts to ***special status*** species include ***a subset of*** those listed under “Terrestrial Wildlife”, “Aquatic Resources”, and “Vegetation,” plus those listed on page 534.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed in "Methodology for Analyzing Effects: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major. Cumulatively, the effects of Alternative F, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on ***special status*** wildlife species. Alternative F would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

Conclusion. In summary, impacts to ***special status*** species under Alternative F ***without additional mitigations*** would be adverse, regional and local, seasonal to year-round, short and long-term, and minor to major. Alternative F would not result in the impairment of ***special status*** species in Grand Canyon National Park. Cumulative effects would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative F would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.2.9.5.6 Alternative G

Analysis. Under Alternative G, ***a mixed-use alternative***, generally larger, shorter trips would be offered, with all indicators of access increased in winter and shoulder seasons, but decreased in summer.

Alternative G would have the same types of impacts as those described under Alternative A, but intensities would differ. Increases in annual user discretionary time would be the lowest of all the new alternatives. Increased use could lead to greater impacts on the Kanab ambersnail, but they would not exceed the moderate threshold.

The increase in access during March and April would increase the potential for recreationists to interrupt humpback chub reproductive activities in the Little Colorado River. Impacts would probably reach the moderate threshold, but the impact of recreation on this population is not known. If the present population continued to decline, any additional disruption of reproductive activity could result in major adverse impacts.

Helicopter activity in the Whitmore area would be about the same as now, with the same impacts on American peregrine falcons as described for Alternative A. ***Continued helicopter and hiking exchanges at Whitmore would cause adverse, short- to long-term, localized, moderate effects to Mohave desert tortoise, but the impacts would be seasonal.*** Increased winter use and the no-motor season ending in December would increase opportunities for impacts to the bald eagle. The impacts could reach the major threshold if distributions were disrupted through increased human activity on the river and in camps near roosting areas. Decreased foot traffic in canyons from the moderate decrease in user discretionary time during summer would decrease potential for flushing occurrences of Mexican spotted owls, but not below the minor impact threshold. Since the southwestern willow flycatcher is a late nester, use patterns in Alternative G would reduce impacts, but not below the moderate threshold level. Decreased summer use would decrease opportunities for impacts to bat species in maternity colonies, but probably not below the moderate threshold. ***California condor and brown pelican impacts would be similar to Alternative A: adverse, regional, short-term, and moderate.***

Impacts to populations of Kanab ambersnail, humpback chub, and southwestern willow flycatcher would affect the entire Grand Canyon population since they are concentrated in localized areas.

Impacts on localized populations and sensitive individuals would be similar to Alternative A. Any amount of use during the reproductive season could affect a local population of ***special status*** species due to their small populations and usually specific habitat preferences.

Mitigation of Effects. As discussed for Alternative A, reasonable mitigations to consider ***singly or in combination*** for reducing or eliminating impacts to ***special status*** species include ***a subset of*** those listed under "Terrestrial Wildlife", "Aquatic Resources", and "Vegetation," plus those listed on page 534.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Effects: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major. Cumulatively, the effects of Alternative G, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on ***special status*** wildlife species. Alternative G would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

Conclusions. In summary, impacts to ***special status*** species under Alternative G ***without additional mitigations*** would be adverse, regional and local, seasonal to year-round, short and long-term, and minor to major. Alternative G would not result in the impairment of ***special status*** species in Grand Canyon National Park. Cumulative effects would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative G would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.2.9.5.7 Modified Alternative H (NPS Preferred Alternative)

Analysis. Under ***Modified*** Alternative H total annual ***user discretionary time*** would increase ***by about 200,000*** hours. Winter user discretionary time would also increase. Trip sizes would decrease for commercial groups ***to 32 people in the summer and 24 in the shoulders***, and the maximum number of trips and people at one time would decrease ***from current***. The no-motor season from would be increased to ***6.5 months with March being a no-motor month***.

Modified Alternative H would have the same types of impacts as those described under Alternative A, but intensities would differ. Increases in most annual use indicators suggest more opportunities for impacts on the Kanab ambersnail, but they would still not exceed the moderate threshold.

The modest increase in access during ***late spring and early summer*** suggests increased opportunities for recreationists to interrupt humpback chub reproductive activities in the Little Colorado River, but impacts would probably not exceed the moderate threshold.

No impacts from motor use would occur during the ***early spring, late*** fall and winter, which would benefit a variety of peregrine falcon prey species. Reducing helicopter activity in the Whitmore area ***to only the mixed motor season months*** would benefit peregrine falcons and impacts to the population should remain minor. ***Continued helicopter and hiking exchanges at Whitmore would cause adverse, short- to long-term, localized, moderate effects to Mohave desert tortoise, but the impacts would be seasonal.*** Increased winter use would increase opportunities for impacts to the bald eagle, but this might be partially offset by the no-motor season extending ***to the end of March***. The impacts would probably still reach the moderate threshold, if distributions were disrupted through increased human activity on the river and in camps near roosting areas. Increased foot traffic in canyons brought about by the large increase in summer access could increase flushing occurrences of Mexican spotted owls up to the moderate impact threshold. ***Modified*** Alternative H would have the third largest summer user discretionary time, implying substantially more opportunities for day hikes into Mexican spotted owl protected activity centers, where the chances of disturbance to nesting owls would increase. Since the southwestern willow flycatcher is a late nester, the increase in May-June use might raise impacts to the major threshold level***, but most likely will remain at moderate levels***; with mitigation measures (closures or restrictions on access to nesting areas) these impacts would be reduced. ***California condor and brown pelican impacts primarily in the high use summer season would be adverse, regional, short-term, and moderate similar to Alternative A.***

The large increase in summer user ***discretionary time*** might result in increased impacts to bats in maternity colonies and cave roosts. If caves are not ***gated***, these impacts may exceed the moderate threshold and significant population declines could occur.

Impacts to populations of Kanab ambersnail, humpback chub, and southwestern willow flycatcher would affect the entire Grand Canyon population because they are concentrated in localized areas.

Mitigation of Effects. As discussed for Alternative A, reasonable mitigations to consider ***singly or in combination*** for reducing or eliminating impacts to ***special status*** species include ***a subset of*** those listed under "Terrestrial Wildlife", "Aquatic Resources", and "Vegetation," plus those listed on page 534.

Cumulative Effects. The impact ratings from individual past, present, and reasonably foreseeable actions are discussed above in "Methodology for Analyzing Effects: Cumulative Impacts." The impact rating from all cumulative actions is regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major. Cumulatively, the effects of ***Modified*** Alternative H, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on ***special status*** wildlife species. ***Modified*** Alternative H would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

Conclusion. In summary, impacts to ***special status*** species under ***Modified*** Alternative H ***without additional mitigations*** would be adverse, regional and local, seasonal to year-round, short and long-term, and minor to major. ***Modified*** Alternative H would not result in the impairment of ***special status*** species in Grand Canyon National Park. Cumulative effects would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. ***Modified*** Alternative H would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.2.9.6 IMPACT ANALYSIS—LOWER GORGE ALTERNATIVES

Potential impacts on individual ***special status*** species are summarized in Table 4- 24, and species that are not likely to be affected by the alternatives are listed in Table 4- 25. The differences among alternatives are described in the following sections.

TABLE 4- 24: SUMMARY OF IMPACTS ON SPECIAL STATUS SPECIES—LOWER GORGE ALTERNATIVES

Common Name	Alternatives				
	1	2	3	Modified 4	5
Lowland Leopard Frog	***Major***	***Mod-Maj***	***Mod-Maj***	***Mod-Maj***	***Mod-Maj***
Relict Leopard Frog	***Minor***	***Minor***	***Minor***	***Minor***	***Minor***
American Peregrine Falcon	Moderate	Minor	***Mod-Maj***	***Mod-Maj***	Major
Bald Eagle	Minor	Minor	Moderate	***Moderate***	Major
California brown pelican	***Moderate***	***Minor***	***Moderate***	***Moderate***	***Major***
California Condor	Moderate	Minor	Major	Moderate	Major
Mexican Spotted Owl	***Minor***	***Minor***	***Min-Mod***	***Min-Mod***	***Moderate***
Southwestern Willow Flycatcher	Moderate	Moderate	Moderate	Moderate	***Mod-Maj***
Yuma clapper rail	***Minor***	***Minor***	***Moderate***	***Moderate***	***Major***
Western yellow-billed cuckoo	***Minor***	***Minor***	***Moderate***	***Moderate***	***Major***
Razorback sucker	***Moderate***	***Minor***	***Moderate***	***Moderate***	***Major***
Mexican Long-tongued Bat	***Major***	Moderate	Moderate	Moderate	Moderate
Spotted Bat	***Moderate***	Minor	Minor	Minor	Minor
Pale Townsend's Big-eared Bat	***Major***	Moderate	Moderate	Moderate	Moderate

TABLE 4- 25: SPECIAL STATUS SPECIES NOT LIKELY TO BE AFFECTED BY LOWER GORGE ALTERNATIVES

Common Name	Reasoning
Kanab ambersnail	***Does not occur in the Lower Gorge***
Humpback Chub	Rarely occur below Diamond Creek; main spawning population is associated with the Little Colorado River in Marble Canyon.
Northern Leopard Frog	Although potential habitat is present, historic population not confirmed to exist below Diamond Creek.
Desert Tortoise ***(Mojave population)***	Known only ***around Whitmore Canyon***.
Desert Tortoise (Sonoran population)	***Known to occur in upland areas not frequented by river runners***
Western Red Bat	Occurs in areas where river-based human visitation is rare.
Southwest River Otter	Extirpated from Grand Canyon National Park.

4.2.9.6.1 Alternative 1 (Existing Condition)

Analysis. ***Recreational use of the Lower Gorge under Alternative 1 would continue to be unregulated except noncommercial launches would be limited to two per day, with a maximum of 16 people each (including guides). There are an average 100 trips per year (including educational and administrative trips) and generally last only a few days. HRR would continue to offer one-day trip per day during the March-October season, with up to 10 boats (100 people) launching at the same time, and three overnight trips per month. No additional campsites would be developed and no limits on trip length would be established.***

The pontoon boat operation at Quartermaster would continue with seven boats in continuous operation throughout the day from May through September, with an average of 188 passengers per day. Pontoon passengers arrive and leave by helicopter, while passengers arriving for HRR day and overnight trips only leave by helicopter.

Lowland Leopard *and Relict Leopard Frog*—In spring of 2004, leopard frog ***egg masses and tadpoles*** were discovered in Surprise Canyon above the river. These frogs were morphologically identified as relict leopard frogs, but a DNA analysis from one specimen suggested that they could be intermediate between relict leopard frogs and lowland leopard frogs (Drost, pers. comm. 2004). ***Recently completed genetic analysis indicated that the frogs in Surprise Canyon are more closely related to the lowland leopard frog (Rana yavapaiensis) than to the relict leopard frog (Rana onca). Relict leopard frog is a candidate for listing under the Endangered Species Act and the lowland leopard frog is*** an ***Arizona wildlife*** species of ***special*** concern. ***Leopard frog*** breeding occurs in spring, and tadpoles transform to frogs June through August (Miller et al. 1982), when visitation is at its peak in the Lower Gorge. ***However, there are no known populations of relict leopard frog within Grand Canyon at this time. The southern extent of relict leopard frogs along the Colorado River is not currently known and further research is needed on the limits of the relict leopard frog along the Colorado River. Recreational impacts on lowland leopard frogs could*** cause ***this species of leopard*** frog to be extirpated from the area (major impact) due to its extremely small and localized known population. Cattle and burros have not been recently documented in ***Surprise Canyon*** but are known to be present in adjacent canyons. Collection or destruction of a few frogs ***or frog habitat*** by wading in the single, small, isolated pool, could reduce the ***lowland leopard frog*** population below viable numbers. ***Since relict leopard frogs have not been identified in Grand Canyon at this time, impacts from river runners on day hikes would be adverse, regional, long-term, year round and minor because of the possible impacts to suitable habitat. Impacts to the lowland leopard frog would be adverse, regional, long-term, year round and major.***

American Peregrine Falcon—Since a 1989 survey of a portion of the region below Diamond Creek (Brown 1989), the number of peregrine falcon territories appears to have decreased based on limited survey data (Ward 2000; GRCA wildlife files). Human activity in the Lower Gorge since 1989 has increased significantly due to the start of pontoon trips in the Quartermaster area, HRR river trips, and increased upriver travel from Lake Mead. No conclusion can be drawn regarding the causative factors responsible for the absence of peregrines from the formerly occupied territories. However, there is little doubt that the large numbers of helicopter flights per day in the Quartermaster area have likely to caused adverse, localized, long-term, moderate impacts to the species. Peregrines might tolerate a great deal of river-based activity in the remainder of the Lower Gorge; they can adapt to a variety of activity filled environments (Ellis 1981; Ellis, Ellis, and Mindell 1991). However, if disturbances began to affect their bird and bat prey base, impacts would increase significantly.

Bald Eagle—The threatened bald eagle is an occasional winter visitor to the Lower Gorge, but population numbers are much greater in the upper reaches of the Grand Canyon. Eagles exhibit a wide range of tolerance to humans, and numerous variables can affect eagle response to human disturbance. High levels of recreational use can disturb wintering bald eagles (Stalmaster and Kaiser 1997). The main impact of foot traffic and motorboats on wintering bald eagles is disruption of feeding activities. During the early morning hours, flushing can interrupt feeding activities and displace eagles. Brown and Stevens (1997) determined that eagle distribution in the Grand Canyon was negatively correlated with the amount of human activity. Eagles are flushed in the canyon as boats pass hunting perches and roosts, but at the low level of present winter use, the effects are probably not outside the range of natural variability. Given the low level of winter use, the present amount of disturbance probably results in an adverse, localized, short-term, minor impact to the bald eagle.

California Brown Pelican—The brown pelican is found occasionally along rivers and lakes in Arizona. Most Arizona records are along the Colorado River including north to Davis Dam and to Lake Mead, and the Gila Valley. Sightings of brown pelicans in Arizona increased in 2004. Brown pelicans were observed along the Colorado River corridor in GRCA in mid to late June 2004. These were thought to be immature pelicans moving upstream from areas such as Lake Mohave. As described above for the Lees Ferry to Diamond Creek stretch, impacts to brown pelican include harassment, possible collision with boats, injury from fishing hooks and monofilament, and poisoning from contaminants such as oil and fuel in the water. Impacts to brown pelican in the Lower Gorge are adverse, regional, short term and moderate.

California Condor—California condors have visited the Lower Gorge infrequently, but the potential for adverse interactions with recreationists does exist (GRCA wildlife files). In all areas besides Quartermaster, the potential would be low for two reasons: (1) condors spend less than 5% of their time in the Grand Canyon below Diamond Creek, and (2) only a small portion of the overall Grand Canyon population has ventured into the area. However, the large number of helicopter flights in the Quartermaster area must be given special consideration based on the potential for collisions between aircraft and condors. The potential for collisions was recognized by the NPS and the U. S. Fish and Wildlife Service in the “Biological Assessment” and resultant “Biological Opinion” for aircraft overflights in Grand Canyon National Park. This concern resulted in an “incidental take statement” in which it was acknowledged that potentially one bird could be killed in aircraft collisions in five years (USFWS 1999). The total number of scenic aircraft flights is considerably greater in the upper regions of Grand Canyon than in the Quartermaster area, but the concentration of flights in such a small area is cause for concern. The fact that flights at this level of intensity have been occurring in the Quartermaster area during the past few years while condors have been in the canyon suggests that impacts are presently at the moderate threshold.

Mexican Spotted Owl—Mexican spotted owls have not been found ***within the park*** in the Lower Gorge, but the area has not been intensively surveyed (Willey and Ward 2003). There is a

Mexican spotted owl territory 15–20 miles up river from Diamond Creek in an area that exhibits some of the characteristics of Lower Gorge habitats. Suitable habitat in the Lower Gorge is very limited and is generally 2–5 miles from the river, in areas with little attractiveness to day hikers (Willey, Ward, and Spotskey 2002). ***These areas are potentially affected by helicopter noise along the tour route in the Quartermaster area. Although***, it is unlikely that the areas ***of suitable habitat*** would be visited frequently ***by river runners, helicopters traveling the overflight tour route in the Quartermaster area have the potential to cause*** adverse, localized, short-term, ***minor effects*** under the current level of river use.

Southwestern Willow Flycatcher—The southwestern willow flycatcher occurs infrequently in the Lower Gorge, but generally one to two pairs nest above Lake Mead. Nesting periods coincide with the peak recreational use period (June and July). Nesting or breeding birds may be disturbed by river runners when they create trails through or expand camps into willow or dense tamarisk stands. The effects of recreational use near willow flycatcher habitat include nest disruption and noise. Motorized use close to willow flycatcher habitat may disturb this species and cause them to abandon the area. Noise from motorized vessels could cause nest abandonment. Nests are generally located over the water, possibly rendering them susceptible to large wakes from jetboats. These impacts could cause a decline in the local population, resulting in an adverse, localized ***to regional***, long-term, moderate impact to this species at this level of recreational activity.

Western yellow-billed cuckoo—Habitat for the western yellow-billed cuckoo is present in the Lower Gorge in Grand Canyon NP, although limited. One bird was observed in 2001. Surveys have been extremely limited to date within the Lower Gorge and, while they have not located nesting western yellow-billed cuckoos, their failure to detect them does not indicate definitively that the species is not nesting within the Lower Gorge. Clearing of suitable habitat (for the purposes of new construction or vegetative management of exiting campsites, for instance) has the potential to directly impact this species unless presence/absence surveys are conducted. Visitor use, including hiking, camping and river landings adjacent to nesting cuckoos may disrupt nesting. Impacts to western yellow-billed cuckoo under Alternative A would be adverse, localized, short-term and minor.

Yuma Clapper Rail—Habitat for the Yuma clapper rail may be present in limited but sufficient quantity for nesting in the Lower Gorge. Yuma clapper rails were recorded twice during the breeding season within the Lower Gorge in 1996 and 1997. Given the presence of potentially suitable nesting habitat, GRCA assumes that the clapper rail may be present in the Lower Gorge during the lifetime of this CRMP. Given the clapper rail's use of marshy habitat, it is unlikely that river runners will use this habitat for camping, however, some disruption of habitat is possible. Under Alternative A, no new campsites are proposed, so impacts to this species would likely be adverse, localized, short-term and minor.

Razorback Sucker —While the razorback sucker is known to occur only rarely within the Lower Gorge of GRCA, larvae were located in 2000 and 2001 in the vicinity of Pearce Ferry in Lake Mead, near the GRCA/Lake Mead interface. It is possible that the adults associated with those larvae could have come from within GRCA boundaries. Boats take out from GRCA at South Cove within Lake Mead. South Cove is located downstream of Pearce Ferry, thus boats that have run the river within GRCA traverse through potentially occupied razorback habitat

within the far western edge of GRCA, the interface between GRCA and Lake Mead, and within Lake Mead to the take-out at South Cove. Impacts to razorbacks, if present in these areas, are likely to be in the form of harassment from boat noise, fuel and other pollutants, and reduction in undisturbed shoreline habitats. If razorback spawning is or may be occurring at South Cove, concentrated use of this area during the spawning period of November–April, may result in disruption of spawning. Impacts to razorback suckers present in Lake Mead, the west end of GRCA, and along the GRCA/Lake Mead interface may occur due to the use of motorized rafts and the use of jet boats. The use of down stream motorized rafts for six months each year and Lower Gorge operations such as jet boats and year-round pontoon boat use bring with them the potential for oil and gas contamination within the river corridor. Fuel storage in plastic containers in the new high water zone near RM 262.5 for pontoon boat use, has the potential to affect water quality in the event there was a fuel spill (See Chapter 4 Environmental Consequences: Water Quality). Impacts on razorback sucker under current conditions are adverse, regional, short-term and moderate.

Bats—Bats are more common in the Lower Gorge than in the upper portion of the Grand Canyon because ***more caves are present***. Over half of the Mexican long-tongued bats encountered in surveys have been found in the Lower Gorge.

Cave dwelling bats such as ***Pale*** Townsend's big-eared bat and Mexican long-tongued bat are likely to be disturbed by river runners exploring side canyon caves at the current level of use. Populations of some ***cave dwelling*** species have declined or disappeared from areas along the lower Colorado River where habitat changes and flooding due to dam construction have occurred over the past 60 years (Leslie, pers. comm. 2004a). Human disturbance is probably the biggest threat to roosting bats. While vandalism and direct aggression toward roosting bats can cause significant damage, even "responsible" cave visitors might unknowingly cause harm to roosting bats simply by their presence (GRCA wildlife files). Repeated disturbance at a roost site might cause bats to abandon the roost and move to a less favorable (but less disturbed) roost (Leslie, pers. comm. 2004a). Hikers in caves can impact bats year-round by causing them to temporarily or permanently abandon roosting sites, maternity colonies, and hibernacula. Disturbance at hibernacula may wake hibernating bats, causing them to burn stored fat and decreasing winter survival (Thomas 1995). Population declines may be accelerated if numbers at maternity colonies are not sufficient to raise roost temperatures to the levels needed for healthy growth of young (Mohr 1972; Leslie, pers. comm. 2004a). ***Under Alternative A, the trip lengths for noncommercial trips launching from Diamond Creek are unlimited. The number of visitors traveling up into the park from Lake Mead is uncontrolled. Although all caves accessible from the river are closed, visitors hike to and enter caves in the Lower Gorge. Under current use levels impacts to cave dwelling bats have been adverse, localized, short- to long-term, seasonal, and moderate to major.***

Mitigation of Effects. Reasonable mitigation actions to consider ***singly or in combination*** for reducing or eliminating impacts to ***special status*** wildlife species ***in the Lower Gorge*** include ***a subset*** of those listed ***above under Mitigation of Effects in the introduction of this chapter.***

Cumulative Effects. The major factor affecting ***special status*** wildlife species in the river corridor is the existence and operation of Glen Canyon Dam, as previously described. Additional cumulative effects that are applicable in the Lower Gorge are described below:

Development on Hualapai tribal lands in the Quartermaster area would continue to have adverse, moderate to major impacts on use of the area as wildlife habitat, and use has likely already displaced some species and individuals from the area. However, based on the amount of available habitat adjacent to or near the developed area, impacts would likely be localized, adverse, short- to long-term, year-round, and moderate, and regional, adverse, short- to long-term, year-round, and minor on ***special status*** wildlife species and habitat.

Extensive helicopter and motorized boat use in the Quartermaster area could cause localized, adverse, short- to long-term, seasonal to year-round, major impacts to wildlife populations both inside and outside the park. This area has by far the most helicopter activity and impacts of any other location in or near the park. Bird and ungulate species could abandon this habitat due to the increased disturbance by motorized vessels and helicopters, and this could result in a loss of bird species diversity within the area. Also, as condors continue to expand their range across the Colorado Plateau and likely reoccupy historical roosting and nesting areas, the potential to collide with aircraft increases. However, helicopter use in this area is under Hualapai Tribe control, and the tribe has indicated that they expect the helicopter use to continue at current or increased levels. ***The park can only control whether river passengers are allowed to exchange in the Quartermaster area.***

The Lower Gorge also experiences high levels of air tour overflights in established flight corridors as described for "Natural Soundscapes"; however, these flights are several thousand feet above the river corridor and would have much less effect than flights in the Quartermaster area. ***Impacts from air tour overflights are adverse, regional, short-term to long-term, year round and minor.***

The lowering of water levels in Lake Mead during the current drought, although not anthropogenic in nature, could benefit the southwestern willow flycatcher as more shoreline vegetation is created as potential nesting habitat. This would have regional, beneficial, short-term, seasonal, minor effects ***on some bird species***.

The impact rating from all cumulative actions on a regional basis is beneficial, short-term, seasonal, and minor ***to adverse, short- to long-term, year round and minor.*** On a local basis ***cumulative effects are*** adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative 1, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on ***special status*** wildlife species. Alternative 1 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

Conclusion. In summary, impacts to ***special status*** species under Alternative 1 ***without additional mitigations*** would be adverse, regional and local, short and long-term, and ***minor*** to major. Alternative 1 would not result in the impairment of ***special status*** species in Grand Canyon National Park. Cumulative effects would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 1 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

4.2.9.6.2 Alternative 2

Analysis. ***This alternative would eliminate the use of the pontoon operation in the Quartermaster area and associated helicopter flights. HRR would be restricted to two day trips per day in the peak season, with a maximum of 30 people each, and one trip per day in the non-peak season. One additional campsite would be constructed (requiring vegetation clearing) on Hualapai tribal land for HRR use. HRR overnight trips would be increased to one per day, with a maximum group size of 30 people. Trip lengths for down river trips would be reduced to four nights during the peak season and five nights during the off season.***

Similar to Alternative 1, impacts to relict leopard frog suitable habitat would be minor, primarily since relict leopard frogs have not been confirmed to be present in the Lower Gorge. The increase in HRR day and overnight trips could increase the potential for impacts, however, these trips currently do not visit Surprise Canyon. Downriver trip length limits will limit the number and lengths of hikes river runners can do in this stretch having a beneficial effect on leopard frogs. Overall, impacts from Alternative 2 on relict leopard frog suitable habitat would still be adverse, regional, long-term and minor, while impacts on lowland leopard frogs would be moderate to major.

Eliminating pontoon trips and associated helicopter use would by itself greatly increase the chance that American peregrine falcons would reoccupy ***eyries*** in the Quartermaster area. However, there would still be impacts from helicopter trips used to ferry out the HRR day and overnight trip passengers. This level of disturbance would probably be tolerated by peregrines in the area; it is doubtful that the HRR trips would impact peregrines elsewhere in the corridor. Consequently, this alternative would reduce impacts to the peregrine falcon to the minor level (but adverse cumulative effects from numerous helicopter flights not associated with river trips would probably negate this reduction).

This alternative would eliminate winter pontoon trips, which would benefit the bald eagle. Impacts to this species would still be expected from winter noncommercial use and a small amount of HRR activity in March, but these levels would be low enough to have a ***minor*** adverse effect on this species.

Eliminating pontoon helicopter flights would greatly reduce the chance for helicopter collisions with California condors. The chance for adverse human interactions would still exist with the ***increased*** level of HRR activity, but the overall impacts would probably be minor (but see the cumulative effects discussion below). ***Similarly, impacts to brown pelicans would also be adverse, regional, short-term and minor.***

Impacts to Mexican spotted owls would remain at ***minor*** levels ***since HRR trips are not likely to hike into spotted owl protected activity centers. Reduced helicopter use would benefit this species.***

The impacts of recreational river use on the southwestern willow flycatcher would be similar to those discussed for Alternative 1, but eliminating the pontoon operation could make it possible for southwestern willow flycatchers to colonize the tamarisk thickets in this area. It is likely, however, that the reduction in passenger numbers and the subsequent reduction in disturbance would be too small to reduce the impacts to the southwestern willow flycatcher to the minor threshold ***and the number of HRR day and overnight trips increase. HRR group sizes are smaller, but the number of trips will increase. This could potentially affect more of the flycatcher critical habitat.*** If nesting areas were closed, it is estimated that the impacts could be reduced to minor. Designation of critical habitat by the U. S. Fish and Wildlife Service for the southwestern willow flycatcher in the Lower Gorge has been proposed. Creating one additional campsite by removing tamarisk could have a very localized adverse effect on potential flycatcher habitat if the vegetation manipulation occurred within the designated critical habitat. The Fish and Wildlife Service would be consulted on any proposed actions within the designated critical habitat. ***Impacts to southwestern willow flycatcher under Alternative 2 would be adverse, localized to regional, long-term and moderate.***

The creation of one campsite may alter Yuma clapper rail and Western yellow-billed cuckoo potential habitat, but surveys for their presence would be done before any vegetation manipulation would occur. Increased HRR day and overnight use would have the potential to adversely affect these birds if nesting along the river, but the reduction in pontoon boat use would be beneficial and offset these impacts. Overall, under Alternative 2, impacts to the rail and cuckoo would be adverse, regional to localized, short-term, and minor.

Reduced pontoon boat use and jetboat use would be beneficial to razorback sucker over current conditions, reducing water pollution and motor noise impact. Down river take outs would still be at levels similar to Alternative A and continue to have adverse effects. Impacts to razorback sucker would be adverse, localized, short-term and minor under Alternative 2.

Impacts to bat species would ***be reduced to a*** moderate level for cave-dwelling bats because ***trip lengths for down river users would be drastically reduced and river runners would have less time to hike to caves.*** The number of hikers ***coming up from Lake Mead*** would probably remain similar to Alternative 1***, continuing to have adverse affects. HRR*** group sizes would be reduced from 100 to 30, which would reduce the potential for adverse interactions ***with bats, but overnight trips would increase drastically from the current average of three per month to one per day increasing evening and early morning encounters. Overall, impacts to special status bat species under Alternative 2 would be adverse, localized, short- to long-term and minor to moderate.***

Mitigation of Effects. As described for Alternative 1, reasonable mitigation actions to consider ***singly or in combination*** for reducing or eliminating impacts to ***special status*** wildlife species include ***a subset*** of those listed ***above under Mitigation of Effects in the introduction to this chapter.***

Cumulative Effects. The impact rating from all cumulative actions on a regional basis is beneficial, short-term, seasonal, and minor, and on a local basis adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative 2, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on ***special status*** wildlife species. Alternative 2 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

Conclusion. In summary, impacts to ***special status*** species under Alternative 2 ***without additional mitigations*** would be adverse, regional and local, ***short-term and long-term, minor*** to major. Alternative 2 would not result in the impairment of ***special status*** species in Grand Canyon National Park. Cumulative effects would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 2 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

4.2.9.6.3 Alternative 3

Analysis. ***Alternative 3 is characterized by a slight decrease in average daily HRR use (from one day trip of 100 people to three day trips with 30 people each), but up to 400 pontoon boat passengers per day. Upriver trip takeouts would be allowed based on continuation of trip takeout needs and commercial jet boats could shuttle kayak trips up to RM 273. An additional commercial use, jetboat tours, would be allowed, with a maximum of two tours per day. A floating, formal dock would be allowed at RM 262.5, contingent on environmental compliance and removal of the "informal" docks at RM 262 and 263. Down river trip lengths would be established at five nights during peak season and eight nights during the off-season.***

Because the amount of ***total*** day ***use*** and overnight use ***from HRR trips, down river users and up river visitors*** would be significant, the potential destruction of habitat or individuals of the ***lowland*** leopard frog at Surprise Canyon would keep impacts on this species at the major level. Closure of Surprise Canyon would reduce impacts to the minor level, if the closure was strictly enforced. ***Reduction in down river trip lengths would have beneficial affects reducing the number of days users could layover at sites and hike into side canyons. Overall, impacts to lowland leopard frogs under this alternative would be adverse, long-term, regional and localized, moderate to major. Impacts to relict leopard frog potential habitat would remain at a minor level.***

With a doubling of pontoon boat passengers and associated helicopter flights into the Quartermaster area, American peregrine falcons would probably not reestablish territories for several miles on either side of this high impact area. Therefore, impacts would remain at least at the moderate level and could increase to major depending on the routes taken by helicopters. If the flight area expanded to accommodate the increased number of pontoon boat passengers per day in the high season (which would coincide with peregrine falcon breeding season), areas not currently impacted could see decreased population levels of a magnitude approaching the major impact threshold. ***Impacts to peregrine falcons under Alternative 3 would be adverse, short- to long-term, regional to localized, moderate to major.***

If winter use reaches the maximum allowable of 400 pontoon passengers per day, the constant flushing and harassment of bald eagles would result in at least ***an adverse, short-term, localized***, moderate impact.

Doubling pontoon passengers and associated helicopter flights per day would double the present chance of condors colliding with aircraft, but the decrease in numbers of HRR day trips would result in a small decrease in the possibility of adverse human interactions from this source of activity. If the level of overnight use reached the maximum allowable level of two launches per day, the chance of adverse interactions would increase dramatically. Condors are drawn to human activity (Snyder and Snyder 2000), and the large increase in the number of humans at the pontoon launch site could attract any condor in the area. With such a large increase in ***pontoon trip related*** helicopter flights in a small area, a collision is much more likely than at the present level of activity. The loss of even one condor would result in a significant decrease in the free-flying condor population in Arizona, which would meet the criteria for a major adverse impact. ***Impacts to brown pelicans would rise to adverse, regional to localized, short-term and moderate levels.***

Impacts to Mexican spotted owls would ***increase to minor to moderate levels due to the increase in helicopter traffic in the Quartermaster area.*** Increased overnight use may allow hikers to reach spotted owl limited potential nesting habitats. ***Reduced trip lengths for down river users would have beneficial effects on spotted owls by limiting the number of layover days and time for river runners to hike into side canyons. Impacts to Mexican spotted owls under this alternative would be adverse, localized, short-term, minor to moderate.***

The impacts of recreational use of the river corridor on the southwestern willow flycatcher would be primarily habitat destruction and disruption of nesting by people on shore. Some disturbance could also probably be attributed to the large number of motorized boats passing nesting areas. It is likely that the reduction in day trip numbers and the subsequent reduction in disturbance would be overshadowed by the possible increase in the number of overnight passengers. The impacts to the southwestern willow flycatcher would remain at the moderate threshold. If the nesting areas were closed to visitor use, and the closure was enforced, it is estimated that the impacts could be reduced to the minor level. Designation of critical habitat by the U. S. Fish and Wildlife Service for the southwestern willow flycatcher in the Lower Gorge has been proposed. The creation of two additional campsites, requiring tamarisk removal, could have a localized adverse effect on potential flycatcher habitat if the vegetation manipulation occurred within the designated critical habitat. The Fish and Wildlife Service would be consulted on any proposed actions that occur within the designated critical habitat. ***Impacts to the flycatcher under Alternative 3 would be adverse, regional to localized, short- to long-term and moderate.***

The increase in pontoon boat use, HRR day and overnight use, and jet boat tours would have adverse effects on Yuma clapper rail and Western yellow-billed cuckoo from motor noise, wakes, and habitat destruction. The creation of two campsites would reduce potential habitat. Under Alternative 3, potential impacts to these two bird species would rise to adverse, localized to regional, short- to long-term and moderate.

An increase in potential adverse impacts to razorback sucker occurs under Alternative 3. The doubling of pontoon passengers, the increase in jet boat trips and addition of jetboat tours, and the increase in HRR trips all have the potential to increase water quality impacts indirectly affecting these fish. Increased fuel storage at RM 262.5 increases the hazard of fuel spills. Downriver traffic taking out at launch ramps would be similar to Alternative 1. Together these actions would cause adverse, short- to long-term, regional to localized, moderate impacts to the razorback sucker.

Impacts to bats would ***be similar to Alternative 2 with a possible increase in adverse impacts over Alternative 2 due to longer trip lengths and higher numbers of HRR overnight users. Impacts to bats under Alternative 3 would be adverse, short- to long-term, localized, and minor to moderate.***

Mitigation of Effects. As described for Alternative 1, reasonable mitigation actions to consider ***singly or in combination*** for reducing or eliminating impacts to ***special status*** wildlife species include ***a subset*** of those listed ***above under Mitigation of Effects in the introduction to this chapter.***

Cumulative Effects. The impact rating from all cumulative actions on a regional basis is beneficial, short-term, seasonal, and minor, and on a local basis adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative 3, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on threatened, endangered, and sensitive wildlife species. Alternative 3 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

Conclusion. In summary, impacts to ***special status*** species under Alternative 3 ***without additional mitigations*** would be adverse, regional and local, ***short- to long-term, minor*** to major. Alternative 3 would not result in the impairment of ***special status*** species in Grand Canyon National Park. Cumulative effects would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 3 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

4.2.9.6.4 Modified Alternative 4 (NPS Preferred Alternative)

Analysis. ***Modified Alternative 4 would have a variable number of trips per day, with up to 40 people (including guides) per trip during the peak season and a variable number of trips per day with up to 35 people during the non-peak season. For pontoon operations there would be a maximum daily capacity of 480 passengers, possibly increasing to 600 plus associated helicopter operations. Four upriver trip takeouts per day would be allowed, plus tow-outs. A floating, formal dock would be allowed at RM 262.5. Trip lengths in peak season would be reduced to three nights in the peak season and five in the off-season.***

The Modified Alternative 4 would have impacts on special status species very similar to Alternative 3 for all the species listed above.

Mitigation of Effects. As described for Alternative 1, reasonable mitigation actions to consider ***singly or in combination*** for reducing or eliminating impacts to ***special status*** wildlife species include ***a subset*** of those listed ***above under Mitigation of Effects in the introduction to this chapter.***

Cumulative Effects. The impact rating from all cumulative actions on a regional basis is beneficial, short-term, seasonal, and minor, and on a local basis adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of ***Modified*** Alternative 4, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on ***special status*** wildlife species. ***Modified*** Alternative 4 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

Conclusion. In summary, impacts to ***special status*** species under ***Modified*** Alternative 4 ***without additional mitigations*** would be regional and local, ***minor*** to major, adverse, and short-term and long-term. ***Modified*** Alternative 4 would not result in the impairment of ***special status*** species in Grand Canyon National Park. Cumulative effects would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. ***Modified*** Alternative 4 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

4.2.9.6.5 Alternative 5 (Hualapai Tribe Proposed Action)

Analysis. ***Alternative 5 would be the same as Modified Alternative 4 except for pontoon boat operations and upriver travel. Under Alternative 5 there would be a dramatic increase in pontoon operations, with a maximum of seven boats carrying a maximum of 960 passengers each day in the Quartermaster area, plus an increase in associated helicopter flights. Upriver travel would be allowed only below RM 273, and no jetboat tours would be allowed.***

Impacts to lowland and relict leopard frogs would be similar to those described in Alternatives 3 and 4. Impacts to lowland leopard frogs under this alternative would be adverse, long-term, regional and localized, moderate to major. Impacts to relict leopard frog potential habitat would remain at a minor level.

With more than four times the number of daily pontoon passengers and associated helicopter flights into the Quartermaster area, compared to Alternative 1, American peregrine falcons would likely not reestablish territories for several miles on either side of this high impact area. If the flight area expanded for safety reasons to accommodate the higher number of round-trip helicopter flights per day in the high season (which would coincide with the peregrine falcon breeding season), other areas not currently impacted could see decreased population levels of a magnitude reaching the major impact threshold. ***Impacts to peregrine falcons under Alternative 5 would be adverse, short- to long-term, regional to localized, and major.***

Impacts to bald eagles and condors under Alternative 5 would be adverse, long-term, regional to localized, and major. If winter pontoon use reached the maximum allowable of 960 passengers per day, the constant flushing and harassment of bald eagles could reach the major impact threshold. A large increase in pontoon boat passengers and associated helicopter flights would vastly increase the present chance of condors colliding with aircraft. If the level of overnight use reached the maximum allowable level of three launches per day, the chance of adverse interactions would increase dramatically. Condors are drawn to human activity (Snyder and Snyder 2000) and the huge increase in the number of humans at the pontoon launch site would attract any condor in this area. Under this scenario, with such a large increase in helicopter flights in a very concentrated area, a collision would be inevitable. The loss of even one condor would result in a significant decrease in the free-flying condor population in Arizona, which would meet the criteria for a major adverse impact. ***Impacts to brown pelicans would increase with increased opportunities for interactions with river users. Impacts would also rise to adverse, regional to localized, short-term and major.***

Impacts to Mexican spotted owls ***from hikers would remain at levels described in Alternatives 3 and 4, but with an increase in helicopter traffic in the Quartermaster area, impacts are likely to rise to major levels.***

The impacts of recreational use of the river corridor on the southwestern willow flycatcher would be primarily due to habitat destruction and disruption of nesting by people on shore. Some disturbance could also probably be attributed to the large number of motorized boats passing nesting areas. It is likely that the increase in day trip numbers and the consequent increase in disturbance would result in adverse impacts to the southwestern willow flycatcher of a moderate ***to major*** threshold. If the nesting areas were closed, and the closure enforced, it is estimated that the impacts could be reduced to the minor level. The creation of three additional campsites, requiring tamarisk removal, could have localized adverse effects on potential flycatcher habitat, if the vegetation manipulation occurs within critical habitat, which is being considered by the U. S. Fish and Wildlife Service. The Fish and Wildlife Service would be consulted on any proposed actions that occurred within critical habitat. ***Under Alternative 5, impacts to southwestern willow flycatcher have the potential to be adverse, regional to localized, short- to long-term and moderate to major.***

Impacts to Yuma clapper rail, western yellow-billed cuckoo and razorback sucker would all increase to adverse, regional to localized, short- to long-term and major due to the increase in pontoon boat use. Increase in contaminants to the water, increase in wakes and disturbance from increased pontoon boat numbers would have adverse affects on these three species and their habitat. The reduction in jetboats would have a minor beneficial effect.

Impacts to bats would ***be similar to those described under Alternatives 3 and 4. Levels of impact would be beneficial over current conditions due to decreased trip lengths for downriver users, but the overall impact rating would be short- to long-term, localized and minor to moderate.***

Mitigation of Effects. As described for Alternative 1, reasonable mitigation actions to consider ***singly or in combination*** for reducing or eliminating impacts to ***special status*** wildlife species include ***a subset*** of those listed ***above under Mitigation of Effects in the introduction to this chapter.***

Cumulative Effects. The impact rating from all cumulative actions on a regional basis is beneficial, short-term, seasonal, and minor, and on a local basis adverse, short- to long-term, seasonal to year-round, and minor to major. Cumulatively, the effects of Alternative 5, when combined with these other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, minor to major effects on ***special status*** wildlife species. Alternative 5 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate ***to major*** contribution to these cumulative effects.

Conclusion. In summary, impacts to ***special status*** species under Alternative 5 ***without additional mitigations*** would be adverse, regional and local, short and long-term, and ***minor*** to major. Alternative 5 would not result in the impairment of ***special status*** species in Grand Canyon National Park. Cumulative effects would be regional to localized, adverse, short- to long-term, seasonal to year-round, and minor to major. Alternative 5 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate ***to major*** contribution to these cumulative effects.

4.3 IMPACTS ON CULTURAL RESOURCES

4.3.1 ISSUES

Cultural resources include archeological and historic properties, as well as traditional cultural properties, ethnographic resources, and cultural landscapes. Impacts from visitation pose a serious threat to these resources, given that they are generally irreplaceable and nonrenewable. Numerous issues have been identified regarding cultural ***resources***, both in public scoping and in internal review. The primary issues are described below.

- Public education and appreciation for cultural resources can have unintended consequences for the integrity of the property. Visitors have expressed a desire for increased information and access to cultural resources; some visitors, however, have suggested that access to cultural resources be restricted.
- Visitor access to popular cultural resources (i.e. attraction sites) can inadvertently disturb significant features, thereby limiting the ability of the site to convey its meaning. Hardening site surfaces and creating trails, while providing access, can be detrimental to the resource.
- Limited availability of campsites and off-river hiking trails to and near cultural resource attraction sites may impact the integrity and significance of cultural resources. When larger groups visit cultural resources, they have greater potential to inadvertently disturb features, artifacts, and traditional cultural areas by their inability to stay on established trails, which are created for single-file movement. Congestion in resource areas can lead to unintentional trampling of important cultural features.
- ***Natural quiet and the ability to hear songbirds were mentioned by some tribal elders as significant aspects of their assessment of the health of the canyon environment. Noise, congestion, crowding, and inappropriate behavior at specific attraction sites that are also traditional cultural properties impact these resources and the tribal values associated with them and may affect the ability of certain traditional tribal practitioners to interact with park resources.***

4.3.2 GUIDING REGULATIONS AND POLICIES

Impacts to cultural resources (archeological sites, historic and prehistoric structures, cultural landscapes, ethnographic resources) are described in terms of type, context, duration, and intensity, which is consistent with CEQ regulations for implementing the National Environmental Policy Act. The following impact analyses are intended, however, to also comply with the requirements of Section 106 of the National Historic Preservation Act. In accordance with the regulations of the Advisory Council on Historic Preservation (ACHP) implementing this section (36 CFR Part 800), impacts to cultural resources were identified and evaluated by (1) determining the area of potential effect; (2) identifying cultural resources present in the area of potential effect that are either listed on or eligible for listing on the National Register of Historic Places; (3) applying the criteria of adverse effect to affected cultural resources that are either listed on or eligible for the national register; and (4) considering ways to avoid, minimize, or mitigate adverse effects.

Under the ACHP regulations a determination of either adverse effect or no adverse effect must also be made for affected cultural resources that are eligible for the national register. An adverse effect occurs whenever an impact alters, directly or indirectly, any characteristic of a cultural resource that qualifies it for inclusion on the register, e.g., diminishing of the integrity of the resource's location, design, setting, materials, workmanship, feeling, or association. Adverse effects also include reasonably foreseeable effects caused by the alternative but that would occur later in time, be farther removed in distance, or be cumulative (36 CFR 800.5). A determination of no adverse effect means there is an effect, but the effect would not diminish in any way the characteristics of the cultural resource that qualify it for the National Register of Historic Places.

CEQ regulations and DO #12 also call for a discussion of the appropriateness of mitigation, as well as an analysis of how effective the mitigation would be in reducing the intensity of a potential impact (e.g., reducing the intensity of an impact from major to moderate or minor). Any resultant reduction in the intensity of impact due to mitigation, however, is an estimate of the effectiveness of mitigation under the National Environmental Policy Act only. It does not suggest that the level of effect as defined by Section 106 of the National Historic Preservation Act is similarly reduced. Even though adverse effects under Section 106 may be mitigated, the effect remains adverse.

According to the NPS *Management Policies 2001,* "planning decisions will follow analysis of how proposals might affect the values that make resources significant, and the consideration of alternatives that might avoid or mitigate potential adverse effects. Planning will always seek to avoid harm to cultural resources, and consider the values of traditionally associated groups." Additionally, planning efforts must include consultation with cultural resource specialists, traditionally associated peoples, and other stakeholders, as appropriate.

4.3.3 MANAGEMENT OBJECTIVES FOR CULTURAL RESOURCES

Management objectives for the *General Management Plan,* as well as the *Colorado River Management Plan,* are included in Chapter 1. The objectives for cultural resources as they relate to management of recreational river use in the Grand Canyon are as follows:

- Maintain the integrity of all significant cultural resources, with site preservation the optimal condition. If preservation is not possible, slow the rate at which their essential material qualities are lost.
- Provide opportunities for present and future populations to understand, experience, and reflect the human history as evidenced through cultural resources in and near the river corridor while protecting them from adverse effects from visitation.
- Preserve the integrity and condition of cultural resources and provide opportunities for traditional access by affiliated American Indian tribal members.

How well each alternative would meet these management objectives is described in Table 2-4 and Table 2-7 in Chapter 2.

4.3.4 METHODOLOGY FOR ANALYZING EFFECTS TO CULTURAL RESOURCES

The inventory and monitoring of cultural resources is an ongoing project for NPS staff and Hualapai tribal staff. Although the systematic monitoring of accessible sites to quantify and document the level of visitation or impact has not been possible, cultural resource personnel do assess and record impacts whenever they have the opportunity. The sites that have been recorded and monitored represent those sites that, for the most part, are known and have received visitation; however, only 3% of the estimated number of cultural sites in the Grand Canyon have been inventoried and only a fraction of these have been formally assessed for visitor impacts. Consequently, many of the 3% of recorded sites are in heavily visited areas such as the river corridor, side canyons, canyon rims, and other areas developed for recreational use. Currently, the principal source of data for the mainstem is the River Corridor Monitoring and Treatment Program, which was created in 1992 under a multi-agency/tribal Section 106 programmatic agreement to monitor cultural sites potentially affected by operations of Glen Canyon Dam.

In order to analyze the effect of each alternative on cultural resources, all available information on known archeological sites, historic properties, traditional cultural properties, and other ethnographic resources was compiled from NPS and Hualapai Tribe cultural resource files. A map with locations of known cultural and natural resources and visitor stopping points (campsites, lunch sites, and attraction sites), including data on use intensity, resulted in the identification of areas of resource concern, in which concentrations of sensitive resources overlapped with visitor use areas. Predictions about visitor impacts were based on data from the Grand Canyon river trip simulator program, predicted use levels from the simulator program, and the River Corridor Monitoring and Treatment Program.

The analysis of impacts was based on the interaction of context, duration, timing, and intensity of visitor impacts. Intensity of impacts, both regional and local, was defined using resource-specific impact thresholds. This method, which assumed that all documented historic and traditional cultural properties are considered eligible for the National Register of Historic Places as contributors to the overall Grand Canyon multiple-property listing, yielded an impact analysis that integrated determination of effect. Key terms for this analysis are defined below.

As defined in the NPS *Cultural Resource Management Guideline* (NPS 1998b), cultural landscapes are settings that humans have created in the natural world. By definition, cultural landscapes do not exist along the Colorado River. While historic vernacular landscapes do exist at both Lees Ferry and Phantom Ranch, none of the alternatives would affect these areas. Therefore, impacts to cultural landscapes will not be analyzed in this document. Furthermore, because archeological sites, historic and prehistoric structures, and ethnographic resources are all similarly affected by crowding, accessibility, increases in user discretionary time and other variables related to management of recreational use on the river, these resources are analyzed as a group. When analysis identified distinctions in impacts between these resources, they are detailed in the text.

4.3.4.1 IMPACT THRESHOLDS

The general process for assessing impacts to the environment is discussed in Section 4.1 of this chapter**.** Effects specific to cultural resources are characterized for each alternative based on the impact thresholds presented below. Additionally, each alternative was evaluated to determine whether effects are direct or indirect. The following intensity descriptions reflect evaluations consistent with those described by the Advisory Council on Historic Preservation (36 CFR 800) relative to applying the criteria of effect.

Intensity

Negligible—Change cannot be measured. Depletion or displacement of elements is barely perceptible. The determination of effect for Section 106 (36 CFR 800) would be no adverse effect.

Minor—Adverse: For archeological resources/historic properties, impacts would be detectable but would not diminish the overall integrity of the resource. Impacts such as social trailing, feature degradation, artifact depletion and displacement, and sediment compaction could occur and would be measurable but would be localized and would not result in changes to defining elements and would not affect or jeopardize defining features or characteristics or aspects of integrity that contribute to eligibility for the National Register of Historic Places. The determination of effect for Section 106 would be no adverse effect.

For cultural landscapes, impacts would be detectable but would not affect a character defining pattern(s) or feature(s) of a landscape listed on or eligible for the national register. The determination of effect on cultural landscapes for Section 106 would be no adverse effect.

For ethnographic resources, impacts would be slight but noticeable but would neither appreciably alter resource conditions, such as traditional access or site preservation, nor the relationship between the resource and the affiliated group's body of practices and beliefs. The determination of effect on traditional cultural properties for Section 106 would be no adverse effect.

Beneficial: Effects would be measurable and localized, resulting in increased stability to character defining features.

Moderate—Adverse: For archeological resources/historic properties, disturbance of a site or sites would result in the loss of overall integrity, but not to the extent that a site's national register eligibility would be jeopardized. Impacts would include measurable change to character-defining elements and would contribute to increased instability of site landscape. Impacts would require stabilization of eroding sediments and reduction in social trailing, artifact displacement, and trampling outside of established trails. The determination of effect for Section 106 would be an adverse effect. A memorandum of agreement would be executed among the NPS and the applicable state or tribal historic preservation officer and, if necessary, the Advisory Council on Historic Preservation, in accordance with 36 CFR 800.6(b).

For cultural landscapes, impacts would alter a character-defining pattern(s) or feature(s) of the cultural landscape, but would not diminish the integrity of the landscape to the extent that its national register eligibility was jeopardized. The determination of effect on cultural landscapes for Section 106 would be an adverse effect.

For ethnographic resources, impacts would be apparent and would alter resource conditions or interfere with traditional access, site preservation, or the relationship between the resource and the affiliated group's practices and beliefs, even though the group's practices and beliefs would survive. The determination of effect on traditional cultural properties for Section 106 would be an adverse effect.

Beneficial: Effects would be measurable and contribute to increased stability of site landscape (e.g., stabilization of eroding sediments; reduction in social trailing, artifact displacement, and trampling outside of established trails).

Major—Adverse: For archeological resources/historic properties, disturbance of a site or sites would result in the loss of overall integrity and significant change to character-defining elements to the extent that it would no longer be eligible to be listed on the national register. Impacts would include destabilization of structures or cultural contexts, depletion or displacement of artifact assemblages, and an increase in exposure or vulnerability to natural elements. The determination of effect for Section 106 would be an adverse effect.

For cultural landscapes, impacts would alter a character-defining pattern(s) or feature(s) of the cultural landscape to the extent that it would no longer be eligible to be listed on the national register. The determination of effect on cultural landscapes for Section 106 would be adverse effect.

For ethnographic resources, impacts would alter resource conditions, or block or greatly affect traditional access, site preservation, or the relationship between the resource and the affiliated group's body of practices and beliefs, to the extent that the survival of a group's practices and/or beliefs would be jeopardized. Impacts would result in significant changes or destabilization to defining elements and resource condition and an increase in exposure or vulnerability to natural elements. The determination of effect on traditional cultural properties for Section 106 would be adverse effect.

Beneficial: Effects would be measurable and result in the stabilization of site features, landscape, artifact assemblages, setting, and sediments (e.g., the elimination of social trailing, artifact displacement, and trampling outside of established trails; restoration of site setting through elimination of invasive species).

Context

Localized—Impacts would be restricted to specific sites.

Regional—Impacts would occur to several specific resource sites within a management zone. This might also include impacts to a site that has regional significance.

Duration

Short-term—An effect that, within five years, would no longer be detectable as the resource was returned to its predisturbance condition or appearance (e.g. trash and other items that could be removed or vegetation that has been trampled, but the has not been denuded).

Long-term—A change in a resource or its condition that would not return the resource to predisturbance condition or appearance and for all practical purposes would be considered permanent (e.g., damage to elements or removal of artifacts).

Timing

Trailing on archeological sites may be more pronounced during the spring growing season, as trampling young vegetation may lead to increased trailing and soil compaction. Also, some ethnographic resources might be more vulnerable to impacts during the spring growing season or at other times of the year depending on specific tribal traditions.

4.3.4.2 MITIGATION OF EFFECTS

Previous mitigation efforts indicate that specific measures can be effective in deterring increased damage of sites due to visitor impacts; however, to sustain current mitigation levels more staff is needed to maintain the completed work. Maintenance is the key to a good preservation-based mitigation program. ***A list of possible mitigation measures to be considered singly or in combination, that are not already incorporated into the alternatives, but are judged likely to reduce impacts to cultural resources if implemented include the following***:

- Monitoring of visitor impacts relative to baseline conditions
- Hardening of popular sites, including creation of formal trails
- Revegetation of areas damaged by social trailing
- Placement of check-dams in areas where social trails have become watercourses
- Increased education of visitors in leave-no-trace ethics
- Stabilization of damaged features and landscapes
- Graffiti removal
- Active management (guides, education, interpretive trails and signs) of popular sites
- Planned research and excavation
- Restrictions on group sizes or numbers of trips allowed at certain sites
- Temporary or permanent closures of exceptionally vulnerable sites
- I***ncreased ranger patrols to ensure*** strict enforcement of the Archeological Resources Protection Act (including increased enforcement staffing)
- Measures to improve traditional access and accommodate traditional practices
- Temporary closure of ethnographic sites to nontraditional visitation

4.3.4.3 CUMULATIVE IMPACTS

Cumulative impacts on cultural resources were determined by combining the impacts of each alternative with other past, present, and reasonably foreseeable future actions (see Section 4.1 of this chapter for detailed list of all actions).

The most significant action that has affected, and will continue to affect, the cultural resources along the mainstem of the Colorado River is the operation of Glen Canyon Dam. Regulated flows of clear water and the lack of sediment inputs have eroded pre- and post-dam river terraces that have long held important archeological sites. Because very little sediment remains in the Colorado River below Glen Canyon Dam, existing terraces and sediment deposits are no longer replaced. Sites thus become more vulnerable to impacts from visitation as the sediments that stabilized cultural resources erode away. This impact affects only those sites located on terraces of the Colorado River. Impacts from the dam result in localized, long-term, year-round, minor to moderate effects to these sites. Side canyon sites are unaffected by dam operations.

Previous visitation has also negatively affected cultural resources. These impacts include artifact displacement, feature damage, trampling, and erosion from social trails that have turned into watercourses. Research activities have also contributed to the effects from visitation. Because most cultural resources are nonrenewable, even small incidents of visitation can diminish the resource. These losses happen generally in the high-use season, are site specific, and result in an adverse, long-term, minor to moderate effect.

4.3.4.4 SECTION 106 SUMMARY

In accordance with the NPS "Servicewide Section 106 programmatic agreement" and the "Grand Canyon National Park Draft General Management Plan Section 106 programmatic agreement," both of which provide a framework for compliance with Section 106 of the National Historic Preservation Act, the NPS conducted an assessment of effects for the implementation of the *Colorado River Management Plan.* Regulations of the Advisory Council on Historic Preservation (36 CFR Part 800.8(c)) allow for agencies to use the NEPA process to comply with Section 106 "in lieu of the procedures set forth in §800.3 through 800.6." When this project was initiated, it was indicated that the NEPA process would be conducted in a manner that would serve as an adequate substitute for the Section 106 process. Additionally the park identified and consulted with the public, as well as appropriate agencies, stakeholders, and American Indian Tribes in a manner consistent with 36 CFR 800.3(f) (see Chapter 5). Development and analysis of alternatives was based largely on these consultations. In accordance with 36 CFR 800.4 through 800.5, thresholds for determining impacts to cultural resources were crafted based on predicted changes to elements of integrity and how those changes may affect National Register of Historic Places eligibility.

The Grand Canyon and its side canyons hold a wealth of cultural resources, including historic and prehistoric archaeological sites, traditional cultural places, and cultural landscapes. Previous impacts from visitation have been documented in archaeological sites both along the river and in the side canyons.

A review of the Grand Canyon cultural resource files has yielded data on prior studies and recorded cultural resources within the area of potential effect (see Chapter 3); these data provided background information for this environmental impact statement. Cultural resources along the river corridor have been inventoried and monitored by park staff as part of ongoing program management and in response to compliance needs of the Glen Canyon Dam environmental impact statement process. A formal monitoring program of effects from Glen

Canyon Dam operations was implemented in 1992 as a result of the *Glen Canyon Dam Final Environmental Impact Statement.* Numerous sites have been identified outside the river corridor itself, part of opportunistic and judgmental inventories in the park. Systematic survey of these areas has not occurred. The environmental impact analysis process for this revision to the *Colorado River Management Plan* used existing inventory and monitoring information for cultural resources evaluations. This impact analysis indicates that archeological survey and monitoring may be an appropriate strategy to refine the inventory during implementation of the selected alternatives. In cases where it was determined there was a potential for adverse impacts to cultural resources listed on or eligible for listing on the National Register of Historic Places, the NPS would coordinate with the Arizona state historic preservation officer to determine the level of effect on the property and the needed mitigation measures. Additionally, because implementation of the management plan may have an adverse effect on significant cultural resources, a programmatic agreement between the NPS, the Arizona State Historic Preservation Office, the Advisory Council on Historic Preservation, the Hualapai Tribe and the Navajo Nation will be instituted in accordance with 36 CFR 800.6.

4.3.4.5 Assumptions

General assumptions used for the analysis of effects for each alternative are discussed in Section 4.1 of this chapter**.** Assumptions that specifically relate to the alternatives discussed in this document and their effect on cultural resources are presented below:

- Variables that contribute to congestion (e.g., group sizes, trip length, numbers of passengers, user discretionary time) contribute to the vulnerability of cultural resources. However, the interaction of the all variables taken together must be evaluated as a whole.
- Mode of travel (i.e., motor vs. oar) and trip type (i.e., commercial vs. noncommercial) are thought to have no effect on cultural resources. The only exception may be in the effect of motorized use related to noise on traditional cultural properties.
- On longer trips visitors have increased amounts of time to interact with the canyon environment and the potential for greater access to sensitive cultural resources. This is particularly true for side canyons, as longer trips are designed to allow visitors this type of opportunity. Off-season hiking (during shoulder and winter months) is more conducive to exploring side canyons, as the extreme heat of the summer precludes hiking too far from the river itself.
- Ongoing sediment depletion in the river corridor due to Glen Canyon Dam have a long-term, cumulative effect on a number of variables related to visitor access and use of the river corridor. Size and distribution of camping beaches has the potential to affect visitation to sensitive cultural resources by changing visitor use patterns, camping locations, and hiking trails. As the distribution and size of beaches diminishes, visitors may be forced to camp in old high-water zone topography, places where cultural site densities are the greatest. This is particularly true for larger groups, as the number and distribution of large camps has been most affected by the diminishing beaches along the river. Sediment depletion has also led to increased visibility of cultural sites, thereby making them more vulnerable to damage from visitation. Likewise, ongoing depletion

has made it impossible for annual spring floods, which were previously sediment laden, to rebuild river terraces and bury or stabilize cultural resources.

- The majority of archeological sites along the mainstem and side canyons represent limited occupation by small groups of people, typically nuclear or extended family groups, residing at a site for portions of a given year. These sites, by their very nature, are relatively small, with structures and artifact areas visible on the surface. Visitation to these sites, while an important component of the visitor experience, can be damaging. Smaller groups tend to be able to keep to established walking areas and congregation areas, while large groups may have more impacts than small groups when visiting small, confined archeological sites in the canyon's backcountry (Monz et al. 2000). Additionally, visitors concentrated at a few sites may intensify impacts at these attractions while effectively limiting visitation at other locations.
- Passenger exchanges at Whitmore bring new visitors to the river corridor, essentially requiring that these visitors are educated about how to protect canyon resources. Cultural resources below Whitmore have seen increased use, mirroring the increase in exchanges, often requiring increased management action on the part of the Park (Hubbard et al. 2001, Bulletts and Drye 2001).
- Not all visitor impacts to cultural resources in the river corridor are from river runners; backcountry users and anglers contribute to impacts in areas that offer reasonable access. For example, angler sites, which are generally located at points of easy access just below Lees Ferry and in upper Marble Canyon, are easily distinguished by tackle, beverage cans, and fish entrails.
- Resources of concern to the affiliated tribes are generally described as archeological sites, locations mentioned in tribal histories, specific plant collection locations, mineral deposits, and spring sources. Over 100 separate places of importance have been identified in the reports generated by the tribes for resources along the Colorado River (Ferguson 1998; Jackson 1994; Stevens 1996; Roberts, Begay, and Kelley 1995; Stoffle et al. 1994; Stoffle, Austin et al. 1995; Stoffle, Loendorf et al. 1995; Hart 1995). While most resources are considered "natural resources" by western scientific standards, they are very much considered cultural resources from a tribal perspective. Specific information related to impacts on natural (i.e., biological) resources that are also considered cultural resources can be found in the "Natural Resources" section of this chapter.

4.3.5 IMPACT ANALYSIS—LEES FERRY ALTERNATIVES

Key variables, indicators, and use estimates for the Lees Ferry alternatives (Table 4- 1 and Table 4- 2) were used to determine changes in use at specific resource sites and projected seasonal changes in use patterns. Because no direct evidence has been collected that links specific use variables (group size, trip length, etc.) to levels and types of visitor impacts, various projected use estimates serve as the basis for assessing potential impacts. Additionally, Table 4- 26 estimates projected visitation at the Little Colorado River confluence and Deer Creek, based on the river trip simulator. This table was used to estimate changes in crowding at two attraction sites that are also traditional cultural properties.

TABLE 4- 26: PROJECTED VISITATION OF LITTLE COLORADO RIVER AND DEER CREEK (MAY – AUGUST)

	Alternatives							
	A	B	C	D	E	F	G	Modified H
Days with 100+ Visitors								
Little Colorado River	28	0	1	11	0	0	0	0
Deer Creek	66	1	64	109	12	4	8	0
Days with 150+ Visitors								
Little Colorado River	11	0	0	0	0	0	0	0
Deer Creek	24	0	27	32	0	0	0	0

4.3.5.1 ALTERNATIVE A (EXISTING CONDITION)

4.3.5.1.1 Analysis

The most noticeable effect to cultural resources from recreational river use would be from continued visitation to sensitive archeological sites, historic properties, cultural landscapes, and traditional cultural properties. This visitation, while often well intentioned, has led to impacts to a number of sensitive sites along the mainstem and side canyons of the Colorado River.

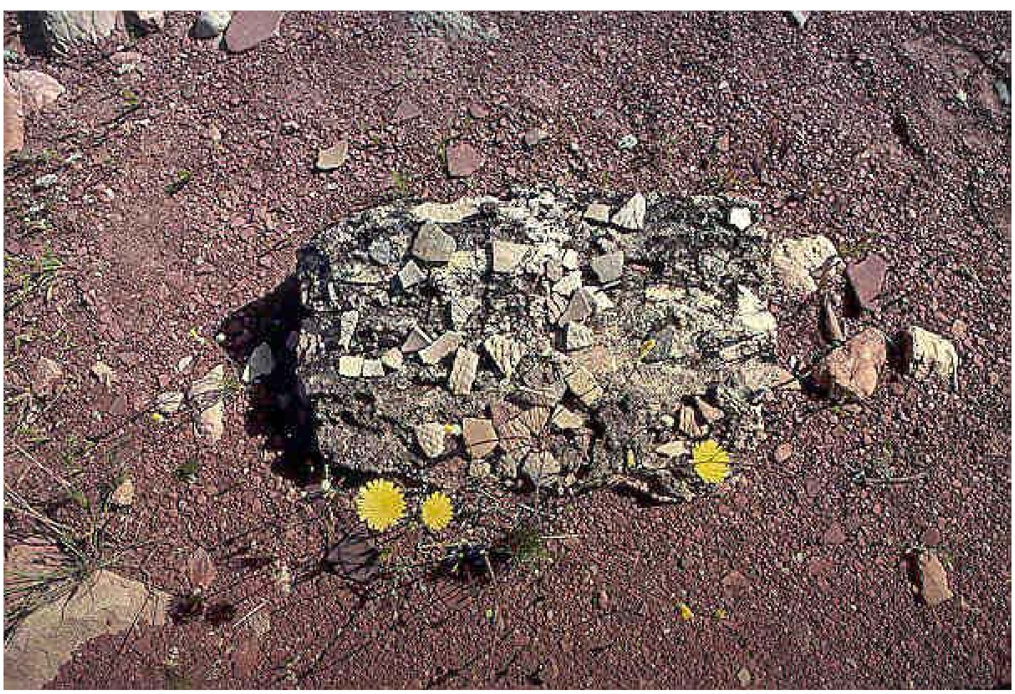
Based on NPS and HDCR site records, a total of 674 prehistoric and historic archeological sites are known to be along the Colorado River from Glen Canyon Dam to Lake Mead, and in side canyons below Lees Ferry within approximately a 2-mile hiking distance from the river (Fairley et al. 1994; Jackson 1997; GRCA site files 2003). Side canyon sites farther than 2 miles are included if they are known to be visited by river runners based on conversations with Grand Canyon river guides, various publications, and park staff. Of the 674 sites, 487 are located along the mainstem of the Colorado River and 187 in side canyons.

Archeological site monitoring of over 300 of these known visitor impacted properties since 1978 (Euler 1979) has identified some type of visitor impact to most of these sites, primarily related to social trailing, on-site camping, trash and artifact displacement. NPS and HDCR personnel have observed ongoing, direct visitor impacts to archeological and ethnographic resources accessible to river users in both the river corridor and side canyons (Balsom 1985; Euler and Gumerman 1978; Fairley et al. 1994; Jackson, Kennedy, and Phillips 2002; Leap et al. 2000; Neal and Gilpin 2000). Foot traffic and camping have created trails and areas of compaction that divert the natural flow of water and often become paths of severe erosion. Over time these trails can become gullies or arroyos that wash away character-defining elements of the cultural resources (Photo 4- 9). In some cases visitors have climbed onto walls or over rubble and trod on fragile artifacts, inadvertently damaging sites. Visitors also impact sites by collecting artifacts and placing them in piles at various points in the site.

Photo 4- 10), and they are known to rearrange rocks in features (e.g., rebuild walls). Presumably these are well-intentioned efforts; however, artifact or rock displacement can destroy the integrity and research potential of these ancient sites, some of which have remained undisturbed for thousands of years. Much less common, but often more damaging, visitor impacts include intentional destruction of site integrity through theft, graffiti, excavation, and feature destruction.

PHOTO 4- 9: EXAMPLE OF EROSION AT A SIDE CANYON SITE

PHOTO 4- 10. DISPLACED PREHISTORIC POTTERY SHERDS COLLECTED AND LEFT BY VISITORS



While the majority of visitors are conscientious about protecting cultural resources, a small percentage of visitors ignore park regulations and engage in acts that are destructive to the resource. Given that, management variables such as group size, launches per day, and trip length can help influence cultural resource vulnerability by contributing to or decreasing the level of site accessibility and crowding at sites.

Under Alternative A the management of recreational use would continue to allow large group sizes, lengthy trips, and spikes in the number of trips and people at one time, and daily launches (see Table 4- 1). User-days would remain capped at current levels, which would probably result in approximately the same number of total yearly passengers. Similarly, user discretionary time would remain similar to current levels.

Given the steady reduction in the number and size of beaches, the large group sizes under this alternative pose the greatest threat to resources in the old high-water zone, where visitors camp when they have been crowded off the beaches. The long trip lengths would increase the level of accessibility to all sites, but particularly those in the side canyons. Additionally, helicopter exchanges at Whitmore would be at their highest level under this alternative. These variables can directly and indirectly affect impacts to cultural sites along the river corridor and side canyons.

Group size, trip length, maximum allowable launches per day, trips and people at one time in the summer season are at their highest in this alternative, indicating a higher probability of crowding at certain attraction sites. Many of these variables regularly spike in the summer. During these spikes, up to nine groups can launch together, leading to congestion and crowding at attraction sites, some of which are cultural resource locations. User discretionary time, however, is relatively low, resulting in large groups of people arriving at the same places and having little time to actually experience the resource. Impacts from summer use result in a localized, adverse, long-term, minor to major effect to specific cultural resources.

Overall use levels under this alternative as measured by user-days, total passengers, and total user discretionary time in the winter and shoulder seasons would be at or near the lowest levels for all alternatives (see Table 4- 2). While these variables indicate some of the lowest levels of off-season use, they coincide with the highest allowable group sizes and trip lengths. Impacts from winter and shoulder season use result in a localized, adverse, long-term, minor to moderate effect to specific cultural resources.

Traditional cultural properties and the biological resources of the canyon are a significant resource to many of the affiliated tribes. Natural quiet and the ability to hear songbirds were mentioned by some tribal elders as significant aspects of their assessment of the health of the canyon environment. Noise from aircraft and motorboats may affect the ability of certain traditional tribal practitioners to interact with park resources. Likewise, congestion, crowding, and inappropriate behavior at specific attraction sites that are also traditional cultural properties negatively impact these resources and the tribal values associated with them. For example, current management has high levels of use at two identified traditional cultural properties, namely the Little Colorado River confluence and Deer Creek. Table 4- 26 indicates that from May to August, the Little Colorado River and Deer Creek experience 28 and 66 days, respectively, in which more than 100 people visited in a single day. The two sites experienced 11 and 24 days, respectively, in which more than 150 people visited in a single day. These numbers are at their highest for Alternative A of all the alternatives. Impacts from crowding and spikes in use result in localized, adverse, long-term, minor to moderate effects to cultural resources, particularly at traditional cultural properties and ethnobotanical locations.

4.3.5.1.2 Mitigation of Effects

Actions needed to mitigate adverse effects would include ***a subset*** of those discussed on page 571 (increased monitoring, patrols, site stabilization, etc.), but because current management of the river corridor allows substantial spikes in use, as well as the longest allowable trip lengths and the largest allowable group sizes of any of the alternatives, it is unlikely that mitigations would be implemented at a level sufficient to reduce impacts to a minor intensity.

4.3.5.1.3 Cumulative Effects

Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, impacts from the management of Glen Canyon Dam, combined with the effects of past visitation by river and backcountry visitors (and researchers), results in measurable changes to localized cultural resources. This effect results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of Alternative A on cultural resources, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. Alternative A would result in a localized, adverse, long-term, minor to moderate contribution to these cumulative effects.

4.3.5.1.4 Conclusion

Effects under Alternative A to individual nonrenewable resources would be direct and measurable. Because the integrity of the resource might be jeopardized, thus affecting the eligibility of the property for the National Register of Historic Places, the intensity of impacts would be ***minor*** to major, depending on accessibility and intensity of visitation from the river. Effects would be adverse, localized, and year-round, with most impacts occurring to readily accessible river corridor sites in the high-use summer months, and to side canyons sites primarily during the shoulder months. For the most part, these impacts would be long-term to permanent. Due to substantial spikes in use and the longest allowable trip lengths and the largest allowable group sizes of any of the alternatives, it is unlikely that reasonable mitigations would be implemented at a level sufficient to reduce impacts to a minor intensity. Alternative A would not result in the impairment of the cultural resources in Grand Canyon National Park. Cumulatively, the effects of Alternative A, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. Alternative A would result in a localized, adverse, long-term, minor to moderate contribution to these cumulative effects.

4.3.5.2 Alternative B

4.3.5.2.1 Analysis

Under Alternative B recreational motor trips would be prohibited and group sizes, maximum daily launches, and estimated total yearly passengers would be the lowest of any of the alternatives (see Table 4- 1). Yearly user discretionary time would increase to 576,754 hours from the current level of 355,081 hours. Implementation of a launch-based system would eliminate spikes in use.

Summer use under this alternative represents a decrease in total user-days (down to 107,418 from 121,869 currently) and total passengers (down to 8,492 from 18,128 currently). This, along with reductions in group size, trip length, number of trips and people at one time, as well as the elimination of Whitmore exchanges, would reduce crowding, thus decreasing the incidence of unintentional impacts at camping and attraction sites. Shorter trip lengths, which reduce the accessibility of side canyon sites would be somewhat offset by an increase in user discretionary time (from 294,506 hours currently to 431,444 hours), which could result in increased accessibility to all sites, particularly in side canyon. While user discretionary time could represent an increase in the number of sites per trip that river runners visit, it could also represent an increase in the amount of time that visitors spend at fewer sites. Overall, summer use would have a beneficial, localized, negligible to minor effect compared to current use.

Overall use levels in the winter and shoulder seasons under this alternative, as measured by user-days and total passengers, would increase above current levels, but would be at much lower levels than the rest of the alternatives. These levels of off-season use coincide with the lowest allowable group sizes and lower trip lengths. Compared to current use, these increases directly contribute to the accessibility and vulnerability of cultural resources and thus represent an adverse, localized, negligible to minor effect.

Eliminating helicopter and hiking exchanges at Whitmore under this alternative would reduce the probability of impacts that have been associated with sites below this point on the river.

Alternative B would have a beneficial effect on traditional cultural properties, ethnobotanical resources, and other significant aspects of tribal assessments of the health of the canyon environment by reducing crowding, noise, and congestion. For example, visitation at the Little Colorado River under this alternative is not expected to exceed 100 people in a single day, and visitation at Deer Creek is only expected to have one day that would exceed 100 visitors. This significant decrease from current conditions represents the lowest level of daily visitation at these sites of all of the alternatives.

4.3.5.2.2 Mitigation of Effects

Actions needed to mitigate adverse effects would include ***a subset*** of those discussed on page 571 (increased education, monitoring, patrols, site stabilization, etc.), and would be needed primarily to mitigate new use in the winter and shoulder seasons. Use levels would generally be lower in the summer months, with the exception of user discretionary time. A monitoring and treatment plan to determine and mitigate impacts from visitation would be needed, but sufficient, to reduce localized impacts to a minor intensity. Levels of additional education, patrols and site stabilization would be determined based on the results of the monitoring program.

4.3.5.2.3 Cumulative Effects

Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, impacts from the management of Glen Canyon Dam, combined with the effects of past visitation by river and backcountry visitors (and researchers), results in measurable changes to localized cultural resources. This effect results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of Alternative B on cultural resources, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. Alternative B would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

4.3.5.2.4 Conclusion

Based on the reduction of use compared to current conditions, Alternative B would directly contribute to the long-term protection and stabilization of individual cultural resource sites, especially those in the mainstem. This would be a beneficial, localized, negligible to minor effect that is highly dependent on site accessibility and vulnerability. However, adverse effects from visitation to nonrenewable cultural resource sites would continue to be measurable and, at times, of severe consequence to individual resources. Thus, most of the effects from visitation would be direct, adverse, negligible to moderate, and irreversible. However, because not all cultural resources along the river corridor are readily accessible (or recognizable) to river users, effects would not occur to the majority of resources in Zone 1. Therefore, effects would be localized and highly dependent on accessibility. Effects would continue to occur year-round, with most impacts occurring during the summer when an increase in user discretionary time offers additional opportunities for visitors to access sensitive resources. Impacts to cultural resources could be reduced to a minor intensity with reasonable mitigation. Alternative B would not result in the impairment of the cultural resources in Grand Canyon National Park. Cumulatively, the effects of Alternative B, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. Alternative B would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

4.3.5.3 ALTERNATIVE C

4.3.5.3.1 Analysis

Under Alternative C recreational motor trips would be prohibited. Group sizes and trip lengths would be at lower levels than current, but estimated total user-days and user discretionary time would be the highest of any of the alternatives (see Table 4- 1). The number of estimated yearly passengers would increase from 22,461 (current) to 25,228. Implementing a launch-based system would eliminate spikes in use.

Summer use under this alternative represents a decrease in total user-days (down to 110,120 from 121,869 currently) and total passengers (down to 11,252 from 18,128 currently). This, along with moderate decreases in group size, trip length, and number of trips and people at one time, would help reduce crowding and the incidence of unintentional impacts at camping and attraction sites. These variables would be somewhat offset, however, by an increase in user discretionary time from 294,506 hours currently to 335,089 hours, which might result in increased accessibility to all sites, particularly side canyon sites. While user discretionary time could represent more sites per trip visited by river runners, it could also represent an increase the amount of time that visitors spent at fewer sites. Overall, summer use would have a beneficial, localized, negligible to minor effect compared to current use.

Under this alternative, overall use levels in the winter and shoulder seasons, as measured by user-days and total passengers, would increase considerably above current levels (see Table 4- 2) and in most cases would represent the highest use of all of the alternatives. Allowable trip lengths would be reduced from 21 to 18 days in the shoulder season and from 30 to 21 days in the winter. Compared to current use, these increases would directly contribute to the accessibility and vulnerability of cultural resources, thus representing an adverse, localized, minor to moderate, effect.

Helicopter exchanges, but not hiking exchanges, at Whitmore would be eliminated under this alternative. No data exist to differentiate impacts from the two exchange types.

Alternative C would have a beneficial effect on some traditional cultural properties, ethnobotanical resources, and other significant aspects of tribal assessments of the health of the canyon environment by reducing crowding, noise, and congestion. For example, visitation at the Little Colorado River under this alternative is expected to have 1 day that would exceed 100 people in a single day, but visitation at Deer Creek is expected to have 64 days that would exceed 100 visitors. The Little Colorado River is not expected to have any days that exceed 150 visitors in a single day, but Deer Creek is expected to have 27. These are significant decreases from current condition for visitation at the Little Colorado River, but the change in use patterns for Deer Creek from current condition would be negligible.

4.3.5.3.2 Mitigation of Effects

Actions needed to mitigate adverse effects would include ***a subset*** of those discussed on page 571 (increased monitoring, patrols, site stabilization, etc.), but because of the considerable increases in winter and shoulder season use, as well as the highest yearly user-days and user discretionary time of any alternative, it is unlikely that the mitigations could be implemented at a level sufficient to reduce impacts to a minor intensity:

4.3.5.3.3 Cumulative Effects

Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, impacts from the management of Glen Canyon Dam, combined with the effects of past visitation by river and backcountry visitors (and researchers), results in measurable changes to localized cultural resources. This effect results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of Alternative C on cultural resources, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. Alternative C would result in a localized, adverse, long-term, minor to moderate contribution to these cumulative effects.

4.3.5.3.4 Conclusion

Based on the projected changes in use patterns from current condition, Alternative C directly contributes to the long-term protection and stabilization of individual cultural resource sites by reducing some variables and indicators of crowding. This is offset, however, by an increase in user-days and user discretionary time in each season, but particularly by the overwhelming increase in these factors in the off-seasons. Overall, this alternative would have a direct, long-term, minor to moderate adverse effect as compared to current condition. Adverse effects from visitation to nonrenewable cultural resources would continue to be measurable, and at times impacts to individual resources would be moderate to major. Effects from Alternative C would be direct, adverse, and measurable to individual non-renewable resources. Because the integrity of resources could be jeopardized, thus affecting national register eligibility of a property, the intensity of impacts would be moderate to major. However, because not all cultural resources along the river corridor are readily accessible (or recognizable) to river users, effects would not occur to the majority of resources in Zone 1. Therefore, these long-term to permanent effects would be localized and highly dependent on accessibility. Effects would occur year-round, with the majority of new impacts occurring in the winter and shoulder seasons. Because of the considerable increases in winter and shoulder season use, as well as the highest yearly user-days and user discretionary time of any of the alternatives, it is unlikely that mitigations would be implemented at a level sufficient to reduce impacts to a minor intensity. Alternative C would not result in the impairment of the cultural resources in Grand Canyon National Park. Cumulatively, the effects of Alternative C, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. Alternative C would result in a localized, adverse, long-term, minor to moderate contribution to these cumulative effects.

4.3.5.4 ALTERNATIVE D

4.3.5.4.1 Analysis

Under Alternative D recreational motor trips would be permitted from May to August and from December to February. Group sizes and trip lengths would be at lower levels than under current conditions, but user discretionary time would be among the highest of any of the alternatives (see Table 4- 1). The number of estimated yearly passengers would decrease from 22,461 currently to 20,427, and estimated total user-days would increase from 171,131 currently to 223,314. Implementing a launch-based system would eliminate spikes in use.

Summer use under this alternative would represent a small increase in total user-days (122,739) from 121,869 currently, and a large increase in total user discretionary time to 461,641 hours from 294,506 currently; however, total projected passengers would decrease from 18,128 currently to 13,765. These numbers indicate that fewer people would have more time to interact with the environment, which might result in increased accessibility to all sites, particularly to side canyon sites. However, reductions in group size, trip length, and the number of trips and people at one time would help reduce crowding and the incidence of unintentional impacts at campsites and attractions. Overall, summer use would have an adverse, localized, negligible to minor effect compared to current use.

Under this alternative overall use levels in the winter and shoulder seasons, as measured by user-days and total passengers, would increase considerably above current levels (see Table 4- 2). Overall, allowable trip lengths would be reduced from current, with the exception of noncommercial 30-day oar trips, which would remain the same. Compared to present conditions, this increase in use would directly contribute to the accessibility and vulnerability of cultural resources, resulting in an adverse, localized, minor to moderate effect.

Helicopter exchanges at Whitmore would be eliminated under this alternative, but not hiking exchanges. No data have been collected to differentiate impacts from the two exchange types.

Alternative D would have a varied effect on some traditional cultural properties, ethnobotanical resources, and other significant aspects of tribal assessments of the health of the canyon environment by reducing the months when boat and helicopter motors could be heard and by reducing some aspects of crowding. For example, visitation at the Little Colorado River under this alternative is expected to have 11 days that would exceed 100 people in a single day, but visitation at Deer Creek is expected to have 109 days that would exceed 100 visitors. The Little Colorado River is not expected to have any days that would exceed 150 visitors in a single day, but Deer Creek is expected to have 32. These would be moderate decreases from current conditions for visitation at the Little Colorado River, but the increase in daily visitor use patterns for Deer Creek from current condition would be considerable. This increase would result in an adverse, short-term, minor effect on localized resources compared to current conditions.

4.3.5.4.2 Mitigation of Effects

Actions needed to mitigate adverse effects would include ***a subset*** of those discussed on page 571 (increased monitoring, patrols, site stabilization, etc.), but because of the considerable increases in winter and shoulder season use, as well as remarkably high user discretionary time, it is unlikely that mitigations could be implemented at a level sufficient to reduce impacts to a minor intensity:

4.3.5.4.3 Cumulative Effects

Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, impacts from the management of Glen Canyon Dam, combined with the effects of past visitation by river and backcountry visitors (and researchers), results in measurable changes to localized cultural resources. This effect results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of Alternative D on cultural resources, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. Alternative D would result in a localized, adverse, long-term, minor to moderate contribution to these cumulative effects.

4.3.5.4.4 Conclusion

Based on the projected changes in use patterns from current conditions, Alternative D would directly contribute to the long-term protection and stabilization of individual cultural resource sites by reducing some variables and indicators of crowding. This would be offset, however, by a substantial increase in user discretionary time in each season and an increase in user-days in the off-season. Overall, this alternative would have an adverse, long-term, minor to moderate effect on cultural resources, as compared to current conditions. Adverse effects from visitation to non-renewable cultural resources would continue to be measurable, and at times impacts to individual resources would be moderate to major. Effects from Alternative D would be direct, adverse, and measurable to individual nonrenewable resources. Because the integrity of the resource might be jeopardized, thus affecting a property's national register eligibility, the intensity of impacts would be moderate to major. However, because not all cultural resources along the river corridor would be readily accessible (or recognizable) to river users, effects would not occur to the majority of resources in Zone 1. Therefore, these long-term to permanent effects would be localized and highly dependent on accessibility. Effects would occur year-round, with the majority of new impacts occurring in the winter and shoulder seasons. Because of the considerable increases in winter and shoulder season use, as well as remarkably high user discretionary time, it is unlikely that that mitigation would be implemented at a level sufficient to reduce impacts to a minor intensity. Alternative D would not result in the impairment of the cultural resources in Grand Canyon National Park. Cumulatively, the effects of Alternative D, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. Alternative D would result in a localized, adverse, long-term, minor to moderate contribution to these cumulative effects.

4.3.5.5 ALTERNATIVE E

4.3.5.5.1 Analysis

Under Alternative E recreational motor trips would be permitted April through September. Group sizes and trip lengths would be at lower levels than now, but user discretionary time would be among the highest of any alternative (see Table 4- 1). The number of estimated yearly passengers would increase from 22,461 currently to 23,812, and estimated total user-days from 171,131 currently to 237,183. Implementing a launch-based system would eliminate spikes in use.

Summer use under this alternative would decrease negligibly in total user-days (down to 121,836 from 121,869 now), and total user discretionary time would increase to 373,761 hours from 294,506 hours now, but total projected passengers would decrease to 15,230 from 18,128 now. These numbers indicate that fewer numbers of people would have more time to interact with the environment, which could result in increased accessibility to all sites, particularly to side canyon sites. However, reductions in group size, trip length, and the number of trips and people at one time would help reduce crowding and unintentional impacts at camping and attraction sites. Overall, summer use would have an adverse, localized, negligible to minor effect compared to current conditions.

Under this alternative, overall use levels in the winter and shoulder seasons, as measured by user-days and total passengers, would increase considerably compared to current levels (see Table 4- 2), but would be relatively low compared to rest of the alternatives. Allowable trip lengths would be among lowest of all alternatives. Compared to current use, the increase in use would directly contribute to the accessibility and vulnerability of cultural resources, resulting in an adverse, localized, minor to moderate effect.

Helicopter exchanges at Whitmore would be restricted to the months from April to September, while hiking exchanges would be permitted all year. No data have been collected to differentiate impacts between the two exchange types.

Implementing Alternative E would have a beneficial effect on traditional cultural properties, ethnobotanical resources, and other significant aspects of tribal assessments of the health of the canyon environment by substantially reducing when boat and helicopter motors could be heard and by reducing crowding and congestion at key attractions. For example, visitation at the Little Colorado River under this alternative is not expected to exceed 100 people in a single day, and visitation at Deer Creek is only expected to have 12 days that would exceed 100 visitors. Neither site is expected to have more than 150 visitors in a single day. This level of visitation represents a substantial decrease from current conditions. This increase would result in a beneficial, short-term, minor effect on localized resources, compared to current conditions.

4.3.5.5.2 Mitigation of Effects

Actions needed to mitigate adverse effects would include ***a subset*** of those discussed on page 571 (increased education, monitoring, patrols, site stabilization, etc.), and would be needed primarily to mitigate new use in the winter and shoulder seasons. A monitoring and treatment plan to determine and mitigate impacts from visitation would be needed, but sufficient, to reduce localized impacts to a minor intensity. Levels of additional education, patrols and site stabilization would be determined based on the results of the monitoring program.

4.3.5.5.3 Cumulative Effects

Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, impacts from the management of Glen Canyon Dam, combined with the effects of past visitation by river and backcountry visitors (and researchers), results in measurable changes to localized cultural resources. This effect results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of Alternative E on cultural resources, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. Alternative E would result in a localized, adverse, long-term, minor to moderate contribution to these cumulative effects.

4.3.5.5.4 Conclusion

Based on the projected changes in use patterns from current conditions, Alternative E would directly contribute to the long-term protection and stabilization of individual cultural resource sites by reducing crowding, especially in the summer. This would be somewhat offset, however, by an increase in user discretionary time in every season and an increase in user-days in the winter and shoulder seasons. Overall, this alternative would have a direct, long-term, negligible to minor adverse effect as compared to current conditions. Adverse effects from visitation to nonrenewable cultural resources would continue to be measurable, and at times impacts to individual resources would be moderate to major. Effects under Alternative E to individual nonrenewable resources would be direct and adverse. Because the integrity of the resource could be jeopardized, thus affecting its national register eligibility, the intensity of impacts would be minor to moderate. However, because not all cultural resources along the river corridor are readily accessible (or recognizable) to river users, effects would not occur to the majority of resources in Zone 1. Therefore, these long-term to permanent effects would be localized and highly dependent on accessibility. Effects would occur year-round, with the majority of new impacts in the winter and shoulder seasons. Impacts to cultural resources could be reduced to a minor intensity with reasonable mitigation. Alternative E would not result in the impairment of cultural resources in Grand Canyon National Park. Cumulatively, the effects of Alternative E on cultural resources, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. Alternative E would result in a localized, adverse, long-term, minor to moderate contribution to these cumulative effects.

4.3.5.6 ALTERNATIVE F

4.3.5.6.1 Analysis

Under Alternative F recreational motor trips would be permitted January through June. Group sizes and trip lengths would be at lower levels than now. User discretionary time would be higher than current conditions, but relatively low compared to other alternatives (see Table 4- 1). estimated yearly passengers would increase from 22,461 currently to 25,415, and estimated total user-days would increase from 171,131 currently to 235,146. Implementing a launch-based system would eliminate spikes in use.

Summer use under this alternative would decline considerably in total user-days, down to 102,291 from 121,869 currently; total user discretionary time would decrease to 269,507 hours from 294,506 currently; and total projected passengers would fall to 13,954 from 18,128 now. These numbers indicate an overall decrease in use. Additionally, reductions in group size, trip length, and the number of trips and people at one time would help reduce crowding and unintentional impacts at camping and attraction sites. Overall, decreased summer use would have a beneficial, localized, negligible to minor effect compared to current conditions.

Under this alternative, overall use levels in the winter and shoulder seasons, as measured by user-days and total passengers, would increase considerably above current levels (see Table 4-2). Additionally, allowable trip lengths would be reduced. Compared to current use, this increase in use would directly contribute to the accessibility and vulnerability of cultural resources, resulting in an adverse, localized, minor to moderate effect.

Helicopter exchanges at Whitmore would be restricted to the months from January to June, while hiking exchanges would be permitted all year. No data have been collected to differentiate impacts from the two exchange types.

Alternative F would have a beneficial effect on traditional cultural properties, ethnobotanical resources, and other significant aspects of tribal assessments of the health of the canyon environment by substantially reducing when boat and helicopter motors could be heard and by reducing crowding and congestion at key attractions. For example, visitation at the Little Colorado River under this alternative is not expected to exceed 100 people in a single day, and visitation at Deer Creek is only expected to have four days that would exceed 100 visitors. Neither site is expected to have more than 150 visitors in a single day. This level of visitation represents a substantial decrease from current conditions. This increase would result in a beneficial, short-term, minor to moderate effect on localized resources compared to current conditions.

4.3.5.6.2 Mitigation of Effects

Actions needed to mitigate adverse effects would include ***a subset*** of those discussed on page 571 (increased education, monitoring, patrols, site stabilization, etc.), and would be needed mitigate impacts from new use in the winter and shoulder seasons. A monitoring and treatment plan to determine and mitigate impacts from visitation would be needed, but sufficient, to reduce localized impacts to a minor intensity. Levels of additional education, patrols, and site stabilization would be determined based on the results of the monitoring program.

4.3.5.6.3 Cumulative Effects

Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, impacts from the management of Glen Canyon Dam, combined with the effects of past visitation by river and backcountry visitors (and researchers), results in measurable changes to localized cultural resources. This effect results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of Alternative F on cultural resources, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. Alternative F would result in a localized, adverse, long-term, minor to moderate contribution to these cumulative effects.

4.3.5.6.4 Conclusion

Based on the projected changes in use patterns from current conditions, Alternative F would directly contribute to the long-term protection and stabilization of individual cultural resource sites by reducing crowding, especially in the summer. This would be somewhat offset, however, by an increase in user discretionary time, total projected passengers, and user-days in the winter and shoulder seasons. Overall, this alternative would have an adverse, long-term, negligible to minor effect as compared to current conditions. Adverse effects from visitation to nonrenewable cultural resources would continue to be measurable, and at times impacts to individual resources could be moderate to major. Effects from Alternative F would be direct, adverse, and measurable to individual nonrenewable resources. Because the integrity of the resource might be jeopardized, thus affecting its national register eligibility, the intensity of impacts would be minor to ***major***. However, because not all cultural resources along the river corridor are readily accessible (or recognizable) to river users, effects would not occur to the majority of resources in Zone 1. Therefore, these long-term to permanent effects would be localized and highly dependent on accessibility. Effects would occur year-round with the majority of new impacts occurring in the winter and shoulder seasons. Impacts to cultural resources could be reduced to a minor intensity with reasonable mitigation. Alternative F would not result in the impairment of the cultural resources in Grand Canyon National Park. Cumulatively, the effects of Alternative F on cultural resources, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. Alternative F would result in a localized, adverse, long-term, minor to moderate contribution to these cumulative effects.

4.3.5.7 ALTERNATIVE G

4.3.5.7.1 Analysis

Under Alternative G recreational motor trips would be permitted January through August. Group sizes would be somewhat lower than current, but would be higher than any of the other alternatives. Trip lengths would generally be at the lowest levels of all of the alternatives, with the exception of noncommercial winter oar trips, which would still be reduced to 21 from 30 currently. Yearly user discretionary time is higher than current condition, but is at the lowest levels of all the other alternatives (see Table 4- 1). The number of estimated yearly passengers would increase from 22,461 now to 28,680, and estimated total user-days would increase from 171,131 currently to 249,910. Implementing a launch-based system would eliminate spikes in use.

Summer use under this alternative would decrease considerably. Total user-days would decline to 101,984 from 121,869 currently; total user discretionary time would decrease to 229,958 hours from 294,506 hours currently (the lowest of any alternative); and total projected passengers would fall to 14,939 from 18,128 currently. As a result, visitors would have less time to interact with the environment. This would be offset, however, by the large group size (40) for commercial motor trips. Because these large groups do not have sufficient time to access side canyon sites, it is anticipated that the impacts would generally be restricted to the most easily accessible sites along the river. Overall, summer use would have a beneficial, localized, negligible to minor effect compared to current conditions.

Overall use levels in the winter and shoulder seasons, as measured by user-days and total passengers, would increase considerably above current levels and would be among the highest of all of the alternatives (see Table 4- 2). Additionally, twice as many winter launches would be allowed as now, and shoulder season launches, while reduced from current levels, would be higher than any other alternative. However, reductions in trip lengths would result in relatively low user discretionary time, particularly in the shoulder seasons. While trip lengths would reduced in the off-seasons, less daylight would likely restrict access to side canyon sites, so impacts would likely be most prevalent at the most easily accessible sites along the river. Compared to current use, these factors indicate that the effect to cultural resources would be adverse, highly localized, and negligible to minor.

Helicopter exchanges at Whitmore would be restricted to the months from January to August, while hiking exchanges would be permitted all year. No data have been collected to differentiate impacts between the two exchange types.

Implementing Alternative G would have a beneficial effect on traditional cultural properties, ethnobotanical resources, and other significant aspects of tribal assessments of the health of the canyon environment by reducing the months when boat and helicopter motors could be heard and by reducing crowding and congestion at key attraction sites. For example, visitation at the Little Colorado River under this alternative is not expected to exceed 100 people in a single day, and visitation at Deer Creek is only expected to have 8 days that would exceed 100 visitors. Neither site is expected to have more than 150 visitors in a single day. This level of visitation represents a substantial decrease from current conditions. This increase would represent a beneficial, short-term, minor to moderate effect on localized resources compared to current conditions.

4.3.5.7.2 Mitigation of Effects

Actions needed to mitigate adverse effects would include ***a subset*** of those discussed on page 571 (increased education, monitoring, patrols, site stabilization, etc.), and would be needed mitigate impacts from new use in the winter and shoulder seasons. Because trip lengths are substantially reduced, adverse effects from visitation by large groups would be generally restricted to easily accessible river corridor sites. Site hardening at major attraction sites would decrease the probability of effect reaching the major threshold. A monitoring and treatment plan to determine and mitigate impacts from visitation would be needed, but sufficient, to reduce localized impacts to a minor intensity. Levels of additional education, patrols and site stabilization would be determined based on the results of the monitoring program.

4.3.5.7.3 Cumulative Effects

Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, impacts from the management of Glen Canyon Dam, combined with the effects of past visitation by river and backcountry visitors (and researchers), results in measurable changes to localized cultural resources. This effect results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of Alternative G on cultural resources, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. Alternative G would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

4.3.5.7.4 Conclusion

Based on the projected changes in use patterns from current condition, Alternative G would directly contribute to the long-term protection and stabilization of individual cultural resource sites by reducing passengers and trip lengths in the summer season. This would be somewhat offset, however, by relatively large group sizes and increased off-season use, as represented by total projected passengers and user-days. Overall, this alternative would have an adverse, long-term, and negligible to minor effect as compared to current conditions. Adverse effects from visitation to nonrenewable cultural resources would continue to be measurable, and at times impacts to individual resources would be moderate to major. Alternative G would have direct, adverse, and measurable impacts to individual nonrenewable resources. Because the integrity of these resources might be jeopardized, thus affecting their national register eligibility, the intensity of impacts would be minor to major. However, because not all cultural resources along the river corridor are readily accessible (or recognizable) to river users, effects would not occur to the majority of resources in Zone 1. Therefore, these long-term to permanent effects would be localized and highly dependent on accessibility. Effects would occur year-round, with the majority of new impacts occurring in the winter and shoulder seasons. Impacts to cultural resources could be reduced to a minor intensity with reasonable mitigation. Alternative G would not result in the impairment of the cultural resources in Grand Canyon National Park. Cumulatively, the effects of Alternative G on cultural resources, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. Alternative G would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

4.3.5.8 MODIFIED ALTERNATIVE H (NPS PREFERRED ALTERNATIVE)

4.3.5.8.1 Analysis

Under Modified Alternative H, recreational motor trips would be permitted from April 1 to September 15. Group sizes would be lower than currently in the summer and considerably lower in the shoulder seasons. Trip lengths would be lower than current conditions, with some opportunities for longer trips in the winter. Yearly user discretionary time would be higher than current conditions, but lower than several other alternatives (see Table 4- 1). ***Estimated yearly passengers would increase to 24,657 from 22,461 currently, and estimated total user-days would increase to 228,986 from 171,131. A launch-based system would eliminate spikes in use.***

Summer use under this alternative would represent the highest level of user-days (124,316) of all the alternatives, including current conditions (121,869). Total projected passengers for this season (16,655) would decrease from current condition (18,128). User discretionary time would be relatively high (393,513 hours) compared to current conditions (294,506) and several

other alternatives. An overall increase in summer use would be offset, however, by reductions in group size, trip length, and numbers of trips and people at one time, which would help reduce crowding and unintentional impacts at camping and attractions. Overall, summer use would have an adverse, localized, minor effect compared to current use.

Use levels in the winter season, as measured by user-days and total passengers, would be higher than current levels but among the lowest of all the alternatives (see Table 4- 2). User-days and total passenger estimates would increase in the shoulder seasons, however much of this increase is the result of high use in September. Trip lengths would be somewhat decreased in the off-season and group sizes would be at the lowest level of all of the alternatives, with shoulder-season commercial trips reduced to 24 passengers and guides. With decreased available daylight it is anticipated that accessibility to side canyon sites would be restricted and that impacts would be generally confined to sites most easily accessible along the river. Compared to current use, these factors indicate that the effect to cultural resources would be adverse, highly localized, and negligible to minor.

Exchanges at Whitmore would be restricted to the months from ***April to September. It is anticipated that the number and type of exchange and their anticipated effects, will be comparable to current conditions.*** No data have been collected to differentiate impacts between the two exchange types.

Modified Alternative H would have a beneficial effect on traditional cultural properties, ethnobotanical resources, and other significant aspects of tribal assessments of the health of the canyon environment by substantially reducing the months when boat and helicopter motors could be heard and by reducing crowding and congestion at key attractions. For example, visitation at the Little Colorado River and Deer Creek is not expected to ever exceed 100 visitors in a day. This level of visitation would represent a substantial decrease from current condition and the lowest level of daily visitation at these sites of all of the alternatives. This increase would result in a beneficial, short-term, moderate effect on localized resources compared to current conditions.

4.3.5.8.2 Mitigation of Effects

Actions needed to mitigate adverse effects would include ***a subset*** of those discussed on page 571 (increased education, monitoring, patrols, site stabilization, etc.), which would be needed to mitigate impacts from new use in the winter and shoulder seasons. A monitoring and treatment plan to determine and mitigate impacts from visitation would be needed, but sufficient, to reduce localized impacts to a minor intensity. Levels of additional education, patrols, and site stabilization would be determined based on the results of the monitoring program.

4.3.5.8.3 Cumulative Effects

Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, impacts from the management of Glen Canyon Dam, combined with the effects of past visitation by river and backcountry visitors (and researchers), results in measurable changes to localized cultural resources. This effect results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of ***Modified*** Alternative H on cultural resources, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. ***Modified*** Alternative H would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

4.3.5.8.4 Conclusion

Based on the projected changes in use patterns from current conditions, ***Modified*** Alternative H would directly contribute to the long-term protection and stabilization of individual cultural resource sites by factors such as reductions in group size, trip length, and numbers of trips and people at one time, even though overall summer use would increase. This would be offset somewhat, however, by increases in summer user discretionary time and off-season use, as represented by total projected passengers, ***user discretionary time,*** and user-days. Off-season user discretionary time, however, would be relatively low as compared to ***the action alternatives***, and small group sizes would help mitigate the effects of increased use. Overall, this alternative would have an adverse, long-term, negligible to minor effect as compared to current conditions. Adverse effects from visitation to nonrenewable cultural resources would continue to be measurable, and at times impacts to individual resources would be moderate to major. Effects to individual nonrenewable resources would be direct, adverse, and measurable. Because the integrity of the resource might be jeopardized, thus affecting its national register eligibility, the intensity of impacts would be minor to moderate. However, because not all cultural resources along the river corridor are readily accessible (or recognizable) to river users, effects would not occur to the majority of resources in Zone 1. Therefore, these long-term to permanent effects would be localized and highly dependent on accessibility. Effects would occur year-round, with the majority of new impacts occurring in the winter and shoulder seasons. Impacts to cultural resources could be reduced to a minor intensity with reasonable mitigation. ***Modified*** Alternative H would not result in the impairment of cultural resources in Grand Canyon National Park. Cumulatively, the effects of ***Modified*** Alternative H on cultural resources, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. ***Modified*** Alternative H would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

4.3.6 IMPACT ANALYSIS—LOWER GORGE ALTERNATIVES

Key variables, indicators, and use estimates (Table 4- 3 for the Lower Gorge alternatives) were used to determine changes in use at specific resource sites and projected seasonal changes in use patterns, respectively.

4.3.6.1 Alternative 1 (Existing Condition)

4.3.6.1.1 Analysis

Direct and indirect impacts to cultural resources would be essentially the same as those identified under Alternative A for the Lees Ferry to Diamond Creek portion of the Colorado River. These impacts consist primarily of trailing and trampling, on-site camping, collection piles, and physical erosion related to trailing and camping. The intensity of the impacts would vary, however, since the Lower Gorge is a different use zone in which the types and levels of use vary dramatically from the upper portion of the corridor. Specifically, 16 mainstem historic properties, 53 side canyon sites, and 22 traditional cultural properties have been documented within the Lower Gorge (Glassco 2003b; NPS 2003j), and their current conditions are included in the data already discussed. The Lower Gorge is unique, however, in that 108 miles of the Colorado River, including the area known as the Lower Gorge, lies adjacent to Hualapai tribal lands. This land status has resulted in overlapping management of cultural resources by the NPS and the Hualapai Tribe. There are only six traditional cultural properties in this section that are regularly monitored for impacts by Hualapai Division of Cultural Resources, and they are all located at heavily visited areas—Diamond Creek, Bridge Canyon, Spencer Canyon, Travertine Canyon, Travertine Falls, and Burnt Springs (Jackson, Kennedy, and Phillips 2002; Glassco 2003a). These areas are specific to Hualapai tribal lands, but access to these locations is through Grand Canyon National Park.

Existing operations and current management practices have generally resulted in a range of impacts to cultural resources from minor to major, depending primarily on a resource's location in relation to the river corridor, intensity and duration of visitation, time of year, and level of sedimentation. If left unmitigated, all of the human-caused impacts would result in an adverse effect to the resource. Without mitigation these cultural resource impacts would remain measurable. Impacts to cultural resources would tend to be long-term or permanent, localized, and highly dependent on accessibility from the river. Impacts at sites that receive intense and frequent visitation, such as at Diamond Creek (for both launches and takeouts), Spencer Canyon, Burnt Spring Canyon, Travertine Canyon, Travertine Falls, and the Quartermaster area, include permanent undesignated trails, trash, vegetation clearing to create camping spots, trampling of culturally significant plants, and/or physical erosion related in part to trailing and camping (Phillips and Jackson 1997; Jackson, Kennedy, and Phillips 2001, 2002). Each of these sites has been identified as a traditional cultural place by the Hualapai Tribe. Since there are fewer attractions and accessible canyons below Diamond Creek, some of which are dependent on the water levels of Lake Mead, the same sites and canyons tend to get visited by most groups traveling downriver.

Effects to cultural resources, primarily traditional cultural properties, can occur through the introduction of audible or visual intrusions that affect the integrity of the resource. Aircraft, motorboats, pontoon excursions, and increased congestion and crowding can negatively affect properties eligible for the National Register of Historic Places. However, the majority of the impacts occur either on or over Hualapai tribal lands and require an evaluation by the tribal historic preservation officer. Thus far, no effects from these operations have been identified by any affiliated tribe.

Depending on the surface elevation of Lake Mead, upriver recreational boating from Lake Mead can vary. This use would not be regulated under this alternative (although personal watercraft or jet skis are prohibited). The amount of use varies in response to lake levels, independent of the management alternatives, and statistics on these varying use levels is not available. Consequently, effects from noncommercial upriver trips are not included in this analysis.

Upriver commercial jetboat traffic is a specific concern for the Hualapai Tribe. The Hualapai Trible's resource staff have indicated that jetboats create wakes that exacerbate beach erosion, thereby threatening archeological and ethnobotanical sites. While this may be a valid concern at specific resource sites, the Lower Gorge for the most part is a depositional environment. Thus effects are generally limited to recently deposited and newly exposed silt banks.

Under current management, HRR day trips generally launch one large trip per day from Diamond Creek, and passengers exit the river by helicopter in the Quartermaster area. According to the 2001 use moratorium, these trips can carry 80 passengers and 20 guides. While smaller trips are the norm, larger trips have been reported by Grand Canyon Resort Corporation employees and park river rangers. The greatest effect to cultural resources from HRR trips is from the impacts caused by large groups. These impacts, however, are generally restricted to Diamond Creek, Quartermaster, and lunch and attraction sites such as Travertine Canyon and Falls and Spencer Canyon. The resulting trash, physical erosion, trampling of culturally significant plants, and undesignated trails have had adverse, short- to long-term, localized, minor to moderate impacts on cultural resources.

HRR overnight trips generally occur once a week and carry 34 passengers, including crew. They generally spend only one or two nights in the Lower Gorge before taking out, via helicopter, at Quartermaster (RM 262). HRR trips camp in one of 15 naturally occurring campsites in the Lower Gorge. No modifications, including installment of temporary facilities, are made to campsites in this area. HRR trips, which are under the supervision of Hualapai tribal members employed by HRR, generally have a set itinerary, and visitors have little time to interact with the environment. Because these trips are short and infrequent, effects to cultural resources are adverse, long-term, highly localized, and negligible to minor.

Noncommercial trips that launch from Diamond Creek have no time limit on their trip. Thus, access to cultural resources in the Lower Gorge is relatively unlimited. Of particular concern is the access provided to side canyon archeological sites and traditional cultural properties. Group sizes are relatively small, however, which decreases the likelihood of crowding and its associated effects at attraction and campsites. Overall, noncommercial use has a direct, adverse, long-term, minor to moderate effect on localized resources.

Physical impacts on cultural resources from pontoon use would continue to be limited to the impacts at the launch/takeout area at Quartermaster (RM 262), where a traditional cultural property is located. Pontoon operations during peak seasons average 188 passengers per day, although daily spikes above 500 passengers have been documented. During the non-peak season (October to March) operators average ***130*** passengers per day. The pontoon tours generally last 30 minutes, with access at the same location in the Quartermaster area. Passengers on pontoon trips rarely have time for exploration, even in the direct vicinity of the helicopter pad and launch area. While archeological sites do exist in the vicinity of the visitor facilities in the Quartermaster area, they are relatively inaccessible due to the overgrowth of vegetation, and they have not been monitored for at least 10 years. Pontoon use has a direct, adverse, long-term, negligible to minor effect on localized resources.

Upriver traffic under this alternative is largely unlimited, with upriver commercial traffic levels tied to peaks in downriver traffic. Wakes from upriver travel are known to erode beaches and banks, most of which are newly deposited or exposed. Effects to archeological sites and historic properties would be negligible, given that these resources are generally located well above the areas that are being eroded. However impacts to ethnobotanical sites and traditional cultural properties could include damage to plants and access restrictions for tribal members, thus effects would be direct, adverse, highly localized, long-term, and negligible to minor.

4.3.6.1.2 Mitigation of Effects

Actions needed to mitigate adverse effects would include ***a subset*** of those discussed on page 571 (increased monitoring, patrols, site stabilization, etc.). However, because current management of the river corridor allows for unregulated use, as well as the longest allowable trip lengths and group sizes of any of the alternatives, it is unlikely that that mitigations would be implemented at a level sufficient to reduce impacts to a minor intensity:

4.3.6.1.3 Cumulative Effects

Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, impacts from the management of Glen Canyon Dam, combined with the effects of past visitation by river and backcountry visitors (and researchers), and the effects of lowering Lake Mead levels, result in measurable changes to localized cultural resources. This results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of Alternative 1 on cultural resources, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. Alternative 1 would result in a localized, adverse, long-term, minor to moderate contribution to these cumulative effects.

4.3.6.1.4 Conclusion

Under Alternative 1 effects to individual nonrenewable resources, particularly traditional cultural properties, would be direct and measurable. Because the integrity of the resource might be jeopardized, thus affecting its national register eligibility, the intensity of impacts would be minor to major, depending on accessibility from the river. Effects would be adverse, localized, and year-round, with most impacts occurring to the limited number of traditional cultural properties used by Grand Canyon Resort Corporation and its contractors and to side canyon sites accessed by recreationists on noncommercial trips. For the most part, these impacts would be long-term to permanent. Because current management of the river corridor allows for unregulated use, as well as the longest allowable trip lengths and group sizes of any of the alternatives, it is unlikely that mitigations would be implemented at a level sufficient to reduce impacts to a minor intensity. Alternative 1 would not result in the impairment of cultural resources in Grand Canyon National Park. Cumulatively, the effects of Alternative 1 on cultural resources, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. Alternative 1 would result in a localized, adverse, long-term, minor to moderate contribution to these cumulative effects.

4.3.6.2 ALTERNATIVE 2

4.3.6.2.1 Analysis

Under Alternative 2 group sizes, total number of daily passengers, and allowable upriver travel would be at the lowest levels of all of the alternatives (see Table 4- 3). Additionally, pontoon use and all associated operations and facilities, would be eliminated.

During the peak season HRR would be allowed to launch two trips per day, each with up to 30 passengers, including guides; During the non-peak season one trip per day of 30 people would be allowed. Because the greatest current effect to cultural resources from HRR trips is the impacts caused by large groups, this alternative would have a direct, beneficial, long-term, negligible to moderate effect compared to current condition at localized sites, particularly at Diamond Creek, Quartermaster, and lunch and attraction sites such as Travertine Canyon and Falls and Spencer Canyon.

HRR overnight trips could launch one trip per day, year-round, with 30 passengers, including crew. It is unknown whether demand would eventually increase for this type of trip. Current trips are infrequent, but group size, trip length, and number of launches is unregulated. Thus, this alternative would provide for greater protection of cultural resources in the event that demand continued to grow. Overall, HRR overnight use would have a direct, beneficial, long-term, negligible to minor effect on cultural resources, compared to current conditions.

The number of noncommercial trips allowed to launch from Diamond Creek would remain unchanged, but trip length would be limited to four nights in the peak season and five nights in the non-peak season. This decrease in allowable trip length would limit access to sensitive archeological sites and traditional cultural properties in side canyons. Group sizes would remain relatively small, decreasing the likelihood of crowding and its associated effects at attractions and campsites. Compared to current conditions, noncommercial use would have a direct, beneficial, long-term, minor to moderate effect on localized resources.

Because the current direct effect on cultural resources from pontoon use is negligible to minor, eliminating pontoon operations would result in a beneficial, long-term, negligible effect.

Upriver traffic under this alternative would be limited to two trips per day below RM 262. This reduction in allowable use would result in a beneficial, long-term, negligible to minor effect on cultural resources compared to current conditions.

4.3.6.2.2 Mitigation of Effects

Actions needed to mitigate adverse effects would include ***a subset*** of those discussed on page 571 (increased monitoring, patrols, site stabilization, etc.). While use levels would be relatively low under this alternative, a monitoring and treatment plan to determine and mitigate impacts from visitation, especially in high-use sites, would be needed, but sufficient, to reduce localized impacts to a minor intensity. Levels of additional education, patrols, and site stabilization would be determined based on the results of the monitoring program.

4.3.6.2.3 Cumulative Effects

Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, impacts from the management of Glen Canyon Dam, combined with the effects of past visitation by river and backcountry visitors (and researchers), and the effects of lowering Lake Mead levels, result in measurable changes to localized cultural resources. This results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of Alternative 2 on cultural resources, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. Alternative 2 would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

4.3.6.2.4 Conclusion

Based on group sizes, trip lengths, and daily passenger limits for trips launching at Diamond Creek, Alternative 2 would directly contribute to the long-term protection and stabilization of individual cultural resource sites compared to current conditions, especially sites located in side canyons and sites frequented by HRR trips. This would be a beneficial, localized, minor to moderate effect that would be highly dependent on site accessibility and vulnerability. However, adverse effects from visitation to nonrenewable cultural resources would continue to be measurable and, at times, of moderate to major intensity to individual resources. Thus, most of the effects from visitation would be direct, adverse, negligible to moderate, and irreversible. However, because not all cultural resources along the river corridor are readily accessible (or recognizable) to river users, effects would not occur to the majority of resources. Therefore, effects would be localized and highly dependent on accessibility. Effects would continue to occur year-round, with most impacts during summer when increased daylight allows more time for visitors to access sensitive resources. Impacts to cultural resources could be reduced to a minor intensity with reasonable mitigation. Alternative 2 would not result in the impairment of the cultural resources in Grand Canyon National Park. Cumulatively, the effects of Alternative 2 on cultural resources, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. Alternative 2 would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

4.3.6.3 ALTERNATIVE 3

4.3.6.3.1 Analysis

Under Alternative 3 group sizes and trip lengths would be at substantially lower levels than now. The total number of pontoon passengers, HRR passengers, and upriver trips would be near or above current levels (see Table 4- 3).

Alternative 3 would allow three daily launches for HRR day trips during the peak season, each with up to 30 people, including guides. Two trips per day of 30 people would be allowed during the non-peak season. Summer passenger totals would be comparable to current conditions, although smaller group sizes would substantially reduce potential impacts from crowding. Winter use would allow for fewer passengers per day, in addition to restricting group size. Overall, this alternative would result in direct, beneficial, long-term, negligible to minor effects at localized sites, particularly at Diamond Creek, Quartermaster, and lunch and attraction sites such as Travertine Canyon and Falls and Spencer Canyon.

HRR could launch two overnight trips per day with a maximum of 30 people (including crew) all year. It is unknown whether demand would eventually increase for this type of trip. Current trips are infrequent, but group sizes, trip lengths, and numbers of launches are unregulated. Thus, this alternative would provide greater protection of cultural resources if demand continued to grow for this type of experience. Overall, HRR overnight use would have a direct, beneficial, long-term, negligible to minor effect on cultural resources, compared to current condition.

The number of noncommercial trips allowed to launch from Diamond Creek would remain unchanged, but trip lengths would be limited to five nights in the peak season and eight nights in the non-peak season. This decrease in allowable trip length would limit access to sensitive side canyon archeological sites and traditional cultural properties. Group sizes would remain relatively small, which would decrease the likelihood of crowding and its associated effects at attractions and campsites. Compared to current conditions, noncommercial use would have a direct long-term, minor beneficial effect on localized resources.

Physical effects from pontoon use on cultural resources would continue to be limited to the impacts at the launch/takeout area at the Quartermaster traditional cultural property (RM 262). Pontoon operations during the peak season would be limited to 400 passengers per day. While this level of use would be higher than the current average, it would be lower than the current spikes in use. Passengers on pontoon trips rarely have time for exploration, even in the direct vicinity of the helicopter pad and launch area. While archeological sites do exist in the vicinity of the Quartermaster visitor facilities, these sites are relatively inaccessible due to the overgrowth of vegetation, but they have not been monitored for at least 10 years. Compared to current conditions, pontoon use would have a direct, adverse, long-term, negligible effect on localized physical resources at Quartermaster.

Upriver traffic under this alternative would be limited to six trips per day below RM 240 (Separation Canyon), which would be an adverse, long-term, negligible effect to cultural resources compared to current condition.

4.3.6.3.2 Mitigation of Effects

Actions needed to mitigate adverse effects would include ***a subset*** of those discussed on page 571 (increased monitoring, patrols, site stabilization, etc. A monitoring and treatment plan to determine and mitigate impacts from visitation, especially in high-use sites, would be needed, but sufficient, to reduce localized impacts to a minor intensity. Levels of additional education, patrols, and site stabilization would be determined based on the results of the monitoring program.

4.3.6.3.3 Cumulative Effects

Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, impacts from the management of Glen Canyon Dam, combined with the effects of past visitation by river and backcountry visitors (and researchers), and the effects of lowering Lake Mead levels, result in measurable changes to localized cultural resources. This results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of Alternative 3 on cultural resources, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. Alternative 3 would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

4.3.6.3.4 Conclusion

Based on group sizes, trip lengths, and daily passenger limits for trips launching at Diamond Creek, Alternative 3 would directly contribute to the long-term protection and stabilization of individual cultural resource sites, especially sites in side canyon and sites frequented by HRR trips. This would result in beneficial, localized, negligible to minor effects that would be highly dependent on site accessibility and vulnerability. However, adverse effects from visitation to nonrenewable cultural resources would continue to be measurable and, at times, of moderate to major intensity to individual resources. Thus, most of the effects from visitation would be direct, adverse, negligible to moderate, and irreversible. However, because not all cultural resources along the river corridor are readily accessible (or recognizable) to river users, effects would not occur to the majority of resources. Therefore, effects would be localized and highly dependent on accessibility. Effects would continue to occur year-round, with most impacts during summer when more available daylight allows additional opportunities for visitors to access sensitive resources. Impacts to cultural resources could be reduced to a minor intensity with reasonable mitigation. Alternative 3 would not result in the impairment of cultural resources in Grand Canyon National Park. Cumulatively, the effects of Alternative 3 on cultural resources, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. Alternative 3 would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

4.3.6.4 MODIFIED ALTERNATIVE 4 (NPS PREFERRED ALTERNATIVE)

4.3.6.4.1 Analysis

Modified Alternative 4 is characterized by a redistribution of HRR operations and represents a consensus between the NPS and the Hualapai Tribe on levels of HRR use and other uses originating at Diamond Creek. ***This alternative, however, presents the NPS's preference for lower levels of pontoon boat use in the Quartermaster area compared to levels proposed by the Hualapai Tribe. Pontoon use levels in this alternative allow for economic growth within the constraints of resource protection.*** Under this alternative, HRR group sizes and trip lengths would be at substantially lower levels than now, and upriver trips would be below current levels (see Table 4- 3).

Daily ***HRR*** passenger totals during the peak season would be limited to 96, with group sizes (including guides) not to exceed 40. No limits would be placed on trips per day in the peak season. This alternative would offer HRR managers increased flexibility in scheduling launches, while encouraging the booking of smaller trips. Two trips of 20 people would be allowed during the non-peak season. Summer passenger totals would be somewhat higher than now, but smaller group sizes would reduce potential impacts from crowding. Winter use would allow for fewer passengers per day, as well as restricted group sizes. Compared to current conditions, this alternative overall would result in a direct, beneficial, long-term, minor effect at localized sites, particularly at Diamond Creek, Quartermaster, and lunch and attraction sites such as Travertine Canyon and Falls and Spencer Canyon.

For HRR overnight use three trips per day of 20 people each (including guides) could launch in the peak season and one trip per day in the non-peak season. It is unknown whether demand would eventually increase for this type of trip. Compared to current conditions where trips are infrequent, but group sizes, trip lengths, and number of launches are unregulated, this alternative would provide greater protection of cultural resources if demand for this type of experience continued to grow. Overall, HRR overnight use would have a direct, beneficial, long-term, negligible to minor effect on cultural resources compared to current conditions.

The number of noncommercial trips allowed to launch from Diamond Creek would remain unchanged, but trip length would be limited to three nights in the peak season and five nights in the non-peak season. This decrease in allowable trip lengths would limit access to sensitive side canyon archeological sites and traditional cultural properties. Group sizes would remain relatively small, decreasing the likelihood of crowding and its associated effects at attractions and campsites. Compared to current conditions, noncommercial use would have direct, beneficial, long-term, minor to moderate effects on localized resources.

Physical effects of pontoon use on cultural resources would continue to be limited to the impacts at the launch/takeout area at the Quartermaster traditional cultural property (RM 262). ***Pontoon operations would continue with six boats in the Quartermaster area, with a preliminary maximum daily capacity of 480 passengers. Maximum daily pontoon passengers could be increased to 600 per day based on favorable performance reviews of concession operations and resource monitoring data. This level of use would be higher than the current average, but comparable to current spikes in use.*** Passengers on pontoon trips rarely have time for exploration, even in the direct vicinity of the helicopter pad and launch area. While archeological sites do exist in the vicinity of the Quartermaster visitor facilities, these sites are relatively inaccessible due to the overgrowth of vegetation, but they have not been monitored for at least 10 years. Compared to current conditions, pontoon use would have direct, adverse, long-term, negligible effects on localized physical resources at Quartermaster.

Five upriver trips per day in the peak season are estimated under this alternative, and two trips per day in the non-peak season. This use would be restricted to the section of river below ***RM240*** (Separation Canyon). This use would result in an adverse, long-term, negligible to minor effect on cultural resources compared to current conditions.

4.3.6.4.2 Mitigation of Effects

Actions needed to mitigate adverse effects would include ***a subset*** of those discussed on page 571 (increased monitoring, patrols, site stabilization, etc.). While reductions in group size and trip length would reduce adverse effects compared to current conditions, a monitoring and treatment plan to determine and mitigate impacts from visitation, especially at high-use sites, would be needed, but sufficient, to reduce localized impacts to a minor intensity. Levels of additional education, patrols, and site stabilization would be determined based on the results of the monitoring program.

4.3.6.4.3 Cumulative Effects

Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, impacts from the management of Glen Canyon Dam, combined with the effects of past visitation by river and backcountry visitors (and researchers), and the effects of lowering Lake Mead levels, result in measurable changes to localized cultural resources. This results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of ***Modified*** Alternative 4 on cultural resources, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. ***Modified*** Alternative 4 would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

4.3.6.4.4 Conclusion

Based on group sizes, trip lengths, and daily passenger limits for trips launching at Diamond Creek, ***Modified*** Alternative 4 would directly contribute to the long-term protection and stabilization of individual cultural resource sites, especially in side canyon and sites frequented by HRR trips. This would result in a beneficial, localized, negligible to minor effect that would be highly dependent on site accessibility and vulnerability. However, adverse effects from visitation to nonrenewable cultural resources would continue to be measurable and, at times, of moderate to major intensity to individual resources. Thus, most of the effects from visitation would be direct, adverse, negligible to moderate, and irreversible. However, because not all cultural resources along the river corridor are readily accessible (or recognizable) to river users, effects would not occur to the majority of resources. Therefore, effects would be localized and highly dependent on accessibility. Effects would continue to occur year-round, with most impacts during summer when more daylight allows additional opportunities for visitors to access sensitive resources. Impacts to cultural resources could be reduced to a minor intensity with reasonable mitigation. ***Modified*** Alternative 4 would not result in the impairment of cultural resources in Grand Canyon National Park. Cumulatively, the effects of ***Modified*** Alternative 4 on cultural resources, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. ***Modified*** Alternative 4 would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

4.3.6.5 ALTERNATIVE 5 (HUALAPAI TRIBE PROPOSED ACTION)

4.3.6.5.1 Analysis

Alternative 5 is characterized by a redistribution of HRR operations and represents a consensus between the NPS and the Hualapai Tribe on levels of HRR use and other uses originating at Diamond Creek. This alternative, however, incorporates the Hualapai Tribe's proposed higher levels of pontoon boat use compared to current conditions. Under this ***Modified*** Alternative HRR group sizes and trip lengths would be at substantially lower levels than currently and upriver trips would be below current levels (see Table 4- 3).

Daily passenger totals during the peak season would be limited to 96, with group sizes (including guides) not to exceed 40. No limits would be placed on trips per day in the peak season, allowing HRR managers increased flexibility in scheduling launches, while encouraging booking of smaller trips. Summer passenger totals are somewhat higher than current conditions, but smaller group sizes would reduce potential impacts from crowding. Two trips of 20 people would be allowed during the non-peak season. Winter use would allows for fewer passengers per day in addition to restricted group sizes. Compared to current conditions, this alternative overall would result in direct, beneficial, long-term, minor effects at localized sites, particularly at Diamond Creek, Quartermaster, and lunch and attraction sites such as Travertine Canyon and Falls and Spencer Canyon.

For HRR overnight trips, three trips per day could launch in the peak season and one trip per day in the non-peak season, with a maximum of 20 passengers per trip, including crew. It is unknown whether demand would eventually increase for this type of trip. Current trips are infrequent, but group sizes, trip lengths, and number of launches are unregulated. Therefore, this alternative would provide for greater protection of cultural resources, should demand continue to grow. Overall, HRR overnight use would have a direct, beneficial, long-term, negligible to minor effect on cultural resources, compared to current conditions.

The number of noncommercial trips allowed to launch from Diamond Creek would remain unchanged, but trip lengths would be limited to three nights in the peak season and five nights in the non-peak season. This decrease in allowable trip length would limit access to sensitive side canyon archeological sites and traditional cultural properties. Group sizes would remain relatively small, decreasing the likelihood of crowding and its associated effects at attractions and campsites. Compared to current conditions, noncommercial use would have direct, beneficial, long-term, minor to moderate effects on localized resources.

Physical effects from pontoon use on cultural resources would continue to be limited to the impacts at the launch/takeout area at the Quartermaster traditional cultural property (RM 262). Pontoon operations during the peak season would be limited to 960 passengers per day, which would be substantially higher than now or any known spikes in daily use. Pontoon boat passengers rarely have time for exploration, even in the direct vicinity of the helicopter pad and launch area. While archeological sites do exist in the vicinity of the Quartermaster visitor facilities, these sites are relatively inaccessible due to the overgrowth of vegetation, but they have not been monitored for at least 10 years. Compared to current conditions, pontoon use would have direct, adverse, long-term, negligible to minor effects on localized physical resources at Quartermaster.

Upriver traffic would not be allowed under this alternative above RM 273, exception for pontoon traffic. This use would result in an adverse, long-term, negligible to minor effect to cultural resources compared to current conditions.

4.3.6.5.2 Mitigation of Effects

Actions needed to mitigate adverse effects would include ***a subset*** of those discussed on page 571 (increased monitoring, patrols, site stabilization, etc.). While reductions in group sizes and trip lengths would reduce adverse effects compared to current conditions, a monitoring and treatment plan to determine and mitigate impacts from visitation, especially at high-use sites, would be needed, but sufficient, to reduce localized impacts to a minor intensity. Levels of additional education, patrols, and site stabilization would be determined based on the results of the monitoring program.

4.3.6.5.3 Cumulative Effects

Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. Cumulatively, impacts from the management of Glen Canyon Dam, combined with the effects of past visitation by river and backcountry visitors (and researchers), and the effects of lowering Lake Mead levels, result in measurable changes to localized cultural resources. This results in adverse, long-term, minor to major impacts that are highly localized.

Cumulatively, the effects of Alternative 5 on cultural resources, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. Alternative 5 would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

4.3.6.5.4 Conclusion

Based on group sizes, trip lengths, and daily passenger limits for trips launching at Diamond Creek, Alternative 5 would directly contribute to the long-term protection and stabilization of individual cultural resource sites, especially in side canyon and sites frequented by HRR trips. This would result in beneficial, localized, negligible to minor effects that would be highly dependent on site accessibility and vulnerability. However, adverse effects from visitation to nonrenewable cultural resources would continue to be measurable and at times of moderate to major intensity to individual resources. Thus, most of the effects from visitation would be direct, adverse, negligible to moderate, and irreversible. However, because not all cultural resources along the river corridor are readily accessible (or recognizable) to river users, effects would not occur to the majority of resources. Therefore, effects would be localized and highly dependent on accessibility. Effects would continue to occur year-round, with most impacts during summer when more daylight allows additional opportunities for visitors to access sensitive resources. Impacts to cultural resources could be reduced to a minor intensity with reasonable mitigation. Alternative 5 would not result in the impairment of cultural resources in Grand Canyon National Park. Cumulatively, the effects of Alternative 5 on cultural resources, when combined with other past, present, and reasonably foreseeable actions, would be localized, adverse, long-term, and minor to major. Alternative 5 would result in a localized, adverse, long-term, minor contribution to these cumulative effects.

4.4 IMPACTS ON VISITOR USE AND EXPERIENCE

4.4.1 ISSUES

Major issues and concerns regarding visitor experience from public scoping, internal scoping, and management documents, such as the 1995 *General Management Plan,* 1989 *Colorado River Management Plan*, include:

- Balance between visitor access and resource protection
- Conflicts between motorized and nonmotorized use and levels of use
- Commercial/noncommercial allocations and seasonal distributions
- Level of helicopter use, seasonality, and exchanges
- Quality of river trips (including crowding, trip length, group size, camp competition, river and camp encounters, scheduling issues, and exchanges)
- Appropriate level of visitor use consistent with natural and cultural resource protection and visitor experience goals
- Appropriate levels and types of upstream travel from Lake Mead
- Range of services and opportunities provided to the public
- Noncommercial permit system

Other issues include the relationships between use levels and experience quality, which have been a focus of recreation management in North America for over 40 years. Social carrying capacity is defined as the use level where impacts exceed standards for a given type of experience (Shelby and Heberlein 1986). Visitor impact and carrying capacity frameworks address these issues by focusing on indicators and standards for specific opportunities. Indicators define the type of impact to be evaluated and standards specify the level of impact that is acceptable or tolerable (***i.e., "how much is too much" impact***).

4.4.2 GUIDING REGULATIONS AND POLICIES

Visitor use in parks is authorized in the NPS Organic Act and managed under the NPS *Management Policies 2001* (NPS 2000a) in the "Use of Parks" section, which includes commercial as well as public use. These policies state that enjoyment of park resources and values by the people of the United States is part of the fundamental purpose of all park units and that the NPS is committed to providing appropriate, high-quality opportunities for visitors to enjoy the parks. Further, the NPS will strive to protect human life and provide for injury-free visits and will seek to provide a safe and healthful environment for visitors and employees.

Because many forms of recreation can take place outside of a national park setting, the NPS therefore seeks to:

- Provide opportunities for forms of enjoyment that are uniquely suited and appropriate to the superlative natural and cultural resources found in a particular park

- Defer to others to meet the broader spectrum of recreational needs and demands that are not dependent on a national park setting. Those others can include local, state, and other federal agencies; private industry; and non-governmental organizations

Unless mandated by statute, the NPS will not allow visitors to conduct activities that:

- Would impair park resources or values
- Create an unsafe or unhealthful environment for other visitors or employees;
- Are contrary to the purposes for which the park was established; or
- Unreasonably interfere with the atmosphere of peace and tranquility, or the natural soundscape maintained in wilderness, and natural, historic, or commemorative locations within the park; NPS interpretive, visitor service, administrative, or other activities; NPS concessioner or contractor operations or services; or other existing, appropriate park uses

The park's 1995 *General Management Plan* provides a foundation from which to protect park resources while providing for meaningful visitor experiences. The *General Management Plan* sets management direction for all areas of the park and establishes a vision for the Colorado River.

> The purpose of Grand Canyon National Park is based on the legislation establishing the park and the legislation governing the NPS. As a place of national and global importance, Grand Canyon National Park is to be managed to:
>
> - Preserve and protect its natural and cultural resources and ecological processes, as well as its scenic, aesthetic, and scientific values
> - Provide opportunities for visitors to experience and understand the environmental interrelationships, resources, and values of the Grand Canyon without impairing the resources. (page 1)

As further stated in the *General Management Plan*, "The Colorado River, as it flows through the park, provides opportunities for one of the world's premier river experience, including [having] one of the longest stretches of navigable white water on earth." (NPS 1995C).

The *General Management Plan* outlines a vision for managing resources and visitor experiences for undeveloped areas in the park, including the Colorado River. Areas proposed or eligible for wilderness designation, including the Colorado River, "offer visitors opportunities for solitude and primitive recreation. The management of these areas should preserve the wilderness values and character."

The following Vision Statement for management of the Colorado River corridor in Grand Canyon National Park is adopted from the *General Management Plan* and revised based on comments received during opportunities for public participation in this planning process.

> The Colorado River Corridor in Grand Canyon National Park would be managed to provide a wilderness river experience in which visitors can intimately relate to the majesty of the Grand Canyon and its natural and cultural resources. Visitors traveling through the canyon on the Colorado River would have the opportunity for a variety of personal outdoor experiences, ranging from solitary to social, with as little influence from the modern world as possible. The Colorado River corridor would be protected and preserved in a wild and primitive condition.

A key part of this vision is the concept of a “wilderness river experience” which is here defined as:

- The natural sounds, silence, smells, and sights of the canyon and the river predominate over those that are caused by humans
- Outstanding opportunities are provided for solitude or a primitive and unconfined type of recreation
- The river is experienced on its own terms (that is, visitors accept an undeveloped, primitive environment and assume the potential risks and responsibilities)
- The natural and cultural objects in the riparian zone and side canyons are viewed in a state as little affected as possible by people, given the existence of dams on the Colorado River
- The effect of the river runner’s presence is temporary rather than long lasting

4.4.3 MANAGEMENT OBJECTIVES FOR VISITOR USE AND EXPERIENCE

Management objectives for the visitor use and experience, as stated in Chapter 1 and as it relates to management of recreational river use in the Grand Canyon include the following:

- Provide a diverse range of quality recreational opportunities for visitors to experience and understand the environmental interrelationships, resources, and values of Grand Canyon National Park
- Levels and types of use enhance visitor experience and minimize crowding, conflicts, and resource impacts
- Manage the Colorado River corridor through Grand Canyon National Park to protect and preserve the resource in a wild and primitive condition and provide a wilderness river experience (without affecting decisions regarding the use of motorboats on the river). (NPS 1995C, 11)

4.4.4 METHODOLOGY FOR ANALYZING EFFECTS TO VISITOR USE AND EXPERIENCE

Several recreation management and planning concepts guide the visitor experience impacts analysis. First, there is a range of recreation opportunities available in Grand Canyon, even on the primitive end of the spectrum. The Recreation Opportunity Spectrum (ROS) concept, institutionalized by many federal and state agencies, recommends specifying types of trips when assessing the quality or quantity of opportunities (Driver et al. 1987; Manning 1999).

Second, recreation quality is related to many variables, and several recreation planning frameworks help specify those relationships (e.g., CCAP [Shelby and Heberlein 1986]; Visitor Impact Management [Graefe, Kuss, and Vaske 1990]; Visitor Experience and Resource Protection [NPS 1997a]; Limits of Acceptable Change [Stankey et al. 1985]). As recommended by these frameworks, this analysis focuses on social indicators, standards, and management actions to reduce impacts when they exceed standards.

Third, there are trade-offs between the quantity and quality of recreation opportunities. Higher use levels produce higher social impacts, which may affect the quality or type of opportunities. However, lower use levels mean that fewer people can take river trips, have high quality experiences, and have the opportunity to understand the values of the canyon or similar wilderness-like areas.

The visitor use and experience impact analysis assesses an array of alternatives that produce different, distinct opportunities. This analysis attempts to make the trade-offs of each alternative apparent. ***An important aspect of analyzing impacts is the determination of the range of opportunities for various trip types. The analysis of public scoping comments clearly indicated that there is no one definition of the ideal Grand Canyon river trip. For example, while some people may prefer a trip without motors of any kind, some may prefer a motorized trip that ends with a helicopter ride. Still others may prefer motorized trips, but find the prospect of encountering a helicopter shuttle unacceptable. Some visitors want a social experience while others prefer to vacation with a small group that is unlikely to encounter other groups. Some want short trips, others want long trips. Preferences also vary on desired seasons and whether trips are commercial or self-guided. All of the variables, and the degree to which each is offered, are considered in this analysis.***

Social impact studies on many rivers, including those in Grand Canyon help identify potential opportunities, indicators, standards, and management actions for this Final *Environmental Impact Statement*. The current (1989) *Colorado River Management Plan* offers additional information by implicitly defining different opportunities in different seasons (primary vs. secondary) and explicitly establishing standards for some indicators. These factors are used to evaluate and compare each of the alternatives, and assess the level of potential impact on visitor use and experience. A full description of these factors can be found in Appendix G. These factors consist of the following:

- River encounters
- Time in sight
- Attraction site encounters
- Campsite encounters
- Camp competition
- Launch and takeout congestion
- Group size
- Trip length
- Discretionary time for off-river activities
- Nonmotorized opportunities
- Whitmore helicopter activity
- Encounters between river users and hikers
- Phantom Ranch exchanges

4.4.4.1 Tools Used to Analyze Effects on Visitor Use and Experience

In addition to the tools described in Section 4.1 of Chapter 4 (Grand Canyon River Trip Simulator and the User Discretionary Time Model), the Recreational Opportunity Spectrum (ROS) management zone and camp size and distribution maps were used to analyze effects on visitor experience. A map with locations of known visitor stopping points (lunch stops and attraction sites), bottleneck areas, launch and takeout sites, and passenger exchange sites, including data on use intensity, was also used to analyze effects. Also, visitor surveys and personal observation of visitation patterns combined with assessment of what is available to visitors under current management and the on-line launch calendar were used to estimate the effects of the actions associated with each alternative. ***Appendix G: Visitor Use and Experience provides additional detail about impact measures, relevant literature, assumptions used in conducting the analysis, and research findings relevant to the following impact analysis.***

4.4.4.1.1 Use Measures

Use measures, such as "20,000 visitors in 2001" or "115,500 user-days per year in the commercial sector" may be familiar to many Grand Canyon boaters. These are useful for understanding use trends over time, or keeping track of access between sectors, but they are less useful for determining carrying capacities (Shelby and Heberlein 1986). These statistics are generally aggregated over such large areas or for such long periods of time, they give little insight relative to impacts during specific times or at specific locations.

With social impacts, it is more important to focus on more narrowly defined use measures, each of which must specify timing (e.g., at one time, per day, per week, per month, per season), location (e.g., at a launch site, in the entire river corridor, at specific attraction sites), and units (e.g., user-days, people, or trips). Throughout the visitor experience impact analysis impacts are related to several different use level measurements, but are primarily focused on: daily launches, trips at one time (TAOT), and the number of people at specific launches or attraction sites.

- *Daily launches*—probably the most important use measure because launches (or trips) are the "units of use" that have encounters, occupy campsites, or influence the probability of encounters at attraction sites. The daily number of people launching would probably provide similar information because the number of trips and people are highly correlated (the correlation in the 1975 study was 0.94), but launches are easier to track.
- *Trips at one time (TAOT)*—provides a different type of use information from daily launches. Different types of trips stay different amounts of time, so the number of trips at one time shows how "full" the river corridor is. This in turn has important effects on competition for attraction sites and campsites.
- *People at one time (PAOT)*—an alternative measure that would probably provide similar information (because it is correlated with trips at one time), but it can under- or over-estimate impacts due to different group sizes by type of trip.

The number of people at specific launch or attraction sites is a third important use measure. It is more useful for these places because it is more difficult to tell who belongs with which group, and the total number at the site is the critical issue.

4.4.4.2 IMPACT THRESHOLDS

The general process for analyzing impacts to resources is discussed in the "Introduction" to Chapter 4. Effects specific to visitor experience are characterized for each alternative. The analysis of impacts was based on the interaction of context, duration, timing, and intensity of visitor impacts. Intensity of impacts was defined using resource-specific impact thresholds. Additionally, each alternative was evaluated to determine whether effects are direct or indirect.

Intensity

Negligible—A majority of all visitors would not notice any effects of changes in visitor use patterns and levels and the effects would not change their experience of river resources and values. Mitigation would not be necessary.

Minor—Visitors might be able to detect the effects of changes in visitor use patterns and levels, and the changes might have a slight but detectable effect on their experience of river resources and values. Other areas within the river corridor would remain available for similar visitor experiences, and visitor satisfaction would be measurable and adversely or beneficially affected. If mitigation was needed to offset adverse effects to visitor experience, it would be relatively simple to implement and would likely be successful.

Moderate—Visitors would be aware of the effects of changes in visitor use patterns and levels, as well as the effects on their experience of river resources and values. Other areas within the river corridor would remain available for similar visitor experiences without effects on river resources and values, but factors used to measure visitor experience would clearly indicate that visitors were adversely or beneficially affected. Some visitors might feel displaced and need to pursue their desired visitor experience on other rivers. Mitigation measures would probably be necessary to offset adverse effects and would likely be successful.

Major—A majority of visitors would be highly aware of the effects associated with changes in visitor use patterns and levels, as well as the effects on their experience of river resources and values. Factors used to measure visitor experience would clearly indicate that a majority of visitors were adversely or beneficially affected. Many visitors would feel displaced and need to pursue their desired visitor experience on other rivers. Mitigation measures to offset adverse effects would be needed, they would have to be extensive, and their success would not be guaranteed.

Context

Localized—Impacts would be realized at specific sites or locations (e.g. campsites, attraction sites, launch and takeout sites, exchange points, or during on-river encounters with other parties.)

Regional—Impacts would be realized at several sites and/or locations and are applicable to one of three management zones.

Duration

Short-term—Impacts would be realized a few moments to one day.

Long-term—Impacts would be realized more than one day to the duration of the trip.

Timing

Impacts have a varying degree of effect based on when they occur, both seasonally and time of day. For example, the high-use season is currently during the peak season summer months.

4.4.4.3 Mitigation of Effects

A list of possible mitigation measures ***to be considered singly or in combination, that are*** not already incorporated into the alternatives, ***but*** are judged likely to reduce impacts to visitor experience ***if implemented*** include the following:

- Increase education efforts to teach visitors and guides ***about minimum impact practices***
- Provide a map of small, medium and large campsites for river runners and ***encourage*** parties of twelve or less to use small campsites, thirteen to twenty-four to use medium campsites, and twenty-four or larger to use larger campsites
- Delineate ***established*** campsites and clear non-native vegetation ***as needed to maintain*** sufficient tent sites for river runners
- Work with the Glen Canyon Dam Adaptive Management Work Group to attempt to reduce beach erosion
- Rehabilitate campsites and attraction sites and link them to systematic monitoring programs
- Develop and foster partnerships to help inventory and monitor campsites and attraction sites
- Restrict group sizes or numbers of trips visiting attraction sites
- ***If crowding conditions persist***, schedule and/or limit the amount of time groups visit attraction sites
- Conduct systematic, seasonal visitor satisfaction surveys
- Require the most advanced “quiet technology” to reduce noise of motorized craft
- Restrict generator use ***to emergency situations and inflating rafts (See new Operating Requirements in Section 2.3 for more detail.)***
- Designate campsites to reserve larger camps for larger trips (or trips with larger boats) and designate and/or schedule river/hiker campsites along the river corridor
- Publicize information about camps where encounters can be expected and urge sensitive users to avoid those places
- Schedule launches throughout the day and, if ***necessary,*** schedule ***take-outs*** and ***last-night camps*** above Diamond Creek ***(see new Operating Requirements in Section 2.3 for more detail)***
- Require outfitters to provide a hiking guide for exchange passengers hiking out and require exchange passengers to begin their hikes out by a certain time in the morning

(especially in the summer months) ***(see new Operating Requirements in Section 2.3 for more detail.)***

- ***Adjust NPS law enforcement presence to address year-round use***

4.4.4.4 CUMULATIVE IMPACTS

Cumulative impacts on visitor experience were determined by combining the impacts of each alternative with other past, present, and reasonably foreseeable future actions (see Section 4.1 for detailed list of all actions).

According to a considerable amount of research, the most important cumulative effect on visitor experience is that beaches and camps in the Grand Canyon are getting smaller and less abundant. Glen Canyon Dam has depleted the canyon of important sediment sources; limited the frequency, duration, and recession of high-flow events that periodically created, maintained, and cleaned beaches of encroaching vegetation; and increased erosion through daily peaking. Studies also generally suggest that camps in critical reaches are more likely to disappear because of erosion, while camps in non-critical reaches are diminished by a combination of erosion and encroaching vegetation. Research has also shown that long-term campsite loss has been most acute in critical reaches (Kearsley, Schmidt, and Warren 1994; Brian and Thomas 1984) (***see Section 4.2.1, Soils for more information***).

Campsite capacities and availability are a major issue for recreation users, who have been adapting to smaller, less frequent, or less inviting beaches and camps in the years since the 1983 flood. If these trends continue, campsite frequency would decline further and create greater competition and crowding problems. Changes in group size limits, use limits, or the implementation of camp scheduling or designated camps for different sized groups are actions that could mitigate the camp frequency issue, as discussed in the alternatives. Encounters between river users and hikers competing for campsites could also have an additional effect on the crowding issue. The cumulative effects of dam operations, vegetation encroachment, and camp competition between hikers and river users to visitors would be localized to regional, adverse, short- to long-term, and of varied intensity, depending on the levels and seasonality of use.

4.4.4.5 ASSUMPTIONS

General assumptions used for analysis of effects from each alternative are discussed in ***Section 4.1 and in Appendix G: Visitor Use and Experience. A few assumptions from Section 4.1 worth repeating for this analysis include:***

- ***Campsites – Campsites are defined as having a common kitchen/group area, cleared areas large enough for tents, an area suitable for toilet set-up, and reasonable access to the river. The common area is generally located near the water (in the new high water zone) to minimize both the carrying of gear and the impacts to vegetation.***

- ***Variances – The NPS recognizes that emergencies and extenuating circumstances, such as flooding at Diamond Creek or medical emergencies, may arise. In these cases, the NPS may administratively decide to grant variances for the components of use presented in the CRMP.***

- ***Whitmore Exchanges – The NPS has the authority to regulate passenger exchanges but it has no control over how visitors access the exchange point outside the park boundary. The total number of passengers leaving river trips at Whitmore (e.g., passengers out) was calculated from the average percentage of total Lees Ferry passengers exchanging at Whitmore from 1998 to 2003. (See Appendix K for more information about Whitmore exchange calculations.)***

4.4.5 IMPACT ANALYSIS—LEES FERRY ALTERNATIVES

4.4.5.1 ALTERNATIVE A (EXISTING CONDITION)

4.4.5.1.1 Analysis

Under Alternative A, management of recreational use would continue to allow large group sizes, lengthy trips, and spikes in trips at one time, people at one time, and daily launches (see Table 4-1). User-days would remain capped at current levels, which would probably result in approximately the same number of total annual recreational users. Similarly, user discretionary time would remain relatively similar to current levels. Under this alternative, river recreational use would continue at approximately the same level as present, although the implementation of a launch-based system should ***reduce or*** eliminate some impacts.

River Encounters. River recreational users would encounter the same average number of motorized and nonmotorized trips per day that they currently encounter. Table 4-27 summarizes likely river encounters for all the alternatives. Results are based on ***Figure G-1 and Figure G-2***, while also considering the pattern of launches through the week and across trip types.

TABLE 4- 27: ESTIMATED AVERAGE RIVER ENCOUNTERS PER DAY FOR MOTORIZED AND NONMOTORIZED TRIPS

	Alternative							
	A	B	C	D	E	F	G	*Modified* H
Motorized Trips								
Summer	4 to 6	--	--	3 to 5	3 to 5	3-5/--	3 to 5	3 to 5
Spring	< 2[a]	--	--	--	2 to 4	3 to 5	3 to 5	--[a]
Fall	--[a]	--	--	--	2 to 4	--	--	***2 to4***[a]
Winter	--	--	--	< 1	--	< 2/--	< 2	--
Nonmotorized Trips								
Summer	2 to 4	2 to 4	2 to 4	2 to 4	2 to 4	2-4/2-4	2 to 4	2 to 4
Spring	< 1	< 1	1 to 3	< 2	1 to 3	2 to 4	2 to 4	1 to 3
Fall	1 to 3	< 1	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Winter	<< 1	<< 1	< 2	< 1	< 1	< 2	< 2	< 1

a. motorized encounters occur only in April in the spring and September 1-15 in the fall.
Note: "--" represents an average, minimal number of river encounters per day during the entire season

Under current management, actual encounter levels in summer may slightly exceed wilderness-like or backcountry standards, although they are probably in compliance if reported encounters were the chosen metric. Motor trips have more encounters than oar trips, but motor passengers ***often*** have higher tolerances. The uneven launch patterns under current management appear to cause some particularly high-encounter days. Because of noncommercial users' lower tolerances for river encounters, summer encounter levels probably have a localized, adverse, short- to long-term, minor to moderate impact on their river experience.

In contrast, because commercial passengers tend to have higher tolerances for river encounters, summer encounter levels probably have localized, adverse, short- to long-term, ***minor*** impacts on their experiences (albeit slightly different for commercial oar and motor passengers). Less than 16% of all users support the general notion of increasing the number of launches to reduce ***time waiting for a permit***, which suggests little support for use increases during the summer.

In current non-summer seasons, encounters are generally lower than wilderness-like standards and have localized, adverse, short- to long-term, minor to moderate impacts on trips. The shoulder season has distinctly lower encounter levels than summer, and winter encounters are lower still. Alternative A would not provide winter launches for motorized users or an increase in winter launches for nonmotorized users; although over half of all users support increasing launches in winter.

Time in Sight. Table 4- 28 summarizes time in sight estimates for all the alternatives. It is primarily based on analyses of 1998 data, with consideration of daily launch levels, trips at one time, patterns of launches, and subsequent encounter levels. Oar trips and motor trips were combined (motor trips have more encounters, but those encounters tend to be shorter). Average time in sight is expressed in terms of 15-minute ranges to reflect the appropriate level of precision.

TABLE 4- 28: ESTIMATED AVERAGE TIME IN SIGHT OF OTHER GROUPS DURING RIVER ENCOUNTERS PER DAY

(in minutes)

	Alternatives							
	A	B	C	D	E	F	G	*Modified* H
Summer	30-45	30-45	30-45	30-45	30-45	30-45	30-45	30-45
Spring	< 15	< 15	15-30	< 15	15-30	30-45	30-45	15-30
Fall	15-30	< 15	15-30	15-30	15-30	15-30	15-30	***30-45***[a] */ **15-30***
Winter	< 15	< 15	< 15	< 15	< 15	< 15	< 15	<15

a. average time in sight of other groups during river encounters are the same as summer during the first two weeks in September.

Current time in sight averages are less than 45 minutes in summer and less than 30 minutes in other seasons, which are at or below the 15% wilderness standard using the "on the water" length of day. Time-in-sight impacts would have adverse, short-term, negligible effects on experiences in this alternative because they are well within recommended wilderness standards.

Attraction Site Encounters. Table 4- 29 estimates the probability of encounters at attraction sites and average numbers of people seen at the high-use sites for all the alternatives. It is based primarily on analyses of 1998 data, with consideration of launch patterns, trips at one time, and average group sizes. Motor and oar trips were grouped together because differences between them were small. Estimates have been given as ranges to reflect the appropriate level of precision.

Current summer use levels produce a 40 to 50% probability of meeting others at lower use sites, but near certainty (80 to 90%) at high-use sites. The number of people observed at high-use sites generally ranges from 10 to 50, with a median of about 30. In non-summer periods, attraction site encounters may be much lower, although they still occasionally approach mid-summer levels. Summer attraction site encounters are probably slightly higher than most users' standards (moderately higher than sensitive users' standards). Attraction sites are the locations where boaters probably feel the most crowded in Grand Canyon, although most are unwilling to miss stopping at popular sites just to avoid encounters.

TABLE 4- 29: PROBABILITY OF ENCOUNTERS AT ATTRACTION SITES, HIGH- AND LOW-USE SITES

	Alternatives							
	A	B	C	D	E	F	G	*Modified* H
High-use Sites[1]								
Probability								
Summer	80-90	70	70	80	85	90/65	85	85
Spring	30-60	30	60	60	70	80	85	50/60
Fall	30-70	50	60	55	55	60	65	***75[2]/45***
Winter	< 25	< 25	40	< 25	30	40	40	< 25
Median number of people								
Summer	20-40	20	20	25	30	35/20	30	30
Spring	20-30	<10	20	15	20	25	25	15/20
Fall	20-30	15	20	15	20	25	25	15/<10
Winter	<10	<10	<10	<10	<10	<10	<10	<10
Lower Use Sites								
Probability								
Summer	40-50	40	40	45	50	50/35	50	50
Spring	20-30	< 10	30	20	25	40	45	25/35
Fall	30-40	20	30	20	35	30	35	***40[2]***/25
Winter	< 10	< 10	20	< 10	< 10	20	20	<10

1. Redwall Cavern, Little Colorado River, Elves Chasm, Deer Creek, and Havasu.

2. Higher probability of encountering another group at attraction sites from September 1-15

Overall, attraction site encounters probably have localized, adverse, short-term, minor impacts on ***most*** users' trips. ***Most*** boaters would prefer to see fewer other groups at ***attraction*** sites, but they are unwilling to miss stops at major attractions. ***They maintain*** some control over encounter levels by the sites they choose to visit and when they go.

Potential mitigation measures to reduce adverse impacts include scheduling or limiting the amount of time groups visit attraction sites. Informal scheduling already appears common among commercial outfitters, but it is unknown whether visitors limit their time at sites because of encounter levels. Most formal scheduling or time limits are likely to be opposed by most boaters***, as confirmed through public comments***. In the 1998 study, less than one-third of boaters were willing to miss one of the five high-use sites if they were assured of seeing no one at the next, and only about one-quarter were willing to miss one of these sites if they were assured of seeing half as many people at the next attraction site. Less than 15% supported the idea of trip leaders signing up for times to stop at attraction sites.

Camp Encounters. Camp encounters occur on about 20% of nights, exceeding standards for wilderness-like experiences (Hall and Shelby 2000). However, the lack of correlation with launch levels means that lower use limits alone ***(fewer launches)*** would probably not reduce camp encounters at specific sites. Trips that use desirable sites close to other desirable sites are likely to have encounters regardless of the launch level. Groups that desire few camp encounters can generally avoid them by avoiding "high encounter" sites. Overall, camp encounters probably have localized, adverse, short-term, minor impacts on users' trips under this alternative.

Potential mitigation measures to reduce adverse impacts involve campsite designations and/or scheduling. In general, this means ensuring that only one group uses the camps in a "cluster" on any given night. While this would reduce camp encounters, it would also reduce campsite availability and increase camp competition, particularly in bottleneck areas. Current Grand Canyon river runners are generally opposed to this type of action; only 20% support having to sign up for camps (Hall and Shelby 2000). A less intrusive option is to publicize information about camps where encounters can be expected and urge sensitive users to avoid those places during certain times of the day and/or year.

Camp Competition. Table 4- 30 summarizes trips at one time for all the alternatives, showing 70 trips at one time in the summer peak season, which equates to about 85% of all large primary camps and 40% of all primary campsites (large, medium, and small camps) being used during the peak season.

TABLE 4- 30: TRIPS AT ONE TIME IN SUMMER, FALL, WINTER, AND SPRING

	Alternatives							
	A	B	C	D	E	F	G	*Modified* H
Summer (June average)	57	57	57	55	57	51	50	57
Summer (peaks)	70	60	60	58	60	54	53	60
Spring (March average)	16	19	50	35	45	47	48	***38***
Spring (April average)	31	19	50	35	44	47	48	***49***
Fall (Sept. average)	54	35	49	45	41	51	53	***60*** [a]
Fall (October average)	38	35	49	45	44	51	53	***34***
Winter (Jan. average)	10	12	40	21	31	36	40	23

a. September 1–15 only.

Current peak use periods appear to create competition and visitor conflict in bottleneck areas (e.g., adjacent to major attraction sites, such as the Little Colorado River, Phantom Ranch, Elves Chasm, Deer Creek, Havasu, and Lava Falls), but negligible adverse impacts elsewhere. Overall, competition over campsites is probably having localized, adverse, short- to long-term, minor impacts on most users' trips, although possibly of a moderate intensity in critical reaches (e.g., Marble Canyon, Upper Granite, and Muav Canyon Reaches).

Potential mitigation measures to reduce adverse impacts include scheduling or campsite designation that would reserve larger camps for larger trips (or trips with larger boats). The trade-off is a heavier "management footprint," which most current users do not appear to support (only 20% of 1998 Grand Canyon boaters supported formal camp scheduling). A slightly higher percentage (32 to 39%, depending on the group) supported designating larger camps. Informal scheduling already occurs and might be further encouraged. Providing better information about existing camp sizes and locations could also prove helpful.

Launch and Takeout Congestion. Table 4- 31 shows maximum and average number of people launching at Lees Ferry (including crew) for all the alternatives. The estimates refer to the highest use in days (maximum and average people launching per day during the summer peak season). Currently, the number of people launching in summer can approach 200 per day (166 people + commercial crew), but is generally below 160. Launch congestion in the spring and fall is currently lower than in the summer.

TABLE 4- 31: PEOPLE LAUNCHING AT LEES FERRY ON THE HIGHEST USE SUMMER DAYS

Number of People (Including Crew)	Alternatives							
	A	B	C	D	E	F	G	*Modified* H
Maximum people launching	196	74	92	116	139	180	159	152
Average people launching	130–160	55–65	70–80	95–105	110–120	140–150	110–120	110–120

Diamond Creek is likely to have more congestion problems than Lees Ferry because it has a more constrained area and less developed facilities. In addition, Diamond Creek takeout congestion is likely to increase because of Lake Mead water levels continuing to drop. Due to lower Lake Mead water levels, takeouts on the Lake have shifted from Pearce Ferry to South Cove, which adds about 15 miles of travel to trips and discourages use of the lake as a takeout. Although, commercial motor trips are likely to continue the common practice of taking deadhead rafts to Lake Mead because it is difficult to bring large trucks down the Diamond Creek road.

Currently about 10% of commercial motor and 55% of commercial oar trips take out at Diamond Creek (about 20% of all commercial trips); about 84% of noncommercial oar trips take out at Diamond Creek. (The Lower Gorge section of this chapter has additional information about Diamond Creek congestion impacts.) Overall, launch congestion is probably causing localized, adverse, short-term, minor impacts on high-use days at Lees Ferry and Diamond Creek.

Mitigation measures to reduce adverse impacts related to launch and takeout congestion are often related to facility improvements. This does not necessarily mean substantial capital developments (e.g., more launch ramps, larger parking areas, etc.). Formalized organization of an area may have substantial benefits (e.g., even simple things like marking areas for use by individual groups), and the availability of launching equipment (e.g., a crane or trailer that can move boats to an unoccupied place away from the water) could be helpful at a constrained location such as Diamond Creek. Another mitigation measure that may help reduce launch and takeout congestion impacts is scheduling launches more efficiently during the day/season/year.

Group Size. Table 4- 32 shows the percent of commercial motor and oar launches with different size groups (including guides) for all the alternatives. In general, ***83 to 98% of commercial passengers prefer to be in medium to small groups, and almost all noncommercial boaters prefer to be in small groups; therefore, the fact that one fifth of all current trips have a large (31 to 40) or very large (up to 44) group size probably has a regional, adverse, short-to-long-term, moderate impact on those trips***. Data also show that most Grand Canyon boaters do not want to be part of or meet large groups, which probably also has regional, adverse, short- to long-term, moderate impacts on the users that encounter those trips.

TABLE 4- 32: PERCENTAGES OF COMMERCIAL MOTOR AND OAR LAUNCHES WITH DIFFERENT SIZE GROUPS

	Alternatives							
	A	B	C	D	E	F	G	*Modified* H
Commercial Motor Trips								
Maximum group size	43	--	--	25	30	30	40	32/24[a]
Small groups (20 or less)	36	--	--	36	36	36	36	36
Medium groups (21-30)	27	--	--	64	64	64	27	27
Large groups (31-40)	35	--	--	0	0	0	37	37[a]
Very large groups (up to 44)	2	--	--	0	0	0	0	0
Commercial Oar Trips								
Maximum group size	39	25	30	25	25	30	30	32/24[a]
Small groups (20 or less)	13	13	13	13	13	13	13	13
Medium groups (21-30)	80	80	80	80	80	80	80	80
Large groups (31-40)	7	0	0	0	0	0	0	7[a]
Very large groups (>40)	0	0	0	0	0	0	0	0

Note: Percentages include crew.

a. Must be 32 or less in summer; 24 or less in non-summer periods.

Potential mitigation measures to reduce adverse impacts include reducing group size and/or designating certain camps, or limiting attraction site use for large groups to minimize their impact on other groups. Discouraging large groups from stopping at an attraction site if another group is already there is one option, although this cuts out those users from a potential trip highlight (and 1998 data suggests that most users would prefer to see the site rather than skip it to avoid crowding). It also may not make sense at high-use sites where multiple trips may stop in any case.

Trip Length. Currently there is a diversity of trip lengths available in the commercial and noncommercial sectors during different times of the year, providing the longest trip lengths of all Lees Ferry Alternatives. Under Alternative A, commercial oar and motor, and noncommercial trips have the opportunity to take 18-day trips in the summer months; although most ***commercial*** motor trips are 6 to 8 days (especially in June and July) and most ***commercial*** oar trips are 12 to 14 days, 78% of noncommercial trips are 17 or 18 days (see Figure 3-8). Although commercial outfitters have the opportunity to offer 18-day summer trips, under the current user-day based system, some outfitters offer shorter trips because there is a general incentive to offer more (albeit shorter) trips during the primary season. 18-day, “slower-paced trips” only comprise about 2 to 4% of summer ***commercial*** motor trips (less than 5% of all trips). The shoulder or secondary season offers 18-day trip lengths for commercial motor trips and 21-day trip lengths for commercial oar trips and noncommercial trips; 30-day trip lengths are offered during the winter months for all sectors.

In terms of the level of importance to visitor experience, the “length of time traveling through an undisturbed environment” was the third highest ranked distinguishing feature of a Grand Canyon river trip. Data show that nearly one-third of commercial passengers and 51% of noncommercial users felt their trip lengths are too short under current management, which probably has a regional, adverse, long-term, moderate impact on their trips.

Potential mitigation measures to reduce adverse impacts may include “grandfathering” the small number of longer motor trips into an appropriate time in the launch schedule to preserve motor trip diversity, which would have unnoticeable effects on TAOT-related impacts. Mitigation might allow variances for longer noncommercial trips with additional stipulations about how they operate and interact with other canyon users.

Discretionary Time. Under the no action alternative, user discretionary time would remain similar to current levels. Overall, user discretionary time is relatively low compared to action alternatives with winter and shoulder seasons at the lowest levels for all alternatives (see Appendix H). This low level of user discretionary time indicates little time for people to actually experience the resource during their “free time,” resulting in regional, adverse, long-term, minor impacts to visitor experiences.

Nonmotorized Opportunities. Table 4- 33 summarizes the estimated number of launches and people (not including crew) during nonmotor periods for all the alternatives. In general, current management has a nonmotorized season, but it is only three months long (the shortest of all alternatives) and does not occur during any summer month. Noncommercial boaters comprise the majority of users during the nonmotorized period; 21% noncommercial trips compared to 4% commercial oar trips.

TABLE 4- 33: ESTIMATED NUMBER OF LAUNCHES AND PEOPLE ON TRIPS DURING NO-MOTOR PERIODS

	Alternatives							
	A	B	C	D	E	F	G	*Modified* H
Number of Launches								
Noncommercial	55	397	488	183	304	368	275	***251***
Commercial oar	28	338	606	92	30	138	48	***33***
Total	83	735	1,094	275	334	506	322	***284***
Number of People on Trips								
Noncommercial	900	5,000	7,500	2,200	4,400	4,200	4,000	***3,880***
Commercial oar	700	7,900	17,100	2,100	700	3,600	1,200	***589***
Total	***1,600***	12,900	24,600	4,400	5,100	7,800	5,100	***4,469***
Percentage of Sector/Total Launches								
Noncommercial	21%	100%	100%	43%	54%	67%	43%	***50%***
Commercial oar	4%	100%	100%	16%	5%	20%	7%	***6%***
Total	9%	100%	100%	27%	28%	41%	24%	***26%***
Percentage of Sector/Total People								
Noncommercial	21%	100%	100%	42%	57%	63%	44%	***55%***
Commercial oar	4%	100%	100%	15%	4%	19%	6%	***3%***
Total	7%	100%	100%	22%	21%	31%	18%	***18%***

Data show that nonmotorized trips offer a “slower, more relaxed pace; smaller more comfortable groupings; and enhanced sensitivity to the natural environment” (Shelby and Neilson 1976). A compelling finding in recreation research literature on social impacts is that people report oar trips better enable them to “experience the Grand Canyon environment.” Less than 10% of current trips occur during the nonmotorized period, which represents a regional, adverse, long-term, major impact on nonmotorized opportunities available to visitors seeking this experience. For those who view the motor/nonmotor conflict from a social values perspective, the limitation of a nonmotorized opportunity for only three months out of the year is also a regional, adverse, long-term, major impact. The only mitigation measure to reduce adverse impacts is to increase the nonmotorized season, which is addressed in the action alternatives.

Whitmore Exchanges. Table 4- 34 identifies Whitmore ***exchange estimates*** associated with all the alternatives. It summarizes the number of people involved in ***hiking and*** helicopter exchanges. ***Approximately 400 people currently enter river trips by hiking the 1.3 mile Whitmore Trail from the rim and very few to none exit river trips there***. Currently, ***3,635*** people enter river trips by helicopter at Whitmore and ***6,630*** people exit river trips there, for a total of ***10,265*** people (the majority being commercial motor passengers) per year. Under current management, uneven launch patterns create distinct patterns of helicopter use at Whitmore, with the greatest use in the summer, especially June (97%) and July (94%). Most helicopter activity occurs on Mondays, Sundays, and Saturdays (respectively) during the months of June and July, with close to 5 river trips exiting or 25 helicopter flights per day. Spring and fall helicopter activity levels are lower, with no activity in March, 20% activity in April, and 40% activity on some days in the fall.

TABLE 4- 34: WHITMORE EXCHANGE ESTIMATES

	Alternatives							
	A	B	C	D	E	F	G	*Modified* H
Regulations								
Shuttle exchanges?	unlimited	no	no	no	in motor	in motor	in motor	***April-Sept***
Comm. hiking exchanges?	unlimited	no	yes	yes	yes	yes	yes	***April-Sept***
Time of day restrictions	no	--	--	--	yes	yes	yes	yes
Months shuttles allowed	5.5	0	0	0	6	4	6	6
Max river trips per day	5	0	0	0	1	2/3	2	2
Max flights per day	22 [a]	0	0	0	5 [a]	15 [a]	10 [a]	10 [a]
Shuttle/Exchange								
Shuttle people (in)	***3,635***	0	0	0	2,500	3,300	3,700	***3,635***
Shuttle people (out)	***6,630***	0	0	0	2,500	6,600	7,200	***5,715***
Total People Shuttled	***10,265***	0	0	0	5,000	9,900	10,900	***9,350***
Hiking (in)	***~400*** [b]	0	2,500	2,500	0	0	0	***~400*** [b]
Hiking (out)	0	0	2,500	2,500	0	0	0	***0***
Total People Hiking	***~400*** [b]	0	5,000	5,000	0	0	0	***~400*** [b]
Total people (in)	***3,635***	0	2,500	2,500	2,500	3,300	3,700	***4,035***
Total people (out)	***6,630*** [c]	0	2,500	2,500	2,500	6,600	7,200	***5,715*** [d]
Total People	***10,265***	0	5,000	5,000	5,000	9,900	10,900	***9,750***
Consequences								
River trips on shuttles/year	310	0	0	0	114	298	326	***261***
Shuttle flights per year	1,360	0	0	0	500	1,310	1,430	***1,143***
Typical trips/day in peak	1-5	0	0	0	1	3	2	2
Typical flights/day in peak	5-25	0	0	0	5	13	9	***7***
Typical hours/day in peak	1-7	0	0	0	1.5	3.5	2.5	***2***
Estimated days with activity	135	0	0	0	114	122	183	183

a. Flights are roundtrips
b. An estimated number of 400 people hike in on the Whitmore Trail to join river trips
c. An average of total Lees Ferry passengers exchanging at Whitmore from 1998-2003
d. An estimated amount of use based on 1998-2003 data (See Appendix K)

Low altitude helicopter activity at Whitmore contrasts sharply with other components of Grand Canyon River experiences. Noise from helicopters is perceived by oar passengers, who are generally more sensitive to aircraft noise, as “interfering with natural quiet” to “extremely annoying;” whereas, commercial motor trip passengers oftentimes perceive the noise as a sign of an exciting end to and a memorable feature of their Grand Canyon river experience. Repeat visitors in small groups also tend to perceive helicopter noise as an annoyance and 70% of all river users support management actions that reduce or eliminate helicopter noise impacts at Whitmore. Current Whitmore helicopter activity is probably a localized, adverse, short-term, minor impact to passengers who use them or other groups who do not encounter them (but may adjust their trip to avoid them). For those users who directly encounter Whitmore helicopter activity, however, impacts probably have a localized, adverse, short-term, moderate effect. For those who have a value-based objection to any helicopter activity in backcountry or wilderness-like settings, even a single encounter may have localized, adverse, short-term, major effects to their Grand Canyon river experiences. For those who look forward to their helicopter ride out of the Canyon after a river trip, this alternative has a localized, beneficial, short-term, moderate effect on their experiences.

Potential mitigation measures to help reduce adverse impacts include restricting helicopter use to certain hours of the day and publicizing those times (providing reasonable no-helicopter periods), so that direct encounters could be avoided. Another mitigation measure that might help reduce the impact is to limit the number of helicopters flying per day during the nonmotorized 3-month season.

Encounters between River Users and Hikers. Under current management encounters between river users and hikers are relatively small, occur most often at specific locations, and occur primarily during the spring and fall. Hiker-river encounters occur most often near Phantom Ranch and occasionally at attraction sites, including Deer Creek, Hance, Granite, Tapeats, and Hermit. Current encounters between river users and hikers probably have negligible effects on both parties, especially since prime hiking seasons are in the spring and fall when river use is relatively low.

Phantom Ranch Exchanges. Table 4- 35 shows the estimated levels of Phantom exchanges under all the alternatives. Under current management, over half of all Phantom Ranch exchanges occur on commercial oar trips, although they are common on noncommercial trips, as well. ***More than*** 2,000 people join and more than 2,000 exit river trips at Phantom Ranch yearly. From a social dynamic point of view, Phantom Ranch exchanges probably have localized, adverse, short-term, minor impacts on new arrivals and original passengers; although trips that exchange all passengers probably have negligible impacts. For guides and passengers who don't exchange at Phantom Ranch, impacts are probably negligible. The opportunity to hike in or out at Phantom Ranch has localized, beneficial, short-term, moderate effects on visitors' experiences, especially for those who only want to take a partial trip.

TABLE 4- 35: ESTIMATED NUMBERS OF PEOPLE INVOLVED IN PHANTOM RANCH EXCHANGES

	Alternatives							
	A	B	C	D	E	F	G	*Modified* H
Commercial Oar								
People in	***1,300***	2,400	***4,500***	1,700	1,300	1,500	1,300	1,300
People out	***1,300***	2,500	***4,700***	1,800	1,300	1,500	***1,400***	1,300
Total	***2,600***	***4,900***	***9,100***	***3,500***	2,600	3,000	***2,700***	2,600
Commercial Motor								
People in	***900***	0	0	500	700	800	900	700
People out	900	0	0	500	700	800	900	700
Total	***1,800***	0	0	1,000	1,500	1,600	1,800	1,500
Noncommercial								
People in	300	400	600	400	600	500	700	***600***
People out	300	400	600	400	600	500	700	500
Total	600	800	1,200	800	1,200	1,000	1,400	***1,100***
All Trip Types								
People in	2,400	2,800	***5,100***	***2,700***	2,600	2,800	2,900	***2,600***
People out	***2,500***	***2,900***	***5,200***	2,700	***2,700***	***2,900***	2,900	***2,600***
Total	***4,900***	***5,700***	***10,300***	***5,400***	***5,300***	***5,700***	***5,900***	***5,200***

Note: Numbers in the table are rounded to the nearest 100.

From a safety standpoint, every year NPS rangers engage in several search and rescues of Phantom Ranch exchange hikers (particularly those hiking out) who hike up trails during the heat of the day. The inability for some exchange passengers to begin hiking early enough to beat the heat may be related to how far upstream they were able to camp (e.g., camp competition) and the effects of "last night on the river" parties. This potential health and safety risk to exchange passengers probably has a localized, adverse, short- ***to long***-term, major impact or safety risk factor to those passengers not prepared (physically, skillfully, experientially, and/or knowledgeably) to hike out of the canyon during the heat of the day.

Requiring outfitters to present accurate information about the difficulty of the hike and provide a hiking guide for exchange passengers (at least those hiking out) are potential mitigation measures to minimize search-and-rescue events; having outfitters responsible for the costs associated with exchange-related search-and-rescue events is another option with similar outcomes. Requiring exchange passengers to begin their hikes by a certain time (at least in summer) may also reduce these problems, although this could require passengers to spend an extra night at Phantom Ranch if they cannot get from camp to the trails to meet the deadline. This could potentially nullify the primary reason many users exchange at Phantom Ranch; they want to take a short trip.

4.4.5.1.2 Mitigation of Effects

Actions required to mitigate effects would include ***a subset*** of those listed above, but because current management of the river corridor allows substantial spikes in use and the largest allowable group sizes of any of the alternatives, it is unlikely that mitigations would be implemented at a level sufficient to reduce impacts to a minor intensity.

4.4.5.1.3 Cumulative Effects

Continued sediment depletion from the operation of Glen Canyon Dam and vegetation encroachment would continue to diminish campsite capacities and availability. Visitors would continue to experience the erosion of beaches and campsites, and campsite frequency would continue to decline further, creating competition and crowding problems. The operations of Glen Canyon Dam would continue to have localized to regional, adverse, long-term and moderate to major impacts on aspects of the visitor experience, dependent on beaches for campsites and off-river activities. Additional impacts from encounters between river users and hikers at campsites and attraction sites would have negligible effects on river users, since river use levels would be relatively low during prime hiking seasons.

The cumulative effects of dam operations and vegetation encroachment would continue to diminish campsite availability and would exacerbate visitor crowding. The cumulative impact would be localized to regional, adverse, short- to long-term, and moderate to major in the summer due to spikes in use, but minor to moderate in the shoulder and winter seasons.

PHOTO 4- 11: BEACH EROSION AT FURNACE FLATS

PHOTO 4- 12: BEACH WITH VEGETATION ENCROACHMENT

4.4.5.1.4 Conclusion

Under Alternative A, adverse impacts to visitor experience on Grand Canyon river trips would be mostly perceptible and measurable; requiring mitigation, with greater impacts occurring during the high-use summer months. Because of the variability of visitors' perceptions, values, and level of sensitivity to certain impacts, the intensity of impacts would be within a range of negligible to major depending on one's perspective and desired experience. The uneven launch patterns and group sizes of all Lees Ferry alternatives appear to cause some particularly high river encounters, perceived crowding at popular attraction sites, launch and takeout congestion, and competition for campsites during the summer months; resulting in minor to moderate, direct to indirect, short- to long-term adverse impacts to most visitors. Large group size also has a moderate, direct, short- ***to long***-term adverse impact on some commercial passengers on trips with large group sizes and most nonmotorized boaters who encounter them. Although this alternative provides the longest allowable trip lengths of any alternative, ***this alternative*** has a minor to moderate adverse impact to most visitors, based on research findings ***that show that nearly one-third of commercial passengers and 51% of noncommercial boaters felt their trip lengths are too short under current management***. Because of the shortest nonmotorized season of all the alternatives, nonmotorized opportunities may have major, direct to indirect, short-to long-term adverse impacts to people seeking nonmotorized opportunities. Many visitors, including those on nonmotorized trips, in small groups, and repeat visitors are sensitive to direct encounters with Whitmore helicopter activity; resulting in minor to moderate, direct to indirect, short-term adverse impacts to their river experiences.

Overall, this alternative would provide a range of negligible to major, localized to regional, short- to long-term adverse impacts with minor to moderate, localized to regional, short- to long-term benefits to visitors seeking a variety of river trip opportunities in Zone 1. ***Management objectives would be met (with reasonable mitigation) except for reducing impacts from crowding during the summer months.*** The cumulative effects of dam operations and vegetation encroachment would continue to diminish campsite availability and would exacerbate visitor crowding. The cumulative impact would be localized to regional, adverse, short- to long-term, and moderate to major in the summer due to spikes in use, but minor to moderate in the shoulder and winter seasons.

4.4.5.2 Alternative B

4.4.5.2.1 Analysis

Under Alternative B, recreational motor trips would be prohibited and group sizes, trips at one time, people at one time, daily launches, user-days, and estimated total yearly passengers would be at their lowest of any of the alternatives (see Table 4- 1). Trip lengths would be substantially reduced from current condition, although user discretionary time would increase from current levels (from 355,081 to 576,754), and the implementation of a launch-based system would eliminate spikes in use. Summer use represents a decrease in total user-days (from 121,869 to 107,418) and total passengers (from 18,128 to 8,492). These, in relation to reductions in group size, trip length, trips at one time, people at one time, and the elimination of Whitmore exchanges would reduce crowding issues. Under this alternative, overall use levels in the winter and shoulder seasons, as measured by user-days and total passengers, would increase above current levels, but would be at ***much*** lower levels ***than the rest of the alternatives***. These levels of off-season use coincide with the lowest allowable group sizes and ***shorter*** trip lengths.

River Encounters. River recreational users would encounter no motorized trips and an overall reduction of all river encounters compared to current levels (see Table 4-27). Actual encounter levels would meet and possibly exceed wilderness-like standards (fewer than two or three encounters per day) in all seasons and even launch patterns and reduced group sizes would decrease spikes in river encounter days compared to current levels. Only noncommercial oar trips would have an opportunity to experience a Grand Canyon river trip in the winter season and, therefore only encounter other smaller, noncommercial trips. Since nearly half of Grand Canyon boaters prefer to see no other groups, and 75% prefer to see fewer than two or four trips per day, compared to current conditions, this alternative would probably have localized, beneficial, short- ***to long***-term, major effect to most noncommercial users and localized, adverse, short- ***to long***-term, negligible effects to most commercial passengers.

Time in Sight. Time-in-sight impacts would remain similar to current for all seasons except fall, which would decrease from 15–30 minutes (current) to less than 15 minutes (see Table 4- 28). This alternative would continue to have negligible effects on experiences because time in sight would be within wilderness standards.

Attraction Site Encounters. Attraction site encounters would be lower than current levels in summer and the sizes of groups would be smaller (see Table 4- 29); use levels would produce a 40% probability of meeting others at lower use sites and near 70% at high-use sites. In non-summer periods, attraction site encounters would be at their lowest of all alternatives; the average number of people seen at high-use sites would be at acceptable densities (less than 30 people in other groups encountered). Compared to current conditions, attraction site encounters would ***most likely*** meet most people's standards, with localized, beneficial, short-term, major effects to most users' experiences.

Camp Encounters. Under Alternative B, camp encounters would probably continue to occur slightly under 20% of the time in the summer, although groups would probably continue to encounter other groups, albeit smaller groups, in bottleneck areas; however, groups may have slightly higher camp encounters in the spring than they currently encounter. Compared to current conditions, this alternative would likely not reduce camp encounters at specific sites, even though this alternative would slightly reduce summer trips at one time and camp competition, and impacts on most users' experiences would be localized, adverse, short-term, and negligible.

Camp Competition. Current data show that 60 trips at one time produces occupancy rates of about 70% of large primary camps, and 40% of medium and large primary camps, but only about 25% of all camps (see Table 4- 30). In general, this alternative would reduce summer trips at one time and camp competition, although it would slightly increase trips at one time and camp competition in non-summer seasons. Peak-use periods would continue to create competition and visitor conflict in bottleneck areas, but negligible impacts elsewhere. Compared to current conditions, competition over campsites would probably have localized, adverse, short- to long-term, negligible impacts on most users' trips, although impacts in critical reaches could be localized, adverse, short- to long-term, and minor.

Launch and Takeout Congestion. Due to the implementation of a launch-based system and lower group sizes, this alternative would reduce the number of trips launching from Lees Ferry per day in the summer (to four launches per day) and, as a result, reduce the number of takeouts and congestion problems at Diamond Creek (see Table 4- 31). Compared to current conditions, this alternative would reduce launch and takeout congestion at Lees Ferry and Diamond Creek, resulting in localized, beneficial, short-term, negligible impacts.

Group Size. Lower group size limits of 25 for commercial oar trips would reduce the adverse effects of being in or meeting larger trips, with the improvement in "own group size" providing the more important benefit (see Table 4- 32). The greatest improvement from reduced group size limits comes from eliminating large groups of 43, and introducing 8-person, nonmotorized trips. Overall, lower group size limits in this alternative would result in regional, beneficial, short- ***to long***-term, moderate impacts, as compared to current conditions.

Trip Length. This alternative further lowers trips at one time by reducing summer maximum trip lengths from 18 days (current) to 16 days. In non-summer periods, in which shoulder seasons currently have a 21-day maximum trip length and the winter season has a 30-day trip length, trip length maximums would be reduced to 18 days for noncommercial boaters, as no other sector would be allowed to take winter trips. Because data show most boaters' prefer longer trip lengths and this alternative would shorten trip lengths, drastically in winter, this alternative would probably have regional, adverse, long-term, major impacts on most boaters' experiences. Potential mitigation measures to reduce adverse impacts might include allowing variances for longer trips.

Discretionary Time. Under Alternative B, discretionary time would be in the mid-range in non-summer seasons and one of the highest in the summer season (see Appendix H). This higher level of user discretionary time in the summer indicates potentially more time for people to experience and explore their environment, especially when there are more daylight hours. Overall, compared to current conditions, this alternative would probably have regional, beneficial, long-term, moderate effects on most people's experiences.

Nonmotorized Opportunities. Compared to current conditions, this alternative would offer people year-round opportunities to take nonmotorized trips; therefore, it would probably have localized, beneficial, short-term, major impacts on visitors seeking nonmotorized trips, although it would probably have regional, adverse, long-term, major impacts on those seeking motorized trips (see Table 4- 33).

Whitmore Exchanges. *Under this alternative, passengers would not be permitted to embark or disembark from the river in the Whitmore area.* Helicopter exchange opportunities would also be eliminated under this alternative (see Table 4- 34); thereby, eliminating noise, physical and visual impacts ***from helicopters***; congestion at Whitmore helipad; perceived safety risks from low flying aircraft; camp competition for sites near the helipad; and the perceived "artificial end" to some river trips. Eliminating helicopters would reduce trip diversity and most likely increase use levels at Diamond Creek, where most trips would probably takeout if Whitmore was not available and possibly increase interest in jetboat pick-ups in the Lower Gorge (see the Lower Gorge impact analysis for further details). For people who felt that helicopters are inappropriate in the canyon, this alternative would have localized, beneficial, short-term, major effects on their river experiences; conversely, for those who view helicopter exchanges as a "feature" of their trips, this alternative would have localized, adverse, short-term, major impacts on theirs, as compared to current conditions.

Encounters between River Users and Hikers. Under this alternative, encounters between river users and hikers would remain relatively small, occur most often at specific locations, and occur primarily during the spring and fall. Hiker/river recreationist encounters would most likely continue to occur most often near Phantom Ranch, and occasionally at attraction sites, including Deer Creek, Hance, Granite, Tapeats, and Hermit. Since river use would only slightly increase during the shoulder seasons, encounters between river users and hikers would probably continue to have negligible impacts on both parties, as compared to current conditions.

Phantom Ranch Exchanges. Assuming the proportion of trips using exchanges at Phantom Ranch would remain the same as present, a slight increase (***about 800***) of people would probably exchange at Phantom Ranch per year (see Table 4- 35). If this assumption is correct, this alternative would probably result in a slight increase in camp congestion near Phantom Ranch for exchanges, having negligible impacts on boaters' experiences, as compared to current conditions.

4.4.5.2.2 Mitigation of Effects

Due to motorized opportunities being eliminated in this alternative, thereby excluding people seeking motorized river opportunities, it is unlikely that reasonable mitigations would be implemented at a level sufficient to reduce adverse impacts to a minor intensity.

4.4.5.2.3 Cumulative Effects

Continued sediment depletion from the operation of Glen Canyon Dam and vegetation encroachment would continue to diminish campsite capacities and availability. Although visitors would continue to experience the erosion of beaches and campsites, even launches, smaller group size limits, and shorter trip length limits may help mitigate the camp frequency issue. Additional impacts from encounters between river users and hikers at campsites and attraction sites would have negligible effects on river users, since river use would increase only slightly from current conditions during prime hiking seasons.

Although the cumulative effects of dam operations and vegetation encroachment would continue to diminish campsite availability, the mitigating actions of this alternative would offset visitor crowding. The cumulative impact would be localized to regional, adverse, short- to long-term, year-round, and minor to moderate.

4.4.5.2.4 Conclusion

Under Alternative B, adverse impacts to visitors' experiences on Grand Canyon river trips would be mostly perceptible and measurable. Because of the variability of visitors' perceptions, values, and level of sensitivity to certain impacts, impacts would be negligible to major, depending on one's perspective and desired experience. The even launch patterns, small group sizes, low level of year-round nonmotorized use, the elimination of helicopter exchanges at Whitmore, and considerably increased discretionary time during the summer season would be desirable to many people seeking nonmotorized trips. The reduction in trip length, group size, trips at one time, people at one time, and the elimination of Whitmore helicopter exchanges would produce few river encounters and reduce perceived crowding at popular attraction sites, launch and takeout congestion, and camp competition, resulting in direct to indirect, localized to regional, beneficial, short- to long-term, negligible to major impacts to nonmotorized river experiences. In contrast, because this alternative would exclude people seeking motorized trips ***and reduce trip lengths for those seeking longer oar trips***, this alternative would result in direct to indirect, adverse, long-term, major impacts to their river experiences.

Overall, this alternative would provide a range of localized to regional, adverse, short- to long-term, negligible to major impacts, with localized to regional, beneficial, short- to long-term moderate to major impacts for visitors seeking a variety of river trip opportunities in Zone 1. Due to motorized opportunities being eliminated in this alternative, thereby excluding people seeking motorized river opportunities; it is unlikely that reasonable mitigations would be implemented at a level sufficient to reduce adverse impacts to a minor intensity. Although the cumulative effects of dam operations and vegetation encroachment would continue to diminish campsite availability, the actions of this alternative would offset visitor crowding. The cumulative impact would be localized to regional, adverse, short- to long-term, year-round, and minor to moderate.

4.4.5.3 ALTERNATIVE C

4.4.5.3.1 Analysis

Under Alternative C recreational motor trips would be prohibited and the implementation of a launch-based system would eliminate spikes in use. Group sizes and trip lengths would be at lower levels than current, although total shoulder and winter estimated passengers and total estimated user-days would be among the highest of all alternatives (see Table 4- 1). Estimated yearly passengers increase from 22,461 (current) to 25,228. Summer use under this alternative represents a decrease in total user-days (***from 121,869 to 110,120***) and total passengers (from 18,128 to 11,252). This, along with moderate reductions in group size, trip length, trips at one time, and people at one time, serves to reduce crowding. Under this alternative, overall use levels in the winter and shoulder seasons, as measured by user-days and total passengers, would increase considerably above current levels and in most cases represents the highest use of all of the alternatives. Allowable trip lengths would be reduced from 21 to 18 days in the shoulder season and from ***30*** to 21 days in the winter. Whitmore helicopter exchanges would be eliminated in this alternative, although hiking exchanges would be offered.

River Encounters. River recreational users would encounter no motorized trips and a slight reduction in summer encounters, but an overall increase in shoulder and winter as compared to current levels (see Table 4-27). While summer encounters might continue to be slightly higher than wilderness-like standards (fewer than two or three encounters per day), even launch patterns and reduced group sizes would probably reduce the number of high encounter days. In the off-season this alternative would provide distinctly lower encounter levels than in summer, which would be acceptable for wilderness-like opportunities. Only visitors on noncommercial oar trips would have the opportunity to experience a Grand Canyon river trip in the winter season and, therefore, only encounter other smaller, noncommercial trips. Since nearly half of Grand Canyon boaters prefer to see no other groups, and 75% prefer to see fewer than two to four trips per day, compared to current condition, this alternative would probably have a localized, beneficial, short- ***to long***-term, moderate effect to most noncommercial users and a negligible effect to most commercial passengers.

Time in Sight. Time-in-sight impacts would remain similar to current for all seasons except spring, which would increase from less than 15 minutes (current) to 15–30 minutes (see Table 4-28). This alternative would continue to have negligible effects on experiences because time in sight would be well within wilderness standards.

Attraction Site Encounters. Attraction site encounters would be ***slightly*** lower than current levels in summer and the sizes of groups would be smaller (see Table 4- 29); use levels would produce a 40% probability of meeting others at lower use sites and near 70% at high-use sites. In non-peak periods, attraction site encounters would continue to be within the current range of probability in all seasons except winter, when the probability of encountering other groups at high-use attraction sites would be 40%. The average number of people seen at high-use sites would be within acceptable densities (less than 30 people in other groups encountered) for all seasons. Compared to current conditions, attraction site encounters would probably meet most people's expectations, with the exception of high-use sites in the summer, resulting in localized, beneficial, short-term, minor effects on ***most*** users' experiences.

Camp Encounters. Camp encounters under Alternative C would probably continue to occur slightly under 20% of the time in the summer, although groups would probably continue to encounter other smaller groups in bottleneck areas. Groups would have considerably higher camp encounters in spring and winter months than they currently encounter; however, from 16–31 trips at one time currently to 50 in the spring and from 10 trips at one time currently to 40 in the winter would exceed the current *Colorado River Management Plan* camp encounter standard of 10%. Compared to current conditions, this alternative would increase the probability of camp encounters at specific sites, especially during the non-summer seasons and probably have localized, adverse, short-term, minor impacts on most users' experiences.

Camp Competition. Fifty trips at one time in the spring months produces occupancy rates of about 60% of large primary camps, and 35% of medium and large primary camps, but only about 22% of all camps (see Table 4- 30); compared to the current 16–31 trips at one time in the spring, occupancy rates are currently only 20%–37% of large primary camps, 10%–20% of medium and large primary camps, and only about 5%–10% of all camps. In general, this alternative would considerably increase spring and winter trips at one time and camp competition; thereby, potentially creating visitor conflict in bottleneck areas in seasons when there are none. Compared to current conditions, competition over campsites would probably have localized, adverse, short-term, minor impacts on most users' trips, although possibly localized, adverse, short-term, minor to moderate impacts in critical reaches.

Launch and Takeout Congestion. Due to the implementation of a launch-based system and lower group sizes, this alternative would reduce the number of trips launching from Lees Ferry to four launches per day, therefore reducing the number of takeouts and congestion problems at

Diamond Creek (see Table 4- 31). Compared to current conditions, this alternative would reduce launch and takeout congestion to a negligible level at Lees Ferry and Diamond Creek.

Group Size. Lower group size limits of 30 for commercial oar trips would reduce localized, adverse, short-term effects of being in or meeting larger trips, with the improvement in "own group size" providing the more important benefit (see Table 4- 32). The greatest improvement from reduced group size limits would come from eliminating groups of ***up to*** 43 people. Overall, lower group size limits in this alternative would have beneficial, negligible impacts, as compared to current conditions.

Trip Length. This alternative would further lower trips at one time by reducing summer maximum trip lengths from 18 days (current) to 16 days, shoulder season trips from 21 days to 18 days maximum, and winter trips from 30 days to 21 days. Because data show most boaters' prefer longer trip lengths and this alternative would shorten trip lengths in all seasons, this alternative would probably have localized, adverse, long-term, ***and*** moderate to major impacts on most boaters' experiences. Potential mitigation measures to reduce adverse impacts might include allowing variances for longer trips.

Discretionary Time. Discretionary use time under Alternative C would be the highest of all alternatives in non-summer seasons and in the mid-range in summer (see Appendix H). This higher level of user discretionary time indicates potentially more time for people to experience and explore their environment throughout the year, although mostly when there are fewer daylight hours. Compared to current conditions, this alternative would probably have localized, beneficial, short-term, minor effects on most people's experiences.

Nonmotorized Opportunities. Compared to current conditions, this alternative would offer more people year-round opportunities to take nonmotorized trips, probably with a beneficial, ***long***-term, major impact on visitors seeking nonmotorized trips. However, impacts on those seeking motorized trips would probably be adverse, long-term, and major (see Table 4- 33).

Whitmore Exchanges. Eliminating helicopter exchange opportunities under this alternative would eliminate noise, physical, and visual impacts; congestion at the Whitmore helipads; perceived safety risks from low-flying aircraft; and camp competition for sites near the helipad (see Table 4- 34***)***. Hiking ***exchange*** opportunities would continue to be provided (***for up to 2,500 in and 2,500 out***), although at substantially lower levels of current helicopter exchanges (from 10,000 to 5,000 passengers). The elimination of helicopters for people to begin or end their trips would most likely increase use levels at Diamond Creek, where most trips would probably take out if Whitmore was not available and possibly increase interest in jetboat pick-ups in the Lower Gorge (see the Lower Gorge alternatives for further analysis). For people who feel helicopters are inappropriate in the canyon, this alternative would have beneficial, short- and long-term, major effects on their river experience; conversely, for those who view helicopter exchanges as a "feature" of their trips, impacts would be adverse, short and long-term, and major, as compared to current conditions.

Encounters between River Users and Hikers. ***Under this alternative*, e**ncounters between river users and hikers at specific locations would ***slightly*** increase ***at specific locations*** during the spring and fall because of ***a slight*** increase in river use during hiking seasons. Hiker/river encounters would most likely occur at popular beach campsites or attraction sites, potentially creating allocation conflicts. Hikers might arrive at the river late in the day, seeking a beach camp only to find it was already occupied by a river party (especially at Hance, Granite, Tapeats, or Hermit). Because river use would increase during the hiking seasons, encounters between river users and hikers would probably have localized, adverse, short-term, moderate impacts on both parties, as compared to current conditions. Potential mitigation measures to reduce adverse impacts could include educating river users, including publicizing information about where encounters might be expected, urging sensitive users to avoid those places, and scheduling and/or delineating “overlap” campsites.

Phantom Ranch Exchanges. Assuming the proportion of trips using exchanges at Phantom Ranch would remain the same as present, the number of people exchanging at Phantom Ranch would probably increase from ***4,900 to 10,300*** total people per year (see Table 4- 35). If this assumption is correct, this alternative would result in a large increase in camp congestion near Phantom Ranch for trips exchanges there, resulting in localized, adverse, short-term, moderate impacts on boaters’ experiences, as compared to current conditions.

4.4.5.3.2 Mitigation of Effects

Due to motorized opportunities being eliminated in this alternative, thereby excluding people seeking motorized river opportunities; it is unlikely that reasonable mitigations would be implemented at a level sufficient to reduce adverse impacts to a minor intensity.

4.4.5.3.3 Cumulative Effects

Continued sediment depletion from the operation of Glen Canyon Dam and vegetation encroachment would continue to diminish campsite capacities and availability. Although visitors would continue to experience the erosion of beaches and campsites, even launches, smaller group size limits, and shorter trip length limits may help mitigate the camp frequency issue. Additional impacts from encounters between river users and hikers at campsites and attraction sites would have adverse, moderate impacts on river users, since river use would increase from current conditions during prime hiking seasons.

Although the cumulative effects of dam operations, vegetation encroachment, and encounters between river users and hikers would continue to diminish campsite availability, the mitigating actions of this alternative would offset visitor crowding. Cumulative impacts would be localized to regional, adverse, short- to long-term, and minor in the summer, but moderate in the winter and shoulder seasons due to increased overall use.

4.4.5.3.4 Conclusion

Under Alternative C, adverse impacts to visitors’ experiences on Grand Canyon river trips would be mostly perceptible and measurable. Because of the variability of visitors’ perceptions, values, and level of sensitivity to certain impacts, the intensity of impacts would be negligible to major, depending on one’s perspective and desired experience. The even launch patterns, smaller group sizes, the elimination of helicopter exchanges, and substantially increased discretionary time during non-summer seasons would be desirable to many people seeking nonmotorized trips. Because this alternative substantially increases overall use in the winter and shoulder seasons, as measured by user-days and total passengers, this alternative would increase the probability of camp encounters, camp competition at bottleneck areas, and perceived crowding at popular attraction sites; resulting in minor to moderate, direct to indirect, short- to long-term, localized, adverse impacts on nonmotorized experiences. For people seeking nonmotorized river trip opportunities, this alternative provides a range of negligible to major, short- to long-term, beneficial to adverse impacts to their river experiences. In contrast, because this alternative would exclude people seeking motorized trips, this alternative would result in major, direct to indirect, long-term, adverse impacts to theirs.

Overall, this alternative would provide a range of negligible to major, localized to regional, short- to long-term adverse impacts with minor to moderate, localized to regional, short- to long-term benefits to visitors seeking a variety of river trip opportunities in Zone 1. Due to motorized opportunities being eliminated in this alternative, thereby excluding people seeking motorized river opportunities; it is unlikely that reasonable mitigations would be implemented at a level sufficient to reduce adverse impacts to a minor intensity. Although the cumulative effects of dam operations, vegetation encroachment, and encounters between river users and hikers would continue to diminish campsite availability, the actions of this alternative would offset visitor crowding. Cumulative impacts would be localized to regional, adverse, short- to long-term, and minor in the summer, but moderate in the winter and shoulder seasons due to increased overall use.

4.4.5.4 ALTERNATIVE D

4.4.5.4.1 Analysis

Recreational motor trips under Alternative D would be permitted from May to August and December to February. Group sizes and trip lengths would be at lower levels than current and discretionary time would increase considerably, since user discretionary time is among the highest of any of the alternatives (see Table 4- 1). Estimated yearly passengers would decrease from 22,461 (current) to 20,427 and ***estimated*** total user-days would ***increase*** from 171,131 (current) to ***223,314***, but the implementation of a launch-based system would eliminate spikes in use. Summer use represents a small increase in total user-days (from 121,869 to 122,739) and a large increase in total user discretionary time (from 294,506 to 461,641), but a decrease in total projected passengers (from 18,128 to 13,765). These numbers indicate that fewer people would have more time to experience their environment. Reductions in group size, trip length, trips at one time, and people at one time serve to reduce crowding. Under this alternative, overall use levels in the winter and shoulder seasons, as measured by user-days and total passengers, would increase considerably above current levels. Overall, allowable trip lengths would be reduced from current, with the exception of noncommercial 30-day oar trips, which would remain the same. Whitmore helicopter exchanges would be eliminated in this alternative, although hiking exchanges would be offered.

River Encounters. River recreational users would encounter a slight reduction of motorized trips (from four to six currently to three to five) in summer and no motorized trips in spring and fall, as compared to current levels (see Table 4-27). While summer encounters might continue to be slightly higher than wilderness-like standards (fewer than two or three encounters per day), even launch patterns and smaller group sizes would probably reduce the number of high encounter days. In the off-season this alternative would provide distinctly lower encounter levels than in summer and might provide wilderness-like opportunities. Only people on nonmotorized trips would have the opportunity to experience a Grand Canyon river trip in shoulder seasons and would only encounter other smaller, nonmotorized trips. Since nearly half of Grand Canyon boaters prefer to see no other groups, and 75% prefer to see fewer than two to four trips per day, compared to current conditions, this alternative would probably have beneficial, short- ***to long***-term, a moderate to major effect on most noncommercial users and adverse, negligible effects on most commercial passengers.

Time in Sight. Time-in-sight impacts would continue to be within the same range as current all year (see Table 4- 28) and within wilderness standards. Effects on experiences would be negligible.

Attraction Site Encounters. Attraction site encounters would remain similar to current levels in summer, although the sizes of groups would be smaller (see Table 4- 29); use levels would produce a 45% probability of meeting others at lower use sites and 80% at high-use sites. In non-summer periods attraction site encounters would continue to be similar to current levels in all seasons except fall, where the probability of encountering other groups at lower use sites would be 20% as compared to 30%–40% current. The average number of people seen at high-use sites would be within the acceptable range (less than 30 people in other groups encountered) for all seasons. Compared to current conditions, attraction site encounters would probably meet most people's standards, with negligible effects on most users' experiences.

Camp Encounters. Camp encounters would probably continue to occur slightly under 20% of the time in the summer under Alternative D, although groups would probably continue to encounter other groups, albeit smaller groups, in bottleneck areas. Groups would have more camp encounters in spring and winter months than they currently encounter; however, from a current 16–31 trips at one time to 35 in the spring, and from a current 10 trips at one time to 21 in the winter, encounters would exceed the current *Colorado River Management Plan* camp encounter standard of 10%. Compared to current conditions, this alternative would increase the probability of camp encounters at specific sites, especially during non-summer seasons, and probably have localized, adverse, short-term, minor effects on most users' experiences.

Camp Competition. A total of 35 trips at one time in the spring months would produce occupancy rates of about 42% of large primary camps, and 25% of medium and large primary camps, but only about 15% of all camps (see Table 4- 30), as compared to the current 16–31 trips at one time in the spring, in which occupancy rates are only 20%–37% of large primary camps, 10%–20% of medium and large primary camps, and only about 5%–10% of all camps. In general, this alternative would increase spring and winter trips at one time and camp competition, thereby potentially creating possible visitor conflict in bottleneck areas in seasons when there currently are none. Compared to current conditions, competition over campsites would probably have localized, adverse, short-term, minor impacts on most users' trips, although adverse impacts in critical reaches could be minor to moderate.

Launch and Takeout Congestion. Due to the implementation of a launch-based system and lower group sizes, this alternative would reduce the number of trips launching from Lees Ferry per day in the summer (to five launches per day), therefore reducing the number of takeouts and congestion problems at Diamond Creek (see Table 4- 31). Compared to current conditions, this alternative would reduce launch and takeout congestion to a negligible level at Lees Ferry and Diamond Creek.

Group Size. Lower group size limits of 25 for both sectors would reduce the adverse effects of being in or meeting larger trips, with the improvement in "own group size" providing the more important benefit (see Table 4- 32). The greatest improvement from reduced group size limits would come from eliminating groups of 43 and introducing 8-person, nonmotorized trips. Overall, lower group size limits in this alternative would result in localized, beneficial, short- ***to long***-term, minor impacts, as compared to current conditions.

Trip Length. This alternative would further lower trips at one time by reducing summer maximum trip lengths from 18 days (current) to 10 days for commercial motor trips and 16 for commercial oar and noncommercial trips). Shoulder seasons trip length maximums would be reduced from 18 days (current) for commercial motor trips to 10 days and from 21 days (current) for commercial oar and noncommercial trips to 18 days. Winter season trip length maximums would be reduced from 30 days (current) for all sectors to 18 days for commercial motor trips; 21 days for commercial oar trips; 18 days for noncommercial oar trips. Because data show most boaters prefer longer trips and this alternative would shorten most trips in all seasons, even though it would provide various trip length opportunities, this alternative would probably have adverse, ***long***-term, minor impacts on most boaters' experiences. Potential mitigation measures to reduce adverse impacts might include allowing variances for longer trips.

Discretionary Time. Discretionary time would be one of the highest of all alternatives year-round under Alternative D (see Appendix H). This higher level of user discretionary time indicates potentially more time for people to experience and explore their environment, especially during times of the year when there are more daylight hours. Overall, compared to current conditions, this alternative would probably have a beneficial; short-term, major effect on most people's experiences.

Nonmotorized Opportunities. Compared to current conditions, this alternative would offer an additional month of nonmotorized opportunities; therefore, probably have a minor beneficial impact on visitors seeking nonmotorized trips, although probably have localized, adverse, ***long***-term, minor impacts on those seeking motorized trips (see Table 4- 33).

Whitmore Exchanges. Eliminating helicopter exchanges ***at Whitmore under this alternative*** would eliminate noise, physical, and visual impacts; congestion at the Whitmore helipad; perceived safety risks from low flying aircraft; and camp competition for sites near the helipad (see Table 4- 34). Hiking ***exchange*** opportunities would continue to be provided ***(for up to 2,500 in and 2,500 out)***, although at substantially lower levels of current helicopter exchanges (from 10,000 to 5,000 passengers). No longer allowing helicopter exchanges would most likely increase use levels at Diamond Creek, where most trips would probably take out if Whitmore was not available, and would possibly increase interest in jetboat pick-ups in the Lower Gorge (see the Lower Gorge alternatives for further analysis). For people who feel helicopters are inappropriate in the canyon, this alternative would have a localized, beneficial, short-term, major effect on their river experiences; conversely, for those who view helicopter exchanges as a “feature” of their trips, impacts would be adverse, short and long-term, and major, as compared to current conditions.

Encounters between River Users and Hikers. Under this alternative, encounters between river users and hikers would slightly increase ***at specific locations*** during the spring and fall because of a slight increase in river use during hiking seasons. Hiker/river encounters would most likely continue to occur at specific locations (popular beach campsites or attraction sites); therefore, encounters between river users and hikers would probably have localized, adverse, short-term, minor impacts on both parties, as compared to current conditions. Potential mitigation measures to reduce adverse impacts might include educating river users, including publicizing information about where encounters could be expected and urging sensitive users to avoid those places, and scheduling and/or delineating “overlap” campsites.

Phantom Ranch Exchanges. Assuming the proportion of trips using exchanges at Phantom Ranch would remain the same as present, the number of people exchanging per year would probably increase slightly (from ***4,900 to 5,400*** total people; see Table 4- 35). This would result in a slight increase in camp congestion near Phantom Ranch for trips exchanges there, with localized, adverse, short-term, negligible effects on boaters’ experiences, as compared to current conditions.

4.4.5.4.2 Mitigation of Effects

Impacts to visitor experience could be reduced to a minor intensity with reasonable mitigation. Actions required to mitigate adverse effects would include educating river users, including publicizing information about where encounters may be expected and urge sensitive users to avoid those places, scheduling and/or delineating river and hiker campsites, and allowing variances for longer noncommercial trips.

4.4.5.4.3 Cumulative Effects

Continued sediment depletion from the operation of Glen Canyon Dam and vegetation encroachment would continue to diminish campsite capacities and availability. Although visitors would continue to experience the erosion of beaches and campsites, even launches, smaller group size limits, and shorter trip length limits in the summer and shoulder seasons may help mitigate the camp frequency issue. Additional impacts from encounters between river users and hikers at campsites and attraction sites would be localized, adverse, short-term, and minor on river users, since river use would increase slightly from current conditions during prime hiking seasons.

Although the cumulative effects of dam operations, vegetation encroachment, and encounters between river users and hikers would continue to diminish campsite availability, the mitigating actions of this alternative would offset visitor crowding. Cumulative impacts would be localized to regional, adverse, short- to long-term, and moderate in the summer, but minor to moderate in the winter and shoulder seasons.

4.4.5.4.4 Conclusion

Under Alternative D, adverse impacts to visitors' experiences on Grand Canyon river trips would be mostly perceptible and measurable. Because of the variability of visitors' perceptions, values, and level of sensitivity to certain impacts, the intensity of impacts would be negligible to major, depending on one's perspective and desired experience. The even launch patterns, smaller group sizes, mid-range level of mixed motorized and nonmotorized use, the elimination of helicopter exchanges at Whitmore, the increased level of hiking exchanges at Whitmore, and substantially increased discretionary time throughout the year would be desirable to many people seeking both motorized and nonmotorized opportunities. Although this alternative substantially increases overall use in the winter and shoulder seasons, as measured by user-days and total passengers, this alternative would increase the probability of camp encounters and camp competition at bottleneck areas during the non-summer months.

Overall, this alternative would provide a range of negligible to major, localized to regional, short- to long-term, adverse impacts with minor to major, localized to regional, short- to long-term benefits to most visitors seeking a variety of river trip opportunities in Zone 1. Adverse impacts to visitor experience could be reduced to a minor intensity with reasonable mitigation. Although the cumulative effects of dam operations, vegetation encroachment, and encounters between river users and hikers would continue to diminish campsite availability, the actions of this alternative would offset visitor crowding. Cumulative impacts would be localized to regional, adverse, short- to long-term, and moderate in the summer, but minor to moderate in the winter and shoulder seasons.

4.4.5.5 ALTERNATIVE E

4.4.5.5.1 Analysis

Recreational motor trips under Alternative E would be permitted April through September. Group sizes and trip lengths would be at lower levels than current, while discretionary time would be relatively high throughout the year (see Table 4- 1). Estimated yearly passengers would increase from 22,461 (current) to 23,812, and estimated total user-days would increase (from 171,131 to 237,183), while a launch-based system would eliminate spikes in use. Summer use would decrease slightly in terms of total user-days (from 121,869 to 121,836), and total ***summer*** user discretionary time would increase (from 294,506 hours to 373,761), even though total projected ***summer*** passengers would fall from 18,128 to 15,230. These numbers indicate that visitors ***in the summer*** would have ***less*** time to experience and explore their environment. Reductions in group size, trip length, trips at one time, and people at one time, would reduce crowding and congestion. Under this alternative, overall use levels in the winter and shoulder seasons, as measured by user-days and total passengers, would increase considerably above current levels, but are relatively low compared to the rest of the alternatives. Allowable trip lengths, reduced from current, are among the lowest of all the alternatives. Whitmore helicopter exchanges would be restricted to the motorized season, although hiking exchanges would be offered year-round.

River Encounters. River recreational users would encounter a slight reduction of motorized trips (from four to six currently to three to five) in summer and the same number of nonmotorized encounters that currently occur (see Table 4-27). While summer encounters might continue to be slightly higher than wilderness-like standards (fewer than two or three encounters per day), even launch patterns and smaller group sizes would probably reduce the number of high encounter days. In the off-season this alternative would provide lower encounter levels than summer and might provide wilderness-like opportunities. Boaters would encounter an increase of motorized trips in spring (from less than two to two to four) and in fall (from zero to two to four) and an increase of nonmotorized trips in spring (from less than one up to three). Motorized and nonmotorized trips would have the opportunity to experience a Grand Canyon river trip in the shoulder seasons, but only nonmotorized trips would be allowed in the winter and would encounter smaller groups than now. Since nearly half of Grand Canyon boaters prefer not to see other groups, and 75% prefer to see no fewer than two to four trips per day this alternative would probably have a localized, adverse, short-***to long-***term negligible effect to most noncommercial users and most commercial passengers.

Time in Sight. Time-in-sight impacts would remain the same as current for all seasons with the exception of spring, which would increase from less than 15 minutes to 15–30 minutes (see Table 4- 28). This alternative would continue to have negligible effects on experiences because time in sight would continue to be within wilderness standards.

Attraction Site Encounters. Attraction site encounters would remain similar to current levels in summer, ***but*** the sizes of groups encountered would be smaller (see Table 4- 29); use levels would produce a 50% probability of meeting others at lower use sites and 85% at high-use sites. In non-summer periods attraction site encounters would continue to remain similar to current in all seasons except spring, when the probability of encountering other groups at high-use sites would be 70% as compared to 30%–***60%*** currently, ***and winter, when the probability of encountering other groups at high-use sites would be 30% as compared to <25%***. The average number of people seen at high-use sites would be within the acceptable range (less than 30 people in other groups encountered) for all seasons.

During the summer season, only three of the major attraction sites would experience any days with more than 100 visitors in a single day, although not encountered at the same time. Deer Creek would have the highest number of such days (12), but this would be significantly lower than the highest level of visitation (79 at Havasu Creek) under current conditions. None of these sites would experience days with more than 150 people in a single day. This would be a substantial decrease from current conditions (Table 4-30). Since attraction site encounters would remain similar to current levels in summer, compared to current conditions, attraction site encounters would probably meet most people's standards and have a localized, short-term, negligible effect on their experiences.

Camp Encounters. Camp encounters would probably continue to occur slightly under 20% of the time in the summer, although groups would still be encountered in bottleneck areas, and they would be smaller. Groups would have more camp encounters in the spring and winter months than currently (in spring from 16–31 trips at one time to 44–45 and in winter from a current 10 trips at one time to 31), exceeding the current *Colorado River Management Plan* camp encounter standard of 10%. Compared to current conditions, this alternative would increase the probability of camp encounters at specific sites, especially during non-summer seasons, and probably have localized, adverse, short-term, ***and minor*** to moderate effects on most users' experiences.

Camp Competition. Forty-five trips at one time in the spring months produces occupancy rates of about 55% of large primary camps, and 31% of medium and large primary camps, but only about 20% of all camps (see Table 4- 30); as compared to the current 16–31 trips at one time in the spring, in which occupancy rates are only 20%–37% of large primary camps, 10%–20% of medium and large primary camps, and only about 5%–10% of all camps. In general, this alternative would increase spring and winter trips at one time and camp competition, thereby potentially creating possible visitor conflict in bottleneck areas in seasons when there currently are none. Compared to current conditions, competition over campsites would probably have localized, adverse, short-term, and minor to moderate impacts on most users' trips, although possibly an adverse, moderate impact in critical reaches.

Launch and Takeout Congestion. A launch-based system would reduce the number of trips launching per day from Lees Ferry in the summer (to 5.5 launches per day), and as a result, reduce the number of takeouts and congestion problems at Diamond Creek (see Table 4- 31). Compared to current conditions, this alternative would reduce launch and takeout congestion to a negligible level at Lees Ferry and Diamond Creek.

Group Size. Group size limits of 25 for commercial oar trips and 30 for commercial motor trips would help reduce the adverse effects of being in or meeting larger trips, with the improvement in "own group size" providing the more important benefit (see Table 4- 32). The greatest improvement from reduced group size limits would come from eliminating large trips of 43 and introducing 8-person, noncommercial trips. Overall, lower group size limits in this alternative would have localized, beneficial, negligible impacts, as compared to current conditions.

Trip Length. This alternative would lower trips at one time by reducing summer maximum trip lengths from 18 days (current) to 8 days for commercial motor trips; from 18 to 14 days for commercial oar trips; and from 18 to 16 days for noncommercial trips. Shoulder seasons maximum trip lengths would be reduced from 21 days to 8 days for commercial motor trips, to 16 days for commercial oar trips, and to 18 days for noncommercial trips. Winter season maximum trip lengths would be further reduced from 30 to 21 days for noncommercial oar trips only, since no other sector would be allowed to take a winter trip. Because data show most boaters prefer longer trips, and this alternative would shorten trip lengths in all seasons and reduce opportunities to take winter trips, this alternative would probably have localized, adverse, ***long***-term, moderate impacts on most boaters' experiences. Potential mitigation measures to reduce adverse impacts may include allowing variances for longer trips.

Discretionary Time. Under Alternative E, discretionary time would be in the mid-range of all alternatives year-round (see Appendix H). More user discretionary time indicates potentially more time for people to experience and explore their environment, especially when there are more daylight hours. Overall, compared to current conditions, this alternative would probably have a localized, beneficial, short and long-term, moderate effect on most people's experiences.

Nonmotorized Opportunities. Compared to current conditions, this alternative would offer three additional months of nonmotorized opportunities, with beneficial, ***long***-term, moderate impacts to visitors seeking nonmotorized trips, although impacts on those seeking motorized trips would be adverse, ***long***-term, and moderate (see Table 4- 33).

Whitmore Exchanges. Under this alternative, helicopter exchange opportunities would be provided during the six-month motorized season, and hiking opportunities would continue to be provided, although currently rarely ever utilized (see Table 4- 34). The number of passengers that could be exchanged by helicopter would be decreased from 6,800 out and 3,500 in to 2,500 out and 2,500 in), eliminating the higher activity days. However, these more even use patterns would potentially ensure that almost every day in the six-month motorized season, helicopter activity would be encountered at Whitmore. For people who feel helicopters are inappropriate in the canyon, this alternative would probably have localized, adverse, short-term, minor effects on their river experience, since there would be three additional months in which they would not encounter helicopter activity. Conversely, for those who view helicopter exchanges as a “feature” of their trips, and because this alternative would reduce the number of helicopter exchanges from current levels, this alternative would probably have localized, adverse, short-term, minor effects on their experiences.

Encounters between River Users and Hikers. Under this alternative, encounters between river users and hikers would increase during the spring and fall (especially during April and September when there would be more river launches) because river use would increase during hiking seasons. Hiker/river recreationist encounters would most likely continue to occur at specific locations (popular beach campsites or attraction sites); therefore, encounters between river users and hikers would probably have localized, adverse, short-term, moderate impacts on both parties, as compared to current conditions. Potential mitigation measures to reduce adverse impacts might include educating river users, including publicizing information about where encounters may be expected and urging sensitive users to avoid those places, and scheduling and/or delineating “overlap” campsites.

Phantom Ranch Exchanges. Assuming the proportion of trips using exchanges at Phantom Ranch would remain the same as present, the number of exchanges would increase slightly from ***4,900 to 5,300*** total people per year (see Table 4- 35). This would result in a slight increase in camp congestion near Phantom Ranch for trips ***exchanging*** there, with localized, adverse, short-term, negligible effects on boaters’ experiences, as compared to current conditions.

4.4.5.5.2 Mitigation of Effects

Impacts to visitor experience could be reduced to a minor intensity with reasonable mitigation. Actions required to mitigate adverse effects would include ***a subset of*** those listed in Alternative A in addition to restricting helicopter exchanges during certain hours of the day and the nonmotorized season, and publicizing those times so that direct encounters can be avoided; and allowing variances for longer noncommercial trips.

4.4.5.5.3 Cumulative Effects

Continued sediment depletion from the operation of Glen Canyon Dam and vegetation encroachment would continue to diminish campsite capacities and availability. Although visitors would continue to experience the erosion of beaches and campsites, even launches and smaller group size and trip length limits may help mitigate the camp frequency issue. Additional impacts from encounters between river users and hikers at campsites and attraction sites would have adverse, moderate impacts on river users, since river use would increase from current conditions during prime hiking seasons.

Although the cumulative effects of dam operations, vegetation encroachment, and encounters between river users and hikers would continue to diminish campsite availability, the mitigating actions of this alternative would offset visitor crowding. The cumulative impact would be localized to regional, adverse, short- to long-term, and moderate in the summer, but minor to moderate in the winter and shoulder seasons.

4.4.5.5.4 Conclusion

Under Alternative E, adverse impacts to visitors' experiences on Grand Canyon river trips would be mostly perceptible and measurable. Because of the variability of visitors' perceptions, values, and level of sensitivity to certain impacts, the intensity of impacts would be negligible to major, depending on one's perspective and desired experience. The even launch patterns, smaller group sizes, mid-range level of mixed motorized and nonmotorized use, helicopter exchanges at Whitmore only during the motorized season, hiking exchange opportunities at Whitmore and increased discretionary time throughout the year would probably be desirable to many people seeking both motorized and nonmotorized river trips. Because this alternative increases overall use levels in the winter and shoulder seasons, as measured by user-days and total passengers, this alternative would increase the probability of camp encounters and camp competition at bottleneck areas during the non-summer months.

Overall, this alternative would provide a range of negligible to major, localized to regional, short- to long-term, adverse impacts with minor to moderate, localized to regional, short- to long-term benefits to visitors seeking a variety of river trip opportunities in Zone 1. Adverse impacts to visitor experience could be reduced to a minor intensity with reasonable mitigation. Although the cumulative effects of dam operations, vegetation encroachment, and encounters between river users and hikers would continue to diminish campsite availability, the actions of this alternative would offset visitor crowding. The cumulative impact would be localized to regional, adverse, short- to long-term, and moderate in the summer, but minor to moderate in the winter and shoulder seasons.

4.4.5.6 ALTERNATIVE F

4.4.5.6.1 Analysis

Recreational motor trips under Alternative F would be permitted January through June. Group sizes and trip lengths would be at lower levels than current conditions, but discretionary time would be higher than current condition, although relatively low as compared to several other alternatives (see Table 4- 1). Estimated yearly passengers would increase from 22,461 (current) to 25,415 and estimated total user-days would increase (from 171,131 to 235,146, although the implementation of a launch-based system would eliminate spikes in use. Summer use represents a considerable decrease in total user-days (from 121,869 to 102,291), total user discretionary time (from 294,506 to 269,506), and total projected passengers (from 18,128 to 13,954). These numbers indicate an overall decrease in ***summer*** use. In addition, reductions in group size, trip lengths, trips at one time, and people at one time, serve to reduce crowding and congestion during certain months, although concentrated motorized use in May and June would increase crowding and congestion during those months. Under this alternative, overall use levels in the winter and shoulder seasons, as measured by user-days and total passengers, would increase considerably above current levels. Allowable trip lengths would be reduced from current condition and helicopter exchanges at Whitmore would be restricted to the motorized season, although hiking exchanges would be offered year-round.

River Encounters. River recreational users would encounter a slight reduction of motorized trips in summer (from four to six currently to three to five), although these encounters would be concentrated in a two-month period as compared to the current four-month period, in combination with the same number of nonmotorized encounters that currently occur (see Table 4-27). Because of this concentrated two-month motorized use in the summer, encounters would be higher than wilderness-like standards (fewer than two or three encounters per day), although even launch patterns and smaller group sizes would probably produce constant high encounter days during May through June that currently only occur during the month of June. In the nonmotorized season, this alternative would provide lower encounter levels than currently occur in the summer and would probably provide more wilderness-like opportunities. Boaters would encounter an increase of motorized trips in spring (from less than two to three to four) and an increase of nonmotorized trips in spring (from less than one to one to three). Motorized and nonmotorized trips would have the opportunity to experience a Grand Canyon river trip in both shoulder seasons, albeit at much higher levels, and would encounter slightly smaller groups than currently. Since nearly half of Grand Canyon boaters prefer to see no other groups, and 75% prefer to see fewer than two to four trips per day, this alternative would probably have localized, adverse, short- ***to long***-term, moderate effects to most noncommercial users compared to current conditions, although the effect would probably be localized, adverse, short- ***to long***-term, and major in the shoulder seasons. Impacts on most commercial passengers would be localized, adverse, short- ***to long***-term, and minor.

Time in Sight. Time-in-sight impacts would remain similar to current for all seasons except spring, which would increase from less than 15 minutes currently to 30–45 minutes (see Table 4-28), but would continue to meet wilderness standards, albeit in a season where people expect very few other trips on the river. This could potentially have localized, adverse, short-term, minor effects on experiences during high-use periods, as people would view other river trips for longer periods of time and possibly perceive this as feeling crowded.

Attraction Site Encounters. Attraction site encounters would remain similar to current levels in summer, ***but*** the sizes of groups would be smaller and camp encounters would be concentrated in May and June (see Table 4- 29). Use levels would produce a 50% probability in May and June and a 35% probability ***in July and August*** of meeting others at lower use sites; use levels would produce a 90% probability in May and June and a 65% probability in July and August at high-use sites. In non-summer periods, attraction site encounters would increase in spring, where the probability of encountering other groups at high-use sites would be 80% (as compared to 30%–40% current) and 40% at lower use sites. Due to the increased levels of use in May and June, the average number of people seen at high-use sites would probably exceed wilderness-like standards, but would be within the acceptable range for other months. Compared to current conditions, attraction site encounters would probably exceed most people's standards in May and June, with localized, adverse, short-term, minor to moderate effects on users' experiences during these months, but localized, adverse, short-term, minor effects during the rest of the year.

Camp Encounters. Under Alternative F summer camp encounters would probably occur more often during May and June than they do currently, although less often in July and August. Groups would encounter other groups, albeit smaller groups, in bottleneck areas during the high-use months, would have higher camp encounters in spring and winter months than they currently encounter (from a current 16–31 trips at one time to 47 in spring and from a current 10 trips at one time to 36 in winter), and would exceed the current *Colorado River Management Plan* camp encounter standard of 10%. Compared to current conditions, this alternative would increase the probability of camp encounters at specific sites, especially during May and June, which would probably have localized, adverse, short-term, moderate effects on most users' experiences during May and June, and localized, adverse, short-term, minor effects during the rest of the year.

Camp Competition. A total of 47 trips at one time in the spring produces occupancy rates of about 60% of large primary camps, and 33% of medium and large primary camps (see Table 4-30); but only about 21% of all camps, as compared to the current 16–31 trips at one time in the spring, in which occupancy rates are only 20%–37% of large primary camps, 10%–20% of medium and large primary camps, and only about 5%–10% of all camps. In general, this alternative would increase spring and winter trips at one time and camp competition; thereby, potentially creating visitor conflicts in bottleneck areas in seasons when there currently are none. It would also create visitor conflicts and crowding issues at primary campsites during May and June. Compared to current conditions, competition over campsites would probably have localized, adverse, short-term, moderate impacts on most users' trips during May and June, and possibly localized, adverse, short- to long-term, moderate to major impacts in critical reaches.

Launch and Takeout Congestion. Although this alternative would reduce spikes in the number of trips launching from Lees Ferry per day in the summer, it would continue to contribute to launch and takeout congestion during May and June because there would be six launches per day during those months (see Table 4- 31). Compared to current conditions, this alternative would continue to contribute to launch and takeout congestion at a localized, adverse, short-term, minor level in May and June at Lees Ferry and Diamond Creek. Possible mitigation measures to reduce these impacts may include scheduling launches and takeouts.

Group Size. Lower group size limits of 30 for commercial motor and oar trips and would help reduce adverse effects of being in or meeting larger trips, with the improvement in "own group size" providing the more important benefit (see Table 4- 32). The greatest improvement from reduced group size limits would come from eliminating large trips of 43 and introducing 8-person, noncommercial trips. Overall, smaller group limits would have regional, beneficial, short- to long-term, negligible impacts, as compared to current conditions.

Trip Length. This alternative would further lower trips at one time by reducing summer maximum trip lengths from 18 days currently to 10 days for commercial motor trips, from 18 to 16 days for commercial oar trips, and from 18 to 16 days for noncommercial trips. Shoulder season trip length maximums would be reduced from 18 days currently to 10 days for commercial motor trips, from 21 to16 days for commercial oar trips, and from 21 to 16 days for noncommercial trips. Winter season trip length maximums would be reduced from 30 days currently to 18 days for noncommercial motor trips and 21 days for noncommercial oar trips. Because data show most boaters' prefer longer trips lengths overall and this alternative shortens trip lengths in all seasons, this alternative would probably have regional, adverse, long-term, moderate to major impacts on most boaters' experiences. Potential mitigation measures to reduce adverse impacts may include allowing variances for longer trips.

Discretionary Time. Under Alternative F discretionary time would be in the high-range of all alternatives in non-summer seasons and one of the lowest in summer (see Appendix H). This higher level of user discretionary time in non-summer seasons indicates potentially more time for people to experience and explore their environment, although during times of the year when there are less daylight hours. Overall, compared to current conditions, this alternative would probably have regional, adverse, long-term, negligible effects on most people's experiences.

Nonmotorized Opportunities. Compared to current conditions, this alternative would offer three additional months of nonmotorized opportunities (see Table 4- 33), resulting in regional, beneficial, long-term, moderate impacts to people seeking nonmotorized trips. However, impacts on those seeking motorized trips would be regional, adverse, long-term and moderate.

Whitmore Exchanges. Under this alternative, helicopter exchange opportunities would be provided during the six-month motorized season and hiking opportunities would continue to be provided, although currently rarely ever utilized (see Table 4- 34). There would be a limit of how many passengers that would be able to exchange by helicopter (from ***3,635 in and 6,630 out*** to 3,400 in and 6,600 out). More even use patterns would potentially ensure that almost every day in the six-month motorized season, helicopter activity would be encountered at Whitmore. For people who feel helicopters are inappropriate in the canyon, this alternative would probably have localized, adverse, short-term, minor effects on their river experiences, since they would have three additional months in which they would not encounter helicopter activity. Conversely, for those who view helicopter exchanges as a "feature" of their trips, and because this alternative would provide a similar number of helicopter exchanges to current conditions, this alternative would have localized, adverse, short-term, negligible effects on their experiences.

Encounters between River Users and Hikers. Under this alternative, encounters between river users and hikers would increase during the spring and fall because of an increase in river use during hiking seasons and occur most often at specific locations. Hiker/river encounters would most likely increase at specific locations (popular beach campsites or attraction sites); therefore, encounters between river users and hikers would probably have localized, adverse, short-term, and moderate to major impacts on both parties, as compared to current conditions. Potential mitigation measures to reduce adverse impacts could include educating river users, including publicizing information about where encounters may be expected and urging sensitive users to avoid those places, and scheduling and/or delineating "overlap" campsites.

Phantom Ranch Exchanges. Assuming the proportion of trips using exchanges at Phantom Ranch would remain the same as present, an increase in the number of people (from 4***,900 to 5,700*** total people) would probably exchange at Phantom Ranch per year (see Table 4- 35). If this assumption is correct, this would result in an increase in camp congestion near Phantom Ranch for trips exchanging there, having potentially localized, adverse, short-term, minor effects on boaters' experiences, as compared to current conditions.

4.4.5.6.2 Mitigation of Effects

Impacts to visitor experience could be reduced to a minor intensity with reasonable mitigation. Actions required to mitigate adverse effects would include ***a subset*** of those discussed in Alternative A in addition to allowing variances for longer noncommercial trips.

4.4.5.6.3 Cumulative Effects

Continued sediment depletion from the operation of Glen Canyon Dam and vegetation encroachment would continue to diminish campsite capacities and availability. Although visitors would continue to experience the erosion of beaches and campsites, even launches and smaller group size and trip length limits may help mitigate the camp frequency issue, even though this alternative has higher year-round total user-days than current, with higher concentrations of use during May and June. Additional impacts from encounters between river users and hikers at campsites and attraction sites would have adverse, short-term, ***and*** moderate to major effects on river users, since river use would increase from current condition during prime hiking seasons.

The cumulative effects of dam operations, vegetation encroachment, and encounters between river users and hikers would continue to diminish campsite availability and exacerbate visitor crowding. The cumulative impact would be localized to regional, adverse, short- to long-term, and moderate to major in May and June due to increased levels of use, but regional, adverse, short- to long-term, and moderate during the rest of the year.

4.4.5.6.4 Conclusion

Under Alternative F, adverse impacts to visitors' experiences on Grand Canyon river trips would be mostly perceptible and measurable. Because of the variability of visitors' perceptions, values, and level of sensitivity to certain impacts, the intensity of impacts would be negligible to major, depending on one's perspective and desired experience. The even launch patterns, smaller group sizes, higher level of mixed motorized and nonmotorized opportunities, restricted helicopter exchanges and year-round hiking exchanges at Whitmore, and increased discretionary time during non-summer seasons would probably be desirable to many people seeking both motorized and nonmotorized river trips. Because this alternative substantially increases overall use in the non-summer season and concentrates motorized trips during May and June in the summer season, this alternative would exceed most people's attraction site standards, exceed the current *Colorado River Management Plan* camp encounter standard, and create visitor conflicts and crowding issues at primary campsites during these months with higher levels of use.

Overall, this alternative would provide a range of negligible to major, localized to regional, short- to long-term, adverse impacts with minor, localized to regional, short- to long-term benefits to visitors seeking a variety of river trip opportunities in Zone 1. Adverse impacts to visitor experience could be reduced to a minor intensity with reasonable mitigation. The cumulative effects of dam operations, vegetation encroachment, and encounters between river users and hikers would continue to diminish campsite availability and exacerbate visitor crowding. The cumulative impact would be localized to regional, adverse, short- to long-term, and moderate to major in May and June due to increased levels of use, but regional, adverse, short- to long-term, and moderate during the rest of the year.

4.4.5.7 ALTERNATIVE G

4.4.5.7.1 Analysis

Recreational motor trips under Alternative G would be permitted January through August, and group sizes would be somewhat lower than current, but would be higher than any of the other alternatives. Trip lengths would generally be at the lowest of all the alternatives, with the exception of noncommercial winter oar trips, which would be reduced from 30 to 21 days. Yearly user discretionary time would be higher than current condition, but is among the lowest of all the other alternatives (see Table 4- 1). Estimated yearly passengers would increase from 22,461 (current) to 28,680 and estimated total user-days would increase (from 171,131 to 249,910), although the implementation of a launch-based system would eliminate spikes in use.

Summer use would represent a considerable decrease in total user-days (from 121,869 to 101,984), total user discretionary time (from 294,506 to 229,958) and total projected passengers (from 18,128 to 14,939). These numbers indicate an overall decrease in ***summer*** use, particularly in the amount of time that visitors have to experience and explore their environment; however, this is offset by the large group size of 40 for commercial motor trips. Under this alternative, overall use levels in the winter and shoulder seasons, as measured by user-days and total passengers, would increase considerably above current levels and are among the highest of all the alternatives. Additionally, winter launches would be twice those currently allowed and shoulder launches, while reduced from current, would be higher than any other alternative; however, reductions in trip lengths would result in relatively low discretionary time, particularly in the shoulder seasons. Helicopter exchanges at Whitmore would be restricted to the motorized season and hiking exchanges would continue to be offered year-round.

River Encounters. River recreational users would encounter a slight reduction of motorized trips (from 4–6 currently to 3–5) in the summer, in combination with the same number of nonmotorized encounters that currently occur (see Table 4-27). While summer encounters would provide slightly higher than wilderness-like standards (fewer than 2 or 3 encounters per day), even launch patterns would probably reduce the number of high encounter days. In the non-summer seasons, this alternative would provide lower encounter levels than summer, but higher encounters than currently occur. Boaters would encounter an increase of motorized trips in spring (from less than 2 to 3–5), as well as an increase of nonmotorized trips in spring (from less than 1 to 2–4). Motorized and nonmotorized trips would have the opportunity to experience a Grand Canyon river trip in both shoulder seasons at much higher levels than current and would encounter similar group sizes as current. Since nearly half of Grand Canyon boaters prefer to see no other groups, and 75% prefer to see fewer than 2 to 4 trips per day, compared to current conditions, this alternative would have localized, adverse, short- ***to long***-term, moderate effects on most noncommercial users, although impacts in the shoulder seasons would probably be localized, adverse, short-***to long***-term, and major. Impacts to most commercial passengers would be localized, adverse, short- ***to long***-term, and minor.

Time in Sight. Time-in-sight impacts would remain the same as current for all seasons with the exception of spring, which would increase from less than 15 minutes currently to 15–30 minutes (see Table 4- 28). This alternative would continue to have negligible effects on experiences because time in sight would continue to be within wilderness standards.

Attraction Site Encounters. Attraction site encounters would remain similar to current levels in summer with similar group sizes (see Table 4- 29); use levels would produce a 50% probability of meeting other groups at lower use sites and 85% at high-use sites in summer. In non-summer periods, attraction site encounters would continue to remain similar to current levels in all seasons except spring, where the probability of encountering other groups at high-use sites would also be 85% as compared to 30 to 40% current. The average number of people seen at high-use sites would exceed the acceptable range of less than 30 people in other groups encountered. Compared to current conditions, attraction site encounters would probably exceed most people's standards and have localized, adverse, short-term, minor effects on most users' experiences.

Camp Encounters. Under Alternative G summer camp encounters would probably occur more often than currently occur. Groups would expect to encounter other, similar size groups in bottleneck areas throughout the year, have much higher camp encounters from September through April than they currently encounter, (from a current 16-31 trips at one time to 48 in spring and from a current 10 trips at one time to 40 in winter), and exceed the current *Colorado River Management Plan* camp encounter standard of 10%. Compared to current conditions, this alternative would increase the probability of camp encounters at specific sites during the non-summer seasons and probably have localized, adverse, short-term, moderate to major effects on most users' experiences.

Camp Competition. A maximum of 48 trips at one time in spring produces occupancy rates of about 60% of large primary camps, and 33% of medium and large primary camps, but only about 21% of all camps (see Table 4- 30), as compared to the current 16–31 trips at one time in the spring, in which occupancy rates are only 20%–37% of large primary camps, 10%–20% of medium and large primary camps, and only about 5%–10% of all camps. In general, this alternative would increase spring and winter trips at one time and camp competition, potentially creating visitor conflicts in bottleneck areas in seasons when there currently are none. It would also create visitor conflicts and crowding issues at primary campsites throughout the year. Compared to current conditions, competition over campsites would probably have localized, adverse, short- to long-term, moderate to major impacts on most users' trips and possibly localized, adverse, short- to long-term, major impacts in critical reaches.

Launch and Takeout Congestion. Due to the implementation of a launch-based system, this alternative would reduce the number of trips launching from Lees Ferry per day in the summer (to 5.5 launches per day) and, as a result, reduce the number of takeouts and congestion problems at Diamond Creek (see Table 4- 31). Compared to current conditions, this alternative would reduce launch and takeout congestion at Lees Ferry and Diamond Creek, resulting in localized, beneficial, short-term, negligible impacts.

Group Size. Group size limits of 40 for commercial motor and 30 for oar trips would exacerbate the crowding and congestion issue, as discussed above (see Table 4- 32). Because data show that most Grand Canyon boaters do not want to be part of or meet large groups, this alternative would continue to have regional, adverse, short- to long-term, moderate impacts on most boaters' experiences.

Trip Length. This alternative lowers trips at one time by reducing summer maximum trip lengths from 18 days currently to 8 days for commercial motor trips, and from 18 to 14 days for commercial and noncommercial oar trips. Shoulder season trip length maximums would be reduced from 18 to 8 days for commercial motor trips and from 21 to16 days for commercial and noncommercial oar trips. Winter season trip length maximums would be reduced from 30 to 18 days for noncommercial motor trips and 21 days for noncommercial oar trips. Because data show most boaters' prefer longer trips and this alternative would shorten trip lengths in all seasons, this alternative would probably have regional, adverse, long-term, moderate to major impacts on most boaters' experiences. Potential mitigation measures to reduce adverse impacts may include allowing variances for longer trips.

Discretionary Time. Under Alternative G, discretionary time would be in the mid-range of all alternatives in non-summer seasons and the lowest of all alternatives in summer (see Appendix H). This overall higher level of user discretionary time in non-summer seasons indicates potentially more time for people to experience and explore their environment, although during times of the year when there are less daylight hours. Overall, compared to current conditions, this would probably have a regional, adverse, long-term, negligible effect on most people's experiences.

Nonmotorized Opportunities. Compared to current conditions, this alternative would offer an additional month of nonmotorized opportunities (see Table 4- 33). Therefore, impacts on people seeking nonmotorized river trips would be regional, beneficial, long-term, and minor impact, while impacts on those seeking motorized trips would be regional, adverse, long-term, and minor.

Whitmore Exchanges. Under this alternative, helicopter exchange opportunities would be provided during the eight-month motorized season and hiking opportunities would continue to be provided, although currently rarely utilized (see Table 4- 34). There would be an increased limit of how many passengers would be able to exchange by helicopter (from current of ***3,635*** in and ***6,630*** out to 3,700 in and 7,200 out), potentially ensuring that helicopter activity would be encountered almost every day during the motorized season at Whitmore. For most people, this alternative would probably have a localized, adverse, short-term, moderate effect on their river experiences, since they would have an additional month in which to encounter helicopter activity. Conversely, for those who view helicopter exchanges as a "feature" of their trips, and because this alternative would provide more helicopter exchanges than currently occur, this alternative would have a localized, beneficial, short-term, minor effect on their experiences.

Encounters between River Users and Hikers. Under this alternative, encounters between river users and hikers would increase during the spring and fall because of an increase in river use during hiking seasons. Hiker/river encounters would most likely increase at specific locations (popular beach campsites or attraction sites); therefore, encounters between river users and hikers would probably have localized, adverse, short-term, ***and moderate*** to major impacts on both parties, as compared to current conditions. Potential mitigation measures to reduce adverse impacts could include educating river users about where encounters may be expected and urging sensitive users to avoid those places, and possibly scheduling and/or delineating "overlap" campsites.

Phantom Ranch Exchanges. Assuming the proportion of trips using exchanges at Phantom Ranch would remain the same as present, an increase in the number of people (from ***4,900*** to ***5,900*** total people) would probably exchange at Phantom Ranch per year (see Table 4- 35). If this assumption is correct, this would result in an increase in camp congestion near Phantom Ranch for trips exchanging there, having localized, adverse, short-term, moderate effects on boaters' experiences, as compared to current conditions.

4.4.5.7.2 Mitigation of Effects

Impacts to visitor experience could be reduced to a minor intensity with reasonable mitigation. Actions required to mitigate adverse effects would include ***a subset*** of those discussed in Alternative A in addition to allowing variances for longer noncommercial trips.

4.4.5.7.3 Cumulative Effects

Continued sediment depletion from the operation of Glen Canyon Dam would continue to diminish campsite capacities and availability. Although visitors would continue to experience the erosion of beaches and campsites, even launches and shorter trip length limits may help mitigate the camp frequency issue. Additional impacts from encounters between river users and hikers at campsites and attraction sites would have adverse, moderate to major effects on river users, since river use would increase from current condition during prime hiking seasons.

The cumulative effects of dam operations, vegetation encroachment, and encounters between river users and hikers would continue to diminish campsite availability and exacerbate visitor crowding. The cumulative impact would be localized to regional, adverse, short- to long-term, and moderate to major year-round.

4.4.5.7.4 Conclusion

Under Alternative G, adverse impacts to visitors' experiences on Grand Canyon river trips would be mostly perceptible and measurable. Because of the variability of visitors' perceptions, values, and level of sensitivity to certain impacts, the intensity of impacts would be negligible to major, depending on one's perspective and desired experience. The even launch patterns, and increased discretionary time during the winter and shoulder seasons, restricted helicopter exchanges at Whitmore would be desirable to many people seeking both motorized and nonmotorized river trips. Although because of larger group sizes (similar to current), increased helicopter exchanges at Whitmore during the motorized season, considerably higher level of mixed motorized and nonmotorized use during the winter and shoulder seasons, as measured by user-days and total passengers, this alternative would considerably increase the probability of camp encounters, camp competition, and perceived crowding at popular attraction sites during the non-summer months.

Overall, this alternative would provide a range of negligible to major, localized to regional, short- to long-term, adverse impacts with minor, localized to regional, short- to long-term benefits to visitors seeking a variety of river trip opportunities in Zone 1. Adverse impacts to visitor experience could be reduced to a minor intensity with reasonable mitigations. The cumulative effects of dam operations, vegetation encroachment, and encounters between river users and hikers would continue to diminish campsite availability and exacerbate visitor crowding. The cumulative impact would be localized to regional, adverse, short- to long-term, and moderate to major year-round.

4.4.5.8 *MODIFIED* ALTERNATIVE H (NPS PREFERRED ALTERNATIVE)

4.4.5.8.1 Analysis

Under ***Modified*** Alternative H, recreational motor trips would be permitted ***April 1 through September 15, for a total of 5.5 months,*** and ***commercial*** group sizes would be lower than current in the summer and considerably lower in the shoulder seasons. Trip length would be lower than current conditions, with opportunities for longer ***noncommercial oar*** trips in the winter season. Yearly user discretionary time would be higher than current conditions, but would be lower than several other alternatives (see Table 4- 1). Estimated yearly passengers would increase from ***22,460*** (current) to ***24,657*** and estimated total user-days would increase (from 171,131 to ***228,986***), although the implementation of a launch-based system would eliminate spikes in use.

Summer use represents the highest level of user-days ***of all the alternatives (***from 121,869 [current] to ***124,316) and the second highest*** total projected passengers (from ***18,127 to 16,655***) of all the alternatives. ***Summer*** discretionary time would be relatively high compared to current conditions (from 294,506 to ***393,513) and the third highest of all the alternatives***. These numbers indicate an overall increase in summer use; however, this is offset by reductions in group size, trip length, people at one time, and trips at one time, which serve to reduce crowding and congestion. Under this alternative, overall use levels in the winter and shoulder seasons, as measured by user-days and total passengers, would increase above current levels. ***Winter use represents an increase of user-days (from 6,159 to 34,087) and total projected passengers (from 318 to 1,855) for noncommercial boaters. The shoulder seasons represent an incremental increase (or step-up) of user-days and total projected passengers in the spring with an incremental decrease (or step-down) in the fall, with the first two weeks in September bumping overall shoulder season use up from current. Commercial g***roup sizes in the off seasons would be at the lowest level of all the alternatives, with shoulder commercial trips reduced to 24 passengers plus guides. ***Shoulder season trip lengths are further reduced for both commercial and noncommercial motorized trips (from 18 to 12 days; from 21 to 12 days,***

respectively). Oar trips are also reduced (from 21 to 18 days for commercial oar trips September 1-15, and 21 days the remainder of the shoulder seasons, with noncommercial oar trips 21 days the entire shoulder seasons). Whitmore helicopter exchanges would be restricted to ***6 months (April through September) and before 10AM,*** while hiking exchanges would be offered ***year-round.***

River Encounters. River recreational users would encounter a slight reduction of motorized trips (from four to six currently to three to five) in summer and the same number of nonmotorized encounters that currently occur (see Table 4-27). While summer encounters may continue to be slightly higher than wilderness-like standards (fewer than two or three encounters per day), even launch patterns and lower group sizes would probably reduce the number of high encounter days. In the non-summer seasons, this alternative would provide lower encounter levels than summer, ***with the exception of the first two weeks in September,*** and may provide wilderness-like opportunities. Boaters would encounter an increase of motorized trips in spring (from less than two ***encounters*** to a ***negligible amount*** for the majority of spring to ***one to three encounters in April***) and in fall (from a ***negligible amount of encounters for the majority of fall*** to ***two to four encounters*** the first two weeks in September), and an increase of nonmotorized trips in spring (from less than one to up to three). Motorized and nonmotorized trips would have the opportunity to experience a Grand Canyon river trip in non-summer seasons except winter, when only nonmotorized ***noncommercial*** trips would be allowed to take a river trip, and would encounter smaller groups than current. Since nearly half of Grand Canyon boaters prefer to see no other groups, and 75% prefer to see fewer than two or four trips per day, compared to current conditions, this alternative would have localized, adverse, short-term, ***negligible effects on most commercial passengers. Because of noncommercial users' lower tolerances for river encounters, this alternative would probably have localized, adverse, short-term, minor*** effects on ***their experiences.***

Time in Sight. Time-in-sight impacts would be similar to current ***in summer and winter, but would be slightly higher during the last two weeks of April in spring (***from less than 15 minutes currently to 15-30 minutes***) and the first two weeks in September (from 15-30 minutes currently to 30-45 minutes) in fall*** (see Table 4- 28). This alternative would continue to have localized, adverse, short-term, negligible effects on experiences because time in sight would continue to be ***at or below the 15%*** wilderness standard (***Applied to a five hour "on-the-water" period, 15% is about 45 minutes per day. Applied to a 12 hour day, 15% equals about 1.75 hours.***).

Attraction Site Encounters. Attraction site encounters would be slightly higher than current levels in summer although the sizes of groups encountered would be smaller; use levels would produce a 50% probability of meeting others at lower use sites and 85% at high-use sites (see Table 4- 29). In non-summer periods, attraction site encounters would ***be slightly higher in fall (with the first two weeks of September raising the probability of encountering another group at high-use attraction sites from 30-70% to 75%).*** The average number of people seen at high-use sites would be within the acceptable range (less than 30 people in other groups encountered) during all seasons. Compared to current conditions, attraction site encounters would probably meet most people's standards and have localized, adverse, short-term, negligible effects on most users' experiences.

Camp Encounters. Under ***Modified*** Alternative H, camp encounters would probably continue to occur slightly under 20% of the time in the summer, although groups would probably continue to encounter other groups, albeit smaller groups, in bottleneck areas ***near attraction sites or exchange points***. Groups would have higher camp encounters in spring, winter, ***and fall*** months than they currently encounter, however (from a current 16–31 trips at one time ***to 38–49*** in spring; from a current 10 trips at one time to 23 in winter; and ***from 38–54 trips at one time to 34–64 in fall***) and would exceed the current *Colorado River Management Plan* camp encounter standard of 10%. Compared to current conditions, this alternative would slightly increase the probability of camp encounters at specific sites, especially during non-summer seasons, resulting in localized, adverse, short-term, minor effects on most users' experiences.

Camp Competition. A maximum of ***49*** trips at one time in the spring months (***primarily the last two weeks of April)*** produces occupancy rates of about ***61%*** of large primary camps, and ***34%*** of medium and large primary camps, but only about ***22%*** of all camps (see Table 4- 30), as compared to the current 16–31 trips at one time in the spring, in which occupancy rates are only 20%–37% of large primary camps, 10%–20% of medium and large primary camps, and only about 5%–10% of all camps. ***Also, a maximum of 60 trips at one time in the fall months (primarily the first two weeks of September) produces occupancy rates of about 74% of large primary camps, 49% of medium and large primary camps, and about 31% of all camps.*** In general, this alternative would ***slightly increase*** winter trips at one time and ***increase spring and fall trips at one time and*** camp competition, thereby, potentially creating visitor conflict in bottleneck areas in seasons when there currently are none. Compared to current conditions, competition over campsites would probably have localized, adverse, short- to long-term, minor impacts on most users' trips, although impacts in critical reaches could be localized, adverse, short- to long-term, and moderate ***during the last two weeks of April and the first two weeks of September.***

Launch and Takeout Congestion. Due to the implementation of a launch-based system, this alternative would reduce the number of trips launching from Lees Ferry per day in the summer (to 5.5 launches per day) and, as a result, reduce the number of takeouts and congestion problems at Diamond Creek (see Table 4- 31). Compared to current conditions, this alternative would reduce launch and takeout congestion at Lees Ferry and Diamond Creek, resulting in localized, adverse, short-term, negligible impacts.

Group Size. Lower group size limits of 32 in the summer and 24 during the rest of the year for commercial motor and oar trips would help reduce adverse effects of being in or meeting large trips (see Table 4- 32). The greatest improvement from reduced group size limits comes from eliminating large trips of 43 and introducing 8-person, noncommercial trips. Compared to current conditions, lower group size limits would reduce impacts of encountering large groups, resulting in regional, beneficial, short- to long-term, negligible impacts.

Trip Length. This alternative lowers trips at one time by reducing summer maximum trip lengths from 18 days currently to 10 days for commercial motor trips and from 18 to 16 days for commercial oar trips and noncommercial ***oar*** trips. ***Noncommercial motor trips, which currently consist of <10% of all noncommercial use, would be reduced in the summer from 18 to 12 days.*** Shoulder season trip length maximums would be reduced from 18 to ***12*** days for commercial motor trips ***during the motorized season*** and from 21 to18 days for commercial oar trips ***for the entire shoulder season. Noncommercial motor trips would be reduced from 21 to 12 days also during the motorized season and noncommercial oar trips would be reduced from 21 to 18 days the first two weeks of September, but remain 21 days for the remainder of the shoulder season.*** Winter season trip length maximums would be reduced from 30 to 25 days for noncommercial oar trips. ***Commercial oar trips would be eliminated in the winter season in this alternative, since they are not currently being utilized and the commercial companies didn't think many would sell (public comments received during the public comment period).***

Because data show most boaters' prefer longer trips and this alternative would shorten trip lengths in all seasons, this alternative would probably have regional, adverse, long-term, minor to moderate impacts on most boaters' experiences. Potential mitigation measures to reduce adverse impacts could include allowing variances for longer trips.

Discretionary Time. Under ***Modified*** Alternative H, discretionary time would be in the mid-range of all alternatives in non-summer seasons and in the high-range in the summer (***see Table 4-1***). This overall higher user discretionary time level ***from current*** indicates potentially more time for people to experience and explore their environment, especially during times of the year when there are more daylight hours. Overall, compared to current conditions, this would result in regional, beneficial, long-term, moderate effects to most people.

Nonmotorized Opportunities. Compared to current conditions, this alternative would offer ***two and a half*** additional months of nonmotorized opportunities (see Table 4- 33). ***Since data show that nonmotorized trips offer a "slower, more relaxed pace, smaller more comfortable groupings, and enhanced sensitivity to the natural environment" this alternative would probably have regional, beneficial, long-term, minor impacts to people seeking this type of experience, as well as for those who view the motor/nonmotor conflict from a social values perspective. For those people seeking motorized trip opportunities for more than the allotted 5.5 months, this alternative would probably have regional, adverse, long-term minor impacts.***

Whitmore Exchanges. ***Under Modified Alternative H, passenger exchanges would be allowed to accommodate trips launching during the mixed-use season (April 1 through September 15). All exchanges must be completed by 10:00 AM local time each day (with exceptions for safety reasons, as described in the assumptions section of this Chapter). Exchanges of commercial passengers would only be allowed by companies currently conducting Whitmore exchanges (i.e., grandfather clause in contracts). Although the NPS has no authority over transportation outside the park boundary, this analysis assumes that commercial companies currently offering passenger exchanges at Whitmore would continue to be transported by helicopter between Hualapai tribal land and Bar 10 Ranch. For passengers beginning their river trips at Whitmore, an estimated 3,635 would be transported in by helicopter and 400 would hike in for a total of 4,035 passengers entering the river corridor. Using actual 1998-2003 trip data, this would result in an estimated 5,715 passengers exiting the river corridor at Whitmore*** (***see Table 4-*** 34 ***and Appendix K for more information about Whitmore exchange calculations).***

Since this alternative would have a slight reduction of passengers exchanging at Whitmore, while restricting exchanges to certain hours of the day during the mixed use season, direct encounters with helicopters could be avoided. For most people ***sensitive to helicopter activity,*** this alternative would probably have a localized, beneficial, short-term ***moderate*** impact on their river experiences, since they would ***be able to avoid*** helicopter activity ***at Whitmore after 10:00 AM and for half of the year.*** Conversely, ***because this alternative would reduce exchanges to before 10:00 AM during the mixed-use season, impacts on people who view helicopter exchanges as a 'feature' of their motorized trips would probably*** be localized, adverse, short-term, and minor.

Encounters between River Users and Hikers. Under this alternative, encounters between river users and hikers would increase during the spring and fall ***(especially during the last two weeks of April and the first two weeks of September, respectively)*** because of a stepped-up increase in river use during ***popular*** hiking seasons. Hiker-river encounters would most likely increase at specific locations (popular beach campsites or attraction sites); therefore, encounters between river users and hikers would probably have localized, adverse, short-term, ***and*** minor to moderate impacts on both parties, as compared to current conditions.

Phantom Ranch Exchanges. Assuming the proportion of trips using exchanges at Phantom Ranch would remain the same as present, a slight increase in the number of people (from ***4,900 to 5,200*** total people) would probably exchange at Phantom Ranch per year (see Table 4- 35). If this assumption is correct, this would result in similar camp congestion near Phantom Ranch for trips exchanging there. Impacts would be ***localized, adverse. short-term, and*** negligible on boaters' experiences, as compared to current conditions.

4.4.5.8.2 Mitigation of Effects

Impacts to visitor experience could be reduced to a minor intensity with reasonable mitigations. Actions required to mitigate adverse effects would include those listed in ***the other alternatives plus the following:***

Potential mitigation measures to reduce adverse impacts of encounters between river users and hikers and camp competition could include educating river users about where encounters and competition for campsites may be expected and urging sensitive users to avoid those places, as well as encouraging both parties to share large campsites with other users, especially during the months of April and September. Another possible mitigation measure could include providing river users and hikers a river campsite map with site capacities, so sensitive users may avoid campsites that have the possibility of being shared with other groups during busy use periods and the popular hiking season.

Potential mitigation measures to reduce adverse impacts of shortened trip lengths could be to encourage people who want to take longer river trips to take them during the months their particular trip type has the longest trip lengths (e.g., from September 16 through March 31 for noncommercial oar enthusiasts; from September 1 through October 31 or April 1 through April 30 for commercial oar passengers).

4.4.5.8.3 Cumulative Effects

Continued sediment depletion from the operation of Glen Canyon Dam and vegetation encroachment would continue to diminish campsite capacities and availability. Although visitors would continue to experience the erosion of beaches and campsites, even launches, smaller group size, and shorter trip length limits may help mitigate the camp frequency issue. Additional impacts from encounters between river users and hikers at campsites and attraction sites would have adverse effects of minor to moderate intensity on river users, since river use would increase from current conditions during prime hiking seasons ***(especially during the last two weeks in April and the first two weeks in September).***

Although the cumulative effects of dam operations, vegetation encroachment, and encounters between river users and hikers would continue to diminish campsite availability, the mitigating actions of this alternative would offset visitor crowding. The cumulative impact would be localized to regional, adverse, short- to long-term, and moderate in the summer, ***minor to moderate in the shoulder seasons (especially during the first two weeks in September),*** but minor in the winter.

4.4.5.8.4 Conclusion

Under ***Modified*** Alternative H, adverse impacts to visitors' experiences on Grand Canyon river trips would be mostly perceptible and measurable. Because of the variability of visitors' perceptions, values, and ***their*** level of sensitivity to certain impacts, the intensity of impacts would be negligible to moderate, ***and adverse or beneficial*** depending on ***their*** perspective and desired experience. The even launch patterns, smaller group sizes, higher level of mixed motorized and nonmotorized opportunities ***at similar to current*** levels of ***Whitmore*** exchanges during the motorized season, and increased discretionary time throughout the year, but especially during the summer season, would most likely be desirable to most people seeking both motorized and nonmotorized trips.

Overall, this alternative would provide a range of negligible to moderate, localized to regional, short- to long-term, adverse impacts with minor to moderate, localized to regional, short- to long-term benefits to visitors seeking a variety of river trip opportunities. Adverse impacts to visitor experience could be reduced to a minor intensity with reasonable mitigation. Although the cumulative effects of dam operations, vegetation encroachment, and encounters between river users and hikers would continue to diminish campsite availability, the mitigating actions of this alternative would offset visitor crowding. The cumulative impact would be localized to regional, adverse, short- to long-term, and moderate in the summer, ***minor to moderate in shoulder seasons (especially during the first two weeks of September),*** but minor in the winter.

4.4.6 IMPACT ANALYSIS—LOWER GORGE ALTERNATIVES

4.4.6.1 ISSUES

Major issues and concerns regarding visitor experience are discussed early in this chapter. Other issues specific to Lower Gorge management include the relationship between the types and the levels of recreational activities on the Colorado River below Diamond Creek and their effects on visitor experience. There is little specific information available about Lower Gorge visitors. Most of the social impact studies focused on visitors participating in the main canyon river trips.

Although the 1989 *Colorado River Management Plan* defined opportunities in different seasons, and established indicators for experience quality, these indicators and standards were never specifically applied to the river segment below Diamond Creek. Research and studies relating to the distribution, size and conditions of campsites in the Lower Gorge is also very limited; campsites are becoming overgrown with vegetation, and lower Lake ***Mead*** levels have affected campsite availability in the lower reaches, thereby affecting river encounters as well as campsite competition.

4.4.6.2 GUIDING REGULATIONS AND POLICIES:

In addition to the laws, regulations and policies outlined earlier in this chapter, other guidance for management of the Lower Gorge includes the Hualapai tribal laws that require all non-tribal members to have permits for visiting the reservation, the Hualapai Environmental Review Code, and the "Memorandum of Understanding" signed May 14, 2003.

4.4.6.3 MANAGEMENT OBJECTIVES FOR VISITOR USE AND EXPERIENCE IN THE LOWER GORGE

Management objectives for the Lower Gorge are the same as those described earlier in this chapter. However, the activities and opportunities described for Zone 3 may be inconsistent with the wilderness experience management objectives described in the *General Management Plan* (see page 607). The activities and opportunities described for the Lower Gorge Management Zones represent the trade-offs between the quantity and quality of recreation opportunities. Objectives for management of the Lower Gorge acknowledge the Hualapai Tribe's vision "to protect the resources of the tribe and to provide for the development of economic opportunities for existing and future members of the tribe."

4.4.6.4 METHODOLOGY FOR ANALYZING EFFECTS TO VISITOR USE AND EXPERIENCE

The methodology and impact thresholds used for analyzing effects to visitor experience for the Lees Ferry alternatives applies to the Lower Gorge alternatives. However, tools described in Section 4.1 are not applicable for this section of river. The Grand Canyon River Trip Simulator does not incorporate river traffic below Diamond Creek, and the user discretionary time model was developed for longer, overnight trips. Similar to the Lees Ferry alternatives, the Management Zones map and the camp size and distribution map were used to analyze effects on visitor experience.

The Lower Gorge has received much less management and research attention than the upper canyon. There is very little information about use levels, impacts, relationships between use and impacts, the importance of various impacts, tolerances for impacts, or preferences for different types of experiences. Lower Gorge river visitors have never been surveyed (except to the extent that the 1976 and 1998 studies included visitors on some continuation trips), and no research or monitoring has focused on tourists who take pontoon or look and leave helicopter trips.

It is possible to assess social impacts in the Lower Gorge based on information from several sources, including reconnaissance trips, ranger reports, interviews with NPS and Hualapai Tribe staff, and research from the upper canyon or other rivers. However, these assessments are necessarily more conceptual and qualitative than for the upper canyon, even though some impacts may be quantifiable. In all cases, professional judgment is necessary to integrate information and ***evaluate impacts***.

4.4.6.4.1 Mitigation of Effects

The reasonable mitigation measures for impacts to visitor experience discussed in the Lees Ferry ***alternatives also generally apply*** to the Lower Gorge alternatives.

4.4.6.4.2 Cumulative Impacts

Cumulative impacts on visitor experience were determined by combining the impacts of each alternative with other past, present, and reasonably foreseeable future actions (see Section 4.1for detailed list of all actions). As discussed in the Lees Ferry alternatives, an important cumulative effect on visitor experience is that beaches and camps in Grand Canyon are getting smaller and less abundant. These conditions are exacerbated in the Lower Gorge due to the lower Lake Mead levels. Below Separation, there are fewer, less desirable camps due to river bank configurations and vegetation encroachment. The operation of Glen Canyon Dam has regional, adverse, long-term, major, impacts on aspects of visitor experiences dependent on beaches for camping and off-river activities.

The Hualapai Tribe's desire to promote a sustainable economy and offer a diversity of recreational opportunities represent trade-offs between the quantity and quality of visitor experiences. Activities conducted on tribal lands such as helicopter tours also have cumulative effects on visitor experience in the Lower Gorge. The trade-offs may have regional, adverse, long-term, major impacts for visitors seeking a wilderness river experience in the Lower Gorge. Otherwise, the increased diversity of recreational opportunities may have regional, long-term, beneficial impacts of varied intensity, depending on the levels and seasonality of use, ***and the perspective of the visitors***.

4.4.6.4.3 Assumptions

General assumptions used for analysis of effect from each alternative are discussed in Section 4.1. Assumptions that relate to the Lees Ferry alternatives and their effect on visitor experience can be generally applied for the Lower Gorge alternatives with some exceptions explained below.

Important social impacts for the Lower Gorge are similar to those for the upper canyon, with some new additions (e.g., jetboat and powerboat encounters below Separation, pontoon tour and helicopter activity in the Quartermaster area). Table 4- 36 lists social impacts in the Lower Gorge and assesses importance to river visitors, quality of information relating impacts to use levels, and quality of information about visitors' tolerances or standards.

TABLE 4- 36: RELEVANCE AND QUALITY OF INFORMATION ABOUT LOWER GORGE SOCIAL IMPACT ISSUES

	Relative Importance	Quality of Information	
		Use-Impact Relationship	Impact Standards
River encounters	Medium	Medium	Medium
Attraction site encounters	Medium	Low	Medium
Launch congestion	Low	Medium	Medium
Camp encounters	Low	High	High
Camp competition	High	Medium	High
Group size	Medium	Medium	Medium
Trip length	Medium	--	Low
Nonmotorized opportunity	Medium	--	Low
Quartermaster development	Medium	--	Medium
Pontoon activity	Medium	Low	Low
Helicopter activity	High	Low	Low

The importance ratings indicate which social impacts are likely to have larger effects on the quality of visitor experiences; they are made on a low/medium/high scale. For example, impacts from helicopter activity in the Quartermaster area are high importance because they fundamentally affect the type of experience available in that part of the Lower Gorge. Camp competition is also high importance because the number of camps is small relative to the number of trips in the Gorge at one time. In contrast, camp encounters are rated low importance because Lower Gorge camps are well defined and generally out of sight of other camps, while launch congestion is low importance because previous research shows this is less salient and time spent at launches is small relative to trip length. Additional information about importance is provided for each impact.

The use-impact relationship ratings indicate level of knowledge about use and impacts, usually by applying research findings from the upper canyon or other rivers. They are made on a low/medium/high scale. The only high knowledge rating is for camp encounters, because it is known how many camps are in sight of others and occupancy probabilities can be determined from use patterns. Three impacts are rated low knowledge (attraction site encounters, pontoon boat activity, and helicopter activity) because little is known about annual use levels, let alone seasonal or daily use patterns and how those affect specific impacts. Several impacts (group size, trip length, amount of nonmotorized opportunity, and Quartermaster area development levels) are not directly affected by use levels.

The impact standards ratings indicate what is known about visitor tolerances or preferences for various impacts. This evaluative information is critical for deciding when impacts are unacceptable, and it is generally developed from studies for the upper canyon or other rivers. For example, most is known about standards for camp competition and camp encounters (both rated high knowledge) because of the persistent research finding that backcountry groups want to camp by themselves and out of sight from others. Several other impacts are rated low knowledge because not much is known about people who take Lower Gorge trips. For example, the NPS has no ***data on*** preferences of ***visitors for*** Lower Gorge trip lengths, nonmotorized opportunities, or tolerances for pontoon boat tours or helicopter activity in the Quartermaster area.

River Encounters. The Lower Gorge has four distinct types of river/lake use that produce different types of river encounters defined as contacts between groups, except when both groups are at camps or they are using the same attraction site. Generally, river encounters result in direct, short-term, localized, adverse or beneficial impacts on visitor experience.

- "*Standard" Encounters*—These are similar to encounters in the upper canyon between downstream motor or oar trips (not including HRR trips). Standard encounters probably have the least intrusive impacts of any river encounter. However, they are moderately important for experience quality because the Lower Gorge has some primitive lower density opportunities (particularly in the non-summer season) that appear important to some visitors.

  There is little information about "standard" encounters in the Lower Gorge, but they probably have characteristics similar to those in the upper canyon. Although data are unavailable for confirmation, numbers of standard encounters per day are probably correlated with use levels and roughly equal to the number of trips passing Diamond Creek per day.

- *Hualapai River Runners (HRR) Encounters*—Under current management, these encounters have longer durations than "standard" encounters because current HRR trips travel in larger groups of boats (up to 10) with more passengers (up to 80 total). There is no information about current HRR encounter rates, but it is assumed that most groups in the Lower Gorge encounter the daily HRR trips.

- *Jetboat Encounters*—These are encounters with the jetboats used to pick up commercial continuation trips, noncommercial river trip tow-outs (existing uses), or providing lake-based canyon tours or dropping off canoeists or kayakers (potential uses). For visitors using jetboats to leave the river, jetboats are likely to be considered a trip feature – a fast way to cover the flat water miles to the takeout while still seeing the scenery of the lower Grand Canyon. For those who don't use them, the large jetboats contrast sharply with the "downstream only," more primitive opportunities found in the upper canyon and first part of the Lower Gorge.

- *Lake Mead Powerboat Encounters*—These are similar to jetboat encounters because they occur only on the segments below Separation, but they generally involve fast-moving powerboats that are noisier and present a contrast to other downstream craft (even if the downstream trips are motorized themselves). As with jetboats, impacts are probably more adverse when lake levels are low; powerboats are "traditional" on the flat, green water of large reservoirs, and river trips are more obviously "over" at Separation Canyon at those levels.

Attraction Site Encounters. Attraction site encounters are probably a moderately important impact issue for Lower Gorge visitors, particularly in the 14 miles down to Separation. Information from the 1998 study suggests that Travertine Falls is visited by nearly all continuation motor trips, and Travertine Canyon is also commonly visited; average visits at each are about an hour. At these two sites, 57% of the continuation groups encountered another group and average number of people met was 37. Travertine Falls is probably similar to Havasu or Deer Creek in the upper canyon, an attraction that most trips visit and the most likely place for encounters. Because attraction site information for continuation trips is limited and there is no information for Diamond down or HRR trips, it is difficult to estimate attraction site encounters under current management or any of the new alternatives. Generally, attraction site encounters result in direct, short-term, localized, adverse or beneficial impacts to visitor experience.

Camp Encounters. As discussed for the Lees Ferry alternatives, camp encounters are probably less related to use levels than to geographical factors. Groups have camp encounters in the Lower Gorge when they stay at two camps near mile 241 that are in sight of one another, or when they share a camp because of camp competition problems (see below). Camp encounters may have direct, short-term, localized, adverse or beneficial impacts.

Camp Competition. Camp competition is probably the limiting factor for overnight use in the Lower Gorge. Vegetation encroachment and effects from Lake Mead (e.g., sediment deposits, eroding cut banks, or inundated beaches) have substantially reduced the number of usable camps to an average of one every 2.8 miles between Diamond and mile 260; by comparison, upper canyon camp densities are about one per mile (although it is less in “bottlenecks”). Low camp densities mean that even ***few*** trips at one time (12-15) can create substantial campsite competition. Averaging just six trips a day would fill every good camp, even if trips only spend two nights in the Gorge. By comparison, peak use in the upper canyon has about 60 trips at one time competing for about 200 sites. Camp competition may have direct or indirect, short- or long-term, localized, adverse or beneficial impacts.

Launch and Takeout Congestion. As discussed for the Lees Ferry alternatives, launch congestion is probably less important for long multi-day trips, but more important for shorter trips (such as HRR or Diamond Down trips). Launch and takeout congestion may have direct or indirect, short-term, localized, adverse or beneficial impacts on visitor experience. In the Lower Gorge, the critical access area is Diamond Creek because it is used for both put-ins and takeouts and has relatively less space than other access points. Diamond Creek takeout congestion may increase because Lake Mead water levels continue to drop. Currently about 10% of upper canyon commercial motor and 55% of commercial oar trips take out at Diamond (about 20% of all commercial trips). About 84% of noncommercial trips takeout at Diamond. More even launch distributions in new upper canyon alternatives should partially off-set higher Diamond Creek use levels.

Due to lower Lake Mead water levels, takeouts on the Lake have shifted from Pearce Ferry to South Cove. This adds about 15 miles of lake travel, and discourages use of the lake as a takeout for rowing trips. The South Cove launch area is undergoing improvements, and there are already separate ramps for public use and commercial raft takeouts.

Group Size. Specific information about group size preferences among Lower Gorge visitors is lacking, but they are unlikely to be substantially different from upper canyon preferences for small or medium size groups, at least for overnight continuation and Diamond Down trips. For these groups, seeing or being in groups larger than about 30 is probably undesirable. HRR day users may be more amenable to larger groups, but there is no data to support this. Group size has direct, short- or long-term, regional, adverse or beneficial impacts on visitor experience.

Trip Length. There is little information about trip length preferences of Lower Gorge visitors. In general, this may be a less important impact for most Lower Gorge trips. It may be a key component for continuation trips intended to extend already-long trips from Lees Ferry, and week-long (or longer) non-summer Diamond Down trips that include layovers and extensive hiking. However, most trips travel through the Lower Gorge in one day (HRR day trips), two days (HRR overnight trips, commercial continuation trips that meet a jetboat pick-up) or 3 to 4 days (most noncommercial continuation and Diamond Down trips). In these cases, long trips are not a distinguishing feature. Trip length has direct or indirect, short- and long-term, regional, adverse or beneficial impacts on visitor experience.

Nonmotorized Opportunities. The presence of motorized continuation trips, motorized HRR trips, jetboat pick-ups, pontoon boats, and substantial helicopter activity essentially precludes full nonmotorized opportunities in the Lower Gorge. However, if one takes a trip in the winter or the upper canyon nonmotor season under current management, it is possible to avoid most motorized use between Diamond Creek and Lake Mead. Nonmotorized opportunities may have direct or indirect, short- or long-term, regional, adverse or beneficial impacts on visitor experience.

Quartermaster Area Development and Activity Levels. The activity and development levels in Zone 3 (RM 260 to 277) and particularly the Quartermaster area provide a sharp contrast to river trip experiences in other parts of the Grand Canyon. For people accessing the area as part of helicopter, pontoon boat, or HRR tours, the activity and development in the area may also have experiential impacts, perhaps partially off-set by the convenience of helicopter access. The activities and facilities in this area have direct and indirect, short- and long-term, localized, impacts on visitor experience.

- *Pontoon boat activity*—Pontoon boat tours probably have smaller impacts on downstream visitors than helicopters, but they contribute to the mechanized, high density setting of ***Zone 3.*** They make less noise than large jetboats, and do not throw large wakes, but they are large, visible from a long distance, and put large numbers of tourists on the water.
- *Facilities*—The number of pontoon boats is related to the level of development such as docks and trails between the river and helipads. Trails and ramadas near docks or helipads also affect the development footprint, but probably less than docks and boats. As a general strategy, concentrating use to hardened trails or staging areas is the best way to minimize biophysical or cultural impacts, as well as guide tourists to appropriate places for scenic viewing or other activities. The ramadas provide important shade in summer, and similar to the docks, their design and size probably influences whether they are intrusive.
- *Helicopter activity*—The impacts of the Whitmore helicopter activity discussed in the Lees Ferry Alternatives are assumed for the Quartermaster area. The analyses recognize the greater level of noise disturbance from the combined "look and leave tours" and helicopter activity associated with pontoon tours. However, as stated in the general assumptions in Section 4.1, it is assumed that this activity would continue, and the NPS has no authority over helicopter flights that take place on Hualapai tribal lands.

PHOTO 4- 13: QUARTERMASTER AREA DOCK

PHOTO 4- 14: QUARTERMASTER AREA HELIPAD

4.4.6.5 ALTERNATIVE 1 (EXISTING CONDITION)

4.4.6.5.1 Analysis

Alternative 1 is the no-action alternative for the section of river between Diamond Creek and Lake Mead, and existing operations and current conditions would continue. Use in the Lower Gorge is characterized by upriver travel for continuation trip takeouts and Lake Mead boaters, HRR day trips and occasional overnight trips; noncommercial launches from Diamond Creek and pontoon tours in the Quartermaster area. Launch and takeout congestion occurs at Diamond Creek primarily during the peak use summer months. HRR and pontoon tour passengers exit the river by helicopter at the Quartermaster area. Based on agreements between the NPS and Hualapai Tribe in 2000, a moratorium was placed on recreational use levels occurring at that time.

River Encounters. In current peak summer seasons about one to four commercial trips and one to two noncommercial trips pass by or put-in at Diamond Creek each day, probably producing an average of two to four encounters per day between Diamond Creek and Separation. However, uneven use patterns probably create ***some*** days with less and others with many more. Because encounter averages are similar to those for the upper canyon, they are probably within most users' tolerances for the Lower Gorge and have a negligible adverse impact. On high-use days, however, encounters probably have a minor adverse impact on visitor experience. Below Separation Canyon, many commercial continuation trips off-load passengers to jetboats, and rafts deadhead to South Cove. These encounters likely have beneficial negligible impact because very few people are present, although boats may be passing at a higher speed.

> *HRR Encounters*—There is no information about current HRR encounter rates, but it is assumed that most groups in the Lower Gorge encounter the daily HRR trips, although it is possible to avoid them by launching or passing Diamond Creek later in the day. This would be considered a negligible adverse impact to visitor experience in this section of river.
>
> *Jetboat Encounters*—Under current management, 1 to 4 round trip jetboat pick-ups occur per day in summer, as a result of the uneven Lees Ferry launch patterns. As a result, trips traveling below Separation may have 2 to 8 jetboat encounters per day, resulting in minor to moderate adverse impact on visitor experience, depending upon whether the trip is motor or nonmotor.
>
> *Lake Mead Powerboat Encounters*—The number of powerboat encounters is primarily influenced by Lake Mead water levels. Although powerboats are allowed to travel from Lake Mead under current management, this type of use is limited due to low lake levels. Encounters at current levels may be considered a beneficial moderate impact compared to an adverse impact during "full pool" lake conditions.

Attraction Site Encounters. Because there is limited attraction site information for continuation trips and no information for trips launching from Diamond Creek, it is difficult to estimate attraction site encounters under current management. Current summer use patterns create levels of encounters similar to the upper canyon, with Travertine Canyon being the high-use attraction site. Uneven use patterns may increase encounters on some days, but data to examine this is not available. The daily HRR trips increase the likelihood of encounters at Travertine Canyon. The effects of attraction site encounters currently have a minor to moderate adverse impact during high-use periods. These impacts are minor and beneficial to visitors during low use seasons and on low use days due to uneven launch and river traffic patterns.

Camp Encounters. Under current management, encounters rarely occur due to distribution and location of camps in the Lower Gorge. Camps located in the first 14 miles to Separation Canyon are not within sight of another. Two camps within sight at mile 241 are smaller camps and receive lower use than others. The effects of camp encounters have a negligible to minor adverse impacts on visitor experience in the Lower Gorge.

Camp Competition. Under current management, most commercial continuation trips camp close ***to*** Separation to ensure an early exchange with the jetboat passenger transport. Launches from Diamond Creek are currently below limits defined by current management, resulting in a minor beneficial impact. If the limits were reached, camp sharing is likely and would be a minor to major adverse impact, especially for those either on the first or last night of their river trip.

Launch and Takeout Congestion. Currently about 20% of commercial trips (10% motor and 55% nonmotor), and 84% of noncommercial trips takeout at Diamond Creek. In addition, up to 10 or 12 HRR boats may currently launch each day. To mitigate congestion, the Hualapai Tribe has requested that upper canyon trips takeout prior to 7:00 am or after 10:00 am daily during summer months. Noncommercial or educational trips launching from Diamond are subject to this schedule as well. Although trips exiting at Diamond prefer an early takeout due to high summer temperatures, there is a high level of compliance with the Tribe's requested scheduling. This is a minor adverse impact on upper canyon trips, and minor to moderate adverse impact to visitors launching from Diamond.

The South Cove facilities are of adequate size to handle ***the*** current number of takeouts. Noncommercial visitors would be most affected by this activity since commercial passengers ***mostly*** exit by jetboat or by helicopter at Quartermaster. This would be a negligible to minor adverse or beneficial impact depending on the number of trips taking out on a particular day.

Group Size. As stated earlier in this section, like the upper canyon, visitors prefer small or medium group sizes, at least for overnight trips. Under current management, there are minor to moderate adverse group size impacts associated with large commercial continuation trips, and moderate to major adverse impacts for the 10 boat/80 ***passenger*** day use trips, especially when stopped for lunch or for attraction site visits.

Trip Length. During the summer months, most trips travel through the Lower Gorge in one to five days. However, currently there are no trip length limitations. This allows for a diversity of trip lengths including the opportunity to extend the full-canyon river trip. This is a negligible to minor beneficial impact on visitor experience.

Nonmotorized Opportunities. Currently, the no-motors seasons do not apply to the Lower Gorge. HRR day trips operate from March to October, and pontoon tours operate year-round. These activities during the fall to spring months would have an effect on visitors seeking nonmotorized opportunities in the Lower Gorge. These effects have minor to major adverse impacts depending upon the number of motorized downriver and pontoon trips. The effects would be negligible and beneficial for visitors seeking motorized opportunities.

Quartermaster Area Development and Activity. The Quartermaster area lies within Zone 3, which is characterized as a "rural natural setting due to the substantial shift from a semi-primitive experience to more of an urban-oriented experience" (see Chapter 2, Management Zones). There is a mix of activities – on the river and within Hualapai tribal lands adjacent to the river including helicopter and pontoon boat tours as well as the river traffic and jetboats and powerboats traveling up from Lake Mead.

Pontoon Boat Activity—Currently, up to 5 pontoon boats may be operating at one time within a 5-mile section of the river. The number of passengers fluctuates daily, with current daily averages at 188 passengers for May through September. For river passengers being transported by jetboat, the impact would be minor to moderate, but for those on Diamond Down or continuation trips, the effects of this activity has a minor to major adverse impact on visitor experience. The opportunity to participate in a short, scenic river tour would have minor to moderate beneficial effects on visitor experience.

Helicopter Activity—Under the current management, helicopter activity associated with pontoon tours fluctuates daily. For visitors who specifically seek these types of tours, the impacts probably have a minor to moderate beneficial effect. For visitors on jetboat transports, the effects are likely a minor adverse impact to their experience. For those river runners who directly encounter this type of use in the area, however, impacts probably have a major adverse effect.

Facilities—The helipads, ramadas and toilets at the Quartermaster area are provided for the convenience and safety of the visitors to this area. The docking facilities currently in use are makeshift structures and are often moved because of changing river and lake levels and conditions. This alternative would include placement of a small floating dock to ensure visitor safety and to protect shoreline resources. The effects of current conditions have moderate to major adverse impacts on visitor experience. Upon completion of the appropriate compliance, placement of an adequate docking facility would have long-term beneficial impacts to visitors using the facilities, but may have an adverse impact on river runners.

4.4.6.5.2 Mitigation of Effects

Previous mitigation efforts indicate that specific measures can be effective in reducing impacts to visitor use and experience, if adequate funding, staffing, monitoring, and implementation of the measures are maintained. Additional ***possible*** mitigation measures ***to be considered singly or in combination that are*** not already incorporated into the alternatives, ***but*** are judged likely to reduce impacts to visitor experience ***if implemented*** include the following:

- Work cooperatively with the Hualapai Tribe to increase education efforts in teaching visitors and guides ***minimum impact practices***
- Provide a map of small, medium and large campsites to river runners, including those designated for HRR use
- ***Educate visitors about*** Management Zones including the type, intensity and timing of activities in those river segments

- Work cooperatively with the Hualapai Tribe to inventory and monitor campsites and attraction sites
- ***Work cooperatively with the Hualapai Tribe to*** restrict group sizes or numbers of trips visiting Travertine Canyon and other attractions at one time
- In cooperation with the Hualapai Tribe, conduct visitor use studies on Lower Gorge recreationists, including HRR and noncommercial trips launching from Diamond Creek, pontoon tourists, and Lake Mead boaters
- Require the most advanced “quiet technology” to reduce noise of motorized craft
- Schedule launches and takeouts throughout the day and ***if necessary*** schedule ***last-night camps*** above Diamond Creek and ***first-night camps*** below Diamond Creek

4.4.6.5.3 Cumulative Effects

Continued sediment depletion from the operation of Glen Canyon Dam and vegetation encroachment would continue to diminish campsite capacities and availability. These conditions are exacerbated in the Lower Gorge due to lower Lake Mead levels. Visitors would continue to experience the erosion of beaches and campsites, and campsite density would continue to decline, creating competition and crowding problems. The operation of Glen Canyon Dam would continue to have localized to regional, adverse, long-term, moderate to major impacts on aspects of visitor experiences dependent on beaches for campsites and off-river activities. Additional impacts from the helicopter tours conducted on Hualapai tribal lands would have localized, adverse, short-term, moderate to major impacts for river users in the Lower Gorge.

The cumulative effects of dam operations and vegetation encroachment would continue to diminish campsite size and availability and would exacerbate visitor crowding. The cumulative effects of helicopter tours on Hualapai tribal lands would continue to exacerbate noise disturbances on visitors’ experiences. Cumulative impacts would be localized to regional, adverse, short- to long-term, and moderate to major in the summer due to spikes in use, but minor to major in the shoulder and winter seasons, especially for those seeking a wilderness experience in the Lower Gorge.

4.4.6.5.4 Conclusion

Impacts to visitors on trips continuing from Lees Ferry and noncommercial trips launching from Diamond Creek may differ for those visitors on HRR day use trips and visitors on pontoon tours. Currently, approximately 80% of commercial and 15% of noncommercial trips launching from Lees Ferry continue their trips below Diamond Creek. Most of the commercial trips have passengers who started their trips from Phantom Ranch or Whitmore, and end their trip by jetboat exchange near Separation, typically spending just one night in the Lower Gorge. Noncommercial boaters continue below Diamond to extend their Grand Canyon trips for an average of three days. In contrast HRR day users typically spend six hours on a river trip, and visitors taking pontoon tours spend less than one hour in the Grand Canyon.

Under Alternative 1, for HRR and other trips, river and attraction site encounters have negligible to moderate, short-term adverse impacts. Encounters with jetboats, powerboats, and pontoon tours have minor to major short-term adverse impacts for some visitors and beneficial effects for visitors seeking that experience. Campsite competition is a minor impact because launch limits are below the allowable for overnight trips. Current HRR maximum group size has adverse impacts especially when trips stop for attractions or lunch. For river runners, this alternative provides a range of localized to regional, adverse, short- to long-term, negligible to major impacts. For visitors seeking a variety of river trip opportunities and activities in the Lower Gorge, this alternative provides a range of beneficial, localized to regional, short- to long-term, negligible to moderate impacts. The cumulative effects of dam operations and vegetation encroachment would continue to diminish campsite size and availability and would exacerbate visitor crowding. The cumulative effects of helicopter tours on Hualapai tribal lands would continue to exacerbate noise disturbances on visitors' experiences. Cumulative impacts would be localized to regional, adverse, short- to long-term, and moderate to major in the summer due to spikes in use, but minor to major in the shoulder and winter seasons, especially for those seeking a wilderness experience in the Lower Gorge.

4.4.6.6 ALTERNATIVE 2

4.4.6.6.1 Analysis

Alternative 2 is characterized by a decrease in overall use and an elimination of pontoon boat operations. During peak use months, two HRR day trips, one HRR overnight trip, and two noncommercial trips would be allowed to launch each day. All HRR trips ***would*** have a maximum group size of 30 (including guides). Trip lengths would be limited to four nights (5 days). Upriver travel would be allowed to RM 262, and commercial jetboat pick-ups would be limited to two per day.

River Encounters. Standard encounter levels would likely decrease slightly due to even launch patterns from Lees Ferry alternatives. Under Alternative 2 the number of trips launching from Diamond Creek would be reduced. The effects would have negligible to minor beneficial impacts on visitor experience.

> *HRR Encounters*—A maximum of 3 HRR trips would launch daily; ***2*** day use and 1 overnight trip. Day use trips would continue to launch early to meet takeout schedules. The maximum number of boats is reduced from current, but the number of encounters would likely increase. With HRR overnight daily launches, the impacts may have minor to moderate adverse effects on other trips in the Lower Gorge.
>
> *Jetboat Encounters*—Under Alternative 2, all upriver travel from Lake Mead is prohibited above RM 262 in Zone 3. The absence of jetboats and powerboats in Zone 2 would have moderate to major beneficial impacts on visitor experience, especially for noncommercial trips. Encounters with commercial motorized ***trips*** would likely have a negligible to minor adverse impact to those visitors.
>
> *Lake Mead Powerboat Encounters*—Similar to jetboat encounters, the effects would have moderate to major beneficial impacts on river runners in Zone 2.

Attraction Site Encounters. The effects of attraction site encounters are likely to change from current management due to even Lees Ferry launch patterns and the number of HRR daily launches. Unless HRR trips were spaced to avoid using attractions at the same time, there may be minor to moderate adverse impacts to HRR and other visitors during high-use periods. The effects may be minor adverse during the non-peak months due to increased shoulder and winter use in the Lees Ferry alternatives.

Camp Encounters. These effects would be similar to current management, and have negligible to minor adverse impacts on visitor experience in the Lower Gorge.

Camp Competition. This alternative includes designating a campsite below Separation Canyon for HRR day and overnight use. This would serve to reduce campsite competition, and would have a minor beneficial effect, especially for visitors on HRR trips, and provides some predictability for other trips seeking camps in this river segment.

Launch and Takeout Congestion. Alternative 2 has similar numbers of boats and/or trips as current management. This is a minor adverse impact on upper canyon trips, and minor to moderate adverse impact to visitors launching from Diamond Creek.

Takeout conditions at South Cove would also be similar to current for river use, and the restrictions on upriver travel would likely decrease powerboat and jetboat launches. Overall this may have a minor beneficial effect.

Group Size. Under the Lees Ferry alternatives, the maximum group size including guides is reduced. The maximum HRR group size is also reduced to 30 from a maximum of 100. The effects of group size reduction has moderate to major beneficial impacts on visitor experience.

Trip Length. Under this alternative, the maximum trip length is 5 days in peak months, and 6 days in non-peak months. This limits trip length diversity for Lower Gorge trips, but still allows for the opportunity to lengthen upper canyon trips. This limitation may have a negligible to moderate adverse impact on visitor experience, particularly during non-peak months for visitors seeking a longer Lower Gorge trip. The jetboat restrictions at RM 262 may offset some of these impacts because commercial river trips utilizing jetboat passenger transport would have to lengthen the trips in the Lower Gorge. These restrictions would require trips to be at least one day longer in the Lower Gorge and would likely have minor beneficial impacts for visitors on those trips.

Nonmotorized Opportunities. Year-round HRR day and overnight motorized trips would continue under this alternative. Motorized trips continuing into the Lower Gorge would be restricted to the mixed use season in the upper canyon. The prohibition of pontoon boat tours and restrictions on upriver travel from Lake Mead have a minor to major beneficial impact for visitor experience for those seeking nonmotorized opportunities in the Lower Gorge.

Quartermaster Area Development and Activity. Under Alternative 2, pontoon activity is prohibited and upriver travel from Lake Mead would be allowed to RM 262.

> *Pontoon Boat and Helicopter Activity*—The absence of pontoon boat and ***associated*** helicopter activity would have moderate to major beneficial impacts for nonmotorized

trips. For commercial motor continuation trips, jetboat exchanges may occur in this location, and the impact may have minor to moderate beneficial effects for those visitors. For visitors seeking the opportunity to participate in a short, scenic river tour, the impacts of this alternative would have would have minor to moderate adverse effects.

Facilities—Under this alternative all existing facilities (helipads, ramadas and toilets) on tribal lands would remain. There would not be a dock for use by passengers leaving HRR trips at the Quartermaster area. The absence of the docking facility would likely have minor to moderate adverse impacts to visitors on HRR trips. The lack of this facility would otherwise have negligible to moderate long-term beneficial effects for other river visitors.

4.4.6.6.2 Mitigation of Effects

Previous mitigation efforts indicate that specific measures can be effective in reducing impacts to visitor use and experience, if adequate funding, staffing, monitoring, and implementation of the measures are maintained. Additional ***possible*** mitigation measures ***to be considered singly or in combination, that are*** not already incorporated into the alternatives, ***but*** are judged likely to reduce impacts to visitor experience ***if implemented*** include the following:

- Work cooperatively with the Hualapai Tribe to increase education efforts in teaching visitors and guides minimum impact ethics, camping protocols, and visitor behavior.
- Provide a map of small, medium and large campsites to river runners, including those designated for HRR use.
- Publicize information about Management Zones including the type, intensity and timing of activities in those river segments.
- Work cooperatively with the Hualapai Tribe to inventory and monitor campsites and attraction sites.
- Restrict group sizes or numbers of trips visiting Travertine Canyon and other attractions at one time.
- In cooperation with the Hualapai Tribe, conduct visitor use studies on Lower Gorge recreationists, including HRR and noncommercial trips launching from Diamond Creek, pontoon tourists, and Lake Mead boaters.
- Require the most advanced "quiet technology" to reduce noise of helicopters and motorized craft.
- Improve launch and takeout facilities (e.g., marking areas for use by individual groups, providing a crane or trailer to move boats to an unoccupied place away from the water).
- Schedule launches and takeouts throughout the day and schedule ***last-night camps*** above Diamond Creek and ***first-night camps*** below Diamond Creek.

4.4.6.6.3 Cumulative Effects

Continued sediment depletion from the operation of Glen Canyon Dam and vegetation encroachment would continue to diminish campsite capacities and availability. These conditions are exacerbated in the Lower Gorge due to lower Lake Mead levels. Visitors would continue to experience the erosion of beaches and campsites, and campsite density would continue to decline, creating competition and crowding problems. The operation of Glen Canyon Dam would continue to have localized to regional, adverse long-term, moderate to major impacts on aspects of visitor experiences dependent on beaches for campsites and off-river activities. Additional impacts from the helicopter tours conducted on Hualapai tribal lands would have localized, adverse, short-term, ***moderate*** to major impacts for river users in the Lower Gorge.

Although the cumulative effects of dam operations and vegetation encroachment would continue to diminish campsite size and availability, the mitigating actions of this alternative would offset visitor crowding. However, the cumulative effects of helicopter tours on Hualapai tribal lands would continue to exacerbate noise disturbances on visitors' experiences. Cumulative impacts would be localized to regional, adverse, short- to long-term, and moderate to major, especially for those seeking a wilderness experience in the Lower Gorge.

4.4.6.6.4 Conclusion

Under Alternative 2, the number of HRR trips increases the river and attraction site encounters having minor to moderate adverse short-term impacts. The reduced group size and the reduced encounters with the motorized pontoon, jetboats and powerboats result in moderate to major long-term beneficial impacts to visitors seeking those experiences. The designation of one HRR campsite would have direct and indirect minor long-term beneficial impacts, reducing campsite competition for visitors on HRR trips. For river runners, this alternative would provide a range of localized to regional, adverse, short- to long-term, negligible to moderate impacts. For visitors seeking a variety of river trip opportunities and activities in the Lower Gorge, this alternative would provide a range of localized to regional, beneficial, short- to long-term, negligible to major impacts. Although the cumulative effects of dam operations and vegetation encroachment would continue to diminish campsite size and availability, the mitigating actions of this alternative would offset visitor crowding. However, the cumulative effects of helicopter tours on Hualapai tribal lands would continue to exacerbate noise disturbances on visitors' experiences. Cumulative impacts would be localized to regional, adverse, short- to long-term, and moderate to major, especially for those seeking a wilderness experience in the Lower Gorge.

4.4.6.7 ALTERNATIVE 3

4.4.6.7.1 Analysis

Alternative 3 is characterized by an ***increase*** in average daily HRR use, and would allow for 400 pontoon boat passengers a day. During peak use months, 3 HRR day trips, 2 HRR overnight trips, and 2 noncommercial trips would be allowed to launch each day. All HRR trips have a maximum group size of 30 (including guides). Trip lengths would be limited to five nights (6 days). Upriver travel is allowed to Separation, and commercial jetboat pickups are limited to four per day. This alternative allows two daily jetboat tours from Lake Mead. A floating formal dock would be allowed at RM 262.5, contingent on environmental compliance.

River Encounters. Although there are more HRR trips launching under this alternative, standard encounter levels would be similar to Alternative 2. More even launch patterns under the Lees Ferry alternatives may slightly decrease encounters for continuation and noncommercial trips. The effects would have negligible to minor beneficial impacts under this alternative.

> *HRR Encounters*—A maximum of 5 HRR trips would launch daily; 3 day use and 2 overnight trips. Day use trips travel at similar speeds to meet takeout schedules. The maximum number of boats per trip is reduced but the number of encounters would likely increase. With HRR overnight daily launches, the impacts may have moderate adverse effects on other trips in the Lower Gorge.
>
> *Jetboat Encounters*—Under Alternative 3, similar to current management, upriver travel is allowed to Separation. The number of jetboat pickups each day would be slightly reduced from current, however the addition of jetboat tours ***would*** result in minor to moderate adverse impacts for noncommercial and HRR trips. The effects are otherwise minor and beneficial for those visitors on tours and for commercial passengers exiting the canyon by jetboat.
>
> *Lake Mead Powerboat Encounters*—Same as Alternative 1: moderate beneficial impact at current lake levels, otherwise moderate adverse effects.

Attraction Site Encounters. The effects of attraction site encounters are likely to change from current due to even Lees Ferry launch patterns and the number of HRR daily launches. Unless HRR trips were spaced to avoid using attractions at the same time, there may be minor to moderate adverse impacts to HRR and other visitors during high-use periods. The effects may be minor adverse to visitors during the non-peak months due to increased shoulder and winter use in the Lees Ferry alternatives.

Camp Encounters. These effects would be similar to current management, and have negligible to minor adverse impacts on visitor experience in the Lower Gorge.

Camp Competition. This alternative includes designating two campsites below Separation Canyon for HRR day and overnight use. This would serve to reduce campsite competition, and would have a moderate beneficial effect for visitors on HRR trips. The number of campsites would remain unchanged with the additional HRR overnight trips, resulting in minor to moderate adverse impacts to other overnight trips.

Launch and Takeout Congestion. Alternative 3 increases the maximum number of boats, trips and people launching each day. This is a moderate adverse impact to visitor experience for trips utilizing the Diamond Creek area.

Takeout conditions at South Cove would also be affected by the increased launches and jetboats for pick-ups and tours, and have moderate adverse impacts due to size of the facility and timing of landings.

Group Size. Same as Alternative 2: The effects of the reduced group size of 30 has moderate to major beneficial impacts on visitor experience.

Trip Length. Under this alternative, the maximum trip length is ***5 nights (***6 days) in peak months, and ***8 nights (***9 days) in non-peak months. These limits are similar to the current average maximum trip length, providing more diversity than Alternative 2. This limitation may have a negligible to minor adverse impacts on visitor experience, particularly during non-peak months for visitors seeking a longer Lower Gorge trip.

Nonmotorized Opportunities. Year-round HRR day and overnight motorized trips would continue under this alternative. Motorized trips continuing into the Lower Gorge would be restricted to the mixed use season in the upper canyon. The increased daily pontoon tours and upriver travel would have moderate to major adverse impacts for visitors seeking nonmotorized opportunities in the Lower Gorge.

Quartermaster Area Development and Activity. Under Alternative 3, pontoon boat activity is increased to 400 passengers per day, and upriver travel from Lake Mead would be allowed into this area.

> *Pontoon Boat Activity*—Up to 5 pontoon boats may be operating at one time within a 5-mile section of the river. The number of passengers would increase from a daily average of 188 to 400, increasing the ***average*** number of tours per day. The impacts of increased number of tours and people on the river may have moderate to major adverse impacts for nonmotorized trips, and likely minor adverse impacts to motor or jetboat passengers. For visitors seeking the opportunity to participate in a short, scenic river tour, this alternative would have moderate beneficial effects.
>
> *Helicopter Activity*—The helicopter activity associated with pontoon tours would increase and likely have a moderate to major adverse impact on river runners. For visitors on jetboat transports, the effects are likely a minor adverse impact to their experience. Similar to Alternative 1, the impacts would have a ***minor to moderate*** beneficial effect for visitors seeking these types of tours.
>
> *Facilities*—Under this alternative all existing facilities (helipads, ramadas and toilets) on tribal lands would remain. There would be a dock facility for HRR trips and pontoon boats. The dock would be sized to allow mooring of five pontoon boats and two HRR rafts while unloading and loading passengers. The presence of a dock and facilities would have minor to moderate beneficial impacts to HRR and pontoon tour passengers. The facilities would have moderate to major adverse effects for other river visitors.

4.4.6.7.2 Mitigation of Effects

Previous mitigation efforts indicate that specific measures can be effective in reducing impacts to visitor use and experience, if adequate funding, staffing, monitoring, and implementation of the measures are maintained. ***In addition to mitigation measures described for Alternatives 1 and 2,*** mitigation measures not already incorporated into Alternative 3 that are judged likely to reduce impacts to visitor use and experience in the Lower Gorge include:

- Restrictions on the number of trips at attractions sites at one time, and
- Restrictions on jetboat pick-up times and locations.

4.4.6.7.3 Cumulative Effects

Continued sediment depletion from the operation of Glen Canyon Dam and vegetation encroachment would continue to diminish campsite capacities and availability. These conditions are exacerbated in the Lower Gorge due to lower Lake Mead levels. Visitors would continue to experience the erosion of beaches and campsites, and campsite density would continue to decline, creating competition and crowding problems. The operation of Glen Canyon Dam would continue to have localized to regional, adverse long-term, moderate to major impacts on aspects of visitor experiences dependent on beaches for campsites and off-river activities. Additional impacts from the helicopter tours conducted on Hualapai tribal lands would have localized, adverse, short-term, major impacts for river users in the Lower Gorge.

Although the cumulative effects of dam operations and vegetation encroachment would continue to diminish campsite size and availability, the mitigating actions of this alternative would offset visitor crowding. However, the cumulative effects of helicopter tours on Hualapai tribal lands would continue to exacerbate noise disturbances on visitors' experiences. Cumulative impacts would be localized to regional, adverse, short- to long-term, and moderate to major, especially for those seeking a wilderness experience in the Lower Gorge.

4.4.6.7.4 Conclusion

Under Alternative 3, the smaller group size has moderate to major, short- to long-term beneficial impacts, however, the increased daily HRR launches increases the river and attraction site encounters having minor to moderate adverse short-term impacts. The level of motorized jetboat, powerboat and pontoon use has a moderate to major long-term adverse impact to visitors seeking nonmotorized opportunities. The designation of two HRR campsites would have moderate, long-term beneficial impacts, reducing campsite competition for visitors on HRR trips. The number of camps available to other trips remains the same, and has minor short-term adverse impacts to those river trips. A docking facility sized to accommodate the maximum number of pontoon boats and for HRR passenger loading and unloading would have moderate beneficial impacts to HRR and pontoon passengers. The placement of a facility in the river corridor would have minor to major long-term, adverse impacts to other river visitors, depending on visitors' perspectives. For river runners, this alternative would provide a range of localized to regional, adverse, short- to long-term, negligible to major impacts. For visitors seeking a variety of river trip opportunities and activities in the Lower Gorge, this alternative would provide a range of localized to regional, beneficial, short- to long-term, minor to moderate impacts. Although the cumulative effects of dam operations and vegetation encroachment would continue to diminish campsite size and availability, the mitigating actions of this alternative would offset visitor crowding. However, the cumulative effects of helicopter tours on Hualapai tribal lands would continue to exacerbate noise disturbances on visitors' experiences. Cumulative impacts would be localized to regional, adverse, short- to long-term, and moderate to major, especially for those seeking a wilderness experience in the Lower Gorge.

4.4.6.8 *MODIFIED* ALTERNATIVE 4 (NPS PREFERRED ALTERNATIVE)

4.4.6.8.1 Analysis

The Modified Alternative 4 is characterized by a redistribution of HRR operations and represents a consensus between Grand Canyon National Park and the Hualapai Tribe on ***levels of*** HRR ***use*** and other trips launching at Diamond Creek. ***This alternative allows for pontoon operations to continue in the Quartermaster area with a preliminary maximum daily capacity of 480 passengers. These daily limits may be increased to 600 passengers per day based on favorable performance reviews of concession operations and resource monitoring data.***

During peak use months, daily passenger totals ***for HRR trips*** are limited to 96, with a maximum group size of 40 (including guides). There would be no daily launch limits on the number of ***HRR*** day-use trips within these passenger and group size limits. During the non-peak months two HRR trips of 35 (including guides) are allowed. Three HRR overnight trips of 20 (including guides) and 2 noncommercial trips would be allowed to launch each day during peak season. Trip lengths would be limited to three nights (4 days) in peak and five nights (6 days) in non-peak season.

Upriver travel ***would be*** allowed to ***Separation Canyon (RM 240)***, and commercial jetboat pickups are limited to four per day during peak months and one per day in non-peak months. A floating formal dock would be allowed at RM 262.5, contingent on environmental compliance.

River Encounters. Although there are more HRR trips launching under this alternative, standard encounter levels would be similar to other Lower Gorge alternatives. More even launch patterns under the Lees Ferry alternatives may slightly decrease encounters for continuation and noncommercial trips. ***The effects would have a negligible to minor beneficial impact to visitor experience.***

> *HRR Encounters*—Day use trips would travel at similar speeds to meet takeout schedules. The variable number of HRR trips would have minor to major effects, depending on the number of trips. The maximum number of boats per trip is reduced but the number of encounters would increase. With the three HRR overnight trips launching daily, the impacts may have moderate to major adverse effects on other trips in the Lower Gorge.
>
> *Jetboat Encounters*—Under ***Modified*** Alternative 4, ***similar to current management,*** upriver travel is allowed to ***Separation Canyon. The number of jetboat pickups each day would be slightly reduced from current. The effect would have negligible to minor adverse impacts depending upon whether the trip is motor or nonmotor.***
>
> *Lake Mead Powerboat Encounters*—Similar to ***current management, the number of powerboat encounters is primarily influenced by Lake Mead water levels. Encounters with powerboats at current river levels may be considered a moderate beneficial impact compared to an adverse impact during "full pool" lake conditions***.

Attraction Site Encounters. The effects of attraction site encounters are likely to change from current due to even Lees Ferry launch patterns and the variable number of HRR daily launches. Unless HRR trips were spaced to avoid using attractions at the same time, there may be moderate to major adverse impacts to HRR and other visitors during high-use periods. During the non-peak months the effects would likely have minor adverse impacts due to increased shoulder and winter use in the Lees Ferry alternatives.

Camp Encounters. These effects would be similar to current management, and have negligible to minor adverse impacts on visitor experience in the Lower Gorge.

Camp Competition. This alternative has the highest number of overnight launches (5), and includes designating 3 campsites below Separation Canyon for HRR day and overnight use. Although there are more camps above Separation, more trips would be competing for these sites, and result in a moderate to major adverse impact on visitor experience for all trips. The designated campsites below Separation ***may*** relieve competition ***for trips that do not have jetboat tow-outs.*** This would have moderate beneficial effects for HRR trips ***and minor to moderate beneficial impacts for other trips in Zone 2.***

Launch and Takeout Congestion. ***Modified*** Alternative 4 has the highest maximum number of boats, trips, and people launching per day. This is a moderate to major adverse impact to visitor experience for trips utilizing the Diamond Creek area.

Takeout conditions at South Cove would also be affected by the increased launches having minor adverse impacts due to the size of the facility and timing of landings.

Group Size. Compared to current, the HRR day trip group size would have minor to moderate beneficial impacts to visitor experience. The smaller, 20-person HRR overnight trip would have moderate beneficial impacts on visitor experience.

Trip Length. Under this alternative, the maximum trip length is ***3 nights (***4 days) in peak months, and ***5 nights (***6 days) in non-peak months. These limits are similar to the current average trip length for peak season, but less for non-peak months. This limitation may have minor adverse impacts on visitor experience, particularly during non-peak months for visitors seeking a longer Lower Gorge trip.

Nonmotorized Opportunities. Year-round HRR day and overnight motorized trips would continue under this alternative. Motorized trips continuing into the Lower Gorge would be restricted to the mixed use season in the upper canyon. ***The increased daily pontoon tours and upriver travel would have moderate to major adverse impacts for visitors seeking nonmotorized opportunities, especially in the peak use period.***

Quartermaster Area Development and Activity. Under ***Modified*** Alternative 4, ***480–600 passengers are allowed to take pontoon tours,*** and upriver travel from Lake Mead would be allowed in this area.

> *Pontoon Boat Activity*—Up to ***5*** pontoon boats may be operating at one time. The number of passengers would ***increase*** from a daily average of 188 to ***480 and possibly up to 600*** maximum daily. ***The impacts of the increased number of tours and people on the river may have a moderate to major adverse impact for nonmotorized river trips, and likely minor adverse impact to motor or jetboat passengers. For visitors seeking the opportunity to participate in a short, scenic river tour, the impacts would have moderate beneficial effects.***

Helicopter Activity—The helicopter activity associated with pontoon tours would ***increase and have a moderate to major adverse impact on river runners.*** For visitors on jetboat transports, the effects are likely minor ***adverse*** impact to their experience. Similar to Alternative 1, the impacts would have minor to moderate beneficial effects for visitors seeking these types of tours.

Facilities—Under this alternative all existing facilities (helipads, ramadas and toilets) ***on tribal land*** would remain. ***The informal dock facilities at RM 262 and 263 would be removed and replaced with one dock.*** The dock would be sized to ***safely accommodate pontoon and HRR operations.*** The presence of a dock and facilities would have minor to moderate beneficial impacts to HRR and pontoon tour passengers. The ***larger*** dock ***and existing facilities*** may have minor to major adverse effects for other river visitors.

4.4.6.8.2 Mitigation of Effects

Previous mitigation efforts indicate that specific measures can be effective in reducing impacts to visitor use and experience, if adequate funding, staffing, monitoring, and implementation of the measures are maintained. In addition to those described for Alternatives 1 and 2, mitigation measures not already incorporated into ***Modified*** Alternative 4 that are judged likely to reduce impacts to visitor use and experience in the Lower Gorge include:

- Restrictions on the number of trips at attractions sites at one time, and/or scheduling for trips at attraction sites

4.4.6.8.3 Cumulative Effects

Continued sediment depletion from the operation of Glen Canyon Dam and vegetation encroachment would continue to diminish campsite capacities and availability. These conditions are exacerbated in the Lower Gorge due to lower Lake Mead levels. Visitors would continue to experience the erosion of beaches and campsites, and campsite density would continue to decline, creating competition and crowding problems. The operation of Glen Canyon Dam would continue to have localized to regional, adverse long-term, moderate to major impacts on aspects of visitor experiences dependent on beaches for campsites and off-river activities. Additional impacts from the helicopter tours conducted on Hualapai tribal lands would have localized, adverse, short-term, ***moderate to*** major impacts for river users in the Lower Gorge.

Although the cumulative effects of dam operations and vegetation encroachment would continue to diminish campsite size and availability, the mitigating actions of this alternative ***may*** offset visitor crowding. However, the cumulative effects of helicopter tours on Hualapai tribal lands would continue to exacerbate noise disturbances on visitors' experiences. Cumulative impacts would be localized to regional, adverse, short- to long-term, and moderate to major, especially for those seeking a wilderness experience in the Lower Gorge.

4.4.6.8.4 Conclusion

Under ***Modified*** Alternative 4, the reduced group size to 40 has short- to long-term, minor to moderate beneficial impacts. This alternative allows the highest number of daily launches, increasing river and attraction site encounters. The effects are short-term and have moderate to major adverse impacts from river and attraction site encounters when the maximum number ***of*** trips and passengers launch daily. The level and patterns of motorized jetboat, powerboat, and pontoon use have a moderate ***to major*** long-term ***adverse*** impact to visitors seeking nonmotorized opportunities. The designation of three HRR campsites would have moderate, long-term beneficial impacts, reducing campsite competition for visitors on HRR trips. The number of camps available to other trips remains the same, with moderate, short-term adverse impacts to those river trips. A docking facility sized to accommodate the maximum number of pontoon boats and for HRR passenger loading and unloading would have moderate beneficial impacts to HRR and pontoon passengers. The placement of a facility in the river corridor would have minor to major long-term, adverse impacts to other river visitors, depending on visitors' perspectives. For river runners, this alternative would provide a range of localized to regional, adverse, short- to long-term, minor to major impacts. For visitors seeking a variety of river trip opportunities and activities in the Lower Gorge, this alternative would provide a range of localized to regional, beneficial, short- to long-term, minor to major impacts. Although the cumulative effects of dam operations and vegetation encroachment would continue to diminish campsite size and availability, the mitigating actions of this alternative would offset visitor crowding. However, the cumulative effects of helicopter tours on Hualapai tribal lands would continue to exacerbate noise disturbances on visitors' experiences. Cumulative impacts would be localized to regional, adverse, short- to long-term, and moderate to major, especially for those seeking a wilderness experience in the Lower Gorge.

4.4.6.9 ALTERNATIVE 5 (HUALAPAI TRIBE PROPOSED ACTION)

4.4.6.9.1 Analysis

Alternative 5 is characterized by a redistribution of HRR operations and represents a consensus between Grand Canyon National Park and the Hualapai Tribe on HRR and other trips launching at Diamond Creek. This alternative, however, allows for 960 pontoon boat passengers per day, presenting the Hualapai Tribe's proposed levels ***that are*** higher than current management.

During peak use months, daily passenger totals are limited to 96, with a maximum group size of 40 (including guides). There would be no daily launch limits on the number of day-use trips within these passenger and group size limits. During the non-peak months two HRR trips of 35 (including guides) are allowed. Three HRR overnight trips of 20 (including guides) and 2 noncommercial trips would be allowed to launch each day during peak season. Trip lengths would be limited to three nights (4 days) in peak and five nights (6 days) in non-peak season.

Upriver travel is allowed to RM 273, and commercial jetboat pickups are allowed from this point. A larger, floating formal dock would be allowed at RM 262.5 contingent on environmental compliance.

River Encounters. Although there are more HRR trips launching under this alternative, standard encounter levels would be similar to other Lower Gorge alternatives. More even launch patterns under the Lees Ferry alternatives may slightly decrease encounters for continuation and noncommercial trips. However, the jetboat exchanges in this alternative are below RM 273, and may result with increased standard encounters in Zones 2 and 3, having minor to moderate adverse impacts on visitor experience.

> *HRR Encounters*—Day use trips would travel at similar speeds to meet takeout schedules. The variable number of HRR trips would have minor to major effects, depending on the number of trips. The maximum number of boats per trip is reduced but the number of encounters would increase. With the three HRR overnight trips launching daily, the impacts may have moderate to major adverse effects on other trips in the Lower Gorge.
>
> *Jetboat Encounters*—Under Alternative 5, upriver travel is allowed to RM 273. The absence of jetboats and powerboats in Zone 2 and most of Zone 3, would have moderate to major beneficial impacts on visitor experience, especially for noncommercial trips.
>
> *Lake Mead Powerboat Encounters*—Similar to jetboat encounters, the effects would have moderate to major beneficial impacts on river runners in Zone 2 and in most of Zone 3 (RM 260 to 273).

Attraction Site Encounters. The effects of attraction site encounters are likely to change from current due to even Lees Ferry launch patterns and the variable number of HRR daily launches. Unless HRR trips were spaced to avoid using attractions at the same time, there may be moderate to major adverse impacts to HRR and other visitors during high-use periods. During the non-peak months the effects would likely have minor adverse impacts due to increased shoulder and winter use in the Lees Ferry alternatives.

Camp Encounters. These effects would be similar to current management, and have negligible to minor adverse impacts on visitor experience in the Lower Gorge.

Camp Competition. This alternative has the highest number of overnight launches (5), and includes designating 3 campsites below Separation Canyon for HRR day and overnight use. Although there are more camps above Separation, more trips would be competing for these sites, and result in a moderate to major adverse impact on visitor experience for all trips. The designated campsites below Separation would relieve competition; however, this alternative restricts jetboat exchanges to RM 273 or below, creating more campsite competition. This would have moderate to major adverse impacts to other trips, but likely have moderate beneficial effects for HRR trips.

Launch and Takeout Congestion. Similar to ***Modified*** Alternative 4, this alternative has the highest maximum number of boats, trips, and people launching per day. This is a moderate to major adverse impact to visitor experience for trips utilizing the Diamond Creek area.

Takeout conditions at South Cove would also be affected by the increased launches having minor adverse impacts due to the size of the facility and timing of landings.

Group Size. Compared to current, the HRR day trip group size would have minor to moderate beneficial impacts to visitor experience. The smaller, 20-person HRR overnight trip would have moderate beneficial impacts on visitor experience.

Trip Length. Under this alternative, the maximum trip length is ***3 nights (***4 days) in peak months, and ***5 nights (***6 days) in non-peak months. These limits are similar to the current average trip length for peak season, but less for non-peak months. This limitation may have minor adverse impacts on visitor experience, particularly during non-peak months for visitors seeking a longer Lower Gorge trip. The jetboat restrictions at RM 273 may offset some of these impacts because commercial river trips utilizing jetboat passenger transport would have to lengthen their trips in the Lower Gorge. These restrictions would require trips to be at least one day longer in the Lower Gorge and would likely have minor beneficial impacts for visitors on those trips.

Nonmotorized Opportunities. Year-round HRR day and overnight motorized trips would continue under this alternative. Motorized trips continuing into the Lower Gorge would be restricted to the mixed use season in the upper canyon. The increased daily pontoon tours would result in major adverse impacts for visitors seeking nonmotorized opportunities. Visitors on kayak trips from RM 273, would experience river traffic exiting the canyon and trips originating on the lake. Although this is a nonmotorized activity and provides an alternative use in this area, the opportunity to experience nonmotorized periods may be limited to non-peak, low use periods.

Quartermaster Area Development and Activity. Under Alternative 5, pontoon boat activity is increased to 960 passengers per day, and upriver travel from Lake Mead would be allowed in this area.

Pontoon Boat Activity—Up to 6 pontoon boats may be operating at one time. The number of passengers would increase from the current daily average of 188 to a maximum of 960. The number of tours and people on the river in this section would have major adverse impacts on river visitors. For visitors seeking the opportunity to participate in a short, scenic river tour, the impacts of this alternative would have would have minor to moderate beneficial effects.

Helicopter Activity—The helicopter activity associated with pontoon tours would increase overall and have a major adverse impact on river runners.

Facilities—Under this alternative all existing facilities (helipads, ramadas and toilets) ***on tribal land*** would remain. There would be a dock facility for HRR trips and pontoon boats. The dock would be sized to ***safely*** allow mooring of seven pontoon boats and two HRR rafts while unloading and loading passengers. The presence of a dock and facilities would have minor to moderate beneficial impacts to HRR and pontoon tour passengers. The larger dock may have minor to major adverse effects for other river visitors.

4.4.6.9.2 Mitigation of Effects

Previous mitigation efforts indicate that specific measures can be effective in reducing impacts to visitor use and experience, if adequate funding, staffing, monitoring, and implementation of the measures are maintained. In addition to those described for other Lower Gorge Alternatives, mitigation measures not already incorporated into Alternative 5 that are judged likely to reduce impacts to visitor use and experience in the Lower Gorge include:

- Restrictions on the number of trips at attractions sites at one time, and/or scheduling for trips at attraction sites
- Restrictions on hours of operation for pontoon tours to enable other visitors to travel through the area during reduced levels of use.

4.4.6.9.3 Cumulative Effects

Continued sediment depletion from the operation of Glen Canyon Dam and vegetation encroachment would continue to diminish campsite capacities and availability. These conditions are exacerbated in the Lower Gorge due to lower Lake Mead levels. Visitors would continue to experience the erosion of beaches and campsites, and campsite density would continue to decline, creating competition and crowding problems. The operation of Glen Canyon Dam would continue to have localized to regional, adverse long-term, moderate to major impacts on aspects of visitor experiences dependent on beaches for campsites and off-river activities. Additional impacts from the helicopter tours conducted on Hualapai tribal lands would have localized, adverse, short-term, ***moderate to*** major impacts for river users in the Lower Gorge.

Although the cumulative effects of dam operations and vegetation encroachment would continue to diminish campsite size and availability, the mitigating actions of this alternative would offset visitor crowding. However, the cumulative effects of helicopter tours on Hualapai tribal lands would continue to exacerbate noise disturbances on visitors' experiences. Cumulative impacts would be localized to regional, adverse, short- to long-term, and moderate to major, especially for those seeking a wilderness experience in the Lower Gorge.

4.4.6.9.4 Conclusion

Under Alternative 5, the reduced group size to 40 has short- to long-term minor to moderate beneficial impacts. This alternative allows the highest number of daily launches, increasing river and attraction site encounters. The effects are short-term and have moderate to major adverse impacts from river and attraction site encounters when the maximum number ***of*** trips and passengers launch daily. The level and patterns of motorized jetboat and powerboat use have a moderate to major long-term beneficial impact to visitors seeking nonmotorized opportunities, however the level of pontoon use in the Quartermaster area would have major short-term adverse impacts for those same visitors. The level of pontoon use would otherwise expand opportunities for visitors seeking short, scenic trips. The designation of three HRR campsites would have moderate, long-term beneficial impacts, reducing campsite competition for visitors on HRR trips. The number of camps available to other trips remains the same, with moderate, short-term adverse impacts to those river trips. A docking facility sized to accommodate the maximum number of pontoon boats and for HRR passenger loading and unloading would have moderate beneficial impacts to HRR and pontoon passengers. The placement of a facility in the river corridor would have minor to major long-term, adverse impacts to other river visitors, depending on visitors' perspectives. For river runners, this alternative would provide a range of localized to regional, adverse, short- to long-term, minor to major impacts. For visitors seeking a variety of river trip opportunities and activities in the Lower Gorge, this alternative would provide a range of localized to regional, beneficial, short- to long-term, minor to major impacts. Although the cumulative effects of dam operations and vegetation encroachment would continue to diminish campsite size and availability, the mitigating actions of this alternative would offset visitor crowding. However, the cumulative effects of helicopter tours on Hualapai tribal lands would continue to exacerbate noise disturbances on visitors' experiences. Cumulative impacts would be localized to regional, adverse, short- to long-term, and moderate to major, especially for those seeking a wilderness experience in the Lower Gorge.

4.4.7 APPROACH TO ALLOCATION OPTIONS IMPACT ANALYSIS—COMMON TO ALL ALTERNATIVES

4.4.7.1 SPLIT ALLOCATION APPROACH (NO ACTION) OPTION—PREFERRED OPTION

The current approach to allocation is the split allocation system ***in which recreational river use in Grand Canyon would continue to be allocated between the commercial and noncommercial sectors in a set ratio (albeit a different ratio than is currently set) that will remain the same for the life of the plan.*** As described in Chapter 2, recreational river use in Grand Canyon is allocated between the commercial and noncommercial sectors in a set ratio that has remained the same through the life of the current *Colorado River Management Plan* (NPS 1989). Based on public comments, the NPS appears inflexible and unresponsive to changes in demand between user groups under the current allocation approach.

Beneficial Impacts and Advantages. The appeal of a split allocation system is that within the life of the river management plan, each sector knows it can count on a specific allocation and plan (and invest) accordingly. Because the current allocation system has been in effect for 15 years, commercial companies can rely on their allocations remaining the same, which serves to ensure that the quality of services they offer can be maintained at a high level. For example, they can invest in their guides to provide consistent, quality services to their clients. Guides can be hired on a fairly permanent basis, resulting in seasoned guides who know the river and the resources well. Also, there are clear, long-term benefits in commercial companies investing in their guides to receive special training and certification. Because of this investment in training their guides, commercial companies can rely on them to ensure safety to their passengers, share their knowledge of the river and its resources, and provide well rehearsed, consistent, quality visitor service to their passengers on commercial river trips. Another benefit of the current split allocation system is that companies can invest in equipment (e.g., boats, etc.) and feel some assurance that this equipment will be paid for through steady, dependable future business based on a set allocation ratio. This knowledge of a set ratio also serves to keep company costs down, since it is typically less expensive to ensure a high level of quality when future use is relatively certain. ***Finally, continuing with a split allocation system would make requiring an all-user registration system unnecessary and therefore help avoid all the related complexities to both the user and the NPS.***

Adverse Impacts and Disadvantages. The drawback of a split allocation system lies precisely in determining the appropriate allocations for the various sectors. If a significant number of people affected by the split allocation feel their proportion of the allocation is unfairly disproportional to their demand, then they would feel the allocation system isn't fair and doesn't work. This is indeed what the NPS heard from the public during 2002 public scoping. ***Commercial users generally believe their allocation is either appropriate, somewhat below where it should be, or slightly higher than it needs to be. On the other hand, n***oncommercial groups generally believe their proportion of the overall allocation is unfairly small and point to the waitlist as "proof" of this. Based on the exponential growth of the waitlist, demand undeniably exceeds supply (see the "Permit System Options Analysis" for information about the current waitlist). But, even if the noncommercial allocation in the 1989 *Colorado River Management Plan* had been doubled for the life of the plan, it is likely that the waitlist still would have grown and possibly even faster. Since there is no comparable system for people wanting to go on commercial trips, the waitlist does not give a clear indication of relative demand. Social scientists have speculated that it would cost Grand Canyon National Park around $2.5 million to conduct a demand study to adequately determine demand and the results would still not be absolutely definitive (Shelby and Whitaker 2004).

4.4.7.2 Common Pool Allocation Approach Option

Under the common pool approach to allocation, people interested in either commercial or noncommercial trips would apply for launches through the NPS permit system (see the "Permit System Options Analysis"). Everyone would have to apply through the same system and everyone would have an equal chance of getting a permit to take a river trip of their choice. The NPS would be completely responsive to changes in demand between user groups. For example, if in one year 90% of applicants choose to go on commercial trips, approximately 90% of that year's allocation would go towards commercial companies to accommodate that year's demand. There would be no assurance what the allocation would be for either sector, since demand would dictate allocation.

Beneficial Impacts and Advantages. The appeal of a common pool approach is that it would avoid the potential perceptions of allocation inequities between commercial and noncommercial sectors and ultimately ensure relative use levels that adjust automatically relative to sector demand levels.

Adverse Impacts and Disadvantages. The disadvantage of a common pool allocation is that commercial companies may not be able to plan far enough ahead to properly invest in their guides and necessary equipment. They would have difficulty predicting how large a staff to employ, estimating how long to keep seasonal staff on the payroll, determining a reasonable level of guide training, and estimating equipment needs. This could result in guides being hired on a more temporary or seasonal basis, less special training for these guides, a lowered quality of visitor services provided to visitors, less knowledge sharing by guides to passengers, and possibly less safety for passengers. An additional drawback to the common pool approach may be major economic impacts to commercial companies and their guides.

In other river areas, the common pool allocation approach has become bogged down or overturned, as frustrated company owners have resorted to related lawsuits.

4.4.7.3 Adjustable Split Allocation Approach

Under the adjustable split allocation approach, allocations would be initially set for each sector as in the split allocation system, and future adjustments would be made to the allocations to reflect measured demand. A single registration system would be implemented to enable the NPS to record interest in various types of trips and services. Those seeking commercial trips would then be instructed to contact the commercial company of their choice directly, and those seeking to participate in noncommercial trips would be seamlessly passed through to the noncommercial permit system. Information obtained through this system would be used by the NPS to make demand-responsive transfers between commercial and noncommercial sector allocations.

Beneficial Impacts and Advantages. The appeal of the adjustable split approach to allocation is that the NPS would be able to adapt and respond to changes in demand between user groups within the life of the plan. This approach would offer more security for user-groups than a common pool approach. Commercial companies would be able to anticipate no greater changes to their current allocations that two launches per calendar month. The assurance would allow them to confidently invest in their guides, equipment, and quality services, as future use would be relatively certain.

Adverse Impacts and Disadvantages. The potential ***disadvantage*** of this approach ***is it requires implementing an all-user registration system, which*** has never been tested on another river. This by itself may create fear of the unknown for members of both commercial and noncommercial sectors. In order to mitigate the potential adverse impacts from demand-responsive adjustments between commercial and noncommercial sector allocations, the following safeguards would be imposed:

- The maximum potential transfers between commercial and noncommercial sectors would be limited to two launches per calendar month.
- A sector's allocation would only be eligible for a demand-responsive transfer if its allocation during that calendar month was greater than 40% of total launches (e.g., a sector's allocation could not be reduced below 40% of the combined commercial plus noncommercial launches).
- Demand-responsive adjustments would go into effect two years after the system dictated that an adjustment was warranted. In other words, if demand was measured to be unequal in 2006, then allocations could be adjusted for 2008.

This incremental adjustment in allocation, combined with overall safeguards to long-term trip allocation, would provide a level of security to both sectors, while providing responsiveness to changes in demand. The allocation uncertainty resulting from these adjustments would not be prohibitive to commercial entities serving either sector. Demand fluctuations within the national recreation industry are typically far greater than they would be under this system.

Commercial contracts would be written to ensure that companies retained a reasonable opportunity to realize a profit without unreasonable risk regarding future sales (e.g., graduated franchise fee schedules, etc.). Appropriate limits on trip lengths and group sizes would be established for "switched trips" to ensure that resource and social carrying capacity guidelines would continue to be met. For example, if a trip that used to run as commercial is switched to noncommercial, that trip might retain the shorter trip maximum trip length requirement. Or, if a trip which is used to run as noncommercial is switched to commercial, that trip might retain the maximum group size limit of 16.

4.4.7.4 NPS Preferred Allocation Option

Option A (the current No Action/Split Allocation System) is the NPS preferred option. Split allocations in which recreational river use in Grand Canyon would continue to be allocated between the commercial and noncommercial sectors in a set ratio (albeit a different ratio than is currently set) that will remain the same for the life of the plan. This type of allocation system offers many advantages: it offers the greatest planning stability for applicants and

management, all user-registration systems do not need to be implemented as would be the case in Option C, and it is understood, since split allocations are currently being used. Complexities from adopting adjustable-split or common pool systems can be avoided.

Profitability for concessions operations is not discussed here because it is implicit that in the implementation of any system the Park Service is required to ensure that concessions operations retain a reasonable opportunity to make a profit.

How well each option would meet objectives is summarized in Table 4-37.

TABLE 4- 37: ***HOW ALLOCATION OPTIONS MEET OBJECTIVES***

Does Option Meet Objective?	*Split Allocation*	*Common Pool*	*Adjustable Split*
Avoid unnecessary complexity for applicants.	*Yes*	*No*	*No*
Help address user perception of allocation inequity.	*No*	*Yes*	*Yes*
Maintain or improve quality of commercial services offered to river users.	*Yes*	*No*	*Yes*
Seek to keep costs to river users as low as possible while adequately funding river operation.	*Yes*	*No*	*Yes*

4.4.8 PERMIT SYSTEM OPTIONS ANALYSIS—INDEPENDENT OF ALL ALTERNATIVES

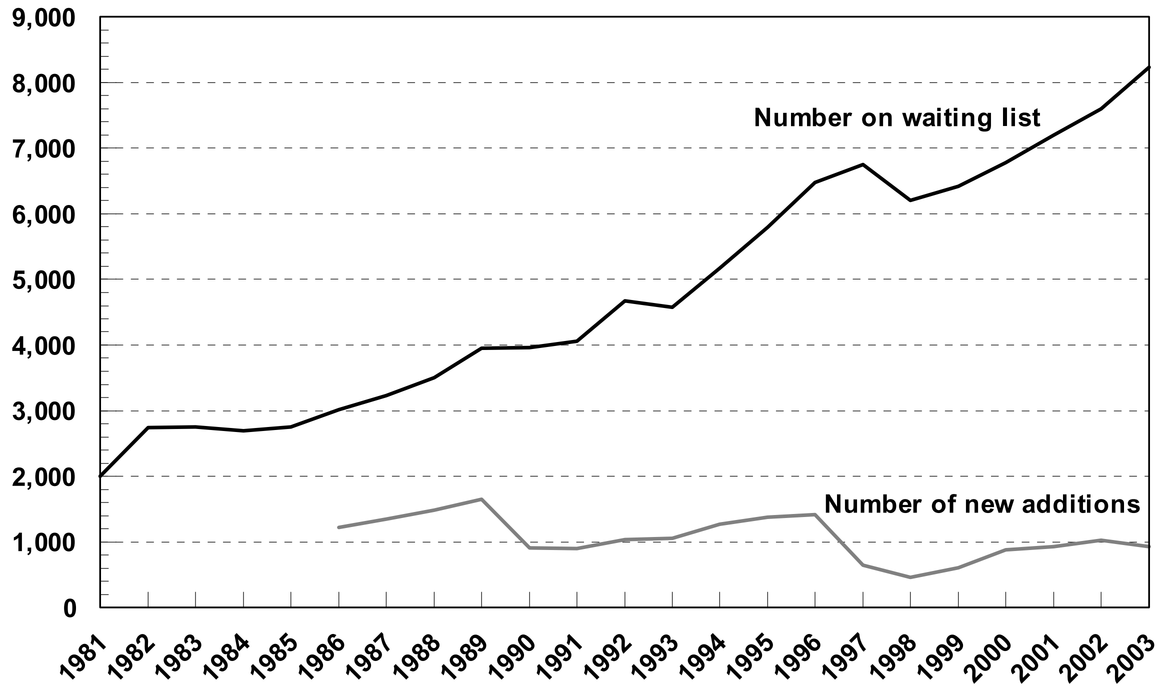
4.4.8.1 BRIEF HISTORY OF THE GRAND CANYON RIVER PERMIT SYSTEM WAITLIST

Limits for Grand Canyon noncommercial river trips were first implemented in 1973 with a first-come/first-served permit system for trips launching from Lees Ferry. Included was a “no-repeat” rule allowing noncommercial boaters to take no more than one trip every two years. By 1975 demand was increasing, leading to the introduction of a lottery in the summer of 1976. Finally, in 1979 the current waitlist + scheduling system were implemented.

Since it was implemented, the noncommercial waitlist has grown immensely (see Figure 4-4). Each year around 1,000 people were joining the list with close to 260 receiving permits and another 200 dropping off the list for various reasons. Taken together, these trends suggest that the waiting list would have continued to grow by over 500 per year, with wait times for those newly joining the waitlist likely to exceed two decades.

Public comments gathered through the current planning process indicated almost universal dissatisfaction with the waitlist system and resultant wait times. As a result, the NPS recognized the likelihood that a different permit distribution system could be selected, and much attention was given to the problems and challenges of transitioning between systems. Recognizing that adding additional names to the waitlist at this time could only make transitioning between systems harder, if the fall of 2003 the NPS placed a temporary moratorium on allowing new additions to the waitlist pending the outcome of this planning process.

FIGURE 4-4: NONCOMMERCIAL WAITING LIST—NUMBER LISTED AND NEW ADDITIONS



4.4.8.2 NO-ACTION OPTION: WAITLIST FOR TRIP LEADERS (CURRENT CONDITION)

The current noncommercial permit system for Lees Ferry to Diamond Creek river trips utilizes a waitlist to distribute permits. Requirements for joining the list, waitlist numbers, maintaining ones place on the list, scheduling launches, and other statistics are outlined in the following paragraphs.

Joining the Waitlist. Individuals wishing to get on the waitlist are required to complete an application (available from the Grand Canyon River Permits Office) and return it to the River Permits Office during the month of February with payment of a $100 new addition fee. People are added to the list in the general order of which their application was received. There are no age restriction for getting on the waitlist; however trip leaders have to be 18 years old by the date of the launch. Individuals may hold no more than one place on the list. In the fall of 2003 a temporary moratorium was placed on new additions to the waitlist pending the outcome of the current planning process.

Waitlist Numbers. Numbers are calculated and distributed each year to people on the waitlist. These numbers represent each individual's relative place on the list. The person on the list the longest is issued first, and the last new addition from the month of February is given the last number. Typically individuals would need a number between 1 and 500 before they would be contacted for participation in the initial scheduling process.

Maintaining One's Place on the Waitlist. Every year in October, all people with numbers higher than 300 are sent a "Continuing Interest" (CI) form. People who want to remain on the list must complete and return a signed copy of this form before January 31 the following year. All people on the list are required to submit a CI form every year whether or not they hear from the River Permits Office. Participants who fail to return a CI form at least 3 of every four years would be removed from the list (of the average 187 people who drop off the list each ear, 35% are in this category). Once on the waitlist, a person can join only one other noncommercial river trip while they are waiting to schedule their own trip. If they participate in a second noncommercial trip, they are removed from the list. After their participation in the first trip, the River Permits Office sends them a letter reminding them of the regulation. If they choose to take a second noncommercial trip, a letter informs them of their removal (and includes an application to re-apply at the end of the list). There is currently no restriction on how many commercial trips someone may participate in while they are on the waitlist. If someone is not on the waitlist, there is no limit on the number of noncommercial trips they may join.

Based on past trends, an average of 42% of those who join the list would drop off or be removed from the list before obtaining and launching their own trip:

- 35% miss two continuing interest deadlines in a four-year period
- 34% participant in two other noncommercial river trips
- 22% get to schedule a launch but then cancel
- 3% do not return the initial scheduling form
- 2% die before they get the chance to go
- 1% become an alternate trip leader on another trip
- The remaining 6% remove their names voluntarily without giving reasons

Each year about 260 launches are scheduled among people on the waiting list and nearly 200 leave the list for various other reasons. If these rates were sustained, it would take nearly 20+ years for an applicant currently at the end of the list to get a launch.

Scheduling Launches. Every year in October, the River Permits Office contacts the top 300 people on the list for Initial Scheduling. In recent years, many people have chosen to stay on the list but defer scheduling, so that NPS has begun contacting more than the first 300 for Initial Scheduling. Applicants are asked to choose launch dates up to two years into the future via a “Launch Date Preference Form.” Applicants can show preferences for as many dates as they wish, or stay on the list and delay scheduling for that year, but they must indicate their decision in writing by December 15. Initial Scheduling is the only time alternative trip leaders may be specified. An alternate trip leader does not have to be on the waiting list, but there are certain restrictions regarding trips released to alternate trip leaders. People who do not receive their choice of launch dates automatically remain on the list. Those who receive launch dates are moved from the waiting list to a list of “Scheduled Permits.” Once given a scheduled launch date, applicants can never be re-instated on the waitlist at their old position, although they may reapply to be placed on the end of the list after their trip has been completed. Except as provided by the alternate trip leader rule, permits are non-transferable, and the trip leader must accompany the trip for its entire length.

In 2001 about 50% of the first 300 people on the list scheduled launch dates, while 43% requested to wait for another year (delayed scheduling). The remaining 7% tried to schedule and were unsuccessful, thus moving back into the list as well. Interestingly, the person who was #1 on the list in 2004 first joined in 1991 (they were #1 in 2003 and 2002, #2, in 2001, and #13 in

2000; this is person has continually delayed scheduling). People who delay initial scheduling can now do so indefinitely (regulations used to prevent this), which allows some people to remain on the list during times when a river trip would be inconvenient in their lives. Dates still available after initial scheduling are released through the cancellation distribution process (see below). Approximately 30% of trip leaders cancel their scheduled launches after initial scheduling, which results in about 60 to 70 launch dates becoming available via the cancellation distribution process each year.

Permit holders with launch dates received during initial scheduling have three options if they cannot make the scheduled date (they are sent a reminder of these options 135 days before the launch):

1. Permit holders can defer (or reschedule) the trip to a new available date. Once a trip has been deferred, the trip leader and new launch date are final and cannot be changed for any reason. Deferment requests must be submitted to the River Permits Office in writing at least 90 days prior to the original launch date. If the trip was never previously deferred or passed to an alternative trip leader, there is the one time option of deferment to a new date exactly three years after the original date. This allows the rebooking to take place before Initial Scheduling for that year and thus avoid overbooking. Medical deferment requests would be considered within 90 days of the launch only if the trip was never deferred or passed to an alternate trip leader, and if the request is accompanied by medical documentation.
2. Permit holders can pass the trip to an alternate trip leader. If the trip has never been deferred, it can be passed to one of the alternate trip leaders listed on the launch date preference form. If no alternative were listed, this is not an option. Once a trip is released to an alternate trip leader, it can never be deferred, and people who have participated in a noncommercial trip within 4 years of the scheduled launch date are prohibited from leading or participating in the trip. This rule is designed to recognize that others may have waited with the original trip leader for this trip. When the leader has to drop out suddenly, they are given a chance to continue as planned as long as they are not a “repeat user” (someone who has been on a private trip within 4 years).
3. Permit holders can exchange launch dates with another permittee. Permit holders can exchange scheduled launches via a written request to the River Permits Office. Privacy regulations prohibit the River Permits Office from supplying any information about other permittees, but the permit holder can use a private website (not affiliated with Grand Canyon National Park) to find other permittees who may be willing to trade launch dates.

Cancellations. ***Launch dates made available as the result of cancellations are handed out through a call in system. Waitlist members are allowed to call-in based on their general place on the waitlist. Launch dates are awarded on a first-call, first-served basis to eligible callers. Those in the tip fifth of the list (currently 1-1500) can call-in on Mondays, then on subsequent days eligibility is increased to include the next group until Friday is reached and all those on the waitlist are eligible to call-in.***

Other Statistics Regarding the Existing Waitlist.

- Waiting times on the list vary widely. The time could be as short as three months (for those who pick up cancellation launches through the secondary distribution system). In the year 2000, about 5% (12) of the noncommercial launches (12) went to people who joined the list in that year. Those who do not try to obtain canceled dates are likely to wait much longer.
- During initial scheduling, about 59% prefer summer launch dates, 11% prefer spring, 27% prefer fall, and 2% prefer winter.
- Based on informal discussion with the River Permits Office staff, people on the list appear to be a diverse group by age, gender, profession, and river skill levels, although systematic information about these variables is not asked or stored.
- Of the people on the waitlist, about 20% are from Colorado, 16% are from California, and 9% are from Arizona. The remaining top 10 states include people from Oregon, Utah, Washington, Idaho, Montana, New Mexico, and Alaska. All 50 states have at least one person on the list, and about 3% are from foreign countries (with about 40% of those from Canada).
- The current distribution system allows "repeat use," oftentimes allowing people who can "work the system" to take multiple trips over the years while others wait for much longer. An analysis by the River Permits Office confirmed this issue with the following statistics:
    - Most noncommercial boaters took only one noncommercial trip in the five year period, with only about 13% being "repeat users."
    - Less than 3% took more than two trips in the five year period. Many people claim to know noncommercial boaters who "run the river every year," which could be true if they know the same people. However, only 60 out of 15,500 people (less than half of one percent) who took noncommercial trips over the five year period averaged one or more trips per year.
    - Only four people averaged more than two trips per year. The record was a person who took 12 trips in the five-year period.
- NPS analysis shows even if the noncommercial allocation of user-days had been doubled over the last 15 years, the waitlist would have grown to over 4,000 names (it would grow at around 250 names per year) even if all the extra people participating in these trips refrained from joining the list after their trips. If an average of one person from each of these additional trips liked the experience so much they joined the waitlist, the list would be about the same as today.

Beneficial Impacts and Advantages. The current waitlist process has some key long-term beneficial impacts. Foremost is its appeal for those on the list, they feel assured they would eventually get to take a Grand Canyon river trip (e.g. they would eventually get to go if they can wait long enough). Those who have reached the top of the list also seem to like the fact that the Initial Scheduling and deferment rules give them considerable control over scheduling their preferred launch date. Many on the waitlist also seem to like the call-in system which allows blocks of waitlist members opportunities to shorten their wait by calling-in and claiming a launch date released through the cancellation line. When first instituted, the waiting list system was generally considered efficient and fair. The wait was only one or two years long for most people, and it assured applicants of a permit and an approximate timeline. Only as demand exceeded the number of permits did the wait become “unreasonable” and difficult to plan for.

Adverse Impacts and Disadvantages. Short- and long-term drawbacks of a waitlist process for trip leaders become more pronounced as the wait within the system increases. In short, many who try are likely never to win. In spring 2003, Grand Canyon’s waitlist had over 8,200 names of hopeful trip leaders and the present *Colorado River Management Plan* allowed approximately 240 to 260 launches to be released for this group each year (around 157 of these can launch within the May through September time period). This means that if someone who wants to lead a May, June, July, August, or September trip joins the waitlist today, they could potentially have to wait over 52 years if everyone ahead of them on the list is also willing only to take any launch date within the May through September time period. The current system has no guarantees that one would eventually reach the top of the list and get to take a Grand Canyon river trip. Much can change in 20 to 50 years, and if random chance patterns continue, a subset of this group either would not be able to wait that long or would not be able to go when they reach their latter years. People change over the years and are not the same as they were 20+ years ago when they first signed up to go on a river trip.

Waitlists also do not provide accurate short- or long-term indications of demand. The length of wait has possibly created a scarcity mentality among trip leaders causing some groups to place multiple people on the waiting list that really only represent one group which wanted to go together. “Redundant” trip members increase the length of the list and make it inefficient. Others who may not be interested in going anytime in the near future (e.g. babies) have joined the list “just in case” they might eventually want to go. Also, since only trip leaders need to be on the waitlist, the NPS has no indication how long other trip members are waiting to take a river trip. All this gives a false sense of how many people are interested in going on a river trip within the year and helps explain why a high percentage of people at the front of the list opt to wait additional years to take a river trip rather than schedule a trip when offered the chance.

The resulting wait times have reached a point where the River Permits Office cannot help most waiting list members within a reasonable timeframe (e.g., a 20 to 50 years is not a reasonable length of time to wait to remain on the list). The waitlist also does not provide key information to the River Permits Office regarding when trip leaders desire or are able to go on river trips. As a result, the NPS cannot use this information to determine true demand for the river. This would continue to have both short- and long-term adverse impacts on the ability of the NPS to assess and address noncommercial visitors’ needs.

This option would also have a long-term adverse impact on commercial users. In a situation where demand greatly exceeds supply, waitlists continue to grow. To many noncommercial users, long waitlists signify that allocation between sectors is inappropriately set. Yet as mentioned earlier, even if the noncommercial allocation had been doubled for the life of the previous *Colorado River Management Plan,* the waitlist still would have increased greatly in size. The result is pressure on the NPS to adjust allocations away from commercial users, which would result in long-term adverse impacts on commercial users.

The incremental growth of the system, with new challenges and issues being addressed by changing rules and added complexities, has created a very ***complex*** system. Each rule change or system nuance was designed to address specific problems, but collectively they appear burdensome to many users and requires substantial administrative effort. These rules are difficult for many to understand, and may create short-term difficulties for groups looking for eligible boaters to participate. If the original trip leader has to cancel and no alternatives are eligible, the entire trip has to cancel. NPS rules on repeat use, add-on fees, continuing interest forms, alternate trip leaders, deferments, and exchanges only apply to noncommercial users on the waitlist, putting an "unequal" burden on them.

Noncommercial passengers not on the waitlist and commercial passengers can take as many trips as they can get on, while waitlist applicants cannot take more than one other noncommercial trip for the length of time they are on the list. The rule was created when the wait was much shorter, but perhaps two trips in 20 years is insufficient for trip leaders to develop and maintain appropriate experience for successful trips. If repeat users can help minimize adverse impacts and substantially improve trips for both for people on the trip and other trips they encounter, a system that discourages those with experience may be counter-productive. These would have both short- and long-term adverse impacts on noncommercial visitors.

The NPS currently schedules noncommercial trips about 1.5 to 2.5 years ahead of launches, which may be too long to fit with most people's vacation planning horizons. About 80% of private boaters report planning less than one year in advance of taking a Grand Canyon river trip (Hall and Shelby 2000), so they are being forced to engage in initial scheduling before they are ready to commit to a trip. This helps explain why many delay initial scheduling, why they want to defer after they have received a launch date, or may have to cancel altogether.

4.4.8.3 Waitlist for Groups Option

Under this option a waitlist would be maintained for groups, where all members of each group would be listed along with the trip leader. Nobody could be listed more than once. Each year those groups who have waited the longest on the current waitlist would be contacted and offered a chance to schedule launch dates. ***Launch dates made available due to cancellations would be distributed the same cancellation system discussed in the no-action permit option***.

Beneficial Impacts and Advantages. This option would be similar to the no-action Option except it would provide short- and long-term opportunities for the NPS to track wait times for all noncommercial users.

Adverse Impacts and Disadvantages. Short- and long-term drawbacks of a waitlist process for groups would be that it would be more ***complex*** than the current system, since everyone who desires a river trip would have to be listed at the time they sign up on the waitlist. This would be impractical for some groups because it is often difficult to know in advance each individual who would be able to take a river trip at the time they join the waitlist, especially if the waitlist and the time groups have to wait to get a river permit is long. This option would also more than double the amount of names on the current waitlist, thus creating a more complex system than currently exists. Also, each year within a specific timeframe, waitlist groups would be expected to verify their "continuing interest" to remain on the list, thus generating ***an unnecessary***

complexity to applicants. Those who failed to meet this requirement twice in any four-year period would be removed from the list. ***Similarly, because wait times would continue to grow and likely outlive the desires of some members, some waitlist members would never succeed in obtaining a permit.***

4.4.8.4 PURE LOTTERY FOR GROUPS OPTION

Under this option each individual would receive an equal chance to obtain a river permit. Pure lotteries are the most commonly used rationing mechanism on multi-day rivers (at least 13 rivers employ pure lotteries to distribute some or all of their permits, including the Yampa and Green Rivers in Dinosaur National Park, the Snake River in Hells Canyon, the Main and Middle Fork Salmon Rivers and the Selway River in Idaho). Most require prospective applicants to compete during the winter for specific dates in the following summer season. Permits are typically awarded to individuals, who can fill the trip with whomever they choose, pay the fees, and take the trip.

Generally, lotteries encourage all the prospective members of a group to apply because more entries create better odds. Groups that improve those odds sometimes organize “permit parties” where every prospective member of the group applies, and applicants strategize about preferable dates. The probabilities of success are not modified by past success or other variables, and users generally re-apply each year. Integrating pure lotteries into the potential Grand Canyon all-user registration system would be straightforward, creating 12 monthly lotteries that would be held one year in advance on the first of the month in which applicants could compete in only one month’s lottery each year.

Launch dates due to cancellations would be awarded as they occur through subsequent runs of the pure lottery.

Beneficial Impacts and Advantages. Lotteries have a long history of use with allocating game permits, and are also the most often-used system for river permits on multi-day river trips. They have withstood some legal challenges and are generally considered a “fair” non-market way to distribute permits. They are also well understood and easy to explain. Pure lotteries give equal consideration to all who apply and minimize the ***complexity for people seeking to obtain a permit***, since groups would not have to maintain their name on the waitlist for 20+ years in the hopes of obtaining a permit. Lotteries put a premium on organizing groups in advance of the application deadlines and strategically choosing dates that a) group want to use, but which are b) less likely to be chosen by other prospective groups. Pure lotteries can also handle a large number of applications and computers can easily randomize the choice of successful applicants, which would probably make them easier and less expensive to administer. This option does an excellent job of retaining the character of a private river trip, allowing people to choose who they really want on their trips. Another major advantage to this option is that it would minimize the time people have to wait to take a Grand Canyon river trip. These would have both short- and long-term beneficial impacts to noncommercial visitors.

Adverse Impacts and Disadvantages. Short- and long-term drawbacks of pure lotteries are many. Foremost, chances are that some people would never win. Pure lotteries do not favor those who have been continually unsuccessful in obtaining a permit. Because they must be held in advance of the launch dates to give time for people to organize trips, lotteries put a premium on advance planning and discourage spontaneous use (by those who can organize a trip on shorter notice). Pure lotteries provide fewer variables that users can control to improve their chances. A study of backpacker and river runner permit system preferences suggests that lotteries and on-site queuing were less preferred than reservations and pricing, presumably because users felt they had more ability to affect their chances with those other systems (Shelby and Colvin 1982).

Odds of success are low in lotteries for high demand rivers like the Selway and Middle Fork Salmon Rivers in Idaho (about 3% of applications are successful). Based on probabilities, a single person applying for a Middle Fork or Selway River permit would only be successful about once every 30 years. Taking the current Grand Canyon river waitlist at face value and using current launch rates, the odds of any single individual obtaining a permit in a pure lottery would be about 3% (260 launches per year/8,000 people on the waitlist).

4.4.8.5 WEIGHTED LOTTERY FOR GROUPS OPTION

With weighted lotteries, probabilities would be altered to favor certain groups or characteristics to better meet “fairness” goals. For example, weighted lotteries for hunting permits often favor residents or those who have been unsuccessful in previous drawings. The logistics of a weighted lottery are similar to a pure lottery, with the exception of the weighted system. Under a weighted lottery system, each launch opportunity would be awarded to a member of the pool of people who had registered their interest in a particular launch date by the drawing deadline. Each applicant would be given one additional chance for each year they had continuously competed in the lottery, but had not been successful. Thus, someone applying for a May launch date who had applied in the lottery for a launch every year for the last five years would be given six chances.

It would be considered a weighted lottery for groups because all trip members listed on the original application before the drawing date would receive a fee discount and would be eligible to be alternate trip leaders should the main applicant not be able to continue the trip as planned. For the lottery drawing, trip members could be listed on only one application. Additional participants could be added later for higher fees, but would not be eligible to be alternate trip leaders. Monthly weighted lotteries would be held one year in advance on the first of the month, and applicants could compete in only one month’s lottery per year.

Launch dates made available due to cancellations would be distributed through the same cancellation system discussed in the no-action Option.

Beneficial Impacts and Advantages. Weighted lotteries also have a long history of use with allocating game permits. They have withstood some legal challenges and are generally considered another “fair” non-market way to distribute permits. They are also well understood and easy to explain. Weighted lotteries minimize the ***complexities for people seeking to obtain a permit,*** since groups would not have to maintain their name on the waitlist for 20+ years in the hopes of obtaining a permit. People would not have quite the incentive to join the list before they’re ready to go; therefore, it would not make much sense to put babies on the list. Weighted lotteries favor those people who have been continually unsuccessful in obtaining a river permit while offering new users a chance, as well. They can also handle a large number of applications and computers can easily randomize the choice of and give a weighted advantage to those who have been continuously unsuccessful in obtaining a permit in the past. This option also does an excellent job of retaining the character of a private river trip, allowing people to choose who they really want on their trips. These would have both short- and long-term beneficial impacts to noncommercial visitors.

Adverse Impacts and Disadvantages. While chances of winning improve for those who are continually unsuccessful, because demand would continue to immensely exceed supply, some would never succeed in obtaining a permit. This would have a long-term adverse impact to noncommercial visitors.

4.4.8.6 POINTS-BASED AUCTION FOR GROUPS OPTION

The concept of a “points-based auction” is that people would be able to earn “waiting points” for the length of time they are registered, and the points become a “currency” that is used to “bid” for permits in monthly “auctions.” Groups that have more people with more time on the list would out-compete smaller groups with less time on the waitlist. Waiting points would be earned by individuals for each year on the registration list, but applications for permits would be made by groups (a roster of trip participants could not exceed group size limits). Members of a group would pool their collective waiting points to compete for a permit. Bidding would take place each month for all dates in the same month one year later. The group with the highest collective number of waiting points at the close of the bidding period would be awarded the permit.

Launch dates made available from cancellations would be distributed through either a call-in system like that used in the no-action Option or through a subsequent point-based auction.

Beneficial Impacts and Advantages. One short-term key benefit of points-based auction systems is the straightforward transition from the current waiting list to a points-based system, although if considerable numbers of waitlist people do not agree to convert their position into points, the system would not have the expected “list-clearing” effect it’s intended to. This option would provide incentives for people to get off the waitlist. In the short- and long-term, this option would favor users who could network better (those who can organize others who have been waiting a long time) and those who have been on the waitlist longer.

Adverse Impacts and Disadvantages. A points-based auction system puts a premium on forming groups with other people who have been waiting a long time, which may in the short- and long-term affect the composition of noncommercial parties, shifting away from groups of friends and acquaintances to groups put together based on “wait points.” Private websites are likely to develop to facilitate these group-forming efforts, which could create a category of “noncommercial tour trips” consisting of people who do not know each other very well (although this may already be happening to some degree), which could affect trip dynamics. Point-based auctions also tend to increase group sizes to the maximum, since groups with more people would accrue more points. This option would also have short- and long-term adverse impacts to those who had not joined the waitlist and penalize groups who had only one person on the list. A points-based auction system integrated with an all-user registration program would be complex and add to the ***unnecessary complexity for people seeking to obtain a permit***, since it would require information about those registered by unsuccessful. While electronic database programs can handle this complexity, this option would not be simple or inexpensive to administer.

4.4.8.7 "HYBRID" WEIGHTED LOTTERY– MODIFIED PREFERRED OPTION

The hybrid weighted lottery option is a combination of several elements of the permit system options listed above and responds to the public's suggestions during public scoping. Once each year, a lottery would be used to award the following year's noncommercial launches. Lottery applications would list the applicant and all potential alternate trip leaders ("potential leaders") and could include up to five launch dates throughout the year for initial consideration. Each applicant's chance in that year's lottery would vary depending on the minimum number of years it would have been since any potential leader had won through the lottery or participated in any part of a Lees Ferry to Diamond Creek river trip. For example, based on the most recent time any potential leader had been on a commercial or noncommercial river trip, the application would receive the following number of chances in the lottery to obtain a river permit:

5 or more calendar years before launch date	***=***	***5 chances***
4 calendar years before launch date	***=***	***4 chances***
3 calendar years before launch date	***=***	***3 chances***
2 calendar years before launch date	***=***	***2 chances***
1 calendar year before launch date	***=***	***1 chance***

Individuals could be listed as potential leaders on only 1 application per year and must be 18 years old by the requested launch date. Once a river permit had been awarded, deposits would be charged immediately and would become nonrefundable. Deferments and/or swapping of permits would not be allowed. Trips could be passed to any of the potential leaders listed on the lottery application, and trip leaders would continue to have the freedom to change their list of participants up to within three weeks of launch.

As any unclaimed or cancelled permits become available, they would be awarded through subsequent lottery drawings. Thus, applications could include more than the five launch dates initially considered. Applicants would be prompted to indicate on their applications the latest date they would be willing to accept a specific launch date should it become available due to cancellations. For example, an applicant would be asked on their application if they would be willing to accept a river trip if it suddenly became available 10 days before the launch is scheduled.

Permits that continue to be unclaimed through the lottery 30 days before the launch would be posted on the internet and awarded on a first-apply, first serve basis.

Beneficial Impacts and Advantages: ***One key advantage of the hybrid weighted lottery is it encourages individuals to apply only for those launch dates when they are genuinely interested in taking a river trip. Another advantage is that it favors those who have been unsuccessful in obtaining a permit in recent years.***

Adverse Impacts and Disadvantages: ***One key disadvantage of the hybrid weighted lottery is that some may try but never succeed in obtaining a permit because launch dates are awarded based on random chance.***

4.4.8.7.1 NPS Preferred Option for Permit System

The NPS modified preferred option for the permit system is the hybrid weighted lottery. This option offers the advantage of favoring those who have been unsuccessful in obtaining a permit in previous years and encourages individuals to apply only for launches when they are genuinely interested in taking a river trip.

Table 4-38 shows how well the options would achieve objectives for the project.

TABLE 4- 38*: HOW PERMIT SYSTEM OPTIONS WOULD ACHIEVE PROJECT OBJECTIVES*

	Does Option Meet Objective?					
Objective	**Waitlist for Trip Leaders**	**Waitlist for Groups**	**Pure Lottery for Groups**	**Weighted Lottery for Groups**	**Point-Based Auctions for Groups**	**"Hybrid" Weighted Lottery for Trip Leaders**
Offer opportunities for new noncommercial users to succeed in obtaining a permit	**No**	**No**	**Yes**	**Yes**	**No**	**Yes**
Favor requests from those who have been unsuccessful in previous years	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**
Minimize complexity of application process for applicants	**No**	**No**	**Yes**	**Yes**	**No**	**Yes**
Preserve the group character of noncommercial trips (those who want to travel together in a group)	**Yes**	**Yes**	**Yes**	**Yes**	**Somewhat**	**Yes**
Encourage people to apply for launches in years when they are really interested in going	**No**	**No**	**Yes**	**No**	**Somewhat**	**Yes**

4.4.9 TRANSITION OPTIONS ANALYSIS

4.4.9.1 NO ACTION OPTION—NEW PERMIT SYSTEM AUGMENTS FROZEN WAITLIST SYSTEM (CURRENT CONDITION)

Under the No Action Option, waitlist members would continue to be allocated 240 launches per year at roughly the same launch pattern that currently occurs until the waitlist is exhausted. All other launches would be awarded through the new permit system selected in the Initial Distribution of Permit section, as described above. This alternative would not allow people to participate in both permit systems.

Beneficial Impacts and Advantages. In the short-term, this option would be easy to implement, since those on the existing waitlist could retain their places on the list. The NPS would not need to take any complex, controversial, or highly expensive steps to clear the waitlist.

Adverse Impacts and Disadvantages. This option would delay the benefits derived through the new permit system, adding long-term complexity, ***and potential confusion for people seeking to obtain a permit.***.

4.4.9.2 Encourage People to Leave Current Waitlist and Reduce Waitlist Allocation Option

Under this option, existing waitlist members would be given 2 options. The could either 1) remain on the waitlist and accept rule changes, or 2) accept payment in the form of an incentive to voluntarily give up their place on the waitlist.

Rule changes for waitlist members would include the following:

1. ***Waitlist members would have to list everyone else from their group at this time. Before anyone of these could apply through the new permit system, they would be required to give up their place on the waitlist member's trip. Further additions to trips would not be allowed.***
2. As waitlist members transition off the list (through incentives, etc.), that proportion of permits would no longer be available to waitlist participants. For example, if 40% of the people on the existing, frozen waitlist take incentives and leave the waitlist, then 40% of the existing allocation would be transferred to the new permit system.
3. Waitlist members would be allowed to band together as new single entries on the list and would be moved forward to the equivalent location on the list as their combined wait dictates. For example, if a waitlist member has been on the list 5 years and another waitlist member has been on the list 9 years, their combined wait would be 14 years. They would then have to give up both their previous waitlist numbers and receive one waitlist number ahead of all those who have waited only 13 years or less. In addition, each person who gives up their waitlist number to "band together" with others from the waitlist would be exempted from being charged their portion of the permit fee.

Incentive options to encourage waitlist members to leave the current waitlist could include the following pending legal review:

1. Receiving $250 in transferable "backcountry credit" for use anytime within the next 5 years in exchange for your name being removed from the list. This "backcountry credit" can be used toward river or backcountry use permits at Grand Canyon National Park.
2. Accepting a refund of $150 in exchange for their name being removed from the waitlist.
3. Accepting $150 in transferable "backcountry credit" for use anytime within the next 5 years plus a free single weighted chance in the new permit system in exchange for their name being removed from the list.
4. Accepting a refund of $75 plus one free single weighted chance in the new permit system in exchange for their name being removed from the waitlist.
5. Accepting one free weighted chance in the new permit system lottery for each year they've been on the current waitlist in exchange for their name being removed from the waitlist. Each person from the waitlist who accepted this offer would start with extra

chances based on the number of years they've been on the waitlist then, if unsuccessful, in subsequent years they would get additional chances al long as they kept applying for the same month each subsequent year.

Beneficial Impacts and Advantages. Through providing all of the above as choices for waitlist members, there would be a greater chance waitlist members would be content with how they have been treated through the transition process. This could have both short- and long-term beneficial impacts on noncommercial visitors.

Adverse Impacts and Disadvantages. This option would delay the implementation of the new permit system pending people moving off the waitlist. This would have both short- and long-term adverse impacts on noncommercial visitors.

4.4.9.3 SAME AS ENCOURAGE PEOPLE TO LEAVE THE CURRENT WAITLIST AND REDUCE WAITLIST ALLOCATION OPTION, BUT THE WAITLIST WOULD BE ABANDONED IN 5 YEARS OPTION

Under this option, all the above would apply with the exception of the existing, frozen waitlist would be abandoned in 5 years from the date of implementation. At the time the waitlist is abandoned, those people who have not accepted any incentives and remain on the list would be given full refunds.

Beneficial Impacts and Advantages. Similarly, but only for 5 years, this option would also provide a greater chance waitlist members would be content with how they are being treated through the transition process. This would have a short-term beneficial impact on noncommercial visitors.

Adverse Impacts and Disadvantages. This option would delay and reduce the full implementation of this *Colorado River Management Plan,* resulting in both short- and long-term adverse impacts to noncommercial visitors.

4.4.9.4 THREE STAGE EXPEDITED TRANSITION (PREFERRED OPTION)

Under this option, three stages of expedited transition would take place during the first four to six months after the Record of Decision (ROD) is signed.

<u>Stage 1</u> would be first stage of transitioning from the current waitlist to the new permit system. In this stage, members of the waitlist would be given one final two-month chance to schedule launch dates through the existing waitlist. A total of 600 launch dates (from the 2007 through 2011 seasons) would be made available for this purpose. All those people who do not succeed in this stage would then transition to stage 2.

<u>Stage 2</u> would be the modified waitlist stage, in which existing waitlist rules would be changed to allow waitlist members to band together and advance up the list based on their combined waits. For example, if Tom had been on the waitlist for five years and Robin for nine years, their combined wait would be 14 years, so they would receive one number and be ahead of all

those who had waited 13 years or less. After a two-month period, where members would be allowed to join together, 600 additional launch dates (from the 2007 through 2011 seasons) would be made available to those combined waitlist members with the greatest wait totals. All those who had not succeeded in this stage would then move onto stage 3.

<u>Stage 3</u> would be the final transition stage. Everyone would need to give up their old waitlist spot and the existing waitlist would no longer exist. In exchange for individual waitlist members giving up their spots, each waitlist member would have their choice of the following two basic options:

- ***One option would consist of individuals on the waitlist trading their spot on the waitlist for one extra chance, in addition to the total chances they would normally have had, in the new hybrid lottery for each year they had been on the existing waitlist. These extra chances would expire only upon being awarded a trip or through participation in nay other trip (noncommercial or commercial). These extra chances would greatly improve each person's chances in the lottery.***

- ***The other option would be for an individual to accept a refund for the price they paid to join and leave the waitlist.***

This three-stage expedited transition process would transition all members off the waitlist within 6 months. The Park expects the majority of stage 1 launch dates will go to people at the very top of the waitlist. In addition, the Park assumes that an average of 3 people will join together to claim each stage 2 launch. Together this would allow 33% (2,400 people) to have gained a launch date through this point in the transition. The 10-year chances for the remaining 4,300 former waitlist members could be calculated as follows: If all 4,300 apply each year and are part of an assumed 7,000 total lottery applications received each year, the Park predicts that over half of these people will have received a launch date within ten years. The Park also predicts that in twenty years, no more than 561 of these people will continue to have been unsuccessful in obtaining a launch date. Therefore, this three-stage expedited transition process, coupled with the new permit system, should result in a much improved success rate for the majority of those who are currently on the waitlist.

Beneficial Impacts and Advantages. ***This option would expedite the transition to the new permit system. It would immediately benefit approximately 33% of waitlist members with launch dates and should result in the majority of the rest obtaining launches within ten years. This would have a short-term beneficial impact for the majority of current waitlist members.***

Adverse Impacts and Disadvantages. ***Since 1,200 launch dates (from the 2007 through 2011 calendar years) would be awarded to people on the waitlist, these dates would not be available to others who were not on the current waitlist. This would result in a short-term adverse impact to these non-waitlist members of the public. However, this impact is minimal considering that these same people would be able to compete for many other launch opportunities in the same time period through the "hybrid" weighted lottery.***

4.4.9.4.1 NPS Preferred Option

The NPS preferred option for the transition system would be the Three Stage Expedited Transition option. This option would expedite the transition to the new permit system, immediately benefit approximately 33% of waitlist members with launch dates, and result in most others to obtain launch dates within 10 years. Table 4-39 illustrates how well each of the options would achieve project objectives.

TABLE 4- 39*: HOW WELL THE TRANSITION SYSTEM WOULD ACHIEVE PROJECT OBJECTIVES*

	Does Option Meet Objective?			
Objective	New Permit System Augments Frozen Waitlist System	Encourage People to Leave Waitlist, and Reduce Waitlist Allocation	Encourage People to Leave Current Waitlist, Reduce Waitlist Allocation, and Abandon List in Five Years	Three Stage Expedited Transition
Expedite transition to the new permit system	No	Somewhat	Somewhat	Yes
Offer opportunities for new noncommercial users to succeed in obtaining a permit	Yes	Yes	Yes	Yes
Ensure those on the waitlist are treated fairly	Yes	Yes	Yes	Yes
Offer ample opportunities for those on the waitlist to succeed in obtaining a permit	Yes	Yes	Yes	Yes

4.5 IMPACTS ON SOCIOECONOMIC CONDITIONS

4.5.1 ISSUES

Changes in river use management regulations for the Colorado River in Grand Canyon National Park could affect the regional and local economy in several ways, including changes in commercial operators' revenue and operating profit and Bar 10 Ranch and Hualapai tribal revenues. These changes could also have impacts on the regional economy and use and trespass implications for portions of the Havasupai and Navajo Reservations.

4.5.2 GUIDING REGULATIONS AND POLICIES

The National Environmental Policy Act requires analysis of social and economic impacts resulting from proposed major federal actions in an environmental impact statement. From this requirement, the NPS has identified conditions that it wants to achieve in association with its management of national parks. These conditions are described in the NPS *Management Policies 2001* (NPS 2000a) and for Grand Canyon National Park. They include the following:

> Public participation in planning and decision-making ensures that the NPS fully understands and considers the public's interest in Grand Canyon National Park, which is part of their national heritage, cultural traditions, and community surroundings. The Service actively seeks out and consults with existing and potential visitors, neighbors, people with traditional cultural ties to the Grand Canyon, scientists and scholars, concessioners, cooperating associations, gateway communities, other partners, and government agencies.
>
> The Service works cooperatively with others to improve the condition of Grand Canyon National Park; to enhance public service; and to integrate the national park into sustainable ecological, cultural, and socioeconomic systems.
>
> In the spirit of partnership, the service seeks opportunities for cooperative management agreements with state or local agencies that would allow for more effective and efficient management of Grand Canyon National Park.
>
> Possible conflicts between alternatives and land use plans, policies, or controls for the area concerned (including those of local and state governments and Indian tribes) and the extent to which the national park would reconcile the conflict are identified in environmental documents.

4.5.3 MANAGEMENT OBJECTIVES FOR SOCIOECONOMIC CONDITIONS

The management objective for socioeconomic conditions as it relates to management of recreational river use in Grand Canyon is to provide a diverse range of recreational opportunities while minimizing the impacts of actions to resources, user groups, and park neighbors.

4.5.4 METHODOLOGY FOR ANALYZING SOCIOECONOMIC EFFECTS

The sources of the data used in the analysis are as follows. For the Lees Ferry alternatives, the model for projecting commercial operators' revenues and gross operating profits is based on individual companies' financial data provided to the NPS on Schedule H at the end of their fiscal year (typically, Dec. 31, 2003). Data on trip prices was compiled by the park's Concessions Management division. For the Lower Gorge alternatives, the NPS relied on financial data provided by the Hualapai Tribe, Bar 10 Ranch for their operations in 2003, and internal ***NPS*** records for the number of takeouts at Diamond Creek.

Analysis of the economic impacts has been performed to evaluate potential effects of the Lees Ferry alternatives on commercial operators, a guest ranch associated with Whitmore helicopter operations, Native American communities, and the regional economy. For the Lower Gorge alternatives, potential effects of the alternatives were evaluated for Hualapai tribal revenue sources.

Environmental consequences of implementing the alternatives were evaluated for each of the subject areas identified above. Assessments of potential economic impacts were based on comparisons between Alternative A (the no-action alternative) and each of the action alternatives. The significance of these impacts was evaluated in relation to the affected environment described in Chapter 3.

The economic impacts to commercial rafting operators have been determined by representing the expected average impact to the operators as a group. The actual specific future impacts to individual operators would depend on their specific circumstances.

The spending impacts of rafters on regional output and employment associated with the Lees Ferry alternatives were estimated using the input-output IMPLAN (Impact Planning) model. The model provides both background economic information and estimates of the cumulative economic effects that result directly and indirectly from an initial spending change.

For the Lower Gorge alternatives, revenue estimates are projected at maximum capacity and are given as ***gross*** revenue. This revenue is projected at the maximum permitted daily rate of use times the number of days in the season or year times the revenue per person for the Hualapai Tribe (after ***some*** commissions and discounts). Impacts to Las Vegas air tour operators were not included in the analysis as they occur outside the analysis area.

The percentage changes shown in the analysis for user-days and passengers are based upon data that can be found in Figures 2-2 to 2-9, and Tables 2-2 and 2-3 with information by trip type. Alternatives B-H are compared with Alternative A (Existing Condition). For example, the percent change from Alternative A to Alternative B would be calculated using the formula ((B-A)/A X 100%).

4.5.4.1 IMPACT THRESHOLDS

The general process for assessing impacts to the environment is discussed in the "Introduction" to Chapter 4. Effects specific to socioeconomic resources are characterized for each alternative based on the impact thresholds presented below. Additionally, each alternative is evaluated to determine whether effects are direct or indirect.

Intensity

Negligible—Impacts would be at the lowest levels of detection and would have no noticeable adverse or beneficial effect. If quantified, they would represent a change of less than 2%.

Minor—Adverse: Impacts would be detectable but would not have any overall adverse effects.

Beneficial: Impacts would be detectable but would not have any overall beneficial effects. If quantified, minor effects would represent a change of between 2% and 10%.

Moderate—Adverse: Impacts would be clearly apparent and adverse.

Beneficial: Impacts would be clearly apparent and beneficial. If quantified, moderate effects would represent a change of between 10% and 20%.

Major—Adverse: Impacts would have substantial adverse effects and could be expected to alter those environments on a long-term basis.

Beneficial: Impacts would have substantial beneficial effects and could be expected to alter those environments on a long-term basis. If quantified, major effects would represent a change of more than 20%.

Context

Localized—Impacts would affect few businesses or localities.

Regional—Impacts would be widespread across the region.

Duration

Short-term—Impacts would last three to five years or less.

Long-term—Impacts would last longer than five years to the life of the plan.

Timing

Impacts from changes in river use are generally seasonal. Lees Ferry seasons are winter (November to February), shoulder seasons (March and April, September and October), and summer (May to August). Lower Gorge seasons are the peak (May to September) and non-peak (October to April).

4.5.4.2 MITIGATION OF IMPACTS

A list of possible mitigation measures to be considered singly or in combination that are not already incorporated into the alternatives, but are judged likely to reduce impacts to socioeconomics if implemented include the following:

- Commercial rafting operators from Lees Ferry to Diamond Creek operate under concessions contracts with the NPS that statutorily require that the operator have a "reasonable opportunity for net profit in relation to capital invested and the obligations of the contract." Thus, changes in operators' revenues and expenses may be mitigated in the concessions contracting process, whereby maximum price rates are set by the NPS, and franchise fees are set according to an in-depth modeling of the required investments and operating costs of the business opportunity.

- Large, one-time costs to operators (e.g., purchases of nonmotor equipment that may be required by an alternative) may be mitigated by extending a phase-in process for the requisite equipment and by considering the depreciated value of the current equipment. Assuming that commercial operators would continue to operate viably, negative impacts, if any, caused by one-time costs are likely to be amortized and therefore negligible for the business community working with this tourism segment.

- Similarly, adverse impacts to Hualapai tribal revenue resulting from reductions in use at Whitmore ***are*** mitigated by the beneficial impacts of Lower Gorge projections.

4.5.4.3 CUMULATIVE IMPACTS

Cumulative socioeconomic impacts were determined by combining the impacts of each alternative with other past, present, and reasonably foreseeable future actions, regardless of what agency or organization undertakes the action. (see Section 4.1.2.6 for a detailed list of all actions).

Glen Canyon Dam has influenced the socioeconomic environment for river runners since its construction in 1961. While recreational river-running saw a steady increase in popularity in the late 1960s and early 1970s, the predictability of flow levels that resulted from operations of the dam contributed to the increase in demand for Grand Canyon river trips by increasing the stability of commercial operations. Consequently, commercial operators were able to better market trips and capitalize on a lowered level of operational uncertainty. Lower flows sometimes result in increased expenditures by concessioners, given the increase in accident-related costs, missed exchanges, and the need for additional equipment, but commercial operators have been able to adjust by modifying operations according to predicted flows. Overall, ongoing operations of Glen Canyon Dam have had a direct, regional, beneficial, long-term, year-round, and moderate to major effect on commercial operations.

The establishment and implementation of management prescriptions for recreational use on the river by Grand Canyon National Park contribute to visitor safety and satisfaction, as well as the protection of the biophysical environment. While these requirements result in capital outlays by commercial operators, they ultimately contribute to the sustainability of river-running operations into the future. Additionally, "Commercial Operating Requirements" add to the value of trips by contributing to the safety and aesthetics of the river environment and to the integrity of its resources. This results in a direct benefit to commercial operators and passengers, as well as noncommercial passengers. It has an indirect benefit on local communities that depend on revenue from commercial operators and businesses that supply all river trips. Overall, "Commercial Operating Requirements" have had a direct and indirect, localized to regional, beneficial, long-term, year-round, and minor to major effect on the socioeconomic environment.

The Hualapai Tribe has indicated that they may increase fees for Whitmore operations and Diamond Creek takeouts. This increase would result in a negligible to minor benefit to tribal income from river-related operations, and in a negligible effect to commercial operators, provided that fees were not raised enough to prohibit marketing of these services. Impacts to river runners (commercial and noncommercial) would be adverse and negligible to minor, depending on the type of trip and the amount of increase. Overall, these operations contribute to the infrastructure of the river-running environment, so unless fees were raised to a prohibitive level, the increase would not diminish the value of the service. Overall, an increase in Hualapai Tribe fees would result in both beneficial and adverse, short- to long-term, localized, minor effects that would be most noticeable in the summer season.

Drought conditions could affect the socioeconomic environment for recreational use of the Colorado River in the Grand Canyon. If conditions resulted in unforeseen adverse effects to resources or river users, changes to river management would be made through an adaptive management process (see Sections 1.7 and 2.3.3).

The combined effects from the operations of Glen Canyon Dam, the implementation of operating requirements, and accessibility and cost of services at Diamond Creek and Whitmore create a favorable socioeconomic environment for commercial operators, their passengers, and localized communities that depend on river-related revenue. To some extent, noncommercial passengers also derive benefit from these effects. Overall these direct and indirect effects are beneficial, localized and regional, short- to long-term, and minor to major; they are most noticeable in the high-use summer season.

4.5.4.4 ASSUMPTIONS

4.5.4.4.1 General

General assumptions used for analysis of effects from each alternative are discussed in Section 4.1 of Chapter 4. Additional assumptions that specifically relate to the *Colorado River Management Plan* alternatives and their socioeconomic effect are presented below.

- The analysis area is the affected populations and area of analysis (or region) as described in Chapter 3.
- Commercial and noncommercial boating in Grand Canyon are separate markets. That is, changes in the supply or demand in one market would not affect the other.

- Demand for river trips, both commercial and noncommercial, would continue to exceed supply. Therefore, there is sufficient unmet demand for additional trip offerings, whether motor or nonmotor, to match an increase in supply.
- As price levels are determined by the NPS, rather than by market equilibrium, these prices are not expected to change as a result of the change in supply.
- ***As discussed in Section 3.5.1.2.12, the contribution of river runners to the Tusayan economy is negligible regardless of the alternative, thus effects to Tusayan will not be detailed in the analysis.***
- Land management agencies and tribes would seek to offset costs through additional user fees. These fees are not anticipated to decrease the demand for commercial or noncommercial river trips beyond supply.
- Socioeconomic effects from trespass onto adjacent Hualapai, Havasupai and Navajo tribal lands are likely to continue, regardless of the alternative. Mitigation of these impacts may be achieved through improved educational efforts with boaters, operators, and guides (implemented by Grand Canyon National Park), and through enhanced permitting by the tribes. This issue is discussed further in the "Adjacent Lands" section of Chapter 4.
- The Grand Canyon air tour industry generates substantial revenues in the Grand Canyon region (over $100 million). Nevertheless, only the air tours that shuttle passengers to and from river trips at Whitmore and Quartermaster are subject to economic effects from river-related recreation. Look-and-leave tours in the Quartermaster area land only on Hualapai tribal land and are operated under the jurisdiction of the tribe. The economic effects of these flights will be addressed as part of the Grand Canyon West operations in the cumulative effects subsection of each Lower Gorge alternative.
- Increases in impacts on natural quiet (i.e., the natural soundscape) in one part of the park must be coupled with a decrease in another part of the park to achieve the substantial restoration goal, per Public Law 100-91. For this reason, increases in river-related flights could affect allowable flights, and thus the opportunity for profit, for air tour operators elsewhere in the park. However, such assessments and management actions are outside the scope and independent of this plan, so they are not further evaluated under cumulative effects of the alternatives.

4.5.4.4.2 Assumptions for the Lees Ferry Alternatives

Regional Impact Analysis. The analysis of regional impacts is based on an analysis of IMPLAN data by Hjerpe and Kim (2003), updated with 2003 river usage data. It uses type SAM multipliers* for total output, employment and labor income for the computation of the total effects (direct, indirect and induced effects) of regional expenditures by both commercial and noncommercial boaters. Because the structure of these economic activities does not fundamentally change among the alternatives, it is assumed that the multipliers remain constant.

* Social Accounting Matrix (SAM) multipliers include the effect of social security transfers, taxes and savings, as well as commuter income spent outside the region.

Since not all of the commercial river runners are based in the region, the total regional economic effects are likely to be slightly overstated.

Noncommercial Boating. The number of days allocated to noncommercial trips increases by more than 28% in each of the alternatives considered. Therefore, the socioeconomic effect on the private boating community, including its associated commercial enterprises, is likely to be beneficial, long-term, and major for all alternatives in comparison to Alternative A (current conditions).

Commercial Boating. The potential for socioeconomic impacts in the commercial boating community is more complex. Therefore, greater emphasis has been required to assess the effect of the alternatives on commercial rafting operators, Bar 10 Ranch, the Hualapai Tribe, and the regional economy.

Three alternatives (C, D and F) include new commercial use during the winter season (November through February) and, for these alternatives, this new use represents 85-96% of the additional user-days allocated. Although demand for commercial trips during this season is unknown, it is assumed that it would be greater than the supply in all three of the alternatives.

Commercial operators would seek to operate efficiently, given the constraints dictated by the alternatives, i.e., they would reconfigure their trips to maximize revenue and meet operating requirements while minimizing operating costs.

Current concession operations are viable under current operating and market conditions. The price of commercial river trips would remain approximately at current levels. Some slight price increases may occur in order to mitigate changes in operating costs and to preserve appropriate opportunity to make a profit. Such changes are not anticipated to decrease the demand for commercial river trips beyond supply.

The average trip lengths for both motor and nonmotor trips remain similar to what they are today, regardless of the number of motor and nonmotor trips offered. Changes to this assumption for alternatives with reduced or no motor use (Alternatives B, C and D) are considered in the impact analysis introduction under the section Major Revenue and Cost Drivers.

Currently, seasonal fluctuations in commercial operations create inefficiencies in staffing, equipment requirements, and other overhead costs; therefore, a less seasonal operation offers operational advantages.

As stated under the Mitigation of Effects section above, there are opportunities to mitigate socioeconomic impacts by adjusting franchise fees and prices. Furthermore, operators are expected to continue to have considerable flexibility and opportunity to reconfigure and adapt their future operations and staffing to maintain their profitability. Given the current demand for rafting employment and the contract hiring of many rafting guides, this assumption seems reasonable.

4.5.4.4.3 Assumptions for the Lower Gorge Alternatives

Two additional assumptions are fundamental to the Lower Gorge analysis:

- The rates for the projected services of the Grand Canyon Resort Corporation of the Hualapai Tribe are computed at best NPS estimates of current (2003) net prices, after commissions and discounts.
- The Grand Canyon Resort Corporation would seek to maximize its revenue by operating these services at their maximum permitted levels. Projected ***gross*** revenue is calculated at the daily maximum permitted use levels over the duration of the entire season or year. These projected figures must be carefully interpreted as estimating the potential for significant long-term growth in such an industry is highly imprecise.

4.5.5 IMPACT ANALYSIS—LEES FERRY ALTERNATIVES

4.5.5.1 ANALYSIS COMMON TO ALL ALTERNATIVES

4.5.5.1.1 Interrelationship of Key Variables

User-days, number of passengers, group size, launches, motor vs. nonmotor, guide-to-client ratio, and trip length are the most important variables in analyzing the economic impacts of the plan alternatives. These variables have a complex inter-relationship in determining resource impacts, revenue, and expenses; change to any one of these variables typically results in changes to the other variables. The alternatives provide different arrangements of these variables. Analysis of these variables is complicated by the number and variation of commercial trips offered and the variation in the types of equipment used. Of these variables, user-days is the most important as it is the most fundamental use constraint for operators. Several examples of the inter-relatedness of these variables follow:

User-Days—If other variables (e.g., trip length, group size, and number of launches) remain constant, decreases in user-days would reduce revenue and profitability.

Trip Length and Number of Passengers—If the number of user-days remains constant, reducing the number of unique passengers by increasing trip length would have a minor impact upon operator revenues. However, such a drop in revenue would be offset by operational cost savings due to decreased labor required to find, serve, and manage customers, and to perform launches.

Number of Launches—If the number of user-days remains constant, decreasing the number of launches implies an increase in trip length, unless an offsetting number of exchanges occur. Launches increase operational costs.

Group Size, Guide-to-Client Ratio—There are economies of scale in rafting operations, whereby operational costs can be decreased by increasing group size. Larger trips generally have a lower guide-to-client ratio, thereby increasing profitability by reducing labor costs. Mandated changes in group size may result in a change in optimal equipment, including van and boat size. Such changes would be short-term in duration, and negligible.

For river use permitting purposes, a passenger is defined as one person for the entire trip through the Upper Gorge. As some trips include passenger exchanges at Phantom Ranch and Whitmore, the number of commercial passengers may be ***more*** than the number of individuals ***at any one time*** on commercial river trips.

4.5.5.1.2 Major Revenue and Cost Drivers

An analysis of the likely effect of each of the alternatives on commercial river runners' revenue shows that changes in user-days are a reasonable proxy for changes in revenue. While the other key variables (number of passengers, number of launches, group size and trip length) have an effect, it is minimal compared to that of user-days. Under each of the alternatives, the changes in expected revenue on a per user-day basis are less than 5% compared to the current situation.

Similarly, the analysis shows that river operation costs are highly variable in nature, and are driven by the number of user-days. This is logical, since fewer user-days require less food, staff time, and other variable costs to be expended. Therefore, user-days can be used as a proxy for gross operating profit (revenue minus direct labor costs). The effect of the other variables, given the current pricing structure, is minor. Under each of the alternatives, the changes in expected gross operating profit on a per user-day basis are less than 5% compared to the current situation.

Research and extensive public comment suggest that trip length is a determining factor in choosing a river trip. Given that average trip length for motor trips is currently between 7 and 8 days, if motors were to be eliminated, the demand for shorter nonmotor trips would be expected to increase (the average nonmotor trip length is currently between 13 and 14 days), as would the number of transfers at Phantom Ranch (and Whitmore). A limiting factor in these transfers is the willingness (and ability) of visitors to hike down into the canyon or up to the rim from the river. Even if one assumes that every motor trip that is eliminated under Alternative B, C and D becomes a nonmotor trip of the same length, our model suggests that the change in commercial river runners' gross operating profit would, in the aggregate, still remain highly correlated to the change in user-days. Therefore, user-days remain a good proxy for gross operating profit.

4.5.5.1.3 Mitigation of Effects through Franchise Fees

Concession franchise fees are determined during the contracting process between commercial operators and the NPS. They are related to the estimated value of the business opportunity to the concessioner, and they must allow a reasonable opportunity for the concessioner to realize a profit, based on the required investments and operating costs of the business opportunity. Concession franchise fees are determined during the contracting process, and they may be higher or lower than a previous contract, based on financial analysis of the current business opportunity. In the case of commercial river-running operations, the adverse economic impacts of some alternatives could be mitigated by charging lower concessions fees, if the analysis determined this was necessary to maintain a reasonable opportunity for profit. Similarly, alternatives with beneficial impacts would allow for higher franchise fees. Thus, a change in operating requirements that would have a significant economic impact would likely result in an offsetting adjustment in the franchise fee.

Franchise fee-based mitigation does not apply to indirect service providers (such as Bar 10 Ranch and Grand Canyon Resort Corporation of the Hualapai Tribe) that do not operate under NPS concession contracts.

4.5.5.2 ALTERNATIVE A (EXISTING CONDITION)

4.5.5.2.1 Analysis

Alternative A describes the existing operations and current conditions. Under this alternative, no new operating restrictions or requirements are proposed associated with the *Colorado River Management Plan* that would affect current river use. That is, user-days would remain capped at current levels, which would result in approximately the same number of total yearly passengers.

Under Alternative A, the No-Action alternative, impacts to commercial river runners' revenue and gross operating profit, and Bar 10 Ranch and Hualapai tribal revenues would be negligible, localized and long-term, with a seasonal emphasis on the higher use summer months of May through August. As the alternative reflects a continuation of current conditions, there would be no impact (beneficial or adverse) to any of the operations mentioned above.

The Hualapai Tribe has proposed a new helicopter fee that would increase fees by $10 per person for approximately 10,300 exchanges per year at Whitmore, but this increase is not part of the NPS alternatives for river rafting and thus is not an impact of this plan.

An analysis by Hjerpe and Kim (2003), based on IMPLAN economic data and updated to 2003 river usage data, estimates that commercial and noncommercial river rafting in the Upper Gorge together generate ***$23.9*** million in regional ***output, approximately $9.1 million in regional income, and supports approximately 402*** jobs (this includes direct, indirect and induced effects using type SAM multipliers). Therefore, river rafting currently makes up less than 1 percent of the regional economy in terms of both output and employment. Changes in river rafting users' projected visitor spending may affect the output of both the region's tourist related sectors (such as retail and lodging businesses) and the regional economy as a whole. Changes in visitor spending may also result in job gains or losses for the regional economy.

Because Alternative A does not change current conditions, socioeconomic impacts from river runner use and spending to tribal lands and the regional economy under this alternative would be negligible, localized and long-term, with a seasonal emphasis on the higher use summer months of May through August.

4.5.5.2.2 Mitigation of Effects

Effects from Alternative A are negligible, so they would not require mitigation.

4.5.5.2.3 Cumulative Effects

Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. The combined effects from the operation of Glen Canyon Dam, the implementation of "Commercial Operating Requirements," and accessibility and cost of services at Diamond Creek and Whitmore create a favorable socioeconomic environment for commercial operators, their passengers, and localized communities that depend on river-related revenue. To some extent, noncommercial passengers also derive benefit from these effects, as well. Overall these direct and indirect effects are localized and regional, beneficial, short- to long-term, and minor to major; they are most noticeable in the high use summer season.

Cumulatively, the effects of Alternative A, when combined with other past, present, and reasonably foreseeable actions, would be localized and regional, beneficial, short- to long-term, and minor to major, which would be most noticeable in the high-use summer season. Alternative A would result in a localized and regional, beneficial, long-term, moderate contribution to these cumulative effects.

4.5.5.2.4 Conclusion

As Alternative A reflects current conditions, the impacts would be negligible. Cumulative effects of Alternative A, when combined with other past, present, and reasonably foreseeable actions, would be localized and regional, beneficial, short- to long-term, seasonal, and minor to major. Alternative A would result in a localized and regional, beneficial, long-term, moderate contribution to these cumulative effects.

4.5.5.3 ALTERNATIVE B

4.5.5.3.1 Analysis

Alternative B is a no-motor, low-use alternative for the Upper Gorge. Under Alternative B, commercial operations would shift to no-motor equipment. Compared with Alternative A, ***commercial motor operations would cease and the number of commercial nonmotor user-days would increase by 152%, yielding a net decline of 14% in*** the total number of commercial user-days. The total number of nonmotor user-days would increase by ***78***%, ***and noncommercial user-days would increase by 28%***. The total number of passengers would decline by ***43***% while the total number of no-motor passengers would increase by ***62***%. The number of launches would follow the same pattern with a decline of ***18***% in the total number and an increase of ***75***% for nonmotor equipment. ***For commercial operations, m***aximum group size would drop from 39 to 25 and maximum trip lengths would decline from 18 to 16 (summer) ***and 21 to 18 (***shoulder seasons). Compared with the other alternatives, Alternative B has the lowest level of use with the smallest number of daily launches, user-days, and total yearly passengers.

The decrease in the total number of ***commercial*** user-days (14%) would result in corresponding projected decreases in commercial river runners' revenue and gross operating profit (revenue minus direct labor costs). In addition, motorized operators would incur significant one-time investments in converting from motorized to nonmotorized equipment. However, these investments are small relative to gross revenue, and they would be readily amortized over the term of the contract. The impact of Alternative B on commercial operators' revenue and gross operating profit is expected to be moderate, adverse, localized and long-term, with a seasonal emphasis on the higher use summer months of May through August (user-days increase in the shoulder season).

Under Alternative B, the passenger exchange at Whitmore would not operate and all Bar 10 Ranch revenue from the exchange would be lost. This represents a major and adverse, localized and long-term impact to Bar 10 Ranch revenue, with a seasonal emphasis on the busier months of May through September. ***There would also be a loss to the helicopter operator.***

Eliminating ***passenger*** exchanges at Whitmore would result in a loss in revenue to the Hualapai Tribe and the net number of takeouts at Diamond Creek is also expected to decline slightly ***due to the decrease in launches and passengers***. Together, the economic impact to Hualapai tribal revenue is estimated to be a gain. The impact to the tribe would be minor and adverse, as it represents between 2% and 10% of its total revenue from river operations. The impacts would be localized and long-term, with a greater impact during the busier months of May through September.

An analysis of regional impacts based on Hjerpe and Kim (2003) indicates that the total (i.e., direct, indirect and induced) effects on the regional economy of Alternative B would amount to a decrease in output of ***nearly $2.2*** million***, a decrease of $0.8 million in income,*** and a loss of ***37*** jobs. These decreases represent a negligible, long-term impact on the regional economy. Small, specialized suppliers and certain specialized communities (e.g., Marble Canyon) might experience greater impacts.

4.5.5.3.2 Mitigation of Effects

Adverse impacts to commercial operators' revenue and gross profit may be mitigated in several ways through the concessions contracting process. Reductions in franchise fees might be one form of mitigation for loss of operators' revenue. Costs of conversion to new equipment (new investment) could be mitigated through a phase-in of nonmotor equipment as the current motor equipment is depreciated or requires replacement or by offering a reduced fee during the initial investment period. Reductions in Bar 10 Ranch revenue may not be mitigated. Alternative B's effects on Hualapai tribal revenue or regional economic spending do not require mitigation as they are minor and negligible, respectively.

4.5.5.3.3 Cumulative Effects

Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. The combined effects from the operation of Glen Canyon Dam, the implementation of "Commercial Operating Requirements," and accessibility and cost of services at Diamond Creek and Whitmore create a favorable socioeconomic environment for commercial operators, their passengers, and localized communities that depend on river-related revenue. To some extent, noncommercial passengers also derive benefit from these effects, as well. Overall these direct and indirect effects are localized and regional, beneficial, short- to long-term, seasonal, and minor to major.

While Alternative B would result in considerable reductions to revenue for several sources, river operations would still generate substantial revenue. Cumulatively, the effects of Alternative B, when combined with other past, present, and reasonably foreseeable actions, would be localized and regional, beneficial, short- to long-term, seasonal, and minor to moderate. Alternative B would result in localized and regional, both beneficial and adverse, long-term, moderate contributions to these cumulative effects.

4.5.5.3.4 Conclusion

Moderate adverse long-term impacts to commercial river-runners' revenue and gross operating profit and major adverse long-term impacts to Bar 10 Ranch revenue are expected from Alternative B. In addition, commercial river runners that currently offer motorized trips would face substantial, one-time conversion costs, which would be readily amortized over the term of the contract. Economic impacts to Hualapai tribal revenues would be minor, adverse and long-term. Impacts on the regional economy would be negligible. Cumulative effects of Alternative B, when combined with other past, present, and reasonably foreseeable actions, would be localized and regional, beneficial, short- to long-term, seasonal, and minor to moderate. Alternative B would result in localized and regional, both beneficial and adverse, long-term, moderate contributions to these cumulative effects.

4.5.5.4 ALTERNATIVE C

4.5.5.4.1 Analysis

Alternative C is a high-use, no-motor alternative for the Upper Gorge. Under Alternative C, commercial operations would shift to no-motor equipment and a winter use season would be opened. Compared with Alternative A, the total number of commercial user-days would increase by up to 48%, while the total number of no-motor user-days would increase by up to ***192***%. The total number of passengers would ***increase*** by an estimated ***12***% while the total number of no-motor passengers would increase by as much as ***216***%. The number of launches would follow the same pattern with an ***increase*** of up to ***22***% in the total number and an increase of up to ***161***% for nonmotor equipment. ***For commercial operations, m***aximum group size would drop from 39 to 30 and maximum trip lengths would decline from 18 to 16 in the summer months and ***a decrease from 21 to 18 days*** in the shoulder season.

The substantial increase in the total number of ***commercial*** user-days (48%) would result in corresponding projected increases in commercial river runners' revenue and gross operating profit (revenue minus direct labor costs). Motorized operators would, however, incur significant one-time investments in converting from motorized to nonmotorized equipment, investments that would be easily amortized over the life of the contract. The impact of Alternative C on commercial operators' revenue and gross operating profit is expected to be major, beneficial, localized and long-term, with a seasonal emphasis on the shoulder and winter seasons.

Alternative C is a no-motor alternative and no helicopter exchanges at Whitmore would be authorized. Hiking exchanges would be limited to 2,500 persons in and 2,500 persons out annually. The effect of these changes would result in a localized, adverse, long-term, major impact to Bar 10 Ranch revenue, with a seasonal emphasis on the busier months of May through September. ***The helicopter operator would also incur losses.***

The elimination of helicopter exchanges at Whitmore would result in a loss of revenue to the Hualapai Tribe. However, the amount derived from the takeouts at Diamond Creek is estimated to increase. Compared with Alternative A, this alternative is projected to produce a decrease in revenue to the Hualapai Tribe. The impact to the tribe would be negligible, as it represents less than 2% of its total revenue from river operations. The impact would be localized and long-term, with a greater impact during the busier months of May through September.

An analysis of regional impacts based on Hjerpe and Kim (2003) indicates that the total (i.e., direct, indirect and induced) effects on the regional economy of Alternative C would amount to a ***region wide*** increase in output of $***12.7*** million***, an increase in income of about $4.9 million,*** and a gain of ***213*** jobs. These increases represent a negligible, long-term impact on the regional economy. Small, specialized suppliers and certain specialized communities (e.g., Marble Canyon) might experience greater impacts.

4.5.5.4.2 Mitigation of Effects

Beneficial impacts to commercial operators' revenue and gross profit do not require mitigation nor do negligible impacts to Hualapai tribal revenue. Costs of conversion to new equipment could be mitigated through a phase-in of nonmotor equipment as the current motor equipment is depreciated or requires replacement. Costs of conversion to new equipment could also be mitigated by extending fee payment over a longer period or through a graduated or reduced franchise fee over the term of the contract. Reductions in Bar 10 Ranch revenue may not be mitigated. The effects of Alternative C on regional economic spending do not require mitigation as they would be negligible.

4.5.5.4.3 Cumulative Effects

Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. The combined effects from the operation of Glen Canyon Dam, the implementation of "Commercial Operating Requirements," and accessibility and cost of services at Diamond Creek and Whitmore create a favorable socioeconomic environment for commercial operators, their passengers, and localized communities that depend on river-related revenue. To some extent, noncommercial passengers also derive benefit from these effects, as well. Overall these direct and indirect effects are localized and regional, beneficial, short- to long-term, seasonal, and minor to major.

While Alternative C would result in considerable reductions to revenue for operations at Whitmore, river operations would still generate substantial revenue. Cumulatively, the effects of Alternative C, when combined with other past, present, and reasonably foreseeable actions, would be localized and regional, beneficial, short- to long-term, seasonal, and minor to major. Alternative C would result in localized and regional, both beneficial and adverse, long-term, moderate contributions to these cumulative effects.

4.5.5.4.4 Conclusion

Major beneficial long-term impacts to commercial river-runners' revenue and gross operating profit and major adverse long-term impacts to Bar 10 Ranch revenue would result from Alternative C. In addition, commercial river runners that currently offer motorized trips would face substantial, one-time conversion costs, which would be readily amortized over the term of the contract. Economic impacts to Hualapai tribal revenues would be negligible. Impacts to the regional economy would be negligible. Cumulative effects of Alternative C, when combined with other past, present, and reasonably foreseeable actions, would be localized and regional, beneficial, short- to long-term, seasonal, and minor to major. Alternative C would result in localized and regional, both beneficial and adverse, long-term, moderate contributions to these cumulative effects.

4.5.5.5 ALTERNATIVE D

4.5.5.5.1 Analysis

Alternative D is an eight-month mixed motor season (summer and winter) and a four-month nonmotor season (spring and fall) alternative for the section of river between Lees Ferry and Diamond Creek. Compared with Alternative A, the total number of commercial user-days would increase by up to 21%, while the total number of no-motor user-days would increase by up to ***58***%. Motor user-days would decline by an estimated ***33***% during the summer and shoulder seasons but, with the added winter season, total motor user-days would experience an estimated 6% reduction. The total number of passengers would decline by as much as ***9***%. The total number of motor passengers would decline by up to 37% and the number of no-motor passengers would increase by as much as ***42***%. The total number of launches would ***increase*** by up to ***13***% with a decline in motor ***launches*** of up to 29% and an increase of up to ***60***% for nonmotor equipment. Maximum group size would decline from 39 to 25 for ***commercial*** nonmotor and 43 to 25 for ***commercial*** motor users. For ***commercial*** motor users, maximum trip lengths would decline from 18 to 10 in the summer and shoulder seasons and from 30 to 18 in the winter. For ***commercial*** nonmotor users, maximum trip lengths would decrease from 18 to 16 in the summer, 21 to 18 in the shoulder, and 30 to 21 ***days*** in the winter***. Maximum trip lengths for nonmotor noncommercial trips in the winter would remain at 30 days.*** Passenger exchanges at Whitmore would be accomplished through hiking and would be limited to 2,500 in and 2,500 out annually.

The increase in the total number of user-days (21%) would result in a corresponding projected increase in commercial river runners’ revenue and gross operating profit (revenue minus direct labor costs). The impact of Alternative D on commercial operators’ revenue and gross operating profit is expected to be major, beneficial, localized and long-term, with a seasonal emphasis on the shoulder and winter seasons.

There would be no helicopter exchanges at Whitmore; hiking exchanges would be limited to 2,500 persons in and 2,500 persons out annually. The impact to Bar 10 Ranch revenue would be major, adverse, localized and long-term, with a seasonal emphasis on the busier months of May through September.

The loss of passenger exchange and helicopter related revenue would result in a loss to the Hualapai Tribe. The number of commercial and noncommercial takeouts at Diamond Creek, however, is projected to increase, producing additional revenue. Compared with Alternative A, total revenues to the tribe are expected to decrease. This would create a minor adverse impact, as it represents between 2% and 10% of its total revenue from river operations. The impact would be localized and long-term, with a greater impact during the busier months of May through September.

An analysis of regional impacts based on Hjerpe and Kim (2003) indicates that the total (i.e., direct, indirect and induced) effects on the regional economy of Alternative D would amount to an increase in output of $***5.8*** million***, increase in income of more than $2.2 million,*** and a gain of ***97*** jobs. These increases represent a negligible, long-term impact on the regional economy. Small, specialized suppliers and certain specialized communities (e.g., Marble Canyon) might experience greater impacts.

4.5.5.5.2 Mitigation of Effects

Increases in commercial operators' revenue and gross profit and negligible changes to regional spending do not require mitigation, nor does the minor impact on Hualapai tribal revenue under this alternative. The losses to Bar 10 Ranch revenue may not be mitigated.

4.5.5.5.3 Cumulative Effects

Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. The combined effects from the operation of Glen Canyon Dam, the implementation of "Commercial Operating Requirements," and accessibility and cost of services at Diamond Creek and Whitmore create a favorable socioeconomic environment for commercial operators, their passengers, and localized communities that depend on river-related revenue. To some extent, noncommercial passengers also derive benefit from these effects, as well. Overall these direct and indirect effects are localized and regional, beneficial, short- to long-term, seasonal, and minor to major.

While Alternative D would result in considerable reductions to revenue for operations at Whitmore, river operations would still generate substantial revenue. Cumulatively, the effects of Alternative D, when combined with other past, present, and reasonably foreseeable actions, would be localized and regional, beneficial, short- to long-term, seasonal, and minor to major. Alternative D would result in localized and regional, both beneficial and adverse, long-term, moderate contributions to these cumulative effects.

4.5.5.5.4 Conclusion

Major beneficial long-term impacts to commercial river-runners' revenue and gross operating profit would result from Alternative D. Bar 10 Ranch revenue would experience a major adverse long-term impact. Economic impact to Hualapai tribal revenue would be minor, adverse and long-term. Impacts on the regional economy would be negligible. Cumulative effects of Alternative D, when combined with other past, present, and reasonably foreseeable actions, would be localized and regional, beneficial, short- to long-term, seasonal, and minor to major. Alternative D would result in localized and regional, both beneficial and adverse, long-term, moderate contributions to these cumulative effects.

4.5.5.6 ALTERNATIVE E

4.5.5.6.1 Analysis

Alternative E proposes a six-month mixed motor and a six-month nonmotor alternative for the section of the river between Lees Ferry and Diamond Creek. This alternative also has small noncommercial groups for the period March through October (except September). Compared with Alternative A, the total number of commercial user-days would increase by 2%, with the ***commercial*** motor user-day***s*** increasing by 4% and the ***total number of*** nonmotor user-day***s*** ***increasing*** by ***65% (with all of the increase in the noncommercial sector)***. The total number of passengers would ***increase*** by ***6***% with the ***commercial*** motor passengers decreasing by 19% and the ***total*** nonmotor passengers ***increasing*** by ***50***%. The total number of launches would ***increase*** by ***31***%; motor launches would ***decrease*** by ***9***% and nonmotor launches would increase by ***77***%. Maximum ***commercial*** group size would drop from 43 to ***30*** for motor users and from 39 to 25 for nonmotor users. Maximum ***commercial*** trip lengths would decline from 18 to 8 days for the ***commercial*** motor users and from 18 to 14 (summer) and 21 to 16 (shoulder) for ***commercial*** nonmotor users.

The increase in the total number of ***commercial*** user-days (***2%***) would result in corresponding projected increases in commercial river runners' revenue and gross operating profit (revenue minus direct labor costs). The impact of Alternative E on commercial operators' revenue and gross operating profit is expected to be minor, beneficial, localized and long-term, with a seasonal emphasis on the shoulder season.

Under Alternative E, ***passenger*** exchanges at Whitmore would be capped at 2,500 in and 2,500 out. Passenger exchanges at Whitmore, currently at 10,300 per year, are not capped. Compared with Alternative A, Alternative E would have major, adverse, localized and long-term impacts on Bar 10 Ranch revenue, with a seasonal emphasis on the busier months of May through September. ***The helicopter operator would also experience a loss.***

With ***passenger*** exchanges at Whitmore declining to 5,000, the Hualapai Tribe would experience a loss of revenue. The projected number of Diamond Creek takeouts would increase and produce a gain. The effect of Alternative E on Hualapai tribal revenue would be a gain and produce an economic impact that is negligible, as it represents less than 2% of its total revenue from river operations. The impact would be localized and long-term, with a greater impact during the busier months of May through September.

An analysis of regional impacts based on Hjerpe and Kim (2003) indicates that the total (i.e., direct, indirect and induced) effects on the regional economy of Alternative E would amount to an increase in ***regional*** output of ***nearly $3.3*** million***, an increase of about $1.4 million in income,*** and a gain of ***53*** jobs. These increases represent a negligible, long-term impact on the regional economy. Small, specialized suppliers and certain specialized communities (e.g., Marble Canyon) might experience greater impacts.

4.5.5.6.2 Mitigation of Effects

Increased commercial operators' revenue and gross profit and negligible impacts to Hualapai tribal revenue do not require mitigation. The adverse impact to Bar 10 Ranch revenue may not be mitigated. No mitigation is required for the regional economy because the impact would be negligible.

4.5.5.6.3 Cumulative Effects

Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. The combined effects from the operation of Glen Canyon Dam, the implementation of "Commercial Operating Requirements," and accessibility and cost of services at Diamond Creek and Whitmore create a favorable socioeconomic environment for commercial operators, their passengers, and localized communities that depend on river-related revenue. To some extent, noncommercial passengers also derive benefit from these effects, as well. Overall these direct and indirect effects are localized and regional, beneficial, short- to long-term, seasonal, and minor to major.

While Alternative E would result in considerable reductions to revenue for operations at Whitmore, river operations would still generate substantial revenue. Cumulatively, the effects of Alternative E, when combined with other past, present, and reasonably foreseeable actions, would be localized and regional, beneficial, short- to long-term, seasonal, and minor to major. Alternative E would result in localized and regional, both beneficial and adverse, long-term, moderate contributions to these cumulative effects.

4.5.5.6.4 Conclusion

Minor beneficial long-term impacts to commercial river-runners' revenue and gross operating profit would result from Alternative E. Impacts to Bar 10 Ranch ***would be major, adverse, localized, and long-term. Impacts to*** Hualapai tribal revenue would be negligible, ***beneficial, localized and long-term.*** Impacts to the regional economy would be negligible***, beneficial, and long-term***. Impacts to the regional economy would be negligible. Cumulative effects of Alternative E, when combined with other past, present, and reasonably foreseeable actions, would be localized and regional, beneficial, short- to long-term, seasonal, and minor to major. Alternative E would result in localized and regional, both beneficial and adverse, long-term, moderate contributions to these cumulative effects.

4.5.5.7 ALTERNATIVE F

4.5.5.7.1 Analysis

Alternative F proposes a six-month mixed motor and a six-month nonmotor alternative for the section of the river between Lees Ferry and Diamond Creek. This alternative also has small noncommercial groups for the period March through October (except September). Compared with Alternative A, Alternative F proposes the total number of commercial user-days would increase by up to 14% with the motor user-***days*** increasing by ***12***% and the ***total*** nonmotor user-days would ***increase*** by ***57***%. The total number of passengers would ***increase*** by ***13***% with the motor passengers decreasing by up to 6% and the nonmotor passengers ***increasing*** by as much as ***48***%. The total number of launches would increase by up to ***38***%; motor launches would increase by as much as 3% and nonmotor launches would increase by up to *77*%. Maximum group size would drop from 43 to 30 for ***commercial*** motor users and from 39 to 30 for ***commercial*** nonmotor users. Maximum trip lengths would decline from 18 to 10 days for the ***commercial*** motor users and from 18 to 16 (summer) and 21 to 18 (shoulder) for ***commercial*** nonmotor users. ***Passenger*** exchanges at Whitmore would be conducted during the six-month motor season with an annual total of 3,400 passengers in and 6,600 out.

The increase in the total number of ***commercial*** user-days (13.8%) would result in corresponding projected increases in commercial river runners' revenue and gross operating profit (revenue minus direct labor costs). The impact of Alternative F on commercial operators' revenue and gross operating profit is expected to be moderate, beneficial, localized and long-term, with a seasonal emphasis on the shoulder and winter seasons.

Under Alternative F, the number of ***passengers exchanging and potentially available for*** helicopter ***shuttles*** at Whitmore would be ***3***% less than current conditions. The impact of Alternative F on Bar 10 Ranch revenue is expected to be ***minor, adverse,*** localized and long-term, with a seasonal emphasis on the busier months of May through September. ***The effect on the helicopter operator is similarly expected to be negligible.***

As the number of helicopter ***shuttles*** would decrease only slightly from current levels and projected increases in the number of takeouts at Diamond Creek could bring in additional revenue, the impact of Alternative F on Hualapai tribal revenue is negligible, as it represents less than 2% of its total revenue from river operations. The impact would be localized and long-term, with a greater impact during the busier months of May through September.

An analysis of regional impacts based on Hjerpe and Kim (2003) indicates that the total (i.e., direct, indirect and induced) effects on the regional economy of Alternative F would amount to an increase in output of $***5.1*** million***, an increase in income of $2.0 million,*** and a gain of ***84*** jobs. These increases represent a negligible, ***beneficial***, long-term impact on the regional economy. Small, specialized suppliers and certain specialized communities (e.g., Marble Canyon) might experience greater impacts.

4.5.5.7.2 Mitigation of Effects

Increased commercial operators' revenue and gross profit do not require mitigation. The adverse impact to Bar 10 Ranch revenue may not be mitigated. No mitigation is required for Hualapai tribal revenue or the regional economy, as the impact would be negligible.

4.5.5.7.3 Cumulative Effects

Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. The combined effects from the operation of Glen Canyon Dam, the implementation of "Commercial Operating Requirements," and accessibility and cost of services at Diamond Creek and Whitmore create a favorable socioeconomic environment for commercial operators, their passengers, and localized communities that depend on river-related revenue. To some extent, noncommercial passengers also derive benefit from these effects, as well. Overall these direct and indirect effects are localized and regional, beneficial, short- to long-term, seasonal, and minor to major.

While Alternative F would result in ***some slight*** reductions to revenue for operations at Whitmore, river operations would still generate substantial revenue. Cumulatively, the effects of Alternative F, when combined with other past, present, and reasonably foreseeable actions, would be localized and regional, beneficial, short- to long-term, seasonal, and minor to major. Alternative F would result in localized and regional, both beneficial and adverse, long-term, moderate contributions to these cumulative effects.

4.5.5.7.4 Conclusion

Moderate beneficial long-term impacts to commercial operators' revenue and gross operating profit would result from Alternative F. Impacts to Bar 10 Ranch ***would be minor, adverse, localized, and long-term. Impacts to*** Hualapai tribal revenue would be negligible, ***beneficial, localized and long-term.*** Impacts to the regional economy would be negligible***, beneficial, and long-term***. Cumulative effects of Alternative F, when combined with other past, present, and reasonably foreseeable actions, would be localized and regional, beneficial, short- to long-term, seasonal, and minor to major. Alternative F would result in localized and regional, both beneficial and adverse, long-term, moderate contributions to these cumulative effects.

4.5.5.8 ALTERNATIVE G

4.5.5.8.1 Analysis

Alternative G is an eight-month (March through October) mixed motor and a four-month (November through February) nonmotor alternative for the section of the river between Lees Ferry and Diamond Creek. Compared with Alternative A, Alternative G proposes the total number of commercial user-days would increase by 2%, with the ***commercial*** motor user-***days*** increasing by 4% and the ***total*** nonmotor user-***days increasing*** by ***79***%. The total number of passengers would increase by ***28***%, with ***commercial*** motor passengers increasing by 5% and ***total*** nonmotor passengers ***increasing*** by ***68***%. The total number of launches would increase by ***47***%; motor launches would increase by 7% and ***total*** nonmotor launches by ***93***%. Maximum group size would drop from 43 to 40 for ***commercial*** motor users and from 39 to 30 for ***commercial*** nonmotor users. Maximum trip lengths would decline from 18 to 8 days for the ***commercial*** motor users and from 18 to 14 (summer) and 21 to 16 (shoulder) for ***commercial*** nonmotor users.

The increase in the total number of ***commercial*** user-days (***2%***) would result in corresponding projected increases in commercial river runners' revenue and gross operating profit (revenue minus direct labor costs). The impact of Alternative G on commercial operators' revenue and gross operating profit is expected to be minor, beneficial, localized and long-term, with a seasonal emphasis on the shoulder season.

The period for ***passenger*** exchanges at Whitmore would be lengthened to the proposed eight-month motorized season and the total number of exchanges increased by approximately *7*%. Compared to Alternative A, the impact of Alternative G on Bar 10 Ranch revenue is expected to be minor, beneficial, localized and long-term, with a seasonal emphasis on the busier months of May through September. ***The helicopter operator would experience a similar gain.***

The increase in the number of exchange ***passengers potentially available for helicopter shuttles*** would result in a gain in revenue to the Hualapai Tribe. The projected number of Diamond Creek takeouts also increases and produces an increase in revenue. Compared with Alternative A, the economic impact of Alternative G is minor and beneficial, as it represents between 2% and 10% of its total revenue from river operations. The impact would be localized and long-term, with a greater impact during the busier months of May through September.

An analysis of regional impacts based on Hjerpe and Kim (2003) indicates that the total (i.e., direct, indirect and induced) effects on the regional economy of Alternative G would amount to an increase in output of ***about $3.9*** million***, an increase of nearly $1.6 million in income,*** and a gain of ***62*** jobs. These increases represent a negligible, long-term impact on the regional economy. Small, specialized suppliers and certain specialized communities (e.g., Marble Canyon) might experience greater impacts.

4.5.5.8.2 Mitigation of Effects

Increased commercial operators' revenue and gross profit, increased Bar 10 Ranch revenue, increased Hualapai tribal revenue, and negligible impacts to the regional economy do not require mitigation.

4.5.5.8.3 Cumulative Effects

Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. The combined effects from the operation of Glen Canyon Dam, the implementation of "Commercial Operating Requirements," and accessibility and cost of services at Diamond Creek and Whitmore create a favorable socioeconomic environment for commercial operators, their passengers, and localized communities that depend on river-related revenue. To some extent, noncommercial passengers also derive benefit from these effects, as well. Overall these direct and indirect effects are localized and regional, beneficial, short- to long-term, seasonal, and minor to major.

Cumulatively, the effects of Alternative G, when combined with other past, present, and reasonably foreseeable actions, would be localized and regional, beneficial, short- to long-term, seasonal, and minor to major. Alternative G would result in a localized and regional, beneficial, long-term, moderate to major contribution to these cumulative effects.

4.5.5.8.4 Conclusion

Minor beneficial long-term impacts to commercial operators' revenue and gross operating profit would result from Alternative G. Bar 10 Ranch revenue and Hualapai tribal revenue would also experience minor beneficial long-term impacts. Impacts to the regional economy would be negligible. Cumulatively, the effects of Alternative G, when combined with other past, present, and reasonably foreseeable actions, would be localized and regional, beneficial, short- to long-term, seasonal, and minor to major. Alternative G would result in a localized and regional, beneficial, long-term, moderate to major contribution to these cumulative effects.

4.5.5.9 MODIFIED ALTERNATIVE H (NPS PREFERRED ALTERNATIVE)

4.5.5.9.1 Analysis

Modified Alternative H is a ***five and one-half*** (***April through September 15***) mixed motor and a six ***and one-half***-month nonmotor alternative for the section of the river between Lees Ferry and Diamond Creek. ***Compared with Alternative A, Modified Alternative H would increase the total number of commercial user-days by 2%, with the commercial motor user-days increasing by 4% and the total nonmotor user-days increasing by 57%. The total number of passengers would increase by 10%, with commercial motor passengers decreasing by 9% and total nonmotor passengers increasing by 44%. The total number of launches would increase by 23%; motor launches would decrease by 9% and total nonmotor launches would increase by 60%. Maximum group size would drop from 43 to 32 (summer) and 24 (remainder) for commercial motor users, and from 39 to 32 (summer) and 24 (reminder) for commercial nonmotor users. Maximum trip lengths would decline from 18 to 10 days (summer) and 12 days (shoulder) for the commercial motor users and from 18 to 16 (summer) and 21 to 18 (shoulder) for commercial nonmotor users.***

For passengers beginning their river trips at Whitmore, an estimated 3,635 would be transported in by helicopter and 400 would hike in for a total of 4,035 passengers entering the river corridor. Using the same average rate of exchanges by trip type as actually occurred during 1998-2003, this would result in an estimated 5,715 passengers exiting the river corridor at Whitmore (see Table 4-32).

The increase in the total number of ***commercial*** user-days (***2%***) would result in corresponding projected increases in commercial river runners' revenue and gross operating profit (revenue minus direct labor costs). The impact of ***Modified*** Alternative H on commercial operators' revenue and gross operating profit is expected to be ***minor***, beneficial, localized and long-term, with a seasonal emphasis on the shoulder season.

Under ***Modified*** Alternative H, ***an estimated 9,350*** passengers could be exchanged at Whitmore provided that ***5,715*** transfer ***out*** and ***3,635*** transfer ***in***. (Presently, about ***10,200 passenger*** exchanges occur with about ***6,600*** ending and ***3,635*** beginning their trips at Whitmore.) In addition, ***400*** hikers could also exchange. The effect of ***Modified*** Alternative H on Bar 10 Ranch revenue is likely to be ***minor, adverse***, localized and long-term, with a seasonal emphasis on the busier months of May through September.

The reduction of ***up to 850 passenger*** exchanges at Whitmore results in ***about 8% fewer passengers potentially available for helicopter shuttles, which represents*** a revenue loss to the Hualapai Tribe***, Bar 10 Ranch, and the helicopter operator*** . The projected number of Diamond Creek takeouts increases under this alternative, producing a revenue gain. Compared with Alternative A, the impact of ***Modified*** Alternative H on Hualapai tribal revenue is ***a potential decrease*** in revenue ***from Whitmore operations, but an increase in Diamond Creek takeout revenue***. This ***overall*** economic impact would be negligible ***and beneficial***, as ***this change in revenue*** represents less than 2% of its total revenue from river operations. The impact would be localized and long-term, with a greater impact during the busier months of May through September.

An analysis of regional impacts based on Hjerpe and Kim (2003) indicates that the total (i.e., direct, indirect and induced) effects on the regional economy of ***Modified*** Alternative H would amount to an increase in ***regional*** output of ***more than $2.9*** million***, an increase in income of $1.2,*** and a gain of ***47*** jobs. These increases represent a negligible, ***beneficial***, long-term impact on the regional economy. Small, specialized suppliers and certain specialized communities (e.g., Marble Canyon) might experience greater impacts.

4.5.5.9.2 Mitigation of Effects

Increased commercial operators' revenue and gross profit, increased Bar 10 Ranch revenue, and negligible impacts to Hualapai tribal revenue and the regional economy do not require mitigation.

4.5.5.9.3 Cumulative Effects

Specific effects from past, present, and reasonably foreseeable actions are discussed earlier in this chapter. The combined effects from the operation of Glen Canyon Dam, the implementation of "Commercial Operating Requirements," and accessibility and cost of services at Diamond Creek and Whitmore create a favorable socioeconomic environment for commercial operators, their passengers, and localized communities that depend on river-related revenue. To some extent, noncommercial passengers also derive benefit from these effects, as well. Overall these direct and indirect effects are localized and regional, beneficial, short- to long-term, seasonal, and minor to major.

Cumulatively, the effects of ***Modified*** Alternative H, when combined with other past, present, and reasonably foreseeable actions, would be localized and regional, beneficial, short- to long-term, seasonal, and minor to major. ***Modified*** Alternative H would result in a localized and regional, beneficial, long-term, ***negligible to minor*** contribution to these cumulative effects.

4.5.5.9.4 Conclusion

Minor beneficial long-term impacts on commercial operators' revenue and gross operating profit would result from ***Modified*** Alternative H. Bar 10 Ranch revenue would experience ***minor, adverse*** long-term impacts. Impacts to Hualapai tribal revenue would be negligible, ***beneficial,***

localized, and long-term. Impacts to the regional economy would be negligible, ***beneficial, and long-term***. Cumulative effects of ***Modified*** Alternative H, when combined with other past, present, and reasonably foreseeable actions, would be localized and regional, beneficial, short- to long-term, seasonal, and minor to major. ***Modified*** Alternative H would result in a localized and regional, beneficial, long-term, ***negligible to minor*** contribution to these cumulative effects.

4.5.6 IMPACT ANALYSIS—LOWER GORGE ALTERNATIVES

4.5.6.1 ANALYSIS COMMON TO ALL ALTERNATIVES

4.5.6.1.1 Estimating Future Use Levels

The Lower Gorge alternatives for the *Colorado River Management Plan* prescribe maximum use limits for future river use below Diamond Creek. To aid in comparisons between the alternatives, ***gross*** revenues for the Hualapai Tribe are projected at these limits. Revenues thus represent the maximum earning capacity of that alternative should that service operate at 100 percent of the limits for each day during the season or year.

Projections for HRR revenue are presented as ***gross*** revenue amounts. ***For this analysis, gross*** revenue is the product of the price of the trip (after commissions and discounts) times the maximum number of trips permitted daily for that alternative times the number of days in the operating season or year. No operational expenses are deducted from these figures. They offer a comparison among the alternatives as to the potential ***maximum*** extent of the business; they do not represent the projected amount available to the Grand Canyon Resort Corporation or the Hualapai tribal budget from that alternative.

Projections for revenue from the pontoon boat operations are also presented in ***gross*** revenue amounts. ***For the pontoon boat operations, these are equivalent to net revenues since*** the expenses incurred by the Hualapai Tribe are negligible as the tours are run by third-party pontoon boat operators that pay the Grand Canyon Resort Corporation royalties for the rights to operate the contract. ***Gross/n***et revenue figures, in this case, do represent a good estimate ***of the*** amount available to the Grand Canyon Resort Corporation under each alternative.

4.5.6.1.2 Economic Impacts on River Rafters

Socioeconomic impacts to commercial and noncommercial river rafters would be the same for all Lower Gorge alternatives because none of the actions proposed under these alternatives would increase the river use fees or otherwise be expected to directly increase the cost to ***all*** rafters using the Lower Gorge. ***At most, the NPS would start collecting the $10.00 fee for entrance to the Lower Gorge. This fee is the same as charged to all other people entering the park at other controlled locations and would be the same for commercial and noncommercial river rafters.*** While the Hualapai Tribe may increase its future tribal land access fees, these would be administered solely by the tribe and, as such, would be independent of the *Colorado River Management Plan*. Therefore no economic impacts to noncommercial or commercial rafters are considered under the Lower Gorge alternatives.

4.5.6.1.3 Economic Impacts on Commercial Rafting Operators

Lower Gorge river use by commercial operators is predominantly limited to continuation trips by the Upper Gorge commercial operators and HRR operations (which are analyzed separately below). Most continuation trips consist of short one- or two-day trips below Diamond Creek to take outs at Lake Mead. These trips would either travel unassisted or may meet up with jetboats for more rapid transfer off the river. Under the Lower Gorge alternatives, commercial rafting operations would continue similar to existing conditions or change slightly depending on operations in the Lees Ferry reach (economic impacts are analyzed above). No changes in operating requirements or in future rafting use are expected to be associated with the Diamond Creek alternatives.

Other factors, such as future Lake Mead water levels or future Hualapai Tribe take out and other user fees, may also affect future continuation trip use levels. However, these factors are independent of the *Colorado River Management Plan* and therefore do not represent plan-related impacts.

4.5.6.1.4 Noncommercial Launches at Diamond Creek

Currently, more than 1,000 noncommercial passengers launch from Diamond Creek annually. No changes to Lower Gorge noncommercial use are proposed in the ***Final*** *Environmental Impact Statement;* therefore the Lower Gorge alternatives would ***not*** be expected to have any impact on future noncommercial use levels.

4.5.6.1.5 Continuation Trip Revenues

Currently, only commercial continuation trips traveling below Diamond Creek choosing to use tribal lands on "river left" of the Colorado River above the high water line (e.g., typically for hiking or camping use) are required to pay use fees to the tribe. According to the Hualapai Tribe financial and use records (Wegner, fax communication, June 2003), no fees are currently being collected from commercial continuation trips. Although the Hualapai Tribe is currently in discussion with the NPS seeking to collect future use fees from all continuation trips, resolution of the issue is currently considered a non-plan related action. Therefore, no economic impacts to tribal revenues from future continuation trip user fees are associated with these alternatives.

4.5.6.1.6 Look and Leave Helicopter Tours

Short "champagne" helicopter landings (look and leave tours) operate year-round from Grand Canyon West to the Quartermaster helipads. These tours—more than 19,000 passengers in 2003—are operated by commercial tour operators under agreement with the Hualapai Tribe. The ***NPS*** has no ***authority*** over helicopter***s operating on or over Hualapai tribal land.*** Therefore, no changes to these trips are considered in the plan and, as such, no economic impacts are attributable to the plan.

4.5.6.1.7 Regional Economic Impacts from Changes in Visitor Spending

Commercial and noncommercial river runners contribute less than 1 percent of total regional economic output and employment, thus their current economic impact is negligible. The substantial growth projected with the build-out of Grand Canyon West suggests considerable increases in local expenditures and employment in the Lower Gorge. The regional economic effects of Alternatives 2–5 are expected to be more modest, however, in spite of their major beneficial impact on Hualapai tribal revenue.

Due to the Lower Gorge's close links with the Las Vegas economy, which is outside the region, much of the impact of the increases in spending projected in Alternatives 2–5 is expected to flow back to the Las Vegas area. The impact of these changes on the Las Vegas economy is negligible. The intensity and timing of this impact differ for each alternative and depend on the Hualapai Tribe's ability to market their services at the projected levels and on the build-out schedule for Grand Canyon West.

4.5.6.2 CUMULATIVE IMPACTS

As a part of the Hualapai Tribe's long-range economic development efforts, Grand Canyon Resort Corporation has prepared a land use plan that includes construction of and improvements to numerous tourist-related facilities for Grand Canyon West, which is located on tribal lands ***north***west of Peach Springs. Estimates of annual visitation in the plan range up to 750,000 unscheduled travelers and an unspecified number of scheduled travelers. Local area effects from future development will depend on the phasing of the construction projects and the number of visitors attracted to Grand Canyon West. Currently, Grand Canyon West offers, among other tour opportunities, short helicopter landings (look-and-leave tours) that operate year-round from Grand Canyon West to helipads on tribal lands in the Quartermaster area. These tours, with more than 19,000 passengers in 2003 are operated by commercial tour operators under agreement with the Hualapai Tribe. The NPS has no ***authority*** over Grand Canyon West or the air trips that originate from it. While some river-based activities are analyzed in the Lower Gorge alternatives, all other Grand Canyon West activities and development are analyzed independently as a cumulative effect. Localized ***socioeconomic*** effects to the Hualapai Tribe from projected Grand Canyon West build-outs, visitation, job growth, and income are beneficial, long-term, year-round, and major. These projections would have a beneficial, long-term, year-round, negligible to minor effect on the regional economy.

4.5.6.3 ALTERNATIVE 1 (EXISTING CONDITION)

4.5.6.3.1 Analysis

HRR Operations. The tribe currently operates commercial rafting trips launching at Diamond Creek. Most of these are single-day trips finishing at Quartermaster where passengers are flown by helicopter to Grand Canyon West. HRR day trips currently operate from March through October and are limited ***(by agreement)*** to 80 passengers daily during both the peak (May through September) and the non-peak seasons. There is no limit on the number of passengers on HRR overnight trips.

Pontoon Trips. Pontoon trips are single-day, scenery-oriented tours that combine a helicopter flight from the Grand Canyon West airstrip to a helipad along the Colorado River, a short pontoon boat ride on the river, and a return flight to Grand Canyon West. Pontoon trips operate year-round without any limit on the maximum number of passengers. ***In 2003 a total of 56,562 passengers was reported by the Hualapai Tribe, with an annual average of 160 passengers per day and a seasonal average of 188 passengers per day from May through September. Daily passenger numbers vary, from 0 to more than 350. When use levels were frozen as part of the Core Team agreement in 2000, the yearly passenger total was 22,670.***

Grand Canyon National Park Entrance Fees. Currently, the park does not collect entrance fees from visitors entering the park from Hualapai tribal lands for either the HRR trips or the pontoon trips. This lack of enforcement results in foregone NPS revenue estimated at up to $650,000 per year. ***This amount represents more than 3% of the park's annual budget and collection of these fees would be a long-term, beneficial, minor impact to the park's budget.*** If enforced, these entrance fees would be borne by the Hualapai Tribe and its commercial operators, and would likely be passed onto the visitors. The increase in price could impact total revenue due to elasticity of demand.

Regional Impact. The Hualapai Tribe's river operations currently have a negligible impact on the regional economy as a whole.

4.5.6.3.2 Mitigation of Effects

No mitigation is necessary under Alternative 1.

4.5.6.3.3 Cumulative Effects

Localized effects to the Hualapai Tribe from projected Grand Canyon West build-outs, visitation, job growth, and income would be beneficial, long-term, year-round, and major. These projections would have a beneficial, long-term, year-round, and negligible to minor effect on the regional economy.

Cumulatively, the effects of Alternative 1, when combined with other past, present, and reasonably foreseeable actions, would be localized, beneficial, long-term, year-round, and major for the Hualapai Tribe, and beneficial, long-term, year-round, and negligible to minor for the regional economy. Alternative 1 would result in a beneficial contribution to these cumulative effects that on a local basis would be long-term and moderate to major, and on a regional basis would be long-term and negligible to minor.

4.5.6.3.4 Conclusion

No change to future HRR or pontoon operations would be associated with this alternative. Therefore, Alternative 1 would have a negligible, ***beneficial,*** localized and long-term impact ***on Hualapai tribal revenue and the regional economy***. Cumulative effects of Alternative 1, when combined with other past, present, and reasonably foreseeable actions, would be localized, beneficial, long-term, year-round, and major for the Hualapai Tribe, and beneficial, long-term, year-round, and negligible to minor for the regional economy. Alternative 1 would result in a beneficial contribution to these cumulative effects that on a local basis would be long-term and moderate to major, and on a regional basis would be long-term and negligible to minor.

4.5.6.4 ALTERNATIVE 2

4.5.6.4.1 Analysis

HRR Operations. Under Alternative 2, HRR operations would run year-round. Maximum use limits would be ***two 30-person trips*** per day ***(including crew)*** in the peak season and ***one 30-person trip*** per day ***(including crew)*** in the non-peak season for the HRR day trips. For the HRR overnight trips, a maximum of ***one 30-*** passengers ***trip*** per day ***(including crew)*** would be allowed year-round. At maximum permitted use levels for the peak and non-peak seasons, revenue is projected to increase by nearly 500%. This increase would result in a beneficial, long-term, major effect for the Hualapai Tribe.

Pontoon Trips. Under Alternative 2, pontoon trips would be eliminated and the Hualapai Tribe would experience a loss of revenue. This loss would result in an adverse, long-term, major effect for the Hualapai Tribe.

Grand Canyon National Park Entrance Fees. If the park enforced the collection of entrance fees from visitors coming from Hualapai tribal lands for either the HRR trips or the pontoon trips under Alternative 2, it would recover currently foregone NPS revenue estimated at up to $250,000 per year. ***This amount represents less than 2% of the park's annual budget and collection of these fees would be a long-term, beneficial, negligible impact to the park's budget.*** If enforced, these entrance fees would be borne by the Hualapai Tribe and its commercial operators and would likely be passed onto the visitors. The increase in price could impact total revenue due to elasticity of demand.

Regional Impact. The Hualapai Tribe's river operations would continue to have a negligible impact on the regional economy as a whole.

4.5.6.4.2 Mitigation of Effects

As the economic impact of Alternative 2 would be beneficial, no mitigation would be necessary.

4.5.6.4.3 Cumulative Effects

Localized effects to the Hualapai Tribe from projected Grand Canyon West build-outs, visitation, job growth, and income would be beneficial, long-term, year-round, and major. These projections would have a beneficial, long-term, year-round, and negligible to minor effect on the regional economy.

Cumulatively, the effects of Alternative 2, when combined with other past, present, and reasonably foreseeable actions, would be localized, beneficial, long-term, year-round, and major for the Hualapai Tribe, and beneficial, long-term, year-round, and negligible to minor for the regional economy. Alternative 2 would result in a beneficial contribution to these cumulative effects that on a local level would be long-term and moderate to major, and on a regional level would be long-term and negligible to minor.

4.5.6.4.4 Conclusion

The impact of Alternative 2 on Hualapai tribal revenue is projected to be an increase of more than ***140***%. This would represent a major, beneficial, localized and long-term economic impact. The impact would be greatest during the peak months of May through September. ***Impacts to the regional economy would be negligible, beneficial and long-term.*** Cumulative effects of Alternative 2, when combined with other past, present, and reasonably foreseeable actions, would be localized, beneficial, long-term, year-round, and major for the Hualapai Tribe, and beneficial, long-term, year-round, and negligible to minor for the regional economy. Alternative 2 would result in a beneficial contribution to these cumulative effects that on a local level would be long-term and moderate to major, and on a regional level would be long-term and negligible to minor.

4.5.6.5 ALTERNATIVE 3

4.5.6.5.1 Analysis

HRR Operations. Alternative 3 proposes maximum use limits of ***three 30-person trips*** per day (peak***, including crew***) and ***two 30-person trips*** per day (non-peak***, including crew***) for the HRR day trips. For the HRR overnight trips, a maximum of ***two 30-person trips*** per day ***(including crew)*** would be allowed year-round. At maximum use rates, Alternative 3 projects a revenue increase of more than 1,000%. This increase would be a beneficial, long-term, major effect for the Hualapai Tribe.

Pontoon Trips. Pontoon boats would operate at a maximum daily limit of 400 passengers. Pontoon trip revenue at maximum use levels could increase by more than 150%. This increase would be a beneficial, long-term, major effect for the Hualapai Tribe.

Grand Canyon National Park Entrance Fees. If the park enforced the collection of entrance fees from visitors coming from Hualapai tribal lands for either HRR trips or pontoon trips, it would recover currently foregone NPS revenue estimated at up to $1.9 million per year under Alternative 3. ***This amount represents about 10% of the park's annual budget and collection of these fees would be a long-term, beneficial, minor to moderate impact to the park's budget.*** If enforced, these entrance fees would be borne by the Hualapai Tribe and its commercial operators, and they would likely be passed onto the visitors. The increase in price could impact total revenue due to elasticity of demand.

Regional Impact. The Hualapai Tribe's river operations would continue to have a negligible impact on the regional economy as a whole.

4.5.6.5.2 Mitigation of Effects

As the economic impact of Alternative 3 would be beneficial, no mitigation would be necessary.

4.5.6.5.3 Cumulative Effects

Localized effects to the Hualapai Tribe from projected Grand Canyon West build-outs, visitation, job growth, and income would be beneficial, long-term, year-round, and major. These projections would have a beneficial, long-term, year-round, negligible to minor effect on the regional economy.

Cumulatively, the effects of Alternative 3, when combined with other past, present, and reasonably foreseeable actions, would be localized, beneficial, long-term, year-round, and major for the Hualapai Tribe, and beneficial, long-term, year-round, and minor for the regional economy. Alternative 3 would result in a beneficial contribution to these cumulative effects that on a local level would be long-term and major, and on a regional level would be long-term and minor.

4.5.6.5.4 Conclusion

Under Alternative 3, the projected increase in HRR and pontoon trip revenues totals more than 500%, a major, beneficial, localized and long-term impact ***on Hualapai tribal revenues***. The impact would be greatest during the peak months of May through September. ***Impacts to the regional economy would be negligible, beneficial and long-term.*** Cumulative effects of Alternative 3, when combined with other past, present, and reasonably foreseeable actions, would be localized, beneficial, long-term, year-round, and major for the Hualapai Tribe, and beneficial, long-term, year-round, and minor for the regional economy. Alternative 3 would result in a beneficial contribution to these cumulative effects that on a local level would be long-term and major, and on a regional level would be long-term and minor.

4.5.6.6 MODIFIED ALTERNATIVE 4 (NPS PREFERRED ALTERNATIVE)

4.5.6.6.1 Analysis

HRR Operations. Maximum use limits for the HRR day trips would be 96 passengers per day in the peak season ***with no limit on the number of groups but group sizes not-to-exceed 40 (including crew),*** and ***two 35-person trips*** per day ***(including crew)*** in the non-peak season. For the HRR overnight trips, the maximum would be ***three trips of 20 people (including crew)*** per day in the peak season and ***one trip of 20 people (including crew)*** per day in the non-peak season. At maximum use rates, ***Modified*** Alternative 4 projects a revenue increase of more than 700%. This increase would be a beneficial, long-term, major effect for the Hualapai Tribe.

Pontoon Trips. Pontoon boats would operate at maximum daily limit of ***480 (with a possible increase to a total of 600)***. Pontoon trip revenue at maximum use levels could increase from more than 205% ***(at 480 passengers per day) to more than 280% (at 600 passengers per day)***. This ***increase*** would be a ***beneficial***, long-term, ***major*** effect for the Hualapai Tribe.

Grand Canyon National Park Entrance Fees. If the park enforced the collection of entrance fees from visitors coming from Hualapai tribal lands for either HRR trips or pontoon trips, it would recover currently foregone NPS revenue estimated at up to $950,000 per year under ***Modified*** Alternative 4. ***This amount represents about 10% of the park's annual budget and collection of these fees would be a long-term, beneficial, minor to moderate impact to the park's budget.*** If enforced, these entrance fees would be borne by the Hualapai Tribe and its commercial operators, and they would likely be passed onto the visitors. The increase in price could impact total revenue due to elasticity of demand.

Regional Impact. The Hualapai Tribe's river operations would continue to have a negligible impact on the regional economy as a whole.

4.5.6.6.2 Mitigation of Effects

As the economic impact of ***Modified*** Alternative 4 is beneficial, no mitigation is necessary.

4.5.6.6.3 Cumulative Effects

Localized effects to the Hualapai Tribe from projected Grand Canyon West build-outs, visitation, job growth, and income would be beneficial, long-term, year-round and major ***cumulative effects***. These projections would have a beneficial, long-term, year-round, negligible to minor ***cumulative*** effect on the regional economy.

Cumulatively, the effects of ***Modified*** Alternative 4, when combined with other past, present, and reasonably foreseeable actions, would be localized, beneficial, long-term, year-round, and major for the Hualapai Tribe, and beneficial, long-term, year-round, and minor for the regional economy. ***Modified*** Alternative 4 would result in a beneficial contribution to these cumulative effects that on a local level would be long-term and major, and on a regional level would be long-term and minor.

4.5.6.6.4 Conclusion

Under ***Modified*** Alternative 4 the projected increase in HRR and pontoon trip revenues totals ***more than 405% (with a potential increase to 450% if pontoon passenger levels increase based on favorable reviews of concession operations and resource monitoring). This represents*** a major, beneficial, localized and long-term impact ***on Hualapai tribal revenues***. The impact would be greatest during the peak months of May through September. ***Impacts to the regional economy would be negligible, beneficial and long-term.*** Cumulative effects of ***Modified*** Alternative 4, when combined with other past, present, and reasonably foreseeable actions, would be localized, beneficial, long-term, year-round, and major for the Hualapai Tribe, and beneficial, long-term, year-round, and minor for the regional economy. ***Modified*** Alternative 4 would result in a beneficial contribution to these cumulative effects that on a local level would be long-term and major, and on a regional level would be long-term and minor.

4.5.6.7 ALTERNATIVE 5 (HUALAPAI TRIBE PROPOSED ACTION)

4.5.6.7.1 Analysis

HRR Operations. ***Alternative 5 use limits for HRR operations would be the same as for Modified Alternative 4.*** At maximum use rates, a net revenue increase under Alternative 5 is projected at more than 700%. This increase would be a beneficial, long-term, major effect for the Hualapai Tribe.

Pontoon Trips. Alternative 5 differs from ***Modified*** Alternative 4 on the maximum number of pontoon boat passengers per day. Under Alternative 5 pontoon boats would operate at a maximum daily limit of 960 passengers, and pontoon trip revenue at maximum levels is expected to increase by more than 500%. This increase would be a beneficial, long-term, major effect for the Hualapai Tribe.

Grand Canyon National Park Entrance Fees. If the park enforced the collection of entrance fees from visitors coming from Hualapai tribal lands for either HRR trips or pontoon trips, it would recover currently foregone NPS revenue estimated at up to $3.9 million per year under this alternative. ***This amount represents about 20% of the park's annual budget and collection of these fees would be a long-term, beneficial, moderate to major impact to the park's budget.*** If enforced, these entrance fees would be borne by the Hualapai Tribe and its commercial operators, and would likely be passed onto the visitors. The increase in price could impact total revenue due to elasticity of demand.

Regional Impact. The Hualapai Tribe's river operations would continue to have a negligible impact on the regional economy as a whole.

4.5.6.7.2 Mitigation of Effects

As the economic impact of Alternative 5 would be beneficial, no mitigation would be necessary.

4.5.6.7.3 Cumulative Effects

Localized effects to the Hualapai Tribe from projected Grand Canyon West build-outs, visitation, job growth, and income would be beneficial, long-term, year-round, and major. These projections would have a beneficial, long-term, year-round, and negligible to minor effect on the regional economy.

Cumulatively, the effects of Alternative 5, when combined with other past, present, and reasonably foreseeable actions, would be beneficial, long-term, year-round and major ***cumulative effects***. These projections would have a beneficial, long-term, year-round, negligible to minor ***cumulative*** effect on the regional economy.

4.5.6.7.4 Conclusion

Under Alternative 5, the projected increase in HRR and pontoon trip revenues totals nearly 600%, a major, beneficial, ***localized and long-term*** impact ***on Hualapai tribal revenues.*** The impact would be greatest during the peak months of May through September. ***Impacts to the regional economy would be negligible, beneficial and long-term.*** Cumulative effects of Alternative 5, when combined with other past, present, and reasonably foreseeable actions, would be localized, beneficial, long-term, year-round, and major for the Hualapai Tribe, and beneficial, long-term, year-round, and minor for the regional economy. Alternative 5 would result in a beneficial contribution to these cumulative effects that on a local level would be long-term and major, and on a regional level would be long-term and minor.

4.6 IMPACTS ON PARK MANAGEMENT AND OPERATIONS

4.6.1 ISSUES

Impacts to biological, physical, paleontological, and cultural resources from visitor use in the river corridor are managed by the NPS, as well as other federal agencies (U. S. Geological Survey, U. S. Fish and Wildlife Service), state agencies (Arizona Game and Fish Department, State Historic Preservation Office) and tribal agencies. Changes in management of visitor use on the Colorado River from Lees Ferry to Lake Mead may affect the operations of these entities.

Since 2000, Grand Canyon National Park, Lake Mead National Recreation Area, and the Hualapai Tribe have met to address management issues from ***upstream of*** National Canyon (RM 165) to the Grand Canyon/Lake Mead boundary (RM 277) by developing mutually agreed on operational and management protocols for the “area of cooperation.”

Management zones for the Lower Gorge reflect a broader range of recreational activities and increased use intensity in Zones 2, 3 and 4. The NPS and the Hualapai Tribe are cooperatively managing the impacts of increased use, including enforcement of boating regulations, commercial activities, natural and cultural resource management and potential user conflicts.

Park staffing levels may not be adequate to manage changes in river use or river use issues.

4.6.2 GUIDING REGULATIONS AND POLICIES

The Division of Visitor and Resource Protection oversees emergency medical services and river patrol operations, including enforcement of environmental and safety regulations. NPS *Management Policies 2001* (NPS 2000a) provide guidance for visitor safety and emergency response (sec. 8.2.5) and law enforcement (sec. 8.3). Management of commercial activities, boating and environmental regulations are addressed in 36CFR 7.4.

The Concessions Division currently manages 16 concession contracts for commercial river trips between Lees Ferry, in Glen Canyon National Recreation Area, and Temple Bar, in Lake Mead National Recreation Area. Concession operations are subject to the provisions of the 1998 NPS Concessions Management Improvement Act; NPS regulations published at 36 CFR Part 51; Chapter 10 of NPS *Management Policies 2001* (NPS 2000a); and Director's Order 89A: Concession Management. Changes in the management of commercial river use resulting from adoption of the final plan would be reflected in prospectuses for future commercial river concession contracts.

The Science Center is responsible for managing the natural and cultural resources in the river corridor. NPS *Management Policies 2001* (NPS 2000a) provide guidance for Natural Resources Management (Chapter 4); Cultural Resources Management (Chapter 5); Wilderness Preservation and Management (Chapter 6); and Use of Parks (Chapter 8).

The Division of Maintenance Trail Crew oversees maintenance of trails and facilities in the backcountry and along the Colorado River corridor. The following sections of NPS *Management Policies 2001* (NPS 2000a) provide guidance for these activities: "Trails in Wilderness" (sec. 6.3.10.2), "Backcountry Use" (sec. 8.2.2.4), and "Hiking Trails" (sec. 9.2.3.2). The park's *Backcountry Management Plan* (NPS 1988) describes trail maintenance standards.

Guidelines for interpretation and educational programs are provided in Chapter 7 of NPS *Management Policies 2001* (NPS 2000a), which direct the NPS to disseminate the mission and goals of Grand Canyon National Park, and the history and significance of its resources, to the public.

4.6.3 MANAGEMENT OBJECTIVES FOR PARK MANAGEMENT AND OPERATIONS

Objectives for park operations are derived from the *General Management Plan* objectives and are as follows: (1) manage and monitor visitor use and park resources to preserve and protect natural and cultural resources and ecosystem processes, and to preserve and maintain a wilderness experience or primitive experience; (2) establish indicators and standards for desired visitor experiences and resource conditions, monitor their condition, and take action to meet the standards if they are not being met; and (3) provide a variety of primitive recreational opportunities consistent with wilderness and NPS policies on accessibility.

The *Colorado River Management Plan* has the following objectives for park management and operations: 1) Ensure sufficient fiscal and human resources are available to implement the revised river management plan; and 2) ***Minimize the adverse effects of administrative use on natural and cultural resources, visitor experience, and wilderness character in the river corridor***.

Current Grand Canyon National Park river corridor programs and operations are summarized in Chapter 3. At present, short-term project funding supports most of the programs. Implementing new river management operations would require short-term funding for implementation and long-term funding to ensure that management objectives, including the protection of park resources and quality visitor experiences, are met.

4.6.4 METHODOLOGY FOR ANALYZING EFFECTS TO PARK MANAGEMENT AND OPERATIONS

The general process for assessing impacts is discussed in the "Introduction" to Chapter 4. For this analysis, park management and operations are the human and fiscal resources available to protect and preserve natural and cultural resources along the Colorado River corridor and provide for safe and enjoyable visitor experiences. The discussion of impacts to park management and operations focuses on rangers and other staff that ensure visitor and employee safety and opportunities for quality experiences, as well as the ability of the resource management staff and trail crew to protect and preserve resources at current staffing and funding levels. Park staff evaluated the impacts of each alternative and based the analysis on current park management and operations presented in Chapter 3.

4.6.4.1 IMPACT THRESHOLDS

Effects on park management and operations are characterized for each alternative based on impact thresholds below. Each alternative was evaluated to determine if effects are direct or indirect.

Intensity

Negligible—Colorado River management and operations would not be affected or the effect would not be apparent to park staff or the public.

Minor—Adverse: Impacts would be measurable but would not have an appreciable effect on or consequences for park management and operations.

Beneficial: Impacts would result in short-term improvements in park management and operations.

Moderate—Adverse: Impacts would be readily apparent and would result in a measurable change in park management or operations in a manner noticeable to staff and the public.

Beneficial: Impacts would result in short- to long-term improvement in park management and operations.

Major—Adverse: Impacts would be readily apparent and would result in a substantial change in river management or operation in a manner noticeable to staff and the public.

Beneficial: Impacts would result in long-term improvement in park management and operations.

Context

Localized—Effects would be realized at specific sites or locations.

Regional—Effects would be realized at several sites and/or locations and would be applicable to one or more management zones.

Duration

Short-term—Effects would occur in a period less than one year, based on short-term funding.

Long-term—Effects would be realized for the life of the plan (up to 10 years).

Timing

Effects would be realized year-round, especially in shoulder (spring and fall) and winter months where use patterns and levels vary from current management.

4.6.4.2 MITIGATION OF EFFECTS

A list of possible mitigation measures to be considered singly or in combination, that are not already incorporated into the alternatives, but are judged likely to reduce impacts to park operations if implemented include the following:

- Increase staff and funding to support visitor and employee safety through education and enforcement of environmental and boating regulations.
- Increase staff and funding to support resource inventory and monitoring programs.
- Increase staff and funding to support resource restoration activities, including campsite and trail maintenance and rehabilitation, native and non-native vegetation management, sensitive and endangered species protections, and archeological site preservation.
- Develop and foster partnerships to inventory and monitor resources and to mitigate impacts to natural and cultural resources.

4.6.4.3 Cumulative Impacts

Cumulative impacts on park management and operations were determined by combining the impacts of each alternative with other past, present and reasonably foreseeable future action (see the "Introduction" to Chapter 4 for detailed list of all actions).

4.6.4.4 Assumptions

The general assumptions used for analysis of effects for each alternative are discussed in the "Introduction" to Chapter 4. Assumptions that specifically relate to the alternatives in this document and their effect on park management and operations are presented below.

- In order to mitigate site-specific resource concerns from changes in visitor use, it is expected that additional funding and staff would be needed. Site-specific concerns would be addressed under each resource impact topic.
- Currently, river operations primarily occur from March through October. Resource management and trails maintenance trips may occur year-round, but fieldwork occurs primarily during from fall through spring. Implementation of a plan that includes year-round recreational use would, at a minimum, involve increased visitor education, river trip orientations and river patrols.
- The impacts to park management and operations are directly proportional to the level of visitation. Trips at one time, people at one time, group size, trip length, and launch patterns estimate the level of visitation.

4.6.4.5 Actions Common to All Alternatives

The following actions are common to all alternatives, including Lees Ferry Alternative A, No Action:

- Administrative river trips, including park management activities, patrols, research, educational and other use, would continue to be evaluated through the park review and approval process. Administrative use of motorized transportation and equipment would be evaluated under the minimum tool policy.
- If a new noncommercial permit system is selected, additional staff time and resources would be needed to design and implement it. Short-term impacts would be major and

include substantial costs and increased staff time to transition from the current waiting list system to the preferred option. Implementation of a new noncommercial permit system would result in major short-term impacts and moderate long-term impacts to park management and operations. These impacts would be adverse in terms of park staffing and costs, but beneficial in terms of providing quality customer service.

- If a new concession contract or contracts were awarded, additional staff time would be required to administer and supervise such contracts.

4.6.5 IMPACT ANALYSIS—LEES FERRY ALTERNATIVES

4.6.5.1 ALTERNATIVE A (EXISTING CONDITION)

4.6.5.1.1 Analysis

Management of recreational use would continue to allow large group sizes, long trips, and spikes in daily launches and use intensity (see Table 4- 1). User-days would remain capped at current levels, which would result in approximately the same number of total annual recreational users.

River management programs and operations would continue at approximately the same level as present. The same level of service, monitoring, oversight, and management activities would continue. There would be no changes in the ability to ensure employee and visitor health and safety; the ability to protect and preserve park resources; and the ability to provide quality visitor services and experiences.

Most river management activities have been funded through short-term project funding and extensive use of volunteers and grants, rather than long-term base funding. Each division has a small number of permanent staff that is involved with river management. Approximately 10 FTEs (i.e., full time equivalents, or the amount of work equivalent to one-person year) in the Visitor and Resource Protection Division are directly devoted to river patrols, permits administration, and river trip put-in (Lees Ferry) and takeout (Meadview) operations. Normal recurring costs related directly to river management are more difficult to quantify in other park divisions, because these duties are related to parkwide activities and programs. It is estimated that the other park divisions currently devote 6-7 FTEs to river operations; volunteers and cooperators donate at least twice that many additional FTEs on projects in the river corridor.

However, most of the monitoring, resource preservation and maintenance activities along the river corridor are not being accomplished. For example, inventory and monitoring programs prescribed in the 1989 *Colorado River Management Plan* and 1997 Resource Management Plan have only been conducted on a limited basis due to funding and staffing constraints, which are expected to continue.

Because Glen Canyon and Lake Mead national recreation areas have many of the same funding and staffing constraints as Grand Canyon National Park, cooperative management efforts between national park system units at Lees Ferry and Meadview would continue to be limited. The river education facility at Lees Ferry is inadequate, but no improvements would be expected.

The 60-mile stretch of river from ***upstream of*** National Canyon to Diamond Creek is within the Area of Cooperation where the NPS and the Hualapai Tribe are cooperating on resource management. These cooperative efforts would continue under the No Action Alternative. The NPS and the Hualapai Tribe would also cooperatively manage congestion and public safety at the Diamond Creek takeout area.

4.6.5.1.2 Mitigation of Effects

Actions required to mitigate effects would include ***a subset*** of the mitigation measures identified in the "Methodology for Analyzing Effects to Park Management and Operations: Mitigation of Effects" section above. Additional mitigation actions would include:

- Continue current efforts to seek short-term funding to support resource management ***and research*** efforts, including cooperative funding with other federal agencies and institutions
- Continue cooperative resource monitoring efforts with the Hualapai Tribe
- Provide NPS support to the Hualapai Tribe at Diamond Creek for visitor education and launch ramp management

Reasonable implementation of mitigation measures would require additional staffing and funding.

4.6.5.1.3 Cumulative Effects

The impacts of Glen Canyon Dam on beaches would continue to have adverse, long-term, major impacts on resource management, especially river corridor archeological site preservation, and vegetation and campsite management. There would be minor adverse impacts to river corridor campsites shared by backpackers and river users, which would not be addressed. The current management would continue to have direct, short- and long-term, beneficial and adverse impacts on cooperative management efforts with the Hualapai Tribe within the Area of Cooperation. Continued use of the Whitmore helicopter pad would have negligible effects on park operations; impacts to current management of Grand Canyon Parashant National Monument would be negligible at the Whitmore trailhead area. Cumulatively, the effects of Alternative A, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year round, moderate to major effects on park operations. Alternative A would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.6.5.1.4 Conclusion

There would be little or no change from current park management and operations. Deficiencies in current staffing and budget would continue and not all of the activities prescribed in Grand Canyon visitor use and resource management plans would be implemented. This would result in adverse impacts that would be negligible in the short-term and moderate in the long-term; impacts would be measurable and noticeable to park staff and the public. If staffing and budget were increased to levels needed to address all of the mandates, there would be measurable, beneficial, long-term, moderate impacts on park operations and the public. Cumulative effects of Alternative A, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year round, moderate to major effects on park operations. Alternative A would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.6.5.2 ALTERNATIVE B

4.6.5.2.1 Analysis

Recreational motor trips would be prohibited and group sizes, daily launch, user-days, and estimated total yearly passengers would be the lowest (see Table 4- 1). Trip lengths would be reduced from current conditions resulting in lower trips at one time. Passenger exchanges at Whitmore would not be allowed. The number of noncommercial summer launches would double compared to current conditions, but generally Alternative B would have the lowest use and smallest group sizes of any alternative.

Shoulder season and winter launches would not be significantly increased over the average current condition, so staffing and funding would need to be increased only slightly at those times to achieve similar levels of coverage as Lees Ferry Alternative A. However, current staffing and funding is considered inadequate to do all the activities that are mandated.

The reduced numbers of river users and trips could proportionally reduce visitor health and safety related-problems, and reduce the number of emergency situations on the river that park rangers respond to. There would be fewer ranger patrols for education and concession evaluations in the high-use seasons. Winter patrols would increase from current conditions.

Reduced numbers of trips and group size would reduce impacts to park resources from river recreation. Mitigation of impacts, such as social trail obliteration and vegetation damage, would be more successful under this alternative. There would be a continued need for administrative river trips for routine maintenance activities (e.g., trail maintenance, revegetation) resource monitoring, and other management actions. Administrative use of motorized craft for research or other management activities would be evaluated through the minimum tool analysis. However, because this is a no-motor alternative, it would be more difficult to gain approval for administrative motor use.

4.6.5.2.2 Mitigation of Effects

Actions required to mitigate effects would include ***a subset*** of the mitigation measures identified in the “Methodology for Analyzing Effects to Park Management and Operations: Mitigation of Effects” section above. Additional mitigation actions would include:

- Continue current efforts to seek short-term funding to support resource management ***and research*** efforts, including cooperative funding with other federal agencies and institutions
- Conduct river patrols during winter months
- Expand resource monitoring and maintenance programs to address year-round use
- Continue cooperative resource monitoring efforts with the Hualapai Tribe
- Provide NPS support to the Hualapai Tribe at Diamond Creek for visitor education and launch ramp management

Reasonable implementation of mitigation measures would require additional staffing and funding.

4.6.5.2.3 Cumulative Effects

The impacts of Glen Canyon Dam on beaches would continue to have adverse, long-term, major impacts on resource management, especially river corridor archeological site preservation, and vegetation and campsite management. However, lower levels of recreational use would not exacerbate impacts compared to current conditions. There would be minor beneficial impacts to management of backcountry use as a result of lower river use. Cooperative management efforts with the Hualapai Tribe would be beneficial and moderate due to reduced resource impacts on Tribal lands, and reduced crowding and conflicts at the Diamond Creek takeout area. Cumulatively, the effects of Alternative B, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year round, moderate to major effects on park operations. Alternative B would result in a localized, beneficial, short- to long-term, seasonal to year-round, negligible to minor contribution to these cumulative effects.

4.6.5.2.4 Conclusion

Alternative B would require minor to moderate changes from current conditions. This would result in short-term minor to long-term moderate adverse impacts on park operations. Staffing levels would remain at current levels, although river patrols and Lees Ferry operations would occur throughout the year (compared to current 8-9 month operations). Resource monitoring and routine management activities would continue at current levels, but the mitigation of natural and cultural resource impacts would probably be more successful with lower use, resulting in beneficial long-term effects on resources in the river corridor. Cumulative effects of Alternative B, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year round, moderate to major effects on park operations. Alternative B would result in a localized, beneficial, short- to long-term, seasonal to year-round, negligible to minor contribution to these cumulative effects.

4.6.5.3 ALTERNATIVE C

4.6.5.3.1 Analysis

Commercial and noncommercial nonmotor trips would be allowed year-round. Commercial group size would be reduced, and maximum trip lengths would be shorter than current conditions. This alternative would have the highest number of winter and shoulder user-days, and winter passengers. Only Alternative G would have a higher number of recreational passengers in spring and fall. This alternative would nearly double the number of noncommercial launches and allow only half the current number of commercial summer launches. Both sectors would have an equal number of launches in the summer and winter. Shoulder season use would be increased for commercial launches. Winter launches would be more than double the current number of launches.

The total number of recreational trips from March to October would be reduced from current. The smaller commercial group size would result in a reduction in recreational use. The increase in recreational use during the winter months would increase the potential for visitor health and safety related-problems and the need for park staff to respond to emergency situations. Ranger patrols for education and concession evaluations would be similar to current levels, but extended through the winter.

While commercial group size and annual number of commercial passengers would be reduced, the number of annual trips, recreational users and user-days would increase over the current situation. The increased number of visitors in the shoulder and winter months would increase the potential for impacts to park resources. High-use levels would offset any mitigation of impacts, such as social trail obliteration and vegetation damage. Administrative river trips would be needed for routine maintenance activities (e.g., trail maintenance, revegetation) resource monitoring, and other management actions, possibly at higher levels in the winter months.

Under this alternative, trips could conduct hiking-only exchanges at Whitmore. The Whitmore Trail is about 1.3 miles from the river to the rim and boundary with the Grand Canyon-Parashant National Monument (Lake Mead National Recreation Area). The trail would require improvement and more frequent maintenance than at present.

Administrative use of motorized craft for research or other management activities would be evaluated through the minimum tool analysis. However, because this is a no-motor alternative, it would be more difficult to gain approval for administrative motor use.

4.6.5.3.2 Mitigation of Effects

Actions required to mitigate effects would include ***a subset*** of the mitigation measures identified in the "Methodology for Analyzing Effects to Park Management and Operations: Mitigation of Effects" section above. Additional mitigation actions would include:

- Continue current efforts to seek short-term funding to support resource management ***and research*** efforts, including cooperative funding with other federal agencies and institutions

- Conduct river patrols during winter months
- Expand resource monitoring and maintenance programs to address year-round use
- Continue cooperative resource monitoring efforts with the Hualapai Tribe
- Provide NPS support to the Hualapai Tribe at Diamond Creek for visitor education and launch ramp management
- Cooperatively manage Whitmore trailhead area with Grand Canyon-Parashant National Monument and Lake Mead National Recreation Area. ***Assess*** human health and safety issues by ***consider*** providing basic facilities, such as shade structures and primitive toilets

Reasonable implementation of mitigation measures would require additional staffing and funding.

4.6.5.3.3 Cumulative Effects

The impacts of Glen Canyon Dam on beaches would continue to have adverse, long-term, major impacts on resource management, especially river corridor archeological site preservation, and vegetation and campsite management. The increased levels of use from fall through spring may exacerbate resource impacts compared to current conditions. There would be negligible impacts to management of backcountry use. Increased winter use would have a moderate impact on NPS and Hualapai Tribe cooperative management efforts. Resource protection and monitoring programs would need to be expanded. The nonmotor river trips would likely result in increased takeouts at Diamond Creek, resulting in moderate to major effects on launch area management. Whitmore hiker exchanges would have major effects on current management of the Whitmore trailhead within the Grand Canyon-Parashant National Monument. The trailhead is accessed by a primitive 9-mile road from the Bar 10 Ranch. There are no facilities or water at the trailhead area. Cumulatively, the effects of Alternative C, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year round, moderate to major effects on park operations. Alternative C would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.6.5.3.4 Conclusion

Alternative C would require moderate to major changes from current conditions. This would result in short-term major to long-term moderate adverse impacts on park operations. The significant increase in winter use could result in a major impact. The effects would have long-term adverse impacts requiring additional staff and funding to support visitor use management, routine maintenance, and resource monitoring programs. River patrols for visitor education and concessions evaluations would occur throughout the year, and trail maintenance would be more frequent and require additional staff and funding. Resource monitoring would be required at a higher level than current due to the increase in visitor use during from fall through spring. If adequate funding and staff were available to implement this alternative, there would be a short-term adverse impact for implementation, and a long-term beneficial effect on river management programs. Lack of funding or staff would be an adverse impact to park management and operations. Cumulative effects of Alternative C, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year round, moderate to major effects on park operations. Alternative C would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.6.5.4 ALTERNATIVE D

4.6.5.4.1 Analysis

This is a mixed motor and nonmotor alternative with the lowest commercial group size. The maximum trip lengths would be shorter than current and motorized use would be allowed in winter and summer only. The number of daily summer launches would be similar to the current average and includes 3-4 small (8 person) noncommercial launches each week.

Increased winter use would increase the potential for visitor health and safety related problems and the need for park staff to respond to emergency situations. Ranger patrols would be similar to current levels during the summer and shoulder months, but would increase in the winter months.

While the commercial group size and annual number of commercial passengers would be reduced, the total number of annual trips, recreational users and user-days increases over current conditions. The increased number of visitors in the shoulder and winter months would increase the potential for impacts to resources, but at a lower level than Alternative C. Mitigation of impacts, such as social trail obliteration and vegetation damage, would not have as great a chance for success compared to current conditions. There would be a continued need for administrative river trips for routine maintenance activities (e.g., trail maintenance, revegetation) resource monitoring, and other management actions, but at higher levels in the winter months.

Trips are permitted to conduct hiking-only exchanges at Whitmore; the trail would require an upgrade and more frequent maintenance than at present.

4.6.5.4.2 Mitigation of Effects

Actions required to mitigate effects would include ***a subset*** of the mitigation measures identified in the “Methodology for Analyzing Effects to Park Management and Operations: Mitigation of Effects” section above. Additional mitigation actions would include:

- Continue current efforts to seek short-term funding to support resource management ***and research*** efforts, including cooperative funding with other federal agencies and institutions
- Conduct river patrols during winter months
- Expand resource monitoring and maintenance programs to address year-round use
- Continue cooperative resource monitoring efforts with the Hualapai Tribe

- Provide NPS support to the Hualapai Tribe at Diamond Creek for visitor education and launch ramp management
- Cooperatively manage Whitmore trailhead area with Grand Canyon-Parashant National Monument and Lake Mead National Recreation Area. ***Assess*** human health and safety issues by ***consider*** providing basic facilities, such as shade structures and primitive toilets

Reasonable implementation of mitigation measures would require additional staffing and funding.

4.6.5.4.3 Cumulative Effects

The impacts of Glen Canyon Dam on beaches would continue to have adverse, long-term, major impacts on resource management, especially river corridor archeological site preservation, and vegetation and campsite management. The increased levels of use in shoulder and winter months could exacerbate impacts compared to current conditions. Effects of this alternative on backcountry management would be negligible. Resource protection and monitoring programs would need to be expanded. Increased winter use would have a moderate impact on NPS and Hualapai Tribe cooperative management efforts. The NPS management presence at Diamond Creek would be expanded into winter, resulting in moderate effects on launch area management. Cooperative management efforts with the Hualapai Tribe would be beneficial due to reduced resource impacts on Tribal lands and reduced crowding and conflicts at the Diamond Creek takeout area. Whitmore hiker exchanges would have major effects on current management of the Whitmore trailhead within the Grand Canyon-Parashant National Monument. The trailhead is accessed by a primitive 9-mile road from the Bar 10 Ranch. There are no facilities or water at the trailhead area. Cumulatively, the effects of Alternative D, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year round, moderate to major effects on park operations. Alternative D would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.6.5.4.4 Conclusion

Alternative D would require moderate to major changes from current conditions. This would result in short-term moderate to long-term minor adverse impacts on park operations, requiring additional staff and funding to support visitor use management, routine maintenance, and resource monitoring programs. River patrols for visitor education and concessions evaluations would occur throughout the year. Upgrading the Whitmore Trail would have short-term adverse impact on park operations, but long-term beneficial effects. Trail maintenance would be more frequent and require additional staff and funding. Resource monitoring and routine maintenance activities would be required more frequently than current conditions due to the overall increased use. If adequate funding and staff were available to implement this alternative, there would be a short-term adverse impact for implementation, and a long-term beneficial effect on river management programs. Lack of funding or staff would be an adverse impact to park management and operations. Cumulative effects of Alternative D, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year round, moderate to major effects on park operations.

Alternative D would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.6.5.5 ALTERNATIVE E

4.6.5.5.1 Analysis

This is a mixed motor and no-motor alternative that would provide winter use opportunities for up to 11 noncommercial trips each week. Alternatives E and G would have the shortest commercial trip lengths during the summer and shoulder months. Under this alternative there would be a difference in commercial motor and oar group sizes. No motors would be allowed from October through March. Whitmore helicopter exchanges would be allowed, but at the lowest levels during the mixed motorized/nonmotorized use period.

Increased winter use would increase the potential for visitor health and safety related problems and the need for park staff to respond to emergency situations. Ranger patrols would be similar to current levels during the summer and shoulder months, but would increase in the winter months.

While the commercial group size and annual number of commercial passengers would be reduced, the total number of annual trips, recreational users and user-days would increase over current conditions. The increased number of visitors from fall through spring would increase the potential for impacts to park resources, but at a lower level than Alternative C. Mitigation of impacts, such as social trail obliteration and vegetation damage, would have a greater chance for success under this alternative and would be similar to Alternative D. There would be a continued need for administrative river trips for routine maintenance activities (e.g., trail maintenance, revegetation) resource monitoring, and other management actions, but at higher levels in the winter months.

This alternative would allow Whitmore helicopter exchanges during the mixed motorized/nonmotorized period (April-September), but at a level significantly lower than current conditions. Similar to Alternatives C and D, hiking options would be allowed throughout the year, and the Whitmore Trail would require an upgrade and more frequent maintenance than at present.

4.6.5.5.2 Mitigation of Effects

Same as Alternative D.

4.6.5.5.3 Cumulative Effects

Same as Alternative D. Helicopter passenger exchanges at Whitmore could result in lower hiking use, but the impact to Grand Canyon-Parashant National Monument would be similar.

4.6.5.5.4 Conclusion

Alternative E would require moderate to major changes from current conditions. This would result in short-term moderate to long-term minor adverse impacts on park operations, the same as Alternative D. Seasonal use patterns would have an apparent, measurable effect on park staffing and funding levels.

4.6.5.6 ALTERNATIVE F

4.6.5.6.1 Analysis

This is a split year motorized/nonmotorized alternative. While nonmotorized trips would be allowed year-round, motorized trips are allowed only from January through June. This alternative would have the highest number of daily launches in May and June, and among the highest number of spring launch. Similar to Alternatives C, E and G, there would be a maximum of two daily launches in winter. This alternative would allow for longer motor trips and winter trips for commercial and noncommercial users. It would allow for helicopter exchanges at Whitmore at levels similar to current conditions, but only from January to June. Hiking exchanges at Whitmore would be allowed throughout the year.

Similar to Alternative E, increased winter use would increase the potential for visitor health and safety related problems and the need for park staff to respond to emergency situations. Ranger patrols would be similar to current levels during the summer and shoulder months, but would increase in the winter months.

4.6.5.6.2 Mitigation of Effects

Same as Alternative D.

4.6.5.6.3 Cumulative Effects

Same as Alternative D. Increased spring use would require better management of the Diamond Creek takeout.

4.6.5.6.4 Conclusion

Alternative F would require moderate to major changes from current conditions, similar to Alternatives D and E. This would result in short-term major to long-term moderate adverse impacts on park operations, due to the substantial shift in seasonal use levels (particularly spring). The change in seasonal use patterns would have an apparent and measurable effect on park staffing and funding. If adequate funding and staff were available to implement this alternative, there would be a short-term adverse impact for implementation, and a long-term beneficial effect on river management programs. Lack of funding or staff would be an adverse impact to park management and operations. There would be moderate to major effects from current conditions.

4.6.5.7 ALTERNATIVE G

4.6.5.7.1 Analysis

This is the highest use alternative. It would allow the largest commercial group size and highest number of daily launches for each season. It would have the shortest noncommercial trip lengths for summer and shoulder seasons. Helicopter exchanges would be allowed at Whitmore a rate similar to current conditions, but only from January through August when motorized trips would be allowed. Similar to other alternatives, the Whitmore hiking option is available year-round.

Increased winter and early spring use would increase the potential for visitor health and safety related problems and the need for park staff to respond to emergency situations. The higher number of trips in spring and fall would require a minimum of two additional FTE for patrol to conduct visitor education, enforcement and concession evaluations from March through October. Resource monitoring, routine maintenance (e.g. social trail obliteration, revegetation) and other resource management actions would need to be conducted more frequently, and would need more FTE dedicated to monitoring and mitigating visitor use impacts.

The high levels of use throughout the year would require additional staff to work cooperatively with the Hualapai Tribe to manage the Diamond Creek takeout. Nonmotorized takeouts would increase threefold from current levels.

4.6.5.7.2 Mitigation of Effects

Actions required to mitigate effects would include ***a subset*** of the mitigation measures identified in the "Methodology for Analyzing Effects to Park Management and Operations: Mitigation of Effects" section above. Additional mitigation actions would include:

- Continue current efforts to seek short-term funding to support resource management ***and research*** efforts, including cooperative funding with other federal agencies and institutions
- Conduct river patrols during winter months
- Expand resource monitoring and maintenance programs to address year-round use
- Continue cooperative resource monitoring efforts with the Hualapai Tribe
- Provide NPS support to the Hualapai Tribe at Diamond Creek for visitor education and launch ramp management
- Cooperatively manage Whitmore trailhead area with Grand Canyon-Parashant National Monument and Lake Mead National Recreation Area. ***Assess*** human health and safety issues by ***consider*** providing basic facilities, such as shade structures and primitive toilets

Reasonable implementation of mitigation measures would require additional staffing and funding.

4.6.5.7.3 Cumulative Effects

The impacts of Glen Canyon Dam on beaches would continue to have adverse, long-term, major impacts on resource management, especially river corridor archeological site preservation, and vegetation and campsite management. The increased levels of use in shoulder and winter months would exacerbate impacts as compared to current conditions. Effects of increased visitation during shoulder months would have moderate impacts on backcountry management. The increased annual use would have a moderate to major impact on the cooperative NPS and Hualapai Tribe management efforts. Resource protection and monitoring programs would need to be expanded, and management presence at Diamond Creek area would be expanded into winter. The effects of the Whitmore hiker exchanges would be the same as Alternative F. Cumulatively, the effects of Alternative G, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year round, moderate to major effects on park operations. Alternative G would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate to major contribution to these cumulative effects.

4.6.5.7.4 Conclusion

Alternative G would require major changes from current conditions that would be apparent to park management and the public. This would result in adverse, short- to long-term, ***major*** impacts on park operations, requiring additional staff and funding to support visitor use management, routine maintenance, and resource monitoring programs. If adequate funding and staff were available to implement this alternative, there would be a short-term adverse impact for implementation, and a long-term beneficial effect on river management programs. Lack of funding or staff would be an adverse impact to park management and operations. Cumulative effects of Alternative G, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year round, moderate to major effects on park operations. Alternative G would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate to major contribution to these cumulative effects.

4.6.5.8 *MODIFIED* ALTERNATIVE H (NPS *MODIFIED* PREFERRED ALTERNATIVE)

4.6.5.8.1 Analysis

This is a mixed motorized/nonmotorized alternative with varying commercial group sizes by season. For the summer months, commercial group size would be reduced and noncommercial launches would be increased, yet an ***estimated*** total number of recreational users would be ***reduced from*** current levels. The commercial group size would be reduced to 24 during the shoulder seasons, and only nonmotorized use would be allowed from September ***16*** through March ***30***. ***Passenger exchanges would be permitted at the Whitmore area from April through September.***

Increased winter and spring use would increase the potential for visitor health and safety related problems and the need for park staff to respond to emergency situations. Ranger patrols would be similar to current levels during the summer and fall, but would increase in the winter and spring.

The increased number of visitors in the shoulder and winter months increases opportunities for impacts to park resources from river recreation, but at a lower level than Alternatives C, F, and G. There would be a continued need for administrative river trips for routine maintenance activities (e.g., trail maintenance, revegetation) resource monitoring, and other management actions, but at higher levels in the winter months.

4.6.5.8.2 Mitigation of Effects

Actions required to mitigate effects would include ***a subset*** of the mitigation measures identified in the "Methodology for Analyzing Effects to Park Management and Operations: Mitigation of Effects" section above. Additional mitigation actions would include:

- Continue current efforts to seek short-term funding to support resource management ***and research*** efforts, including cooperative funding with other federal agencies and institutions
- Conduct river patrols during winter months
- Expand resource monitoring and maintenance programs to address year-round use
- Continue cooperative resource monitoring efforts with the Hualapai Tribe
- Provide NPS support to the Hualapai Tribe at Diamond Creek for visitor education and launch ramp management

Reasonable implementation of mitigation measures would require additional staffing and funding.

4.6.5.8.3 Cumulative Effects

The impacts of Glen Canyon Dam on beaches would continue to have adverse, long-term, major impacts on resource management, especially river corridor archeological site preservation, and vegetation and campsite management. The increased levels of use in the winter could exacerbate resource impacts compared to current conditions. There would be negligible impacts to management of backcountry use. Increased winter use would have a moderate impact on NPS and Hualapai Tribe cooperative management efforts. Resource protection and monitoring programs would need to be expanded. The NPS management presence at Diamond Creek would be expanded into winter, resulting in moderate effects on launch area management. Cooperative management efforts with the Hualapai Tribe would be beneficial due to reduced resource impacts on Tribal lands and reduced crowding and conflicts at the Diamond Creek takeout area. Cumulatively, the effects of ***Modified*** Alternative H, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year round, moderate to major effects on park operations. ***Modified*** Alternative H would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.6.5.8.4 Conclusion

Modified Alternative H would require moderate to major changes from current conditions that would be apparent to park management and the public. This would result in adverse, short- to long-term, moderate impacts on park operations, requiring additional staff and funding to support visitor use management, routine monitoring, and resource monitoring programs. If adequate funding and staff were available to implement this alternative, there would be short-term adverse impacts for implementation, and long-term beneficial impacts to river management programs. Cumulative effects of ***Modified*** Alternative H, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year round, moderate to major effects on park operations. ***Modified*** Alternative H would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.6.6 IMPACT ANALYSIS—LOWER GORGE ALTERNATIVES

The potential for impacts to park management and operations in the Lower Gorge is based on comparisons among Diamond Creek alternatives 1–5, which are distinct from the Lees Ferry alternatives.

The methodology including impact thresholds, cumulative impacts, and mitigation of effects used for the Lees Ferry alternatives apply to the Diamond Creek alternatives.

4.6.6.1 ACTIONS COMMON TO ALL ALTERNATIVES

Consistent with the cooperative efforts of the NPS and the Hualapai Tribe, the following common management actions apply to all Diamond Creek action alternatives:

- ***Work with*** the Hualapai Tribe ***to*** evaluate administrative use including NPS resource management, patrols, and research river trips launching from Diamond Creek. Administrative use of motorized equipment and transportation would be evaluated by a minimum tool analysis
- River trips takeouts and launches at Diamond Creek would be scheduled to reduce congestion and address safety issues, especially during peak use periods. This effort would require cooperative onsite management and would involve offsite education and outreach by the NPS and the Hualapai Tribe
- Daily launch and group size limits for HRR day use and overnight trips would be established. Noncommercial and educational group size limits would be set at 16 and are described in Chapter 2

4.6.6.2 ALTERNATIVE 1 (EXISTING CONDITION)

4.6.6.2.1 Analysis

Current activities and river trip characteristics would remain the same. River trip takeouts at Diamond Creek would be managed similar to present conditions, although with changes to takeout schedules. Group size limits and trip lengths for noncommercial and educational trips are 16 people maximum. HRR day use and overnight trips would have a maximum group size of 100 (all boats launching at once). Upriver travel to Separation Canyon would be allowed; pontoon use in the Quartermaster Area would be limited to levels agreed on between the Hualapai Tribe and NPS in 2000. The Hualapai Tribe placed the existing docks used by HRR and pontoon tours for passenger exchanges. These facilities are temporary and are often moved because of changing river and lake levels. The NPS does not manage or maintain the docks.

Park river operations and resource management activities are currently limited below Diamond Creek. Most park ranger patrols takeout at Diamond Creek. In the past 5 years, patrols average one trip per year through the Lower Gorge. The Meadview ranger routinely conducts patrols in the Lower Gorge from Lake Mead to Separation Canyon. One FTE is dedicated to the Lower Gorge management. The primary activities are visitor education, enforcement of boating and environmental regulations and management of takeouts. NPS resource management activities, including monitoring and maintenance, are infrequent and average less than one trip a year. As a result, resource and visitor use data are limited, and NPS management of trails, camps and sensitive resources is rare in this section of the river corridor. Shortages in staffing and funding for river management and operations contribute to the lack of NPS presence in the 51 miles of the Colorado River below Diamond Creek.

4.6.6.2.2 Mitigation of Effects

Actions required to mitigate effects would include ***a subset*** of the mitigation measures identified in the “Methodology for Analyzing Effects to Park Management and Operations: Mitigation of Effects” section above. Additional mitigation actions would include:

- Develop and implement Lower Gorge resource monitoring and preservation programs in cooperation with the Hualapai Tribe
- Provide boating, health and safety training opportunities for HRR river guides and boat operators
- Provide NPS support to the Hualapai Tribe at Diamond Creek for visitor education and launch ramp management
- Cooperatively design and install a temporary floating dock to accommodate the level of activity agreed to in 2000 and to ensure protection of resources within the river corridor. Implementation would be consistent with federal and state laws and regulations
- Continue current efforts to seek short-term funding to support resource management ***and research*** efforts, including cooperative funding with other federal agencies and institutions

Reasonable implementation of mitigation measures would require additional staffing and funding.

4.6.6.2.3 Cumulative Effects

The impacts of Glen Canyon Dam would be similar to those discussed under the Lees Ferry alternatives—adverse, long-term, major impacts on resource management, especially river corridor archeological site preservation, and vegetation and campsite management. The NPS river management actions would have direct impacts on the Hualapai Tribe's resource management and river operations. There are beneficial and adverse impacts, and they are described in specific resource impact discussions. The effects of current park management and operations on Hualapai tribal and Lake Mead operations would have a major beneficial impact because the park ranger currently conducts frequent patrols to address visitor safety and compliance with boating and environmental regulations. If this activity were to cease, it would be a major adverse impact to Lower Gorge river management. As Lake Mead levels decreased, upriver travel would decrease, and could affect visitor safety and congestion at the South Cove launch area. Cumulatively, the effects of Alternative 1, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, moderate to major effects on park operations. Alternative 1 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.6.6.2.4 Conclusion

There would be little or no change from current park management and operations. Deficiencies in current staffing and budget would continue and not all of the activities prescribed in park visitor use and resource management plans would be implemented. This would result in adverse, short-term, negligible impacts and adverse, long-term, major impacts that would be measurable and noticeable to park staff and the public. If staffing and budget were increased, this would be a moderate beneficial impact to park operations. Cumulative effects of Alternative 1, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, moderate to major effects on park operations. Alternative 1 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.6.6.3 ALTERNATIVE 2

4.6.6.3.1 Analysis

This is the lowest use action alternative for the Lower Gorge. There would be a maximum of five daily launches, including two HRR day use trips. Upriver travel would be restricted above RM 262; jetboat passenger exchanges would take place below this point. Pontoon tours would be prohibited. One campsite would be designated for HRR overnight trips; a low level of campsite development involving vegetation management would be allowed.

The number of recreational passengers launching from Diamond Creek would be reduced from one 10-boat trip of 100 people to three 3-boat trips of 30 people each. Two noncommercial trips could launch, although this use would remain at lower levels during the summer. Compared to Alternative 1, the reduced number of trips during peak summer months would result in less congestion at the Diamond Creek launch area. Limitations on upriver travel (to RM 262) would be a substantial change in NPS patrol operations compared to current limit (RM 240). Upriver travel restrictions impact jetboat services and may result in trips camping one an extra night in the canyon. This would increase user-nights over current conditions and could result in increased campsite impacts. The absence of pontoon boats in the Quartermaster area would be an apparent change in management and operations, especially for enforcement of boating safety regulations. There would continue to be a need for park monitoring and resource management to address impacts to campsites, attraction sites and trails.

4.6.6.3.2 Mitigation of Effects

Actions required to mitigate effects would include ***a subset*** of the mitigation measures identified in the "Methodology for Analyzing Effects to Park Management and Operations: Mitigation of Effects" section above. Additional mitigation actions would include:

- Develop and implement Lower Gorge resource monitoring and preservation programs in cooperation with the Hualapai Tribe
- Provide boating, health and safety training opportunities for HRR river guides and boat operators
- Provide NPS support to the Hualapai Tribe at Diamond Creek for visitor education and launch ramp management
- Conduct park ranger patrols from Lees Ferry to Lake Mead on a routine basis. ***Hire additional park staff as needed to support Lower Gorge management including river patrols, resource management and launch ramp management at Diamond Creek and Lake Mead***
- Continue current efforts to seek short-term funding to support resource management ***and research*** efforts, including cooperative funding with other federal agencies and institutions

Reasonable implementation of mitigation measures would require additional staffing and funding.

4.6.6.3.3 Cumulative Effects

The impacts of Glen Canyon Dam would be similar to those discussed under the Lees Ferry alternatives—adverse, long-term, major impacts on resource management, especially river corridor archeological site preservation, and vegetation and campsite management. NPS river management actions would have direct impacts on the Hualapai Tribe's resource management and river operations. There are beneficial and adverse impacts, and they are described in specific resource impact discussions. The effects of park river management and operations on Hualapai tribal and Lake Mead operations would have a moderate adverse impact because the park ranger patrols would be less frequent above RM 262. As Lake Mead levels decreased, recreational use from the lake would also decrease, affecting visitor safety and congestion at the South Cove launch area. Cumulatively, the effects of Alternative 2, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, moderate to major effects on park operations. Alternative 2 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.6.6.3.4 Conclusion

Alternative 2 would require minor to moderate changes from current conditions. This would result in adverse, short-term, major impacts on park operations, and beneficial, long-term, moderate impacts on visitor safety and resource management. There would be a substantial change in river patrol operations due to limits on upriver travel. Patrols in the upper canyon would have to continue below Diamond Creek to cover sections that the Meadview ranger currently patrols. Additional FTEs and funding to support these operations would result in beneficial, long-term, moderate impacts to operations; otherwise, with current staff and funding levels, impacts would be adverse and major. The lack of pontoon tour boats and upriver jetboat travel for commercial passenger exchange would result in a beneficial, moderate impact to park management due to decreased safety issues and visitor use conflicts. The effects on resource management activities would be moderate, short-term adverse impacts due to the expected increase in camping below RM 262. Otherwise, the effects of this alternative on resource management would be long-term, adverse minor impacts unless additional staffing and funding were allocated to meet the mandates of park resource management and visitor use plans. Cumulative effects of Alternative 2, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, moderate to major effects on park operations. Alternative 2 would result in a localized, adverse, short- to long-term, seasonal to year-round, minor to moderate contribution to these cumulative effects.

4.6.6.4 ALTERNATIVE 3

4.6.6.4.1 Analysis

There would be a maximum of seven daily launches in the summer, including three HRR day use trips; group size would be reduced to 30 from one trip of 100 people. Two HRR overnight trips could launch each day. Noncommercial trips could launch throughout the year. Two HRR day trips would be allowed during non-peak months. Two campsites would be designated below Separation Canyon for HRR trips with a medium level of campsite development (e.g., vegetation removal and limited storage of supplies). Upriver travel would be restricted above Separation Canyon (RM 240) with a maximum of four jetboat tow-outs each day. This alternative would include commercial jetboat tours permitted by Lake Mead and Grand Canyon. Pontoon tours would be allowed in the Quartermaster area with a maximum of 400 passengers per day. A small floating dock would be allowed near RM 263.

Compared to Alternatives 1 and 2, the increased number of launches would result in more congestion at the Diamond Creek launch area. Limitations on upriver travel (to RM 240) would be the same as current conditions, however the effects of the increased number of trips would be of moderate intensity. There could be short-term adverse impacts to park operations in Zone 2 (Diamond Creek to RM 260) until additional FTE become available. The number of daily pontoon tours would double in Zone 3 compared to Alternative 1. Along with the commercial passenger jetboat services, there would be a maximum of two jetboat tours each day. The level of use, especially in Zone 3, would have a major impact on park ranger patrols. It would require daily interaction with river users to ensure visitor safety, provide education and enforce environmental and boating regulations. The management of the dock facility at RM 263 would require cooperative efforts between the NPS and the Hualapai Tribe. The increased daily use would have a direct impact on natural and cultural resources. There would be an increased need for Grand Canyon and Hualapai monitoring and resource management actions to address impacts to camps, attraction sites and trails in the Lower Gorge.

4.6.6.4.2 Mitigation of Effects

Actions required to mitigate effects would include ***a subset*** of the mitigation measures identified in the "Methodology for Analyzing Effects to Park Management and Operations: Mitigation of Effects" section above. Additional mitigation actions would include:

- Develop and implement Lower Gorge resource monitoring and preservation programs in cooperation with the Hualapai Tribe
- Provide boating, health and safety training opportunities for HRR river guides and boat operators
- Provide NPS support to the Hualapai Tribe at Diamond Creek for visitor education and launch ramp management
- Cooperatively design and install a temporary floating dock to accommodate the level of activity agreed to in 2000 and to ensure protection of resources within the river corridor. Implementation would be consistent with federal and state laws and regulations
- ***Conduct park ranger patrols from Lees Ferry to Lake Mead on a routine basis. Hire additional park staff as needed to support Lower Gorge management including river patrols, resource management and launch ramp management at Diamond Creek and Lake Mead***
- Continue current efforts to seek short-term funding to support resource management ***and research*** efforts, including cooperative funding with other federal agencies and institutions

Reasonable implementation of mitigation measures would require additional staffing and funding.

4.6.6.4.3 Cumulative Effects

The impacts of Glen Canyon Dam would be similar to those discussed under the Lees Ferry alternatives—adverse, long-term, major impacts on resource management, especially river corridor archeological site preservation, and vegetation and campsite management. Coupled with the river traffic from the upper canyon, the increased number of launches would have direct major impacts on Diamond Creek launch management. NPS river management actions would have direct impacts on the Hualapai Tribe's resource management and river operations. There are beneficial and adverse impacts, and they are described in specific resource impact discussions. The effects of park river management and operations on Hualapai tribal and Lake Mead operations would have a major impact due to the substantial increase in NPS management presence. As Lake Mead levels decreased, recreational use from the lake would also decrease, affecting visitor safety and congestion at the South Cove launch area. Cumulatively, the effects of Alternative 3, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, moderate to major effects on park operations. Alternative 3 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate to major contribution to these cumulative effects.

4.6.6.4.4 Conclusion

Alternative 3 would require moderate to major changes from current conditions. This would result in adverse, short- and long-term, major impacts on park operations. There would be a substantial change in river patrol operations due to the increased number of daily launches, jetboat tours and pontoon tours. This would be short-term, major, adverse impacts on river patrol operations until more FTEs were secured to conduct additional patrols and manage the Lake Mead launch ramp. If two additional FTEs were secured, long-term impacts to park operations would be major and beneficial. The impacts on resource management activities would be major, long-term and adverse due to the expected increase in camping and off-river activities, and the need for substantial increases in staffing and funding to manage resources. Installation of a dock at RM 263 for pontoon and HRR passengers would be a short-term major impact to operations of the NPS and the Hualapai Tribe, but could be offset by long-term, beneficial impacts of protecting shoreline resources and ensuring visitor safety. Cumulative effects of Alternative 3, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, moderate to major effects on park operations. Alternative 3 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate to major contribution to these cumulative effects.

4.6.6.5 MODIFIED ALTERNATIVE 4 (NPS PREFERRED ALTERNATIVE)

4.6.6.5.1 Analysis

The number of HRR day-use launches would not be limited and could vary, although the maximum group size is 40, and the total number of passengers would be capped at 96 for the peak use months. This alternative would allow up to three HRR overnight trips of 20 people. It designates three campsites below Separation Canyon for HRR trips with a low level of campsite development (e.g., vegetation management). ***Upriver travel will be restricted. There would be a maximum of four jetboat pick-ups per day. Upriver travel will continue to be allowed below Separation Canyon***. During peak use periods, the commercial pick-ups could transport kayakers to RM 273 (near Hualapai boundary) where kayakers begin their downriver trip. Pontoon boat tours would be allowed in the Quartermaster area with a ***preliminary*** maximum of ***480*** passengers daily; ***with a potential increase to 600 passengers per day based on favorable performance reviews of concession operations and resource monitoring data. A formal*** floating dock would be allowed near RM 262.5.

The potential for congestion at Diamond Creek would be similar to Alternatives 1 and 3. Management of river trip takeouts and launches at Diamond Creek would be similar to Alternative 1, but with more scheduling. ***Limitations on upriver travel to RM 240 would be the same as current conditions, however the effects of the increased number of trips would be of be moderate intensity. There could be short-term adverse impacts to park operations in Zone 2 (until additional FTE become available.*** Designating campsites below Separation Canyon on river left for use by HRR trips would be a short-term adverse impact, but would provide long-term major beneficial impacts to the Hualapai Tribe and NPS cooperative river management activities. Pontoon boat tours would be conducted at ***higher*** levels than current operations. Management of the dock facility at RM 262.5 would require cooperative efforts between the NPS and the Hualapai Tribe. The increased daily use would have a direct impact on natural and cultural resources. There would be an increased need for Grand Canyon and Hualapai Tribe monitoring and resource management actions to address impacts to camps, attraction sites and trails in the Lower Gorge.

4.6.6.5.2 Mitigation of Effects

Actions required to mitigate effects would include ***a subset*** of the mitigation measures identified in the "Methodology for Analyzing Effects to Park Management and Operations: Mitigation of Effects" section above. Additional mitigation actions would include:

- Develop and implement Lower Gorge resource monitoring and preservation programs in cooperation with the Hualapai Tribe
- Provide boating, health and safety training opportunities for HRR river guides and boat operators
- Conduct park ranger patrols from Lees Ferry to Lake Mead on a routine basis. ***Hire additional park staff as needed to support Lower Gorge management including river patrols, resource management and launch ramp management at Diamond Creek and Lake Mead***
- Provide NPS support to the Hualapai Tribe at Diamond Creek for visitor education and launch ramp management
- Cooperatively design and install a temporary floating dock to ***safely*** accommodate the level of activity agreed to in 2000 and to ensure protection of resources within the river corridor. Implementation would be consistent with federal and state laws and regulations. ***This would eventually be replaced by a formal floating dock***
- Continue current efforts to seek short-term funding to support resource management ***and research*** efforts, including cooperative funding with other federal agencies and institutions

Reasonable implementation of mitigation measures would require additional staffing and funding.

4.6.6.5.3 Cumulative Effects

The impacts of Glen Canyon Dam would be similar to those discussed under the Lees Ferry alternatives—adverse, long-term, major impacts on resource management, especially river corridor archeological site preservation, and vegetation and campsite management. Coupled with river traffic from the upper canyon, the increased number of launches would have direct, major impacts on Diamond Creek launch management. ***NPS river management actions would have direct impacts on the Hualapai Tribe's resource management and river operations. There are beneficial and adverse impacts, and they are describe in specific resource impact discussions. The effect of park river management and operations on Hualapai tribal and Lake Mead operations would have a major impact due to the substantial increase in NPS management presence.*** As Lake Mead levels decreased, recreational use from the lake would also decrease, affecting visitor safety and congestion at the South Cove launch area. Cumulatively, the effects of ***Modified*** Alternative 4, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, moderate to major effects on park operations. ***Modified*** Alternative 4 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate ***to major*** contribution to these cumulative effects.

4.6.6.5.4 Conclusion

Modified Alternative 4 would require moderate to major changes from current conditions. This would result in adverse, short- to long-term, moderate to major impacts on park operations, and beneficial, long-term, moderate impacts on visitor safety and resource management. There would be a substantial change in the river patrol operations due to ***the increased number of daily launches and pontoon tours. This would be a short-term, major, adverse impact on river patrol operations until more FTEs were secured to conduct additional patrols especially in the Quartermaster area, and manage the Lake Mead launch ramp. If two additional FTEs were secured, long-term impacts to park operation would be major and beneficial. The impact on resource management activities would be major, long-term and adverse due to the expected increase in camping and off-river activities, and the need for substantial increases in staffing and funding to manage resources in this area of the park.*** Installation of a dock at RM 262.5 for pontoon and HRR passengers would be a short-term major impact to the NPS and Hualapai Tribe, but could be offset by long-term beneficial effects of protecting shoreline resources (reducing erosions) and ensuring visitor safety. Cumulative effects of ***Modified*** Alternative 4, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, moderate to major effects on park operations. ***Modified*** Alternative 4 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

4.6.6.6 ALTERNATIVE 5 (HUALAPAI TRIBE PROPOSED ACTION)

4.6.6.6.1 Analysis

Daily launches from Diamond Creek and campsite management actions would be the same as ***Modified*** Alternative 4. Upriver travel from Lake Mead would be allowed to RM 273 (Hualapai

Tribe–Grand Canyon boundary). Pontoon tours would be allowed in the Quartermaster area with a maximum of 960 passengers daily; a large floating dock would be located near RM 262.5.

Management of river trip takeouts and launches at Diamond Creek would be the same as ***Modified*** Alternative 4. Campsites management below Separation Canyon on river left for HRR trips would be a short-term, adverse impact to the NPS during implementation, but would provide long-term, major beneficial impacts to Hualapai Tribe and NPS management of Lower Gorge activities. Compared to other alternatives, the limits on upriver travel to RM 273 would be a significant change in Lower Gorge patrol operations, requiring upper canyon NPS patrols to continue below Diamond Creek, or NPS patrols to launch from Diamond Creek. Pontoon boat tours would occur at significantly higher levels in the Quartermaster area, and upriver travel from Lake Mead would end. However, there would be an overall increase in river boat traffic. Management of the dock facility at RM 262.5 would require cooperation between the NPS and the Hualapai Tribe. The increased daily use would have a direct impact on natural and cultural resources. There would be an increased need for Grand Canyon and Hualapai Tribe monitoring and resource management actions to address impacts to camps, attraction sites and trails in the Lower Gorge.

4.6.6.6.2 Mitigation of Effects

Actions required to mitigate effects would include ***a subset*** of the mitigation measures identified in the "Methodology for Analyzing Effects to Park Management and Operations: Mitigation of Effects" section above. Additional mitigation actions would include:

- Develop and implement Lower Gorge resource monitoring and preservation programs in cooperation with the Hualapai Tribe
- Provide boating, health and safety training opportunities for HRR river guides and boat operators
- Conduct park ranger patrols from Lees Ferry to Lake Mead on a routine basis. ***Hire additional park staff as needed to support Lower Gorge management including river patrols, resource management and launch ramp management at Diamond Creek and Lake Mead***
- Provide NPS support to the Hualapai Tribe at Diamond Creek for visitor education and launch ramp management
- Cooperatively design and install a temporary floating dock to accommodate the level of activity agreed to in 2000 and to ensure protection of resources within the river corridor. Implementation would be consistent with federal and state laws and regulations
- Continue current efforts to seek short-term funding to support resource management ***and research*** efforts, including cooperative funding with other federal agencies and institutions

Reasonable implementation of mitigation measures would require additional staffing and funding.

4.6.6.6.3 Cumulative Effects

The impacts of Glen Canyon Dam would be similar to those discussed under the Lees Ferry alternatives—adverse, long-term, major impacts on resource management, especially river corridor archeological site preservation, and vegetation and campsite management. Coupled with the river traffic from the upper canyon, the increased number of launches would have direct, major impacts on Diamond Creek launch management. NPS river management actions would have direct impacts on the Hualapai Tribe's resource management and river operations. There are beneficial and adverse impacts, and they are described in specific resource impact discussions. The effects of park river management and operations on Hualapai tribal and Lake Mead operations would have a major adverse impact because Meadview ranger patrols would be limited to below RM 273, and upper canyon ranger patrols would have to patrol below Diamond Creek. As Lake Mead levels decreased, recreational use from the lake would also decrease, affecting visitor safety and congestion at the South Cove launch area. Cumulatively, the effects of Alternative 5, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, moderate to major effects on park operations. Alternative 5 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

4.6.6.6.4 Conclusion

Alternative 5 would require major changes from current conditions. This would result in adverse short- to long-term, moderate to major impacts on park operations. There would be a substantial change in the Lower Gorge river patrol operations due to upriver travel limits above RM 273. This would have a long-term, major adverse impact on river patrol operations and would require upper canyon patrols to continue below Diamond Creek; it would limit Meadview ranger patrols to about 5 miles of river within the park. This would also have an adverse impact on visitor safety and resource management activities. Increased pontoon use in the Quartermaster area could be a greater safety concern, but this could be offset by the lack of upriver travel from Lake Mead. Installation of a dock at RM 262.5 for pontoon and HRR passengers would be a short-term, major impact to the NPS and the Hualapai Tribe, but this could be offset by long-term, beneficial impacts of protecting shoreline resources and ensuring visitor safety. Cumulative effects of Alternative 5, when combined with other past, present, and reasonably foreseeable actions, would result in regional to localized, adverse, short- to long-term, seasonal to year-round, moderate to major effects on park operations. Alternative 5 would result in a localized, adverse, short- to long-term, seasonal to year-round, moderate contribution to these cumulative effects.

4.7 IMPACTS ON ADJACENT LANDS

4.7.1 ISSUES

As noted in the 1979 *Colorado River Management Plan*/EIS, the river corridor and its recreational use are influenced to varying degrees by agencies and American Indian tribes that administer or manage lands and resources adjacent to Grand Canyon National Park. River running, in turn, has the potential to affect management of these lands and resources. Numerous issues have been identified regarding adjacent lands, both in public scoping and in internal review. The primary issues are described below:

- Glen Canyon ***National Recreation Area*** is directly affected by the amount of launching activity at Lees Ferry, particularly in the high-use summer season. While congestion can cause logistical problems and delays for parties rigging boats, it does not prevent trips from launching on the day planned. Glen Canyon ***National Recreation Area*** staff routinely address indirect impacts of downriver use, such as vehicular traffic and parking problems; pressure on campground use; illegal camping near the ramp; and conflicts between downriver users, upriver users, and anglers.
- Trips that do not take out at Diamond Creek continue on to ***Pearce Ferry or in the current low water conditions continue on to*** South Cove on Lake Mead. For this reason Lake Mead and the Hualapai Tribe are both directly affected by launch schedules, trip lengths, and group sizes since they ultimately determine the level of use and crowding at the takeouts. Lake Mead and the Hualapai Tribe are also affected by allowable levels of upriver use from Lake Mead into the AOC.
- Impacts on Grand Canyon-Parashant National Monument are related to the number and types of exchanges allowed at the Whitmore exchange. Helicopters exchanges of commercial passengers at the Whitmore helipad and use of fixed-wing aircraft to fly them in and out of Bar 10 Ranch have a localized effect on the soundscape and air quality of the Monument. Additionally, hiking exchanges require maintenance of the Whitmore Trail within the park, which is used to access the rim from the river, and of the primitive roads that offer the only automobile access to neighboring communities.
- Some river recreationists venture onto Navajo Nation lands without the required tribal permit. The level of such trespass is limited by the relative paucity of accessible side canyons, campsites, and attraction sites in this reach. One attraction site, which is particularly sacred to the Navajo Nation and other tribes, is very heavily visited: the Little Colorado River. A considerably lower level of river-related use occurs on other Navajo Nation lands in the river corridor, but trespass still occurs in such places as Jackass Canyon and Eminence Break. The greatest potential for conflicts with Navajo Nation residents, and with land management on the Navajo Reservation, concerns non-permitted use of rim-to-river trails by noncommercial river runners. Adverse impacts resulting from use of these trails may include trespass on Navajo Nation lands, disturbance of local residents on the rim, erosion of unimproved roads, and disturbance of livestock. Other potential impacts to Navajo Nation resources include accumulations of human waste and litter, vandalism, social trailing, and damage to cultural resources. No data exist on the

amount of trespass that occurs or to what degree other types of impact to tribal lands can be attributed to river use.

- Some river recreationists venture onto Havasupai tribal lands without the required permit. Commercial passengers and guides make the 8-mile round-trip to Beaver Falls, or hike even farther to the more spectacular falls, but a larger proportion of noncommercial river runners make the hike because they have more time and less rigid schedules than their commercial counterparts. Some people also join or leave noncommercial trips by way of the Havasupai Reservation, although the number is relatively small. In addition to trespass, impacts of hikers on tribal lands may include accumulations of human waste and litter, vandalism, social trailing, and damage to cultural resources.
- Some river recreationists venture onto Hualapai tribal lands without the required tribal permit. Because of the length of river corridor bordered by Hualapai tribal lands (108 miles) and the many campsites, accessible side canyons, and popular stops in that reach, the potential for trespass is high. The remoteness of the area and extreme difficulties of access effectively prevent tribal presence to enforce permit requirements. In addition to trespass, impacts of hikers on tribal lands include accumulations of human waste and litter, vandalism, social trailing, and damage to cultural resources. The Hualapai Indian Reservation is also affected by helicopter ***transport of*** passengers exchanging at the Whitmore helipad, levels of use in the Lower Gorge, and use of Diamond Creek road for takeouts and launches. For an analysis of impacts associated with these topics, see the “Socioeconomic,” “Visitor Use and Experience,” “Natural Soundscape,” and “Air Quality” sections of this chapter. The following only concerns the issue of trespass and associated impacts.

4.7.2 GUIDING REGULATIONS AND POLICIES

Guiding regulations and policies specific to adjacent lands reflect the management guidance for ***Grand Canyon National Park,*** Glen Canyon, Lake Mead, and adjacent tribal lands. Management guidance for Glen Canyon is provided by the 1979 Glen Canyon National Recreation Area General Management Plan and the Strategic Plan for Glen Canyon National Recreation Area and Rainbow Bridge National Monument, October 1, 2000–September 30, 2005. The recreation area is also preparing a Colorado River Recreation Report that will provide information to help determine the types and amounts of use that are appropriate on the river. Glen Canyon staff manages most of the Lees Ferry area, but activities associated with downstream river running are the responsibility of the park. Written Standard Operating Procedures and a Memorandum of Understanding govern coordination between the two national park system units.

Use of boat ramps and facilities in Lake Mead by river runners, and upriver travel into Grand Canyon from Lake Mead, require close coordination between Lake Mead and Grand Canyon. In an arrangement similar to the one at Lees Ferry, Lake Mead and Grand Canyon have Standard Operating Procedures and a Memorandum of Understanding in place to facilitate coordination.

The Hualapai Tribe occupies a 992,463-acre reservation south of the Colorado River. According to a Memorandum of Understanding between the Hualapai Tribe, Grand Canyon, and Lake Mead signed in September 2000:

> The Hualapai Tribe and the DOI [U.S. Department of the Interior] disagree on the location of the boundary between the Hualapai Indian Reservation and GRCA…. Accordingly, both the Hualapai Tribe and DOI claim jurisdictional authority from about River Mile 164.5 to about River Mile 273.5 from the center of the river to the highwater [sic] mark on river left….To reduce further conflict on this issue, and to work towards a productive relationship, the parties have committed themselves to mutual management of an Area of Cooperation [AOC] to minimize the practical and operational impact of the boundary dispute….The initial AOC as mutually agreed upon by the parties includes the area from the high water mark to high water mark from about River Mile 164.5 to River Mile 277 and that part of Lake Mead from River Mile 277 to Pearce Ferry. (MOU 2000: p. 2)

Management issues pertaining to the AOC are addressed in meetings of a standing federal-tribal Core Team, which includes representatives of the Hualapai Tribe, Grand Canyon National Park, and Lake Mead National Recreation Area. Primary committees of the Core Team address issues of law enforcement, permitting, fire management, and revision of the river management plan, among others. Procedural steps for facilitating negotiation and consensus building among the parties are outlined in the MOU. ***The MOU for the Area of Cooperation is in effect, although Core Team Meetings were suspended in October 2004.***

Consultation with American Indian tribes ***as part of the Colorado River Management Plan revision process is*** discussed in detail in Chapter 5 of this document.

4.7.3 MANAGEMENT OBJECTIVES FOR ADJACENT LANDS

Management objectives for adjacent lands as they relate to management of recreational river use in the Grand Canyon are as follows:

- Minimize adverse effects from river management to areas outside of the park.
- Minimize adverse effects of adjacent land activities on park resources and river activities.
- Work cooperatively with the Hualapai Tribe and other adjacent land managers on alternatives and implementation of the final plan.

4.7.4 METHODOLOGY FOR ANALYZING EFFECTS TO ADJACENT LANDS

The general process for assessing impacts to adjacent lands focuses on the issues previously identified in this chapter. Analysis of environmental consequences identifies the types and degree of effects associated with visitor use management variables on each of the issues and assesses how effects would change with the implementation of each alternative. Analysis focuses on management issues that are not analyzed in the impact analysis for the various resource topics, although impacts to resources that affect adjacent lands are summarized where appropriate.

Analysis of impacts was based on the interaction of context, duration, timing, and intensity of visitor impacts. Intensity of impacts, both regional and local, was defined using specific impact thresholds.

4.7.4.1 Impact Thresholds

The general process for assessing impacts to the environment is discussed in the "Introduction" to Chapter 4. Effects specific to adjacent lands are characterized for each alternative based on the impact thresholds defined below. Additionally, each alternative was evaluated to determine whether effects would be direct or indirect.

Intensity

Negligible—The impact would be barely detectable and/or would affect few neighbors.

Minor—The impact would be slight, but detectable, and/or would affect a minority of neighbors.

Moderate—The impact would be readily apparent and/or would affect many neighbors.

Major—The impact would be severely adverse or exceptionally beneficial and/or would affect the majority of neighbors.

Context

Localized—Impacts would be restricted to specific resources, facilities, locations, or operations

Regional—Impacts would occur to several specific facilities, locations, or operations within a management zone. This could also include impacts to facilities, locations or operations of regional significance.

Duration

Short-term—Effects would occur for a period of less than 1 year.

Long-term—Effects would occur for the life of the plan (10 years or longer).

Timing

Impacts have varying degrees of effect based on when they occur.

4.7.4.2 Mitigation of Effects

Consultations with American Indian tribes as part of the revision of the *Colorado River Management Plan* identified that visitor impacts to cultural and natural resources are a concern on adjacent lands. Impacts from river related visitor use are unknown, but thought to be similar, albeit greatly reduced from the main canyon environment itself. Reasonable mitigations for impacts to specific impact topics are presented in the Environmental Consequences section of each impact topic.

A list of possible mitigation measures to be considered singly or in combination, that are not already incorporated into the alternatives, but are judged likely to reduce impacts to adjacent lands if implemented include the following:

- ***Assess the need to increase*** staffing at access points for adjacent lands
- Increased education about Tribal and Agency boundaries and permitting processes
- Increased efforts to ensure visitors have proper permits outside the park
- Scheduling takeouts

4.7.4.3 CUMULATIVE IMPACTS

Cumulative impacts on adjacent lands were determined by combining the impacts of each alternative with other past, present, and reasonably foreseeable future actions (see Chapter 4 for detailed list of all actions). Specific cumulative impacts are discussed. Grand Canyon National Park, Lake Mead National Recreation Area, and the Hualapai Tribe would continue to derive benefit from cooperative management of the Lower Gorge within the Core Team process. Similarly, Grand Canyon National Park, Glen Canyon National Recreation Area, and Lake Mead National Recreation Area benefit from respective memorandums of understanding that facilitate coordination and management of river facilities. These cooperative efforts result in localized, beneficial, long-term, minor to moderate impacts to Grand Canyon National Park and its adjacent lands.

4.7.4.4 ASSUMPTIONS

General assumptions used for analysis of effects from each alternative are discussed in the "Introduction" to Chapter 4. Assumptions that specifically relate to the plan alternatives and their effect on adjacent lands are presented below:

- Launch schedules, group sizes, and trip lengths affect the degree of use and crowding at put-ins, exchange points, takeouts, and attraction sites on adjacent lands. The interaction of these variables, and the indicators (trips at one time, user discretionary time) that result from that interaction were used to determine the effects of crowding in Glen Canyon, Lake Mead, and the Hualapai Tribe.
- Impacts on Grand Canyon-Parashant National Monument were assessed by considering the number, types, and schedule of exchanges at the Whitmore exchange. ***The NPS has the authority to regulate passenger exchanges but it has no control over how visitors exit the canyon once they have left the Park. For alternatives that present separate caps for hiking and helicopter exchanges, it is assumed that the NPS and the Hualapai Tribe would cooperatively establish a means to regulate the numbers and types of exchanges at Whitmore. The NPS has no authority over helicopter flights on Hualapai Land.***
- The effects of river recreation on adjacent tribal lands result from both authorized and unauthorized visitation. Based on consultations with tribal representatives (see Chapter 5), adverse impacts resulting from this access include disturbance of local residents,

erosion of unimproved roads, and disturbance of livestock, accumulations of human waste and litter, vandalism, social trailing, and damage to cultural and natural resources. Tribal permit fees can help to mitigate these impacts, but because of the remoteness of the river corridor and its adjacent lands, tribal permit systems are difficult to implement and enforce. Under current conditions, NPS rangers inform river visitors that they are required to pay trespass fees to the appropriate tribal jurisdictions when visiting tribal lands, but anecdotal evidence suggests that many do not. It is assumed that changes in use patterns in each alternative cannot be adequately correlated with unpermitted access onto tribal lands, given that increased education and enforcement of the permitting process serves to reduce trespass and assure acknowledgment of tribal laws and sovereignty. Because this is an issue of concern that has been raised by several tribes, it is assumed that an increase in education and enforcement of permit process will be common to all action alternatives.

- Potential conflicts between recreation users and researchers would be similarly mitigated under each alternative through increased education of researchers and the public. Additionally, conflicts over campsites would be reduced as all of the action alternatives reduce spikes in crowding by implementing a launch based system.
- Recreational use of the Colorado River in Grand Canyon National Park would affect management of Glen Canyon Dam only to the extent that the BOR would have to consider potential impacts of dam operations on river running when making decisions. Coordination between recreational river use and dam operations would continue to be achieved through the Glen Canyon Dam Adaptive Management Program. It is anticipated that any potential conflicts between river use and dam operations would be resolved within an existing venue.
- Some river runners may leave or join river trips by way of a number of trails with access on adjacent US Forest Service lands. The amount of river-related use that may occur is unknown but it is anticipated to be very little. For example, the Nankoweap Trail is long, difficult, and requires a lengthy drive over primitive roads to reach the trailhead, making it unattractive as an easy route to meet a river trip. It is assumed that a low level of trespass from river users would occur on the Kaibab National Forest, regardless of the alternative.
- Similarly, river runners (primarily noncommercial) cross BLM land to the north and west of Grand Canyon while leaving or joining river trips. The amount of such use is unknown, but these routes are relatively difficult to access on the rim, and use is thought to be by a very small percentage of river runners.
- Management of recreational river use of the Colorado River directly influences the socioeconomic conditions of the Hualapai Tribe, given that Diamond Creek is a primary takeout, and the Hualapai Tribe manages a variety of operations in the Lower Gorge and Whitmore. An analysis of socioeconomic effects on the Hualapai Tribe is presented in "Impacts on Socioeconomic Conditions."
- Grand Canyon West (GCW) is a 9,000 acre tour-related facility operating on the Hualapai Reservation under the Grand Canyon Resort Corporation (GCRC), which is wholly owned by the Hualapai Tribe. Development plans for GCW include airport expansion, road and view-point access improvements, construction of cluster lodging,

employee housing, camping and RV sites. Current GCRC operations include Hualapai River Runner (HRR) trips, pontoon tours (with helicopter access), helicopter rim-to-river tours, van tours to Diamond Creek and GCW, hotel and ranch accommodations, and excursions to GCW facilities and overlooks. Of these operations, only the HRR and pontoon trips, which access the Colorado River as it passes through Grand Canyon National Park, are included within the scope of the *Colorado River Management Plan*. All other GCRC operations are conducted on sovereign Hualapai tribal lands and are not under the purview of this plan.

- Due to the topography of the Lower Gorge, it is assumed that a low level of trespass from river users would occur in Lake Mead and on Hualapai tribal land, regardless of the alternative. Increased education and improvements to permitting systems will be addressed in the implementation plan.
- It is assumed that, because Lower Gorge alternatives offer a range of opportunities that are consistent with lake use as addressed in the Lake Mead Lake Management Plan, upriver use would have a negligible effect on the management of Lake Mead, regardless of the alternative.
- Impacts to adjacent lands in the Lower Gorge are addressed in the analysis of Lees Ferry alternatives presented below, in the assumptions stated above, or in resource-specific analysis of the Lower Gorge alternatives as presented in each section of Chapter 4, Environmental Consequences. Because these discussions sufficiently address all identified impacts to adjacent lands specific to Lower Gorge alternatives, a separate analysis of Lower Gorge alternatives is not presented in this Section.
- ***All transport of fuel (motor, jet, helicopter, other) in Grand Canyon National Park or Lake Mead National Recreational Area will be conducted in accordance with commercial operating requirements, noncommercial operating requirements, concession contracts or other agreements with NPS. Transport of fuel must adhere to all applicable regulations for the storage and transport of petrochemicals. Potential impacts from the transport and storage of fuel are discussed in the Water Quality section of this chapter.***

4.7.5 IMPACT ANALYSIS—LEES FERRY ALTERNATIVES

4.7.5.1 ALTERNATIVE A (EXISTING CONDITION)

4.7.5.1.1 Analysis

The most noticeable effect to adjacent lands under Alternative A is from overall use and crowding at put-ins, exchange points, takeouts, and attraction sites on adjacent lands. Launches per day is one of the most important factors in assessing and addressing issues of encounters with other groups, congestion at launch and takeout sites and at attraction sites. Put-ins and takeouts have limited space as well as limited staff to manage visitors. Current conditions result in launch delays, visitor conflicts with ramp staff and other visitors, oversights in health and safety procedures, lost revenue for commercial operators who miss scheduled takeouts, and physical impacts to ramps and associated facilities.

Under current conditions, up to nine trips can launch in the summer and up to seven trips can launch in the fall shoulder season from Lees Ferry in a single day. Large groups (up to 43 passengers) compound the problem of congestion created by these spikes in use. Up to six trips take out per day at Diamond Creek, which has the capacity to comfortably accommodate only two takeouts at a time, given that HRR trips are launching from the same beach. Up to 11 trips take out on peak days at the South Cove dock, which reasonably accommodates 5 trip takeouts per day. There is currently no procedure for scheduling takeouts at either Diamond Creek or Lake Mead. Because impacts on adjacent lands from spikes in use are noticeable to staff, operators, and visitors, the effect is moderate, adverse, short-term and localized. The effects are limited to the high-use summer season and the month of September, which has more use than the remainder of the shoulder seasons.

Impacts on Grand Canyon-Parashant National Monument (Parashant) depend on the number, type, and schedule of exchanges allowed at the Whitmore exchange. There are currently no limits on helicopter use for passenger exchanges at Whitmore (currently, approximately 6,800 passengers end and 3,500 passengers begin their trips by helicopter). Nearly all of the helicopter exchanges occur in May, June, July, and August, a small number of exchanges in April, September, and October (see Chapter 3). ***The Whitmore exchange*** (RM 187) is on ***river left*** and consists of a boat tie-up area and nearby helicopter landing pad. It is used by commercial trips as an exchange location for passengers to begin/end their river trip with a 6- minute helicopter flight to and from the Bar-10 Ranch ***through Hualapai tribal land***. The Bar-10 Ranch is located 10-miles north of the rim and provides river runners with a pre- and post-trip base for helicopter transport in and out of the Canyon. Impacts from helicopter exchanges to Parashant are primarily restricted to helicopter noise, which is inconsistent with the wilderness characteristics for which the monument manages. Spikes in helicopter exchanges result in up to 5 river trips exchanging per day, with large trips taking up to 1.5 hours to shuttle all passengers in and out. This use results in a short-term, adverse, moderate, localized effect that occurs primarily in the summer months.

Passengers also have the option of hiking up the Whitmore trail (river right) to the rim on a 1.3 mile, 1,200 vertical feet trail. The hike up the Whitmore trail takes the average hiker less than an hour (less than 30-minutes coming down), but the hike is hot during the summer months and road access is limited. This trail offers access to the Bar-10 Ranch via a 9-mile, unimproved road through BLM lands. Access to St. George, Utah from the ranch is via an 80 mile unimproved dirt road that passes through Parashant National Monument. Effects from hiking exchanges are primarily physical impacts to the Whitmore Trail and to the primitive road between St. George and the Bar-10 Ranch. Very few hiking exchanges occur under current conditions, thus this use results in a negligible localized effect.

Overall, Alternative A would result in a short-term, adverse, moderate, localized effect that occurs primarily in the summer months. This alternative does not meet the management objective of minimizing adverse effects from river management to areas outside of the park.

4.7.5.1.2 Mitigation of Effects

Actions needed to mitigate effects from access onto adjacent lands would include ***a subset*** of those discussed above (increased staffing at access points for adjacent lands, and increased education and enforcement of permitting processes, etc.). Scheduling of takeouts would somewhat mitigate the effects of crowding at takeout and launch facilities, but because current management of the river corridor allows substantial spikes in use, as well as the largest group sizes of any of the alternatives, it is unlikely that that mitigations would be implemented at a level sufficient to reduce impacts to a minor intensity. Similarly, while quiet technology for helicopters could mitigate some of the effects to the soundscape at the Whitmore exchange, spikes in use in this alternative make it unlikely that mitigations would be implemented at a level sufficient to reduce impacts to a minor intensity.

4.7.5.1.3 Cumulative Effects

Cumulatively, Lake Mead and the Hualapai Tribe would continue to derive the benefit of cooperative management of the Lower Gorge within the Core Team process. Similarly, Glen Canyon and Lake Mead benefit from respective memorandums of understanding that facilitate coordination and management of river facilities. These cooperative efforts result in beneficial, long-term, localized, minor to moderate impacts to Grand Canyon National Park and its adjacent lands. Cumulatively, the effects of Alternative A, when combined with these past, present, and reasonably foreseeable actions, would result in localized, adverse, long-term, minor to moderate effects to adjacent lands. Alternative A would result in a localized, adverse, long-term, moderate contribution to these cumulative effects.

4.7.5.1.4 Conclusion

Effects from Alternative A would be direct and measurable to adjacent lands and would result in short-term, adverse moderate effects to localized facilities. This effect would be most pronounced in the high-use summer seasons. Cumulatively, the effects of Alternative A, when combined with these past, present, and reasonably foreseeable actions, would result in localized, adverse, long-term, minor to moderate effects to adjacent lands. Alternative A would result in a localized, adverse, long-term, moderate contribution to these cumulative effects.

4.7.5.2 ALTERNATIVE B

4.7.5.2.1 Analysis

Under Alternative B, recreational motor trips and passenger exchanges at Whitmore are prohibited. Group sizes, maximum daily launches, and estimated total yearly passengers are the lowest of any of the alternatives (***see Table 4-*** 1). Implementation of a launch-based system eliminates spikes in use.

The most noticeable effect to adjacent lands under Alternative B is from the reduction in overall use and crowding at put-ins, exchange points, takeouts, and attraction sites on adjacent lands.

Under this alternative, launches per day are reduced from nine (current) to four in the summer and from seven (current) to two in the shoulder seasons. Reduction in group sizes from up to 43 passengers (current) to 25 similarly alleviates congestion. These factors, along with the implementation of scheduling of takeouts at Diamond Creek and Lake Mead, would effectively reduce congestion at river facilities associated with the *Colorado River Management Plan* on adjacent lands. Consequently, effects to these facilities would be localized, direct, short- to long-term, beneficial and minor to moderate. This effect would be most pronounced in the high-use summer season.

Because no exchanges, hiking or helicopter, are allowed in this alternative, impacts on Parashant would be localized, direct, short- to long-term, beneficial and minor to moderate. This effect would be most pronounced from current condition in the high-use summer season.

Overall, Alternative B would result in localized, direct, short- to long-term, beneficial and minor to moderate effect. This effect would be most pronounced from current condition in the high-use summer season. This alternative exceeds the management objective of minimizing adverse effects from river management to areas outside of the park.

4.7.5.2.2 Mitigation of Effects

Given that implementation of education and enforcement of permit systems is common to all action alternatives, no mitigation would be required for impacts to adjacent lands in Alternative B, which are not anticipated to reach moderate adverse impact thresholds.

4.7.5.2.3 Cumulative Effects

Cumulatively, Lake Mead and the Hualapai Tribe would continue to derive the benefit of cooperative management of the Lower Gorge within the Core Team process. Similarly, Glen Canyon and Lake Mead benefit from respective memorandums of understanding that facilitate coordination and management of river facilities. These cooperative efforts result in a localized, beneficial, long-term, minor to moderate impact to Grand Canyon National Park and its adjacent lands. Cumulatively, the effects of Alternative B, when combined with these past, present, and reasonably foreseeable actions, would result in localized, beneficial, long-term, moderate effects to adjacent lands. Alternative B would result in a localized, beneficial, long-term, moderate contribution to these cumulative effects.

4.7.5.2.4 Conclusion

Compared to current condition, Alternative B would result in localized, direct, short- to long-term, beneficial and minor to moderate effects. This effect would be most pronounced from in the high-use summer season. Cumulatively, the effects of Alternative B, when combined with other past, present, and reasonably foreseeable actions, would result in localized, beneficial, long-term, moderate effects to adjacent lands. Alternative B would result in a localized, beneficial, long-term, moderate contribution to these cumulative effects.

4.7.5.3 ALTERNATIVE C

4.7.5.3.1 Analysis

Under Alternative C, recreational motor trips and helicopter exchanges at Whitmore are prohibited, although hiking exchanges are permitted all year long. Group sizes and trip lengths are at lower levels than current, but estimated total user-days and user discretionary time are the highest of any of the alternatives (***see Table 4-*** 1***).*** Estimated yearly passengers increase from 22,461 (current) to 25,228. Implementation of a launch-based system eliminates spikes in use.

The most noticeable effect to adjacent lands under Alternative C is from the reduction in overall use and crowding at put-ins, exchange points, takeouts, and attraction sites on adjacent lands. Under this alternative, launches per day are reduced from nine (current) to four in the summer and from seven (current) to three in the shoulder seasons. Winter launches increase to 2 per day, but this level is considered negligible in regards to contributing to congestion at launch and takeout facilities. Reduction in group sizes from up to 43 passengers (current) to 30 similarly alleviates congestion. These factors, along with the implementation of scheduling of takeouts at Diamond Creek and Lake Mead, would effectively reduce congestion at river facilities associated with the *Colorado River Management Plan* on adjacent lands. Consequently, effects to these facilities would be localized, direct, short- to long-term, beneficial and minor to moderate. This effect would be most pronounced in the high-use summer season.

Because no helicopter exchanges are allowed in this alternative, noise impacts on Parashant would be localized, direct, short- to long-term, beneficial and minor to moderate.

Hiking exchanges would increase from current, but would be limited to 2,500 passengers hiking in and 2,500 passengers hiking out per year. Given that this number of exchanges did occur, it impacts to the Whitmore trail would probably be noticeable. Additionally, increased traffic on the access road would affect the primitive nature of the road and the surrounding landscape. Unauthorized camping in the vicinity of the trailhead would also likely increase. Effects to adjacent lands from this level of Whitmore hiking exchanges would be direct, localized, long-term, adverse and negligible to minor. It is assumed that most hiking exchange would occur in the cooler, off-season months.

Overall, Alternative C would result in localized, direct, short- to long-term, ***adverse (negligible to minor) and*** beneficial (minor to moderate) effects. This effect would be year-round, but would be most pronounced from current condition in the high-use summer season. This alternative exceeds the management objective of minimizing adverse effects from river management to areas outside of the park.

4.7.5.3.2 Mitigation of Effects

Assuming that implementation of education and enforcement of permit systems is common to all action alternatives, no mitigation would be required for impacts to adjacent lands in Alternative C, which are not anticipated to reach moderate adverse thresholds for impacts.

4.7.5.3.3 Cumulative Effects

Cumulatively, Lake Mead and the Hualapai Tribe would continue to derive the benefit of cooperative management of the Lower Gorge within the Core Team process. Similarly, Glen Canyon and Lake Mead benefit from respective memorandums of understanding that facilitate coordination and management of river facilities. These cooperative efforts result in a localized, beneficial, long-term, minor to moderate impact to Grand Canyon National Park and its adjacent lands. Cumulatively, the effects of Alternative C, when combined with these past, present, and reasonably foreseeable actions, would result in localized, beneficial, long-term, moderate effects to adjacent lands. Alternative C would result in a localized, beneficial, long-term, moderate contribution to these cumulative effects.

4.7.5.3.4 Conclusion

Overall, Alternative C would result in localized, direct, short- to long-term, ***adverse (negligible to minor) and*** beneficial (minor to moderate) effects. This effect would be year-round, but would be most pronounced from current condition in the high-use summer season. Cumulatively, the effects of Alternative C, when combined with these past, present, and reasonably foreseeable actions, would result in localized, beneficial, long-term, moderate effects to adjacent lands. Alternative C would result in a localized, beneficial, long-term, moderate contribution to these cumulative effects.

4.7.5.4 ALTERNATIVE D

4.7.5.4.1 Analysis

Under Alternative D, helicopter exchanges at Whitmore are prohibited, although hiking exchanges are permitted all year long. Group sizes and trip lengths are at lower levels than current, but estimated total user-days and user discretionary time are among the highest of any of the alternatives (see Table 4- 1). Estimated yearly passengers decrease from 22,461 (current) to 20,427 and estimated total user-days increases from 171,131 (current) to 223,314. Implementation of a launch-based system eliminates spikes in use.

The most noticeable effect to adjacent lands under Alternative D is from the reduction in overall use and crowding at put-ins, exchange points, takeouts, and attraction sites on adjacent lands. Under this alternative, launches per day are reduced from nine (current) to five in the summer and from seven (current) to three in the shoulder seasons. Reduction in group sizes from up to 43 passengers (current) to 25 similarly alleviates congestion. These factors, along with the implementation of scheduling of takeouts at Diamond Creek and Lake Mead, would effectively reduce congestion at river facilities associated with the *Colorado River Management Plan* on adjacent lands. Consequently, effects to these facilities would be localized, direct, short- to long-term, beneficial and minor to moderate. This effect would be most pronounced in the high-use summer season.

Because no helicopter exchanges are allowed in this alternative, noise impacts on Parashant would be localized, direct, short- to long-term, beneficial and minor to moderate. However, hiking exchanges would increase from current, but would be limited to 2,500 passengers hiking in and 2,500 passengers hiking out per year. If this number of exchanges did occur, impacts to the Whitmore trail would probably be noticeable. Additionally, increased traffic on the access road would affect the primitive nature of the road and the surrounding landscape. Unauthorized camping in the vicinity of the trailhead would also likely increase. Effects to adjacent lands from this level of Whitmore hiking exchanges would be direct, localized, long-term, adverse and negligible to minor. It is assumed that most hiking exchange would occur in the cooler, off-season months.

Overall, Alternative D would result in localized, beneficial, short- to long-term, and minor to moderate effects, as well as adverse, ***negligible to*** minor effects. Effects would be year-round, but would be most pronounced from current conditions in the high-use summer season. This alternative would exceed the management objective of minimizing adverse effects from river management to areas outside the park.

4.7.5.4.2 Mitigation of Effects

Assuming that implementation of education and enforcement of permit systems is common to all action alternatives, no mitigation would be required for impacts to adjacent lands in Alternative D, which are not anticipated to reach moderate adverse thresholds for impacts.

4.7.5.4.3 Cumulative Effects

Cumulatively, Lake Mead and the Hualapai Tribe would continue to derive the benefit of cooperative management of the Lower Gorge within the Core Team process. Similarly, Glen Canyon and Lake Mead benefit from respective memorandums of understanding that facilitate coordination and management of river facilities. These cooperative efforts result in a localized, beneficial, long-term, minor to moderate impact to Grand Canyon National Park and its adjacent lands. Cumulatively, the effects of Alternative D, when combined with these past, present, and reasonably foreseeable actions, would result in localized, beneficial, long-term, moderate effects to adjacent lands. Alternative D would result in a localized, beneficial, long-term, minor to moderate contribution to these cumulative effects.

4.7.5.4.4 Conclusion

Overall, Alternative D would result in localized, beneficial, short- to long-term, minor to moderate effects, as well as adverse, ***negligible to*** minor effects. This effect would be year-round, but would be most pronounced from current condition in the high-use summer season. Cumulatively, the effects of Alternative D, when combined with past, present, and reasonably foreseeable actions, would result in localized, beneficial, long-term, moderate effects to adjacent lands. Alternative D would result in a localized, beneficial, long-term, minor to moderate contribution to these cumulative effects.

4.7.5.5 ALTERNATIVE E

4.7.5.5.1 Analysis

Under Alternative E, helicopter exchanges at Whitmore are allowed during the 6 month motor season although hiking exchanges are permitted all year long. Group sizes and trip lengths are at lower levels than current, but user discretionary time is among the highest (see Table 4- 1). Estimated yearly passengers increase from 22,461 (current) to 23,812 and estimated total user-days increases from 171,131 (current) to 237,183. Implementation of a launch-based system eliminates spikes in use.

The most noticeable effect to adjacent lands under Alternative E is from the reduction in overall use and crowding at put-ins, exchange points, takeouts, and attraction sites on adjacent lands. Under this alternative, launches per day are reduced from nine (current) to six in the summer and from seven (current) to three in the shoulder seasons. Winter launches increase to 2 per day, but this level is considered negligible in regards to contributing to congestion at launch and takeout facilities. Reduction in group sizes from up to 43 passengers (current) to 30 similarly alleviates congestion. These factors, along with the implementation of scheduling of takeouts at Diamond Creek and Lake Mead, would effectively reduce congestion at river facilities associated with the *Colorado River Management Plan* on adjacent lands. Consequently, effects to these facilities would be localized, direct, short- to long-term, beneficial and minor. This effect would be most pronounced in the high-use summer season.

Helicopter exchanges are allowed in this alternative, but would be restricted to the six month no-motor season and would be limited to 2,500 passengers in and 2,500 out. This represents a substantial decrease from the approximately 6,800 passengers that end and 3,500 passengers that begin their trips by helicopter under current condition. Additionally, the launch schedule would eliminate spikes in use that result in days with longer periods of noise impacts from helicopter shuttles. The impacts on Parashant would be localized, direct, short- to long-term, beneficial and minor.

Hiking exchanges would be allowed year-round, but it is unclear how many passengers would choose to take this trip compared to current condition. Increases in hiking exchanges would result in impacts to the Whitmore trail. Additionally, increased traffic on the access road would affect the primitive nature of the road and the surrounding landscape. Unauthorized camping in the vicinity of the trailhead would also likely increase. Effects to adjacent lands from this level of Whitmore hiking exchanges would be direct, localized, long-term, adverse and negligible to minor. It is assumed that most hiking exchange would occur in the cooler, off-season months.

Overall, Alternative E would result in localized, beneficial, short- to long-term, minor effects, as well as adverse, minor effects. These effects would be year-round, but would be most pronounced from current condition in the high-use summer season. This alternative would meet the management objective of minimizing adverse effects from river management to areas outside of the park.

4.7.5.5.2 Mitigation of Effects

Assuming that implementation of education and enforcement of permit systems is common to all action alternatives, no mitigation would be required for impacts to adjacent lands in Alternative E, which are not anticipated to reach moderate adverse thresholds for impacts.

4.7.5.5.3 Cumulative Effects

Cumulatively, Lake Mead and the Hualapai Tribe would continue to derive the benefit of cooperative management of the Lower Gorge within the Core Team process. Similarly, Glen Canyon and Lake Mead benefit from respective memorandums of understanding that facilitate coordination and management of river facilities. These cooperative efforts result in a localized, beneficial, long-term, minor to moderate impact to Grand Canyon National Park and its adjacent lands. Cumulatively, the effects of Alternative E, when combined with these past, present, and reasonably foreseeable actions, would result in localized, beneficial, long-term, moderate effects to adjacent lands. Alternative E would result in a localized, beneficial, long-term, minor to moderate contribution to these cumulative effects.

4.7.5.5.4 Conclusion

Overall, Alternative E would result in localized, beneficial and adverse, short- to long-term, minor effects, particularly over current conditions. These effects would be year-round, but would be most pronounced from current condition in the high-use summer season. Cumulatively, the effects of Alternative E, when combined with these past, present, and reasonably foreseeable actions, would result in localized, beneficial, long-term, moderate effects to adjacent lands. Alternative E would result in a localized, beneficial, long-term, minor to moderate contribution to these cumulative effects.

4.7.5.6 ALTERNATIVE F

4.7.5.6.1 Analysis

Under Alternative F, helicopter exchanges at Whitmore are allowed during the 6 month motor season (January through June) although hiking exchanges are permitted all year long. Group sizes and trip lengths are at lower levels than current condition. User discretionary time is higher than current condition, but relatively low as compared to several other alternatives (see Table 4-1). Estimated yearly passengers increase from 22,461 (current) to 25,415 and estimated total user-days increases from 171,131 (current) to 235,146. Implementation of a launch-based system eliminates spikes in use.

The most noticeable effect to adjacent lands under Alternative F is from the reduction in overall use and crowding at put-ins, exchange points, takeouts, and attraction sites on adjacent lands. Under this alternative, launches per day are reduced from nine (current) to six in the summer and from seven (current) to four in the shoulder seasons. Winter launches increase to 2 per day, but this level is considered negligible in regards to contributing to congestion at launch and takeout facilities. Reduction in group sizes from up to 43 passengers (current) to 30 similarly alleviates congestion. These factors, along with the implementation of scheduling of takeouts at Diamond Creek and Lake Mead, would reduce congestion at river facilities associated with the *Colorado River Management Plan* on adjacent lands. Consequently, effects to these facilities would be localized, direct, short- to long-term, beneficial and negligible to minor. This effect would be most evident in the high-use summer season.

Helicopter exchanges are allowed in this alternative, but would be restricted to the six month no-motor season and would be limited to a total of 3,400 passengers in and 6,600 passengers out, although hiking would be allowed year-round. This represents a negligible decrease from the approximately 6,800 passengers that end and 3,500 passengers that begin their trips by helicopter under current condition. However, the launch schedule would eliminate spikes in use that result in days with longer periods of noise impacts from helicopter shuttles. The impacts on Parashant would be localized, direct, short- to long-term, beneficial and negligible to minor.

Hiking exchanges would be allowed year-round, but it is unclear how many passengers would choose to take this trip compared to current condition. Increases in hiking exchanges would result in impacts to the Whitmore trail. Additionally, increased traffic on the access road would affect the primitive nature of the road and the surrounding landscape. Unauthorized camping in the vicinity of the trailhead would also likely increase. Effects to adjacent lands from this level of Whitmore hiking exchanges would be direct, localized, long-term, adverse and negligible to minor. It is assumed that most hiking exchange would occur in the cooler, off-season months.

Overall, Alternative F would result in localized, beneficial and adverse, long-term, negligible to minor effects. These effects would be year-round, but would be most pronounced from current condition in the high-use summer season. This alternative meets the management objective of minimizing adverse effects from river management to areas outside of the park.

4.7.5.6.2 Mitigation of Effects

Actions needed to mitigate effects from access onto adjacent lands would include ***a subset*** of those discussed above (increased staffing at access points for adjacent lands, and increased education and enforcement of permitting processes, etc.). Scheduling of takeouts would mitigate the effects of crowding at takeout and launch facilities and quiet technology for helicopters and of exchanges could mitigate some of the effects to the soundscape at the Whitmore exchange. A monitoring program would need to be implemented to gather baseline data on impacts from noise and congestion. Levels of needed mitigation would be determined based on the results of the monitoring program.

4.7.5.6.3 Cumulative Effects

Cumulatively, Lake Mead and the Hualapai Tribe would continue to derive the benefit of cooperative management of the Lower Gorge within the Core Team process. Similarly, Glen Canyon and Lake Mead benefit from respective memorandums of understanding that facilitate coordination and management of river facilities. These cooperative efforts result in a localized, beneficial, long-term, minor to moderate impact to Grand Canyon National Park and its adjacent lands. Cumulatively, the effects of Alternative F, when combined with these past, present, and reasonably foreseeable actions, would result in localized, beneficial and adverse, long-term, moderate effects to adjacent lands. Alternative F would result in a localized, beneficial and adverse, long-term, minor contribution to these cumulative effects.

4.7.5.6.4 Conclusion

Compared to current condition, Alternative F would result in localized, beneficial and adverse, long-term, negligible to minor effects. However, use levels for variables that contribute to congestion at launch and takeout facilities, and that contribute to effects from helicopter exchanges ultimately result in a short-term, adverse, minor to moderate, localized effect that occurs primarily in the summer months. Cumulatively, the effects of Alternative F, when combined with past, present, and reasonably foreseeable actions, would result in localized, beneficial and adverse, long-term, moderate effects to adjacent lands. Alternative F would result in a localized, beneficial and adverse, long-term, minor contribution to these cumulative effects.

4.7.5.7 ALTERNATIVE G

4.7.5.7.1 Analysis

Under Alternative G, helicopter exchanges at Whitmore are allowed during the 8 month motor season (January through August) although hiking exchanges are permitted all year long. Group sizes are somewhat lower than current, but are higher than any of the other alternatives. Trip lengths are generally at the lowest levels of all of the alternatives, with the exception of noncommercial winter oar trips, which are still reduced to 21 from 30 (current condition). Yearly user discretionary time is higher than current condition, but is at the lowest levels of all the other alternatives (see Table 4- 1). Estimated yearly passengers increase from 22,461 (current) to 28,680 and estimated total user-days increases from 171,131 (current) to 249,910. Implementation of a launch-based system eliminates spikes in use.

The most noticeable effect to adjacent lands under Alternative G is from the reduction in overall use and crowding at put-ins, exchange points, takeouts, and attraction sites on adjacent lands. Under this alternative, launches per day are reduced from nine (current) to six in the summer and from seven (current) to five in the shoulder seasons. Winter launches increase to 2 per day, but this level is considered negligible in regards to contributing to congestion at launch and takeout facilities. Reduction in group sizes from up to 43 passengers (current) to 40 somewhat contributes to the alleviation of congestion. These factors, along with the implementation of scheduling of takeouts at Diamond Creek and Lake Mead, would reduce congestion at river facilities associated with the *Colorado River Management Plan* on adjacent lands. Consequently, effects to these facilities would be localized, direct, short- to long-term, beneficial and negligible to minor. This effect would be most evident in the high-use summer season.

Helicopter exchanges are allowed in this alternative, and could occur throughout the eight month no-motor season and would be limited to a total of 3,700 passengers in and 7,200 passengers out, although hiking would be allowed year-round. This represents an increase from the approximately 6,800 passengers that end and 3,500 passengers that begin their trips by helicopter under current condition. The launch schedule would eliminate spikes in use that result in days with longer periods of noise impacts from helicopter shuttles, but large trips would still require several shuttles to complete access. The impacts on Parashant would be localized, short- to long-term and negligible.

Hiking exchanges would be allowed year-round, but it is unclear how many passengers would choose to take this trip compared to current condition. Increases in hiking exchanges would result in impacts to the Whitmore trail. Additionally, increased traffic on the access road would affect the primitive nature of the road and the surrounding landscape. Unauthorized camping in the vicinity of the trailhead would also likely increase. Effects to adjacent lands from this level of Whitmore hiking exchanges would be direct, localized, long-term, and negligible. It is assumed that most hiking exchange would occur in the cooler, off-season months.

Overall, Alternative G would result in localized, short- to long-term, negligible effects. These effects would be year-round, but would be most evident from current condition in the high-use summer season. This alternative meets the management objective of minimizing adverse effects from river management to areas outside of the park.

4.7.5.7.2 Mitigation of Effects

Actions needed to mitigate effects from access onto adjacent lands would include ***a subset*** of those discussed above (increased staffing at access points for adjacent lands, and increased education and enforcement of permitting processes, etc.). Scheduling of takeouts would mitigate the effects of crowding at takeout and launch facilities and quiet technology for helicopters and of exchanges could mitigate some of the effects to the soundscape at the Whitmore exchange. A monitoring program would need to be implemented to gather baseline data on impacts from noise and congestion. Levels of needed mitigation would be determined based on the results of the monitoring program.

4.7.5.7.3 Cumulative Effects

Cumulatively, Lake Mead and the Hualapai Tribe would continue to derive the benefit of cooperative management of the Lower Gorge within the Core Team process. Similarly, Glen Canyon and Lake Mead benefit from respective memorandums of understanding that facilitate coordination and management of river facilities. These cooperative efforts result in a localized, beneficial, long-term, minor to moderate impact to Grand Canyon National Park and its adjacent lands. Cumulatively, the effects of Alternative G, when combined with these past, present, and reasonably foreseeable actions, would result in localized, beneficial and adverse, long-term, moderate effects to adjacent lands. Alternative G would result in a localized, beneficial and adverse, long-term, minor contribution to these cumulative effects.

4.7.5.7.4 Conclusion

Compared to current condition, Alternative G would result in localized, beneficial, short- to long-term, negligible effects. However, use levels for variables that contribute to congestion at launch and takeout facilities, and that contribute to effects from helicopter exchanges, would ultimately result in a localized, adverse, short-term, minor to moderate effect primarily in the summer months. Cumulatively, the effects of Alternative G, when combined with past, present, and reasonably foreseeable actions, would result in localized, beneficial and adverse, long-term, moderate effects to adjacent lands. Alternative G would result in a localized, beneficial and adverse, long-term, minor contribution to these cumulative effects.

4.7.5.8 MODIFIED ALTERNATIVE H (NPS PREFERRED ALTERNATIVE)

4.7.5.8.1 Analysis

Under ***Modified*** Alternative H, recreational motor trips are permitted ***from April 15 to September 15. Exchanges at Whitmore would be allowed from April through September.*** Group sizes are lower than current in the summer and considerably lower in the shoulder season. Trip lengths are lower than current condition, with some opportunities for longer trips in the winter season. Yearly user discretionary time is higher than current condition, but lower than several other alternatives (see Table 4- 1). Estimated yearly passengers increase from 22,461 (current) to ***24,657*** and estimated total user-days increases from 171,131 (current) to ***22,986*** Implementation of a launch-based system eliminates spikes in use.

The most noticeable effect to adjacent lands under ***Modified*** Alternative H is from the reduction in overall ***daily*** use and crowding at put-ins, exchange points, takeouts, and attraction sites on adjacent lands. Under this alternative, ***allowable*** launches per day are reduced from nine (current) to six in the summer. Reduction in group sizes from up to 43 passengers (current) to 32 in the summer and 24 in the non-summer months contributes to the alleviation of congestion. These factors, along with the implementation of scheduling of takeouts at Diamond Creek and Lake Mead, would reduce congestion at river facilities associated with the *Colorado River Management Plan* on adjacent lands. Consequently, effects to these facilities would be localized, direct, short- to long-term, beneficial and negligible to minor. This effect would be most evident in the high-use summer season.

Helicopter exchanges ***can occur*** in this alternative ***during the mixed-use season, with an extension to allow Whitmore exchanges for trips launching on or before September 15. Exchanges must occur before the 10:00 AM. Additionally, only concessioners currently offering this exchange may do so in the future.*** For passengers beginning their river trips at Whitmore, an estimated 3,635 would be transported in by helicopter and 400 would hike in for a total of 4,035 passengers entering the river corridor. Using ***the average percentage of total Lees Ferry passengers exchanging at Whitmore from 1998 to 2003***, this would result in an estimated 5,715 passengers exiting the river corridor at Whitmore ***(See Appendix K for more details about grandfathered use and Whitmore passenger exchange calculations)***.

Hiking ***exchanges can occur in this alternative during the motorized season, with an extension to allow for a Whitmore exchange for trips launching on September 15. Exchanges must occur before the 10:00 A.M. It is anticipated that about the same number of people will hike in or out of the canyon compared to current condition.*** Hiking exchanges would result in impacts to the Whitmore trail traffic on the ***primitive*** access road would affect the primitive nature of the road and the surrounding landscape as well as unauthorized camping in the vicinity of the trailhead***, but at the same level as current condition.*** These effects ***would result in negligible localized effects*** to adjacent lands ***during the motorized season.***

Overall, ***Modified*** Alternative H would result in beneficial localized, direct, short- to long-term, negligible to minor effects. These effects would be year-round, but would be most evident from current condition in the high-use summer season. This alternative meets the management objective of minimizing adverse effects from river management to areas outside of the park.

4.7.5.8.2 Mitigation of Effects

Actions needed to mitigate effects from access onto adjacent lands would include ***a subset*** of those discussed above (increased staffing at access points for adjacent lands, and increased education and enforcement of permitting processes, etc.). Scheduling of takeouts would mitigate the effects of crowding at takeout and launch facilities and quiet technology for helicopters and of exchanges could mitigate some of the effects to the soundscape at the Whitmore exchange. A monitoring program would need to be implemented to gather baseline data on impacts from noise and congestion. Levels of needed mitigation would be determined based on the results of the monitoring program.

4.7.5.8.3 Cumulative Effects

Cumulatively, Lake Mead and the Hualapai Tribe would continue to derive the benefit of cooperative management of the Lower Gorge within the Core Team process. Similarly, Glen Canyon and Lake Mead benefit from respective memorandums of understanding that facilitate coordination and management of river facilities. These cooperative efforts result in a localized, beneficial, long-term, minor to moderate impact to Grand Canyon National Park and its adjacent lands. Cumulatively, the effects of ***Modified*** Alternative H, when combined with these past, present, and reasonably foreseeable actions, would result in localized, beneficial, long-term, moderate effects to adjacent lands. ***Modified*** Alternative H would result in a localized, beneficial, long-term, minor to moderate contribution to these cumulative effects.

4.7.5.8.4 Conclusion

Compared to current condition, ***Modified*** Alternative H would result in beneficial localized, direct, short- to long-term, negligible to minor effects. However, use levels for variables that contribute to congestion at launch and takeout facilities, and that contribute to effects from helicopter exchanges ultimately result in a short-term, adverse, minor to moderate, localized effect that occurs primarily in the summer months. Cumulatively, the effects of ***Modified*** Alternative H, when combined with past, present, and reasonably foreseeable actions, would result in localized, beneficial, long-term, moderate effects to adjacent lands. ***Modified*** Alternative H would result in a localized, beneficial, long-term, minor to moderate contribution to these cumulative effects.

4.8 IMPACTS ON WILDERNESS CHARACTER

4.8.1 ISSUES

Issues and concerns regarding wilderness character from public scoping and management documents such at the 1995 General Management Plan include:

- ***Appropriate types of recreational opportunities consistent with the preservation of the natural and wilderness character of the river***
- ***Appropriate levels of visitor use consistent with the preservation and protection of natural and cultural resources and wilderness character***
- ***Provide outstanding opportunities for solitude or a primitive recreational experience***
- ***Management of administrative, scientific, and commercial activities in a manner compatible with preserving and protecting the wilderness character of the park and the river***

4.8.2 GUIDING REGULATIONS AND POLICIES

NPS Management Policies 2001 (NPS 2000a), provides direction for the management of areas suitable for wilderness designation. The public purpose of wilderness in national parks includes the preservation of wilderness character and resources, as well as for the purposes of recreational, scenic, scientific, educational, conservation, and historical use.

As described in Chapter 3, "wilderness character" is not specifically defined in law or policy. However, the definition of wilderness character is derived from the qualities or characteristics that defines wilderness in the Act. These characteristics, as described earlier in the document include: untrammeled, natural conditions, undeveloped, and outstanding opportunities for solitude or a primitive and unconfined type of recreation.

The General Management Plan outlines a vision for managing resources and visitor experience for undeveloped areas in the park. Areas recommended or eligible for wilderness designation, including the Colorado River, "offer visitors opportunities for solitude and primitive recreation. The management of these areas should preserve the wilderness values and character."

Guiding regulations and policies for natural and cultural resources and visitor use are described elsewhere in Chapter 4, Environmental Consequences.

4.8.3 MANAGEMENT OBJECTIVES FOR WILDERNESS CHARACTER

The NPS recognizes that wilderness is a composite resource with interrelated parts. (NPS 2000a). Natural and cultural resource and visitor experience management objectives for the General Management Plan and Colorado River Management Plan are included in Table 2 in Chapter 1. Management objectives for wilderness character are:

- ***Provide a range of recreational opportunities consistent with the preservation of wilderness character.***
- ***Manage administrative use in a manner consistent with the preservation of the wilderness character of the river***

4.8.4 METHODOLOGY FOR ANALYZING EFFECTS TO WILDERNESS CHARACTER

The general process for assessing impacts to the environment is discussed in the "Introduction" to Chapter 4. The analysis of impacts to wilderness character incorporates the impact analyses for all natural and cultural resources, and visitor use and experience. This impacts analysis will adopt the definition wilderness character to include the following qualities or characteristics of wilderness as described in Chapter 3:

- **Natural—*the wilderness ecosystem is substantially free from the effects of modern civilization. In the context of managing visitor use on the Colorado River, this characteristic pertains to the intended or unintended human-caused impacts to natural and cultural resources.***
- **Undeveloped—*the wilderness is essentially without permanent improvements or evidence of modern human occupation. This characteristic pertains to the presence and development levels of trails, campsites, structures and facilities within the river corridor and areas visited by river users. This also pertains to the types of management activities and how those activities are conducted (motorized transportation, mechanical tools, etc.).***
- **Outstanding opportunities for solitude or a primitive and unconfined type of recreation (Recreation opportunity characteristic)—*wilderness provides outstanding opportunities for people to experience solitude or primitive and unconfined recreation, including the values of inspiration and physical and mental challenge. This characteristic pertains to the recreational activities within the primitive setting and opportunities to experience solitude, natural sounds, adventure, and other recreational attributes.***

This impacts analysis will not include:

- ***Untrammeled—wilderness is essentially unhindered and free from modern human control or manipulation. This characteristic pertains to actions that manipulate or control ecological systems. The Colorado River corridor itself, specifically the riparian zone and near-shore habitats, have been greatly altered by Glen Canyon Dam and its operation.***

The relationship between this characteristic and impacts related to with Glen Canyon Dam operations are discussed in the Cumulative Impacts sections for each resource. Specific management actions such as wildlife manipulations (e.g., fish removal), associated with the Glen Canyon Dam Adaptive Management Program are not analyzed.

4.8.4.1 IMPACT THRESHOLDS

The analyses of impacts to wilderness character are qualitative and based on comment received during public scoping and review of literature regarding wilderness character and values of Colorado River users.

4.8.4.2 INTENSITY

Negligible—*Impacts would have no discernible effect on wilderness character. Natural conditions would prevail. There would be no permanent visual improvements or human occupation. There would be outstanding opportunities for solitude or a primitive and unconfined type of recreation.*

Minor—*Impacts would be slightly detectable within limited areas of the wilderness. Natural conditions would predominate. There would be no permanent visual improvements or human occupation. While there might be short-term impacts within the wilderness, over the long-term, outstanding opportunities for solitude or a primitive and unconfined type of recreation would prevail, but may vary by season.*

Moderate—*Impacts would be readily apparent within limited areas of the wilderness. It would be apparent that man has altered natural conditions within such areas. There would be no permanent visual improvements or human occupation. Outstanding opportunities for solitude or a primitive and unconfined type of recreation would be restricted in limited areas and during limited times of the year.*

Major—*Impacts would substantially alter the wilderness resource throughout the wilderness area. Natural conditions would have been substantially altered by man. Improvements made by man, while not permanent, would be long-term and become part of the landscape. Outstanding opportunities for solitude or a primitive and unconfined type of recreation would be restricted throughout the wilderness.*

The context, duration, and timing of impacts apply to the specific resources analyzed in previous sections of this chapter.

4.8.4.3 MITIGATION OF EFFECTS

Reasonable mitigations for impacts to natural and cultural resources and visitor experience are described in corresponding sections of Chapter 4.

4.8.4.4 CUMULATIVE IMPACTS

Cumulative impacts on wilderness character were determined by combining the impacts of each alternative with other past, present, and reasonably foreseeable future actions (see Section 4.1). Cumulative impacts are described for each alternative for natural and cultural resources and visitor use and experience.

4.8.4.5 ASSUMPTIONS

General assumptions used for analysis of effects from each alternative are discussed in the "Introduction" to Chapter 4. In addition, the term "wilderness" is used in a general manner and does not assume a category other than the Colorado River's recommended potential wilderness status.

The portion of the Colorado River recommended as potential wilderness can generally be described as beginning below Navajo Bridge and ending near Separation Canyon. The river segment near Phantom Ranch, as well as the Cross-canyon corridor is excluded from the wilderness recommendation. Most of Zone 1, Lees Ferry to Diamond Creek, is within the recommended potential wilderness. The north bank of the river below Separation Canyon serves as the wilderness boundary in that area of the park.

Backcountry toilets, facilities, and trails accessible to river users in the recommended wilderness will continue to managed under the park's Backcountry Management Plan. Changes to these actions will be addressed in a future planning efforts.

Placement of structures for scientific purposes, such as the cables above Phantom Ranch and Diamond Creek will be evaluated through minimum requirement protocols.

The existence and operation of Glen Canyon Dam has changed the visitor experience on the river by allowing year round access, changing biota, sediment supply and seasonality of flows. All of these components affect wilderness character.

4.8.5 IMPACT ANALYSIS – LEES FERRY TO DIAMOND CREEK

4.8.5.1 ALTERNATIVE A (EXISTING CONDITION)

4.8.5.1.1 Analysis

This impact topic brings together biophysical conditions (e.g., natural and undeveloped characteristics) with visitor experience (recreation characteristic). Under current conditions, large group sizes, spikes in use resulting in congestion and crowding , and a nine-month motor season would continue.

Natural. Impacts to natural resources and cultural resources would continue as described in those sections of the document. (See also summary in Table 2-4).

Undeveloped. The number and type of facilities and management activities would remain unchanged. Administrative activities such as patrols, resource management, research, and scientific activities would occur at similar levels. These activities would continue to be evaluated through the appropriate process, including the minimum requirement protocols. (See also summary in Table 2-4).

Recreation opportunity. Impacts to visitor use and experience would continue as described in this document. (See also summary in Table 2-4). Visitors would continue to experience larger group sizes, and motorized use for a large portion of the year. Visitors may experience noise from helicopter use in the Whitmore area.

4.8.5.1.2 Mitigation of Effects

Actions required to mitigate effects would include those listed for the specific resources; however, it is unlikely that mitigation would be implement at a level sufficient to reduce impacts to a minor intensity.

4.8.5.1.3 Cumulative Impacts

The cumulative effects from Glen Canyon Dam and commercial overflights are similar to those described for each resource elsewhere in this document. Management of backcountry toilets, trails and facilities described in the current Backcountry Management Plan would have adverse, localized, short term, year-round impacts on wilderness character.

4.8.5.1.4 Conclusion

Under Alternative A, the impacts to the natural, undeveloped, and recreation opportunity characteristics would continue to be detectable and measurable, especially in frequently visited areas along the river corridor. Natural conditions would predominate although impacts to individual natural and cultural resources are affected differently by season and location. The impacts to natural and cultural resources as summarized earlier in the document are adverse, localized, short to long term, seasonal to year-round, and minor to major. There would continue to be no permanent improvements along the river corridor in Zone 1 with the exception of the non-wilderness Phantom Ranch area. As summarized elsewhere in the document impacts to visitor experience under this alternative would be adverse, localized to regional, short to long term and negligible to major for some users, while impacts for other users would be beneficial, depending on perspectives and expectations. Impacts to the natural soundscape are adverse, localized, short-term, and minor to moderate, with major adverse impacts in the Whitmore area. The cumulative effects of Glen Canyon Dam operations would continue to have adverse, localized to regional, short to long-term impact on wilderness character. Overall, this alternative would provide a range of adverse, localized to regional, short-to long-term, seasonal to year round, minor to major impacts on wilderness character in

Zone 1. Impacts to the natural conditions and undeveloped character would be of minor intensity. For visitors seeking outstanding opportunities for solitude or a primitive and unconfined type of experience, the impacts would be adverse and of major intensity during the peak use periods, but minor to moderate during nonmotorized low use periods.

4.8.5.2 Alternative B

4.8.5.2.1 Analysis

Under Alternative B, recreational motor trips would be prohibited, and group size and overall use levels are at their lowest of any of the alternatives.

Natural. Impacts to natural resources and cultural resources are described in those sections of the document. (See also summary in Table 2-4).

Undeveloped. The number and type of facilities and management activities would be reduced from current conditions. Administrative activities such as patrols, resource management, research and scientific activities would occur at reduced levels. These activities would continue to be evaluated through the appropriate process, including the minimum requirement protocols.

Recreation opportunity. Impacts to visitor use and experience would continue as described in the Visitor Use and Experience section this chapter. (See also summary in Table 2-4) Visitors will experience lower use levels, small group sizes, and absence of motorized raft trips. Passengers would not be permitted to embark on or disembark from the river in the Whitmore area.

4.8.5.2.2 Mitigation of Effects

Actions required to mitigate effects would include those listed for the specific resources.

4.8.5.2.3 Cumulative Impacts

The cumulative effects from Glen Canyon Dam and commercial overflights are similar to those described for each resource elsewhere in this document. The cumulative effects of the management of backcountry toilets, trails and facilities described in the current Backcountry Management Plan would have adverse, localized, short term, year-round impacts on wilderness character.

4.8.5.2.4 Conclusion

Under Alternative B, the impacts to the natural, undeveloped, and recreation opportunity characteristics would continue to be detectable and measurable during the higher use periods and in the frequently visited areas along the river corridor. Natural conditions would

predominate although impacts to individual natural and cultural resources are affected differently by season and location. The natural and cultural resource impacts as summarized earlier in the document are adverse, localized, short to long term, seasonal to year-round, and negligible to major. There would continue be no permanent improvements along the river corridor in Zone 1 with the exception of the non-wilderness Phantom Ranch area. As summarized elsewhere in this document, impacts to visitor experience would be adverse, localized to regional, short to long term, and negligible to major for some users, while impacts for other users would be beneficial and moderate to major, especially for those seeking non-motorized opportunities. Impacts to the natural soundscape are adverse, localized, short-term, and negligible to minor with no helicopter impacts at Whitmore. The cumulative effects of Glen Canyon Dam operations would continue to have adverse, localized to regional, short to long-term impact on wilderness character. Overall, this alternative would provide a range of beneficial and adverse, localized to regional, short- to long-term, seasonal to year round negligible to moderate impacts on wilderness character in Zone 1; impacts to the natural conditions and undeveloped character would be of minor intensity. For visitors seeking outstanding opportunities for solitude or a primitive and unconfined type of experience, the impacts would be beneficial and of minor intensity during the peak use periods, but negligible during the non-summer months.

4.8.5.3 ALTERNATIVE C

4.8.5.3.1 Analysis

Under Alternative C, recreational motor trips are prohibited and group sizes are reduced from current. The number of users and user-days in the shoulder and winter months would be the highest among all alternatives.

Natural. Impacts to natural resources and cultural resources are described in those sections of this chapter. (See also summary in Table 2-4).

Undeveloped. The number and type of facilities and management activities would be reduced or similar to current conditions. Administrative activities such as patrols, resource management, research and scientific activities would occur at similar or slightly reduced levels. These activities would continue to be evaluated through the appropriate process, including the minimum requirement protocols.

Recreation opportunity. Impacts to visitor use and experience would continue as described in the Visitor Use and Experience section this chapter. (See also summary in Table 2-4). Visitors will experience smaller group sizes and the absence of motorized raft trips. Visitors would not experience noise from helicopter use in the Whitmore area.

4.8.5.3.2 Mitigation of Effects

Actions required to mitigate effects would include those listed for the specific resources.

4.8.5.3.3 Cumulative Impacts

The cumulative effects from Glen Canyon Dam and commercial overflights are similar to those described for each resource elsewhere in this document. The cumulative effects of the management of backcountry toilets, trails and facilities described in the current Backcountry Management Plan would have adverse, localized, short term, year-round impacts on wilderness character.

4.8.5.3.4 Conclusion

Under Alternative C, the impacts to the natural, undeveloped, and recreation opportunity characteristics would continue to be detectable and measurable year round especially in the frequently visited areas along the river corridor. Natural conditions would predominate, although impacts to individual natural and cultural resources are affected differently by season and location. The natural resources impacts would be in the same range as Alternative A and cultural resource impacts as summarized earlier in the document are adverse, localized, short to long term, seasonal to year-round, and minor to major. There would continue to be no permanent improvements along the river corridor in Zone 1 with the exception of the non-wilderness Phantom Ranch area. As summarized elsewhere in this document, impacts to visitor experience would be adverse, localized to regional, short to long term and negligible to major for some users, while impacts for other users would be beneficial and minor to moderate, especially for those seeking non-motorized opportunities. Impacts to the natural soundscape are adverse, localized, short-term, and minor with no helicopter impacts at Whitmore. The cumulative effects of Glen Canyon Dam operations would continue to have adverse, localized to regional, short to long-term impact on wilderness character. Overall, this alternative would provide a range of minor to moderate impacts on wilderness character for this area of the park. Overall, this alternative would provide a range of beneficial and adverse, localized to regional, short- to long-term, seasonal to year round negligible to moderate impacts on wilderness character in Zone 1. Impacts to the natural conditions and undeveloped character would be of minor intensity. For visitors seeking outstanding opportunities for solitude or a primitive and unconfined type of experience, the impacts would be beneficial and of minor intensity during the peak use periods, but negligible during the non-summer months.

4.8.5.4 ALTERNATIVE D

4.8.5.4.1 Analysis

Under Alternative D, recreational motor trips would be permitted from May to August and December to February. Group sizes and daily launches are the lowest of all alternatives. Shoulder and winter use is higher than current conditions.

Natural. Impacts to natural resources and cultural resources are described in those sections of this chapter. (See also summary in Table 2-4).

Undeveloped. The number and type of facilities and management activities would be reduced or similar to current conditions. Administrative activities such as patrols, resource management, research and scientific activities would occur at similar or slightly reduced levels. These activities would continue to be evaluated through the appropriate process, including the minimum requirement protocols.

Recreation opportunity. Impacts to visitor use and experience would continue as described in the Visitor Use and Experience section in this chapter. (See also summary in Table 2-4). Visitors will experience small group sizes, and the absence of motorized raft use during the spring and fall months, but may encounter motorized trips during the low-use winter months. Visitors would not experience noise from helicopter use in the Whitmore area.

4.8.5.4.2 Mitigation of Effects

Actions required to mitigate effects would include those listed for the specific resources.

4.8.5.4.3 Cumulative Impacts

The cumulative effects from Glen Canyon Dam and commercial overflights are similar to those described for each resource elsewhere in this document. The cumulative effects of the management of backcountry toilets, trails and facilities described in the current Backcountry Management Plan would have adverse, localized, short term, year-round impacts on wilderness character.

4.8.5.4.4 Conclusion

Under Alternative D, the impacts to the natural, undeveloped, and recreation opportunity characteristics would continue to be detectable and measurable, especially during the higher use periods, and in the frequently visited areas along the river corridor. Natural conditions would predominate, although impacts to individual natural and cultural resources are affected differently by season and location. The natural resource impacts would be in the same range as Alternative A and the cultural resource impacts would be in the same range as Alternative C. There would continue to be no permanent improvements along the river corridor in Zone 1 with the exception of the non-wilderness Phantom Ranch area. As summarized elsewhere in this document, impacts to visitor experience would be adverse, localized to regional, short to long term and negligible to major for some users, while impacts for other users would be beneficial and minor to major. Impacts to the natural soundscape are adverse, localized, short-term, and minor to moderate, with no helicopter noise impacts in the Whitmore area. The cumulative effects of Glen Canyon Dam operations would continue to have adverse, localized to regional, short to long-term impact on wilderness character. Overall, this alternative would provide a range of beneficial and adverse, localized to regional, short- to long-term, seasonal to year round negligible to moderate impacts on wilderness character in Zone 1; impacts to the natural conditions and undeveloped character would be of minor intensity. For visitors seeking outstanding opportunities for solitude or a primitive and unconfined type of experience, the impacts would be adverse and of minor intensity during the

peak use periods, but beneficial and negligible during the spring and fall non-motorized use periods.

4.8.5.5 ALTERNATIVE E

4.8.5.5.1 Analysis

Under Alternative E, recreational motor trips would be permitted from April through September. Group sizes are reduced from current. Shoulder and winter use is higher than current conditions. Passengers are allowed to embark on or disembark from the river by helicopter in the Whitmore area during the mixed-use season.

Natural. Impacts to natural resources and cultural resources are described in those sections of this chapter. (See also summary in Table 2-4).

Undeveloped. The number and type of facilities and management activities would be similar to current conditions. Administrative activities such as patrols, resource management, research, and scientific activities would occur at levels similar to Alternative A. These activities would continue to be evaluated through the appropriate process, including the minimum requirement protocols.

Recreation opportunity. Impacts to visitor use and experience would continue as described in the Visitor Use and Experience section of this chapter. (See also summary in Table 2-4) Visitors will experience smaller group sizes and the absence of motorized raft use during the fall, winter, and early spring months. Visitors would not experience noise from helicopter use at Whitmore during the non-motorized use periods as well.

4.8.5.5.2 Mitigation of Effects

Actions required to mitigate effects would include those listed for the specific resources.

4.8.5.5.3 Cumulative Impacts

The cumulative effects from Glen Canyon Dam and commercial overflights are similar to those described for each resource elsewhere in this document. The cumulative effects of the management of backcountry toilets, trails and facilities described in the current Backcountry Management Plan would have adverse, localized, short term, year-round impacts on wilderness character.

4.8.5.5.4 Conclusion

Under Alternative E, the impacts to the natural, undeveloped characteristics would be detectable and measurable, especially at frequently visited locations. The impacts to the recreation opportunity characteristics would be apparent during the higher mixed-use periods,

and in the frequently visited areas and passenger exchange points along the river corridor. Natural conditions would predominate although impacts to individual natural and cultural resources are affected differently by season and location. The natural resource impacts would be in the same range as Alternative A and the cultural resource impacts would be adverse, localized, long term, year-round, and minor to moderate. There would continue to be no permanent improvements along the river corridor in Zone 1 with the exception of the non-wilderness Phantom Ranch area. As summarized elsewhere in this chapter, impacts to visitor experience would be in the same range as Alternative A. Impacts to the natural soundscape are adverse, localized, short-term, and minor to moderate, with moderate to major adverse impacts in the Whitmore area. The cumulative effects of Glen Canyon Dam operations would continue to have adverse, localized to regional, short to long-term impact on wilderness character. Overall, this alternative would provide a range of beneficial and adverse, localized to regional, short- to long-term, seasonal to year round negligible to moderate impacts on wilderness character in Zone 1. Impacts to the natural conditions (except soundscape) and undeveloped character would be of minor intensity. For visitors seeking outstanding opportunities for solitude or a primitive and unconfined type of experience, the impacts would be adverse and of minor intensity during the peak mixed-use periods, but beneficial and minor during six-month non-motorized use periods.

4.8.5.6 ALTERNATIVE F

4.8.5.6.1 Analysis

Under Alternative F, recreational motor trips would be permitted from January through June, with only non-motorized recreational use the remainder of the year. The highest number of motorized launches per day occurs in May and June. Group sizes are reduced from current. Shoulder and winter use is higher than current conditions. Passengers are allowed to embark on or disembark from the river by helicopter in the Whitmore area during the mixed-use season.

Natural. Impacts to natural resources and cultural resources are described in those sections of this chapter. (See also summary in Table 2-4).

Undeveloped. The number and type of facilities and management activities would be similar to current conditions. Administrative activities such as research, and scientific activities would occur at levels similar to Alternative A. However, patrols, and resource management would occur more frequently. These activities would continue to be evaluated through the appropriate process, including the minimum requirement protocols.

Recreation opportunity. Impacts to visitor use and experience would continue as described in the Visitor Use and Experience section this chapter. (See also summary in Table 2-4) Visitors will experience smaller group sizes and the absence of motorized raft use for half of the year beginning in July, and through December. Visitors would not experience noise from helicopter use at Whitmore during the non-motorized period as well.

4.8.5.6.2 Mitigation of Effects

Actions required to mitigate effects would include those listed for the specific resources.

4.8.5.6.3 Cumulative Impacts

The cumulative effects from Glen Canyon Dam and commercial overflights are similar to those described for each resource elsewhere in this document. The cumulative effects of the management of backcountry toilets, trails and facilities described in the current Backcountry Management Plan would have adverse, localized, short term, year-round impacts on wilderness character.

4.8.5.6.4 Conclusion

Under Alternative F, the impacts to natural and undeveloped characteristics would be detectable and measurable, and the impacts to recreation opportunity characteristics would be apparent during the higher mixed-use summer period at the frequently visited areas and passenger exchange points along the river corridor. Natural conditions would predominate, although impacts to individual natural and cultural resources are affected differently by season and location. The natural resource impacts would be in the same range as Alternative A and the cultural resource impacts would be adverse, localized, long term, year-round, and minor to major. There would continue to be no permanent improvements along the river corridor in Zone 1 with the exception of the non-wilderness Phantom Ranch area. As summarized elsewhere in this chapter, impacts to visitor experience would be adverse, localized to regional, short to long-term, negligible to major for some users, and for some user, impacts would be beneficial and minor. Impacts to the natural soundscape are adverse, localized, short-term, and moderate, with major adverse impacts in the Whitmore area. The cumulative effects of Glen Canyon Dam operations would continue to have adverse, localized to regional, short to long-term impact on wilderness character. Overall, this alternative would provide a range of beneficial and adverse, localized to regional, short- to long-term, seasonal to year round minor to major impacts on wilderness character in Zone 1. Impacts to the natural conditions (except soundscape) and undeveloped character would be of minor intensity. For visitors seeking outstanding opportunities for solitude or a primitive and unconfined type of experience, the impacts would be adverse and of minor to moderate intensity during the peak use motorized periods, but beneficial and minor during six-month non-motorized use periods.

4.8.5.7 ALTERNATIVE G

4.8.5.7.1 Analysis

Under Alternative G, recreational motor trips would be permitted for eight months from January through August, with only non-motorized use the remainder of the year. Group sizes are reduced slightly from current. This is the highest use alternative, especially in the shoulder

months. Passengers are allowed to embark on or disembark from the river by helicopter in the Whitmore area during the mixed-use season.

Natural. Impacts to natural resources and cultural resources are described in those sections of this chapter. (See also summary in Table 2-4).

Undeveloped. The number and type of facilities and management activities would be similar to current conditions. Administrative activities such as research, and scientific activities would occur at levels similar to Alternative A. However, patrols, and resource management would occur more frequently, especially in shoulder and possibly winter months. These activities would continue to be evaluated through the appropriate process, including the minimum requirement protocols.

Recreation opportunity. Impacts to visitor use and experience would continue as described in the Visitor Use and Experience section of this chapter. (See also summary in Table 2-4) Visitors will experience that absence of motorized rafts and helicopter noise at the Whitmore area for the last four months of the year.

4.8.5.7.2 Mitigation of Effects

Actions required to mitigate effects would include those listed for the specific resources.

4.8.5.7.3 Cumulative Impacts

The cumulative effects from Glen Canyon Dam and commercial overflights are similar to those described for each resource elsewhere in this document. The cumulative effects of the management of backcountry toilets, trails and facilities described in the current Backcountry Management Plan would have adverse, localized, short term, year-round impacts on wilderness character.

4.8.5.7.4 Conclusion

Under Alternative G, the impacts to the natural, undeveloped, and recreation opportunity characteristics would be apparent during peak use periods, especially at the frequently visited areas and passenger exchange points along the river corridor. Natural conditions would predominate, although impacts to individual natural and cultural resources are affected differently by season and location. The natural resource impacts would be in the same range as Alternative A, and the cultural resource impacts would be the same as Alternative F. There would continue to be no permanent improvements along the river corridor in Zone 1 with the exception of the non-wilderness Phantom Ranch area. As summarized elsewhere in this chapter, impacts to visitor experience would be in the same range as Alternative F. Impacts to the natural soundscape are adverse, localized, short-term, and moderate, with moderate to major adverse impacts in the Whitmore area. The cumulative effects of Glen Canyon Dam operations would continue to have adverse, localized to regional, short to long-term impact on wilderness character. Overall, this alternative would provide a range of beneficial and adverse,

localized to regional, short- to long-term, seasonal to year round minor to major impacts on wilderness character in Zone 1. Impacts to the natural conditions (except soundscape) and undeveloped character would be of minor intensity. For visitors seeking outstanding opportunities for solitude or a primitive and unconfined type of experience, the impacts would be adverse and of moderate intensity during the peak use motorized periods, but beneficial during the four-month non-motorized use period.

4.8.5.8 Modified Alternative H (NPS Preferred Alternative)

4.8.5.8.1 Analysis

Under Alternative H, recreational motor trips would be permitted for five and one-half months from April through September 15, with only non-motorized use from September 16 through March. Group sizes are reduced from current, with lower commercial group sizes in the shoulder months. Passengers are allowed to embark on or disembark from the river by helicopter in the Whitmore area during the mixed-use season.

Natural. Impacts to natural resources and cultural resources are described in those sections of this chapter. (See also summary in Table 2-4).

Undeveloped. The number and type of facilities and management activities would be similar to current conditions. Administrative activities such as research and scientific activities would occur at levels similar to Alternative A. However, patrols, and resource management would occur more frequently, especially in shoulder and possibly, winter months. These activities would continue to be evaluated through the appropriate process, including the minimum requirement protocols.

Recreation opportunity. Impacts to visitor use and experience would continue as described in the Visitor Use and Experience section of this chapter. (See also summary in Table 2-4) Visitors will experience smaller group sizes, especially during the shoulder and winter months, and the absence of motorized rafts and helicopter noise at the Whitmore area for at least six months each year (beginning in late September through March).

4.8.5.8.2 Mitigation of Effects

Actions required to mitigate effects would include those listed for the specific resources.

4.8.5.8.3 Cumulative Impacts

The cumulative effects from Glen Canyon Dam and commercial overflights are similar to those described for each resource elsewhere in this document. The cumulative effects of the management of backcountry toilets, trails and facilities described in the current Backcountry Management Plan would have adverse, localized, short term, year-round impacts on wilderness character.

4.8.5.8.4 Conclusion

Under Alternative H, the natural, undeveloped, and recreation opportunity characteristics would be detectable and measurable during most of the year, but more apparent during higher mixed-use period, at the frequently visited areas and passenger exchange points along the river corridor. Natural conditions would predominate, although impacts to individual natural and cultural resources are affected differently by season and location. The natural resource impacts would be in the same range as Alternative A, and the cultural resource impacts would be the same as Alternative E. There would continue to be no permanent improvements along the river corridor in Zone 1 with the exception of the non-wilderness Phantom Ranch area. As summarized elsewhere in this chapter, impacts to visitor experience would be adverse, localized to regional, short to long-term, and negligible to moderate for some users, and beneficial and minor to moderate for other users. Impacts to the natural soundscape are adverse, localized, short-term, and minor to moderate, with adverse moderate to major impacts in the Whitmore area. The cumulative effects of Glen Canyon Dam operations would continue to have adverse, localized to regional, short to long-term impact on wilderness character. Overall, this alternative would provide a range of beneficial and adverse, localized to regional, short- to long-term, seasonal to year round negligible to moderate impacts on wilderness character in Zone 1. Impacts to the natural conditions (except soundscape) and undeveloped character would be of minor intensity. For visitors seeking outstanding opportunities for solitude or a primitive and unconfined type of experience, the impacts would be adverse and of moderate intensity during the peak use motorized periods, with beneficial and negligible impacts during the longer non-motorized use period with smaller group size.

4.8.6 IMPACT ANALYSIS – LOWER GORGE ALTERNATIVES

4.8.6.1 ISSUES

Issues and concerns regarding wilderness character are discussed in the previous section. The Lower Gorge section within recommended potential wilderness river corridor extends to Separation Canyon, where the wilderness boundary then runs along the north bank of the river to Lake Mead NRA. Zoning in the Lower Gorge allows for increased use levels and a wider variety of activities.

4.8.6.2 GUIDING REGULATIONS AND POLICIES

See other Lower Gorge sections in this chapter.

4.8.6.3 MANAGEMENT OBJECTIVES FOR WILDERNESS CHARACTER IN THE LOWER GORGE

See Management Objectives in previous section and for Visitor Use and Experience in the Lower Gorge.

4.8.6.4 Methodology for Analyzing Effects to Wilderness Character

The general process for assessing impacts to the environment is discussed in the "Introduction" to Chapter 4. The analysis of impacts to wilderness character for the Lower Gorge is the same as described for the Lees Ferry Alternatives.

4.8.6.4.1 Mitigation Of Effects

Reasonable mitigations for impacts to natural and cultural resources and visitor experience are described in corresponding sections of Chapter 4.

4.8.6.4.2 Cumulative Impacts

Cumulative impacts on wilderness character were determined by combining the impacts of each alternative with other past, present, and reasonably foreseeable future actions (see the "Introduction" to Chapter 4). Cumulative impacts are described for each alternative for natural and cultural resources and visitor use and experience.

4.8.6.4.3 Assumptions

General assumptions used for analysis of effects from each alternative are discussed in the "Introduction" to Chapter 4. Assumptions that relate to the Lees Ferry alternatives and their effect on visitor experience can be generally applied for the Lower Gorge Alternatives. The NPS does not have backcountry facilities or maintained trails in the Lower Gorge. The recommended wilderness boundary is described earlier in this section.

4.8.6.5 Alternative 1 (Existing Condition)

4.8.6.5.1 Analysis

Alternative 1 is the no-action alternative for the Lower Gorge. The HRR overnight and day use trips would continue to vary on a day-by-day basis with up to a maximum of 100 passengers per day. Pontoon operations and associated helicopter flights would continue, and the upstream travel would be allowed to Separation Canyon.

Natural. Impacts to natural resources and cultural resources are described in those sections of this chapter. (See also summary in Table 2-7).

Undeveloped. The number and type of facilities and management activities would be similar to current conditions. The use of helicopter landing pads in the Quartermaster area on Hualapai tribal lands would continue at current or increased levels. NPS administrative activities such as patrols, resource management, research, and scientific activities would continue at current levels. Management activities permitted by the NPS would continue to be evaluated through the appropriate process, including the minimum requirement protocols.

***Recreation opportunity.* Impacts to visitor use and experience would continue as described in the Visitor Use and Experience section this chapter. (See also summary in Table 2-7) Visitors would continue to experience large groups, jetboat use in Zones 2, 3, and 4, and encounter pontoon excursions in Zone 3.**

4.8.6.5.2 Mitigation of Effects

Actions required to mitigate effects would include those listed for the specific resources.

4.8.6.5.3 Cumulative Impacts

The cumulative effects from Glen Canyon Dam, commercial helicopter tours on tribal lands are similar to those described for each resource elsewhere in this section. These cumulative effects would have adverse, localized, short term, year-round, minor to major impacts on wilderness character for this area of the park.

4.8.6.5.4 Conclusion

Under Alternative 1, the impacts to natural, undeveloped, and recreation opportunity characteristics would be apparent for most of the year, especially in Zone 3. Natural conditions would predominate in Zone 2, but it may be apparent that natural conditions have been manipulated in some areas within Zone 3. The natural resource impacts would be adverse, localized to regional, short to long term, year round and negligible to major. The cultural resource impacts would be adverse, localized, long term, year round, and minor to major. Development in Zone 2 would be restricted to Diamond Creek and Spencer Canyon, and may change in Zone 3 at the Quartermaster area. Impacts to visitor use and experience would be adverse, localized to regional, short to long-term, and negligible to major for some users, and beneficial and negligible to moderate for other users. Impacts to the natural soundscape in Zones 2 and 3 are adverse, short- to long-term, and moderate to major. The cumulative effects of Glen Canyon Dam operations would continue to have adverse, localized to regional, short to long-term impact on wilderness character. Overall, this alternative would provide a range of adverse, localized to regional, short- to long-term, seasonal to year round, minor to major impacts on wilderness character in Zone 2 and moderate to major impacts in Zone 3. Impacts to the natural conditions and undeveloped character are moderate in Zone 2 and major in Zone 3. For visitors seeking outstanding opportunities for solitude or a primitive and unconfined type of experience, the impacts would be adverse and of moderate to major intensity depending on time of year and location.

4.8.6.6 ALTERNATIVE 2:

4.8.6.6.1 Analysis

Under Alternative 2, there would be daily launch limits from Diamond Creek, and the pontoon operations and facilities at the Quartermaster area would be eliminated. HRR trips would have group size limits, and upstream travel will be allowed to RM 262, and based on the schedules of continuation trips from Lees Ferry.

Natural. Impacts to natural resources and cultural resources are described in those sections of this chapter. (See also summary in Table 2-7).

Undeveloped. The number and type of facilities and management activities would be reduced from current conditions. The use of helicopter landing pads in the Quartermaster area on Hualapai tribal lands would continue at current or increased levels; however the facilities used for the pontoon operations would be eliminated. NPS administrative activities such as patrols, resource management, research, and scientific activities would continue at current levels. Management activities permitted by the NPS would continue to be evaluated through the appropriate process, including the minimum requirement protocols.

Recreation opportunity. Impacts to visitor use and experience would continue as described in the Visitor Use and Experience section this chapter. (See also summary in Table 2-7) Visitors would experience smaller group sizes, and the absence of jetboats in Zone 2 and pontoon boat excursions in Zone 3.

4.8.6.6.2 Mitigation of Effects

Actions required to mitigate effects would include those listed for the specific resources.

4.8.6.6.3 Cumulative Impacts

The cumulative effects from Glen Canyon Dam, commercial helicopter tours on tribal lands are similar to those described for each resource elsewhere in this section. These cumulative effects would have adverse, localized, short term, year-round, minor to major impacts on wilderness character for this area of the park.

4.8.6.6.4 Conclusion

Under Alternative 2, impacts to the natural, undeveloped, and recreation opportunity characteristics would be apparent, especially during the high use periods within Zone 2 and in Zone 3. Natural conditions would predominate in Zone 2, but it may be apparent that natural conditions have been manipulated in some areas within Zone 3. The natural resource impacts would be adverse, localized to regional, short to long term, year round and minor to major. The cultural resource impacts would be adverse, localized, long terms, year round, and negligible to moderate. Development in Zone 2 would be restricted to Diamond Creek and

Spencer Canyon, and the facilities used to support pontoon operations would be eliminated at the Quartermaster area (Zone 3). Impacts to visitor use and experience would be adverse, localized to regional, short to long-term, and negligible to moderate for some users, and beneficial and negligible to major for other users. Impacts to the natural soundscape in Zones 2 and 3 are adverse, short- to long-term, and moderate to major. The cumulative effects of Glen Canyon Dam operations would continue to have adverse, localized to regional, short to long-term impact on wilderness character. Overall, this alternative would provide a range of adverse, localized to regional, short- to long-term, seasonal to year round, minor to major impacts on wilderness character in Zone 2 and in Zone 3. Impacts to the natural conditions and undeveloped character are moderate in Zone 2 in Zone 3. For visitors seeking outstanding opportunities for solitude or a primitive and unconfined type of experience, the impacts would be adverse and of moderate to major intensity during peak use periods and of minor intensity during non-peak use periods.

4.8.6.7 ALTERNATIVE 3:

4.8.6.7.1 Analysis

Under Alternative 3, there would be daily launch limits from Diamond Creek, and the pontoon operations would continue, at higher levels than current. The facilities at the Quartermaster area would be improved to accommodate the number of boats. HRR trips would have group size limits, and upstream travel will be allowed to Separation Canyon, and commercial jet boat tours would be allowed.

Natural. Impacts to natural resources and cultural resources are described in those sections of this chapter. (See also summary in Table 2-7).

Undeveloped. The number and type of facilities and management activities would be increased from current conditions. The use of helicopter landing pads and facilities in the Quartermaster area would continue but at increased levels. NPS administrative activities such as research, and scientific activities would likely continue at levels similar to Alternative 1. However, patrols and resource management activities would increase. Management activities permitted by the NPS would continue to be evaluated through the appropriate process, including the minimum requirement protocols.

Recreation opportunity. Impacts to visitor use and experience would continue as described in the Visitor Use and Experience section in this chapter. (See also summary in Table 2-7). Visitors would experience smaller trips, more motorized rafting and jetboat use in Zone 2 and Zone 3, and increased daily pontoon excursions in Zone 3.

4.8.6.7.2 Mitigation of Effects

Actions required to mitigate effects would include those listed for the specific resources.

4.8.6.7.3 Cumulative Impacts

The cumulative effects from Glen Canyon Dam, commercial helicopter tours on tribal lands are similar to those described for each resource elsewhere in this section. These cumulative effects would have adverse, localized, short term, year-round, minor to major impacts on wilderness character for this area of the park.

4.8.6.7.4 Conclusion

Under Alternative 3, the impacts to natural, undeveloped, and recreation opportunity characteristics would be apparent most of the year in Zone 2 and Zone 3. Natural conditions would predominate in Zone 2, but it will be apparent that some areas in Zone 3 have been manipulated. The natural resource impacts would be adverse, localized to regional, short to long term, year round and minor to major. The cultural resource impacts would be the same as described for Alternative 2. Development in Zone 2 would be restricted to Diamond Creek and Spencer Canyon, and additional facilities including docks will be improved at the Quartermaster area (Zone 3). Impacts to visitor use and experience would be adverse, localized to regional, short to long-term, and negligible to major for some users, and beneficial and minor to moderate for other users. Impacts to the natural soundscape in Zones 2 and 3 are adverse, short- to long-term, and major. The cumulative effects of Glen Canyon Dam operations would continue to have adverse, localized to regional, short to long term impacts on wilderness character. Overall, this alternative would provide a range of adverse, localized to regional, short- to long-term, seasonal to year round, minor to major impacts on wilderness character in Zone 2 and moderate to major impacts in Zone 3. Impacts to the natural conditions and undeveloped character are moderate in Zone 2 and major in Zone 3. For visitors seeking outstanding opportunities for solitude or a primitive and unconfined type of experience, the impacts would be adverse and of major intensity peak use periods in Zone 2 and Zone 3, and minor to moderate during non-peak periods in Zone 2.

4.8.6.8 Modified Alternative 4 (NPS Preferred Alternative)

4.8.6.8.1 Analysis

Under Alternative 4, the number of daily launches would be within the maximum passenger (96) and group size (40 including guides) limits. This alternative limits the number of pontoon passengers to 480 per day (with up to 600 based on favorable operations review). The facilities at the Quartermaster area would be improved to accommodate the number of boats. Upstream travel will be allowed to Separation Canyon, and commercial jetboat pickups have daily limits.

Natural. Impacts to natural resources and cultural resources are described in those sections of this chapter. (See also summary in Table 2-7).

Undeveloped. The number and type of facilities and management activities would be increased from current conditions. The use of helicopter landing pads and facilities in the Quartermaster area on would continue but at increased levels. NPS administrative activities

such as research, and scientific activities would likely continue at levels similar to Alternative 1. However, patrols and resource management activities would increase. Management activities permitted by the NPS would continue to be evaluated through the appropriate process, including the minimum requirement protocols.

Recreation opportunity. Impacts to visitor use and experience would continue as described in the Visitor Use and Experience section in this chapter. (See also summary in Table 2-7). Visitors would experience smaller HRR trips, motorized activity year round, with increased numbers of pontoon excursions in Zone 3.

4.8.6.8.2 Mitigation of Effects

Actions required to mitigate effects would include those listed for the specific resources.

4.8.6.8.3 Cumulative Impacts

The cumulative effects from Glen Canyon Dam, commercial helicopter tours on tribal lands are similar to those described for each resource elsewhere in this section. These cumulative effects would have adverse, localized, short term, year-round, minor to major impacts on wilderness character for this area of the park.

4.8.6.8.4 Conclusion

Under Alternative 4, the impacts to natural, undeveloped, and recreation opportunity characteristics would be apparent in Zone 2 and Zone 3. Natural conditions would predominate in Zone 2, but it will be apparent that some areas in Zone 3 have been manipulated. The natural resource impacts would adverse, localized to regional, short-to long-term, year-round minor to major. The cultural resource impacts would be the same as described for Alternative 2. Development in Zone 2 would be restricted to Diamond Creek and Spencer Canyon, and additional facilities including docks will be improved at the Quartermaster area (Zone 3). Impacts to visitor use and experience would be adverse, localized to regional, short to long-term, and minor to major for some users, and beneficial and minor to major for other users. Impacts to the natural soundscape in Zones 2 and 3 are adverse, short- to long-term, and moderate to major. The cumulative effects of Glen Canyon Dam operations would continue to have adverse, localized to regional, short to long term impacts on wilderness character. Overall, this alternative would provide a range of adverse, localized to regional, short- to long-term, seasonal to year round, minor to major impacts on wilderness character in Zone 2 and moderate to major impacts in Zone 3. Impacts to the natural conditions and undeveloped character are moderate in Zone 2 and major in Zone 3. For visitors seeking outstanding opportunities for solitude or a primitive and unconfined type of experience, the impacts would be adverse and of major intensity during peak use periods in Zone 2 and Zone 3, and minor to moderate during non-peak periods in Zone 2.

4.8.6.9 ALTERNATIVE 5

4.8.6.9.1 Analysis

Under Alternative 5, the number of HRR daily launches would be the same as Alternative 4. The number of pontoon passengers would be 960 per day. The facilities at the Quartermaster area would be improved to accommodate the number of boats. Upstream travel will be allowed to RM 273, including the commercial jetboat pickups.

Natural. Impacts to natural resources and cultural resources are described in those sections of this chapter. (See also summary in Table 2-7).

Undeveloped. The number and type of facilities and management activities would be increased from current conditions. The use of helicopter landing pads and facilities in the Quartermaster area would be at the highest levels. NPS administrative activities such as research, and scientific activities would likely continue at levels similar to Alternative 1. However, patrols and resource management activities would increase. Management activities permitted by the NPS would continue to be evaluated through the appropriate process, including the minimum requirement protocols.

Recreation opportunity. Impacts to visitor use and experience would continue as described in the Visitor Use and Experience section in this chapter. (See also summary in Table 2-7). Visitors will experience smaller HRR trips, absence of jetboats in Zones 2 and 3, and higher levels pontoon excursions in Zone 3.

4.8.6.9.2 Mitigation of Effects

Actions required to mitigate effects would include those listed for the specific resources.

4.8.6.9.3 Cumulative Impacts

The cumulative effects from Glen Canyon Dam, commercial helicopter tours on tribal lands are similar to those described for each resource elsewhere in this section. These cumulative effects would have adverse, localized, short term, year-round, minor to major impacts on wilderness character for this area of the park.

4.8.6.9.4 Conclusion

Under Alternative 5, the impacts to natural, undeveloped, and recreation opportunity characteristics would be apparent in Zone 2 and in Zone 3. Natural conditions would predominate in Zone 2, but it will be apparent that some areas in Zone 3 have been manipulated. The natural resource impacts would be adverse, localized to regional, short- to long-term, year-round and minor to major. The cultural resource impacts would be the same as described for Alternative 2. Development in Zone 2 would be restricted to Diamond Creek and Spencer Canyon, and additional facilities including docks will be improved at the

Quartermaster area (Zone 3). Impacts to visitor use and experience would be adverse, localized to regional, short to long-term, and minor to major for some users, and beneficial and minor to major for other users. Impacts to the natural soundscape in Zones 2 and 3 are adverse, short- to long-term, and moderate to major. The cumulative effects of Glen Canyon Dam operations would continue to have adverse, localized to regional, short to long-term impact on wilderness character. Overall, this alternative would provide a range of moderate to major impacts on wilderness character for this area of the park. Overall, this alternative would provide a range of adverse, localized to regional, short- to long-term, seasonal to year round, minor to major impacts on wilderness character in Zone 2 and moderate to major impacts in Zone 3. Impacts to the natural conditions and undeveloped character are moderate in Zone 2 and major in Zone 3. For visitors seeking outstanding opportunities for solitude or a primitive and unconfined type of experience, the impacts would be adverse and of major intensity during peak use periods in Zone 2 and Zone 3, and minor to moderate during non-peak periods in Zone 2.

4.9 SUSTAINABILITY AND LONG-TERM MANAGEMENT

4.9.1 UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts are environmental consequences that cannot be avoided, whether it be by implementing mitigation measures or by changing the nature of a proposed action. Thus, unavoidable adverse impacts would persist throughout the duration of the action.

Unavoidable adverse impacts are listed in Table 4- 40***:***

TABLE 4- 40: UNAVOIDABLE ADVERSE IMPACTS

Impact Topic	Unavoidable Adverse Impact	Alternatives
Visitor Use and Experience, Natural and Cultural Resources	Congestion from spikes in use	A
Visitor Use and Experience	***Disruption of experience for those adversely affected by helicopter noise***	***A, E, F, G, H***
	Disruption of experience for those adversely affected by motorboat noise during primary season	A, D, E, ***F,*** G, H
	Elimination of opportunity to take a motorized trip in the Lees Ferry to Diamond Creek portion of the Grand Canyon	B, C
	Elimination of opportunity to take a pontoon tour in the Lower Gorge	2
Soundscape	Noise from Whitmore helicopters	A, E, F, G, H
	Noise from boat motors (Lees Ferry Alternatives)	A, D, E, F, G, H
	Noise from Lower Gorge helicopters	1, 2, 3, 4, 5
	Noise from Lower Gorge pontoons	1, 3, 4, 5,
	Noise from ***motor boats in the Lower Gorge***	1, 2, 3, 4, 5
	Noise from jetboats	1, 2, 3, 4
Socioeconomic Environment	Loss of revenue to Bar 10 Ranch from Helicopter Exchanges	B, C, D, E
Cultural Resources	Inadvertent and intentional damage (artifact displacement, sediment compaction, etc.) from visitation to localized resources	All
Cave and Paleontological Resources	Inadvertent and intentional damage (artifact displacement, disturbance to bats, etc.) from visitation to localized resources	All
Biological Resources (Flora and Fauna)	Inadvertent and intentional damage (direct destruction of individual plants and animals, disruption of life cycles, impacts to habitat, etc.) to localized resources from visitation	All
Air Quality	Carbon monoxide emissions	A, D, E, F, G, 1, 2, 3, 4, 5
Soils	Sediment depletion from visitation at camp, lunch and attraction sites	All
Water Quality/ Aquatic Resources	Fossil fuel pollution from boat motors	A, D, E, F, G, H, 1, 2, 3, 4, 5,
	Pollution (human waste, lotions, etc.) and turbidity from visitation	All

4.9.2 RELATIONSHIP BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

This section describes the effects of short-term recreational use of the Colorado River Corridor within the Grand Canyon National Park and whether this immediate use is 1) likely to adversely affect the regional productivity of resources in the Park; and 2) sustainable without significant degradation of the environment. Recreational use includes motor and oar-powered transport, as well as hiking, visitation to attraction sites, camping, swimming, fishing, and helicopter access. Individually, these activities are of short duration, but have the potential to affect the long-term physical condition and productivity because of continual recurrence during the 10-year expected life of the *Colorado River Management Plan*.

Because they are non-renewable resources, cultural, paleontological and cave resources are highly sensitive to even low levels of disturbance and disturbance or destruction of these resources is generally permanent. For example, even short-term***, lower density*** visitation of cultural sites along the river corridor may cause long-term incidental degradation of slopes, structures, and artifacts. With implementation of mitigation measures identified in the action alternatives the adverse effects to long-term productivity are minimized

With the exception of alternative A, short-term uses of resources under all of the Lees Ferry action alternatives, with implementation of mitigation measures, would not affect the long-term productivity of the environment for the Park and its natural resources. The continuation of current use patterns in Alternative A includes significant spikes in use that result in crowding and congestion. Additionally, Alternative A does not include any additional management actions (such as reductions in group size or trip lengths) to minimize adverse impacts. Consequently, the negative effects of concentrated use on visitor experience and natural resources represent a trade-off that is unsustainable and results in lowered long-term productivity, particularly to natural resources.

Aside from the following exceptions, short-term uses proposed in the Lower Gorge alternatives would not adversely affect regional long-term productivity of adjacent lands, air quality, aquatic resources, soil resources, threatened and endangered species, terrestrial wildlife, vegetation, water quality, soundscape and visitor experience:

- Extremely large group sizes for HRR trips in Alternative 1 adversely affect localized resources. Concentrated impacts such as trampling of vegetation and cultural resources, accumulation of human waste, sediment depletion, and disruption of species' life cycles threaten the long-term productivity of these stopping points and the resources that located therein.
- The degree of impacts to visitor experience and natural resources from pontoon use in Alternative 5 indicates that the proposed level of use is unsustainable and compromises the long-term productivity of Park resources.

4.9.3 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

This section describes irreversible and irretrievable commitments of resources through the recreational use of the Colorado River Corridor in the Grand Canyon National Park. An irreversible commitment of resources occurs if the commitment cannot be changed once made throughout the lifespan of the plan. Irretrievably committed resources are used, consumed, destroyed, or degraded during implementation of the plan and could not be reused or recovered during the lifespan of the plan.

With implementation of mitigation, none of the alternatives would represent an irretrievable or irreversible commitment of the following resources:

- Socioeconomic
- Water quality
- Soundscape
- Air quality
- Terrestrial Wildlife
- Aquatic Resources

However, because of their sensitivity to low levels of impacts and their non- or negligibly-renewable nature, some resources would be irretrievably or irreversibly committed. This commitment is discussed in Table 4- 41.

TABLE 4- 41: IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES.

Resource	Type of Commitment/Reason for Commitment	Alternatives	Irretrievable	Irreversible
Cultural, Cave, and Paleontological Resources	Degradation of resource value and integrity from visitation (artifact displacement, vandalism, trampling of cultural resource)	All (lower levels in Alternatives in B, E, F, G, H, 2, 3, 4, and 5)	Permanent	Permanent
Biological Soil Crusts	Trampling of crusts in the OHWZ from excursions into OHWZ	All (lower levels in Alternatives B, D, E, F, H, 2, 3, 4,)	Plan lifespan	Plan lifespan
Sediments in visitor use areas	Sediment depletion and compaction from camping, hiking, boat mooring and wakes, and access to the river	All (lower levels in Alternatives B and 2)	***Beyond plan lifespan***	***Beyond plan lifespan***
Dominant Vegetation in the Old High Water Zone	Modification and destruction ***from excursions into the OHWZ***, and replacement by exotic species	All (lower levels in Alternatives B, D, E, F, H, 2, 3, 4,)	***Beyond plan lifespan***	***Beyond plan lifespan***

CHAPTER 5: CONSULTATION AND COORDINATION

5.1 INTRODUCTION

This section describes the consultation and coordination that has occurred during the preparation of this document. Consultation, coordination, and public involvement have been integral to identifying relevant issues and concerns and to make sure these issues are addressed. This was accomplished primarily through public meetings and workshops, informal ***and formal agency*** meetings, individual contacts, website updates, news releases, and *Federal Register* notices.

5.1.1 ORGANIZATIONS AND AGENCIES CONSULTED

During the NEPA decision-making processes, the NPS is required to consult with certain American Indian tribes, as well as with federal and state agencies and entities because of jurisdictional responsibilities (40 CFR 1502.25). This section documents these consultation and coordination efforts. Consultation will be an ongoing effort through completion of a final document and agency decision.

5.1.1.1 TRIBAL CONSULTATIONS

In keeping with the provisions of the National Environmental Policy Act, National Historic Preservation Act, National Park Service Management Policies 2001, Executive Memorandum on Government- to-Government Relations with Native American Tribal Governments; Executive Order 13007; Executive Order 13175; 512 Department of the Interior Manual [DM] 2; and Director's Order #71: Relationships with Indian Tribes, the NPS established regular consultation with American Indian tribes to address issues and concerns related to the current revisions of the Colorado River Management Plan. Table 5- 1 lists the Tribal consultations that have occurred during the development of this document.

TABLE 5- 1: AMERICAN INDIAN TRIBES CONSULTED

Tribal Nation	Nature of Consultations
Havasupai Tribe	Postal updates, personal contacts with the cultural resource representative, ***and two meetings with tribal representatives. Request for review and comment on DEIS and invitation to participate in Section 106 programmatic agreement.***
Hopi Tribe	Postal updates, personal contacts with the cultural resource representative, ***and three meetings with tribal representatives. Request for review and comment on DEIS and invitation to participate in Section 106 programmatic agreement.***
Pueblo of Zuni	Postal updates and personal contacts with the cultural resource representative. ***Request for review and comment on DEIS and invitation to participate in Section 106 programmatic agreement.***
White Mountain Apache Tribe ***(representing the Yavapai-Apache Nation)***	Postal updates***, meeting with tribal representatives,*** and personal contacts with the cultural resource representative. ***Request for review and comment on DEIS and invitation to participate in Section 106 programmatic agreement.***
Southern Paiute Consortium	Postal updates, personal contacts with the cultural resource representative, ***and two meetings with the tribal representatives. Request for review and comment on DEIS and invitation to participate in Section 106 programmatic agreement.***
San Juan Southern Paiute Tribe	Invitation to enter into consultation. ***Request for review and comment on DEIS and invitation to participate in Section 106 programmatic agreement.***
Navajo Nation	Postal updates, personal contacts with the cultural resource and tribal representatives, and ***numerous*** meetings with the Bodaway/Gap ***Planning Team and*** Chapter members and Navajo Nation representatives. ***Request for review and comment on DEIS and invitation to participate in Section 106 programmatic agreement.***
Hualapai Tribe	Cooperating agency. Frequent consultations, both in meetings and personal contacts via telephone and e-mail, included development of alternatives, impact identification, and review of administrative drafts. ***Request for review and comment on DEIS and invitation to participate in Section 106 programmatic agreement.***

Issues identified during tribal consultations included the following:

- The canyon needs an opportunity to "rest" during the off-season.
- Trespass and nonpayment of fees for access onto tribal lands is a significant concern for the Navajo Nation, the Hualapai Tribe, and the Havasupai Tribe.
- Certain sites, such as Deer Creek, the Little Colorado River confluence, and various natural springs, have special significance to some tribes and should be managed to minimize inappropriate behavior, crowding, and resource degradation.
- River runners do not have a clear understanding of the spiritual, social, economic, and historic significance of the Colorado River to its affiliated tribes. This lack of knowledge is evident in the incidents of inappropriate behavior in the river corridor, including trespass, intentional damage to resources, and disregard of tribal laws and regulations. All tribes requested that visitor education be enhanced to address these issues.
- Some tribes requested the opportunity to obtain full-river commercial use permits.
- Some tribes expressed concern over being able to access important traditionally significant sites and requested that the park work to ensure such access.
- Several issues that were not related to the *Colorado River Management Plan* were identified. Park personnel committed to address these issues in the appropriate venues, such as the revisions of the *Backcountry Management Plan.*
- ***Some tribes offered guidance on appropriate levels and types of river use, including the appropriateness or inappropriateness of motorized transport and the effects of visitation on resources.***
- ***Some tribes clarified their social, spiritual, and economic connection to the river and they suggested measures to strengthen or maintain those connections.***

5.1.1.2 ARIZONA STATE HISTORIC PRESERVATION OFFICER

The 1966 National Historic Preservation Act, as amended in 1992, requires federal agencies to consult with the state historic preservation officer and the Advisory Council on Historic Preservation ***(Council)*** regarding undertakings that may affect historic properties. Consultation by the NPS with the state historic preservation officer (***SHPO***) has occurred informally during the development of this *Draft Environmental Impact Statement.* A formal consultation letter was sent in February 2004, and consultations are ongoing as of the release of this document and ***it was determined that implementation of the Colorado River Management Plan could have an adverse effect on National Register eligible heritage resources in the Colorado River corridor. For this reason, a Section 106 programmatic agreement to avoid, minimize, or mitigate these potential effects was established among the Council, the SHPO, Grand Canyon National Park, the Navajo Nation, and the Hualapai Tribe.***

Relevant consultation documents are presented in Appendix F of this document.

5.1.1.3 GRAND CANYON-PARASHANT NATIONAL MONUMENT

As part of the Arizona Strip Interagency Planning process, the planning staff made monthly progress reports to Grand Canyon-Parashant National Monument and Lake Mead National Recreation Area staff. The national monument staff was also consulted to develop alternatives and identify impacts for passenger exchanges at Whitmore.

5.1.1.4 CORE TEAM—HUALAPAI TRIBE, LAKE MEAD NATIONAL RECREATIONAL AREA, AND GRAND CANYON NATIONAL PARK

The Hualapai Tribe occupies a 992,463-acre reservation south of the Colorado River. In 2000, Grand Canyon National Park, Lake Mead National Recreation Area, and the Hualapai Tribe initiated formal consultation to address management issues on the Colorado River. This resulted in a "Memorandum of Understanding" that recognized the Area of Cooperation as that portion of the Colorado River from approximately RM 165 (***upstream of*** National Canyon) to the RM 277, the boundary between Grand Canyon and Lake Mead. The "Memorandum of Understanding" provided a process to develop mutually agreed upon operational and management protocols applicable within the Area of Cooperation ***(AOC). Management issues pertaining to the AOC are addressed in meetings of a standing federal-tribal Core Team, which includes representatives of the Hualapai Tribe, Grand Canyon National Park, and Lake Mead National Recreation Area. Primary committees of the Core Team address issues of law enforcement, permitting, fire management, and revision of the river management plan, among others. Procedural steps for facilitating negotiation and consensus building among the parties are outlined in the Memorandum of Understanding. Grand Canyon provided updates on the river management planning process and common issues as part this interagency process. Additionally, members of the CRMP subcommittee of the Core Team met regularly to address alternative development, data collection and synthesis, issue identification, impact analysis, and integration of comments into draft versions of the Draft Environmental Impact Statement. The MOU for the Area of Cooperation is in effect, although Core Team meetings were suspended in October 2004.***

When the park re-initiated the planning process as required by the settlement agreement, the Hualapai Tribe requested and was granted cooperating agency status, and a cooperative agreement was signed by Grand Canyon Superintendent Joseph Alston and Hualapai tribal Chairperson Louise Benson on May 14, 2003. In accordance with CEQ regulations (40 CFR 1501.6), lead agencies are to "use the environmental analysis and proposals of cooperating agencies with jurisdiction by law or special expertise, to the maximum extent possible." The Hualapai Tribe provided essential data on the affected environment and assisted in the development of alternatives and mitigation measures***, and reviewed and commented on administrative drafts of the DEIS.***

5.1.1.5 U. S. FISH AND WILDLIFE SERVICE

In compliance with Section 7 of the Endangered Species Act of 1973, as amended, ***a Biological Assessment was submitted and*** formal consultation was initiated ***on June 24, 2005*** following determination of ***the two modified*** preferred alternatives. Informal consultations, initiated in

March 2004, resulted in the identification of ***ten*** special status species (bald eagle, California condor, Mexican spotted owl, southwestern willow flycatcher, Yuma clapper rail, humpback chub, razorback sucker, Kanab ambersnail, ***desert tortoise,*** and California brown pelican) and two candidate species for listing as threatened or endangered species (yellow-billed cuckoo and relict leopard frog). ***The NPS has incorporated recommended mitigations into the FEIS in Section 4.2.9, Special Status Species. The Biological Assessment is included in Appendix F.***

5.1.1.6 NPS INTERDISCIPLINARY TEAM

The NPS Interdisciplinary Team met frequently throughout the development of the Draft Environmental Impact Statement. Team members are listed in Table 5- 2.

5.1.2 PUBLIC INPUT TO THE PLANNING PROCESS

On June 13, 2002, the NPS issued a Notice of Intent in the *Federal Register* to prepare an environmental impact statement for the Colorado River Management Plan. As stated in the notice, "The purpose of this EIS/CRMP is to update management guidelines for the Colorado River corridor through Grand Canyon National Park." This announcement began the public scoping process, and a notice to extend the public scoping period was printed in the *Federal Register* on September 23, 2002.

During the public scoping period, which extended from June 13 to November 1, 2002, the NPS sought public input to reaffirm previously identified agency and public issues and to identify any new public issues and concerns. Scoping is required for documents prepared in compliance with the National Environmental Policy Act, including environmental impact statements, to determine the scope of the document—what will be covered and in what detail. The scoping process must be open to the public; state, local, and tribal governments; and affected federal agencies. The objectives of scoping are:

- Involve as many interested parties as possible in the environmental review process.
- Provide clear, easily understood, factual information to potentially affected parties.
- Provide meaningful and timely opportunities for public input.
- Identify, consider, and evaluate significant issues raised by interested parties to assist in the preparation of the *Colorado River Management Plan and Environmental Impact Statement.*
- Identify and eliminate from detailed study the issues that are not significant.
- Consider public comments throughout the decision-making and review process.

5.1.2.1 PUBLIC *SCOPING* MEETINGS

As part of the scoping process, Grand Canyon National Park retained the services of The Mary Orton Company to help organize and manage a series of public meetings. More than 1,000 people attended a total of seven such meetings, which were held on the dates and in the communities listed below.

August 1, 2002	Denver, Colorado
August 6, 2002	Sandy, Utah (suburb of Salt Lake City)
August 8, 2002	Flagstaff, Arizona
August 13, 2002	Las Vegas, Nevada
August 15, 2002	Mesa, Arizona (suburb of Phoenix)
September 30, 2002	Towson, Maryland (suburb of Baltimore)
October 2, 2002	Oakland, California

The meetings were structured as open houses. Information about the planning process was presented through posters, handouts, and a large map of the project area. NPS personnel were available to answer questions, and rooms were provided for facilitator-led discussion groups. Attendees were invited to write comments on flipchart tearsheets and a map, to provide comments orally to a court reporter, and to submit written comments. A form and a permit-related questionnaire were provided for that purpose. Comments made during the discussion groups were recorded by the facilitators on flip charts.

5.1.2.2 REVIEW AND EVALUATION OF PUBLIC *SCOPING* COMMENTS

Written public comments were submitted to the planning team by e-mail, U.S. mail, and hand delivery, as well as at the open house meetings. Members of the planning team read through every submission, identified specific comments within each submission, and coded them according to criteria developed for the process. When the initial review process was completed, a total of 55,165 comments were identified within the 13,770 submissions. Organization and analysis of the submissions were completed with the assistance of SWCA Environmental Consultants, a firm retained to help develop the environmental impact statement.

Additionally, previously identified agency and public issues were compiled from the "Summary of Public Comment" from the 1997 *Colorado River Management Plan* scoping process conducted in April 1998. These comments were included in the 2002 scoping process database.

Almost every major comment received in 1997 was reiterated in 2002, plus several more. Given the number of comments received, the variations in detail were substantial. While it was not possible to adequately summarize every specific suggestion offered by the public in this process, the major issues stood out and were consistent with those raised in 1997. Information about the 2002 scoping process was disseminated to the public through the park's *Colorado River Management Plan* Internet site, press releases, mailings, and public meetings. A summary table of comments is presented in Appendix B, as well as on the website. The major issues raised in the 2002 scoping comments are as follows:

- Access and visitor services
- Motors and aircraft use

- Allocation and the noncommercial permit system
- Level of use/crowding, trip length, group size
- Resource protection, tribal issues, NPS regulations

5.1.2.3 STAKEHOLDER WORKSHOPS AND EXPERT PANEL MEETINGS

Two stakeholder workshops were conducted during the development of the *Draft Environmental Impact Statement* and involved representatives from nine stakeholder groups, including private boaters, outfitters, wilderness coalition representatives, ecological concerns, researchers, educators, commercial customers, commercial river guides, and people with disabilities. All of the affiliated tribes were invited to participate in the workshops. None of the tribes chose to have representatives participate in the workshops, but some tribal representatives did attend as observers.

On June 24 and 25, 2003, the Mary Orton Company conducted two focused stakeholder workshops and an evening public workshop as part of the process to revise the *Colorado River Management Plan*. These workshops did not re-open the public scoping period, but assisted the CRMP planning team in clarifying issues for the draft impact statement. The goal of the workshops was to clarify areas of agreement and disagreement among stakeholders and the public on what the park should include in a full range of reasonable alternatives in the impact statement. There were two issues of concern:

- Allocation of recreational use
- Motor use on the river

In January 2003 the Mary Orton Company held two more workshops to enable stakeholders to give the park more detailed and in-depth information and to identify areas of consensus. The purpose of the panels was to provide input from academics, researchers, practitioners and other stakeholders.

- Expert Panel #1: Carrying Capacity, Seasonality, and Group Size
- Expert Panel #2: Allocation of Recreational Use Among User Groups
- Stakeholder Workshops #1: Spectrum of Recreational Services Offered to the Public
- Stakeholder Workshop #2: Private River Trip Permit Distribution System

5.1.2.4 PUBLIC COMMENT PERIOD

The Draft CRMP Environmental Impact Statement (DEIS) was released for public review in the fall of 2004. A 90-day public comment period on the CRMP/DEIS began when a Notice of Availability of the Draft was published in the Federal Register on October 8, 2004. Given the complexity of the document and the intense interest in it on behalf of the public, the 90 day public comment period was extended from the ending date of January 7, 2005 to February 1, 2005. From November 10 through December 3, 2004, public meetings were conducted in

seven cities nationwide to present the DEIS and solicit public comment. These meetings, presented below, were attended by approximately 1,000 people:

November 8, 2004	***Denver, Colorado***
November 10, 2004	***Salt Lake City, Utah***
November 16, 2004	***Washington, D.C.***
November 18, 2004	***Las Vegas, Nevada***
November 22, 2004	***Flagstaff, Arizona***
November 30, 2004	***Phoenix, Arizona***
December 2, 2004	***San Francisco, California***

Approximately 10,000 written responses were received during the public review period containing approximately 6,000 substantive and 30,000 nonsubstantive comments. These comments are summarized in Volume III of this document.

Similar to the Public Scoping Meetings, the Public Comment meetings were structured as open houses. Information about the Draft Environmental Impact Statement and the planning process was presented through posters, handouts, and a slide presentation and NPS personnel were available to answer questions. Attendees were invited to write comments on flipchart tearsheets, to provide comments orally to a court reporter, and to submit written comments. An NPS comment form and noncommercial permit questionnaires (Permit System Options Form, Adjustable Split Allocation Form, All User Registration Form) were provided for that purpose.

5.1.2.5 PLAN WEBPAGE

The plan website <www.nps.gov/grca/crmp> has been a useful tool for disseminating information about the status of the plan to the public. Information available on the website includes:

- History and background information
- Plan progress update letters (current and archived)
- Soundings newsletters (current and archived)
- Press releases (current and archived)
- Frequently Asked Questions
- Photos and informational posters and handouts from 2002 public scoping meetings
- 2002 public scoping issue analysis
- "Summary of Public Comment" from 1997 scoping process
- The 1979 *Colorado River Management Plan,* the 1979 *Colorado River Management Plan and Final Environmental Impact Statement,* and the 1989 *Colorado River Management Plan*

- ***The 2004 Draft Environmental Impact Statement for the Colorado River Management Plan***
- Stakeholder workshop handouts***, photos, and posters***
- ***Handouts, posters, photos and the slideshow from public meetings***
- Recent use statistics, graphs, and reports
- January 2002 court settlement documents
- Guiding principles
- ***Media Advisories***
- *Federal Register* documents
- NPS laws and policies

TABLE 5- 2: INTERDISCIPLINARY TEAM MEMBERS

ID Team Member	NPS Department
Michael Anderson	Cultural Resources, Science Center
William Allen	Trails, Maintenance and Engineering
Janet Balsom	Cultural Resources Branch Chief, Science Center
Jill Beshears	Environmental Compliance, Science Center
Carl Bowman	Natural Resources/Air Quality, Science Center
Mathieu Brown	Biological Technician, Science Center
David Chapman	Wilderness/Lees Ferry Ranger/Visitor and Resource Protection
Cole Crocker-Bedford	Natural Resources Branch Chief, Science Center
Jeffrey Cross	Project Manager, Science Center Director
Lori Crystal	Lead Outdoor Recreation Planner, Science Center
David Desrosiers	Wilderness/River District, Visitor and Resource Protection
J. Grace Ellis	Lead Cultural Resource Specialist, Science Center
Rick Ernenwein	Lead Planner, Science Center
Jennifer Dierker	Cultural Resources/Archeology, Science Center
Jacob Fillion	Education, Interpretation
Mae Franklin	Cultural Resources/Tribal Liaison, Science Center
Lenore Grover-Bullington	Lead Natural Resources Specialist, Science Center
Nick Hardig	Chief of Concessions
Kirsten Heins	Permits Program, Visitor and Resource Protection
Linda Jalbert	Lead Wilderness Planner, Science Center
Mary Killeen	Special Assistant to the Superintendent
Allen Keske	Concessions Specialist, Concessions
Lisa Leap	Cultural Resources/Archeology, Science Center
Mark Lellouch	Socioeconomics/Special Assistant
Elaine Leslie	Natural Resources/Wildlife, Science Center
Lori Makarick	Natural Resources/Vegetation, Science Center
Leah McGinnis	Management Assistant, Superintendent's Office
Michael McGinnis	Wilderness/River District, Visitor and Resource Protection
Chris Mengel	Wilderness/River District, Visitor and Resource Protection
Maureen Oltrogge	Public Affairs, Superintendent's Office
John Rihs	Natural Resources/Earth Sciences, Science Center
Laura Shearin	Contracts, Concessions
Rachel Stanton	Environmental Protection Assistant, Maintenance
Steve Sullivan	Permits Program, Visitor and Resource Protection
R.V. Ward	Natural Resources/Wildlife, Science Center
Ken Weber	Social Science, Science Center
Sara White	Environmental Compliance

5.1.3 LIST OF AGENCIES, ORGANIZATIONS, BUSINESSES, AND INDIVIDUALS WHO RECEIVED THE DRAFT PLAN

There are over 1,500 entries on the mailing list for this plan with physical mailing addresses, and an additional 5,000 entries with e-mail addresses only. Compact disks (CDs) are being sent to all persons on the list with physical mailing addresses, and e-mail messages are being sent to all persons on the list with information about how to obtain a copy. In addition, the document is being posted on the Internet so that people can download document files from the park's Colorado River Management Plan website (http://www.nps.gov/grca/crmp). Copies are also being made available at the main library in the cities listed below. A complete list of individuals receiving copies of the *Draft Environmental Impact Statement* is on file at park headquarters.

The following is a partial list of the agencies, offices, and organizations to whom this document is being sent. As requests for copies are received during public review of this document, the list will be updated.

Federal Agencies

Advisory Council on Historic Preservation
Department of Agriculture
  Coconino National Forest
  Kaibab National Forest
Department of the Interior
  Bureau of Indian Affairs
  Bureau of Land Management
    Arizona State
    Arizona Strip
    Grand Canyon-Parashant National Monument
    Grand Staircase-Escalante National Monument
    Vermillion Cliffs National Monument
  Bureau of Reclamation
  NPS
    Arizona State Coordinator
    Bryce Canyon National Park
    Canyonlands National Park
    Flagstaff Area Office
    Grand Canyon-Parashant National Monument
    Glen Canyon National Recreation Area
    Intermountain Regional Office
    Lake Mead National Recreation Area
    Pipe Springs National Monument
    Utah State Coordinator
    Zion National Park
  United States Fish and Wildlife Service
  U. S. Geological Survey
U.S. Environmental Protection Agency

Arizona Congressional Delegation

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Office of Senator John Kyl
Office of Congressman Raul Grijalva
Office of Congressman J. D. Hayworth
Office of Congressman Jim Kolbe
Office of Congressman Ed Pastor
Office of Congressman Rick Renzi
Office of Congressman John Shadegg

Arizona State Agencies

Office of the Governor
State Historic Preservation Office
Department of Environmental Quality
Department of Transportation and Planning
Game and Fish Department

Indian Tribal Governments

Havasupai Tribe
Hopi Tribe
Hualapai Tribe
Navajo Nation
Paiute Indian Tribe of Utah
San Juan Southern Paiute Tribe
Pueblo of Zuni
White Mountain Apache Tribe

Regional, County, Local and City Governments

City of Flagstaff
City of Fredonia
City of Kanab
City of Las Vegas
City of Page
City of Phoenix
City of Williams
Coconino County Board of Supervisors

Organizations and Businesses

American Canoe Association
American Whitewater
Arizona Wilderness Coalition
Grand Canyon Association
Grand Canyon Field Institute
Grand Canyon National Park Foundation
Grand Canyon Private Boaters Association

Grand Canyon Resort Corporation
Grand Canyon River Guides
Grand Canyon River Operators Association
Grand Canyon Trust
Grand Canyon Wildlands Council
Hualapai River Runners
Living Rivers
National Parks Conservation Association
River of Dreams
River Runners for Wilderness
Sierra Club
Southern Utah Wilderness Alliance
Southwest Rivers
The Nature Conservancy
The Wilderness Society

River Concessioners

Arizona Raft Adventures, Inc.
Arizona River Runners, Inc.
Canyoneers, Inc.
Canyon Expeditions, Inc.
Colorado River & Trail Expeditions, Inc.
Diamond River Adventures, Inc.
Grand Canyon Discovery, Inc.
Grand Canyon Expeditions Company
Hatch River Expeditions, Inc.
Moki Mac River Expeditions, Inc.
OARS, Inc./Grand Canyon Dories, Inc.
Outdoors Unlimited River Trips
Tour West, Inc.
Western River Expeditions, Inc.
Wilderness River Adventures

Local Libraries

Denver, Colorado
Flagstaff, Arizona
Las Vegas, Nevada
Phoenix, Arizona
Salt Lake City, Utah
San Francisco, California

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APPENDIXES

Appendixes are provided electronically for this *Final Environmental Impact Statement*. The electronic files are available from the park's Colorado River Management Plan Internet website at <http://www.nps.gov/grca/crmp>, along with electronic files for the entire *Final Environmental Impact Statement*. The Appendixes are also available on Compact Disk, which can be requested by sending an e-mail message with your name and mailing address to <grca_crmp@nps.gov>, or by calling 928-779-6279.

The Appendixes are:

A. LAWS
B. PUBLIC SCOPING SUMMARY
C. SOILS
D. WATER QUALITY
E. AIR QUALITY
F. CONSULTATION
   1. **USFWS Special Status Species List Prior to Formal Consultation**
   2. **Request To Initiate Section 7 ESA Formal Consultation/And Submission Of Biological Assessment**
   3. **Acknowledgement Of Receipt Of Biological Assessment And Initiation Of Biological Opinion**
   4. **Biological Assessment (Redacted And Revised)**
   5. **Initiation Of Section 106 Consultation**
   6. **Draft Programmatic Agreement**
G. VISITOR USE AND EXPERIENCE
H. USER DISCRETIONARY TIME
I. CAMPSITE DISTRIBUTION
J. COMPARISON OF LEES FERRY ALTERNATIVES
K. ESTIMATING USE LEVELS
L. MINIMUM REQUIREMENT ANALYSIS
M. SOLICITOR OPINIONS REGARDING BOUNDARY ISSUES
   1. **1969 Manges (Opinion On Navajo Nation Boundary)**
   2. **1997 Leshy (Opinion On Hualapai Tribal Boundary)**
   3. **2005 Eaton (Response To Hualapai Tribal Comments On CRMP)**

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LIST OF ABBREVIATIONS AND ACRONYMS

The following abbreviations are used throughout this Final EIS:

ac ft	Acre Feet
ACHP	Advisory Council on Historic Preservation
ADEQ	Arizona Department of Environmental Quality
AGFD	Arizona Game and Fish Department
AOC	Area of Cooperation
BAT	Best Available Technology
BLM	Bureau of Land Management
BOR	Bureau of Reclamation, U.S. Department of Interior
B.P.	Before Present
C	Candidate for listing as federally threatened or endangered species
CDs	Compact Disks
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
CI	Continuing Interest
CO	Carbon Monoxide
CRMP	Colorado River Management Plan
dBA	Decibels "A" weighted
DEIS	Draft Environmental Impact Statement
DO	Director's Order
E	(Federally) Endangered (Species)
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
FEIS	Final Environmental Impact Statement
FTE	Full-time Equivalent
GCMRC	Grand Canyon Monitoring and Research Center
GCPBA	Grand Canyon Private Boater's Association
GCRC	Grand Canyon Resort Corporation
GCRTS	Grand Canyon River Trip Simulator
GCW	Grand Canyon West
GIS	Geographical Information Systems
GMP	General Management Plan
GRCA	Grand Canyon National Park
HDCR	Hualapai Department of Cultural Resources
hp	Horsepower
HMMH	Harris Miller Miller & Hansen, Inc.
HRR	Hualapai River Runner
IMPLAN	Impact Planning Model
L	(River) Left
LNT	Leave No Trace
mg/l	Milligram per Liter
ml	Milliliter
MOU	Memorandum of Understanding
mph	Miles per Hour
NA	Not Available or Not Applicable
NAAQS	National Ambient Air Quality Standards
NAU	Northern Arizona University
n.d.	No Date
NEPA	National Environmental Policy Act
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
NPDES	National Pollution Discharge Elimination System
NPS	National Park Service, U.S. Department of Interior
NRA	National Recreation Area
NRHP	National Register of Historic Places
NTU	Nephelometric Turbidity Unit
O_3	Ozone
OTI	Oriental Tours Incorporated
PAOT	People at One Time
Pb	Lead
PL	Public Law
PM	Particulate Matter
PM_{10}	Ten Micrometers in Aerodynamic Diameter

ppm	Parts per Million
ppm/hr	Parts per Million per Hour
R	(River) Right
RM	River Mile
ROD	Record of Decision
ROS	Recreation Opportunity Spectrum
RTS	Grand Canyon River Trip Simulator
SC	(Grand Canyon National Park) Species of Concern
Sec.	Section
SHPO	State Historic Preservation Office
SO_2	Sulfur Dioxide
SR	(Species Listed as) Salvage Restricted (by State Department)
T	(Federally) Threatened (Species)
TAOT	Trips at One Time
TCP	Traditional Cultural Properties
TES	Threatened and Endangered Species
THPO	Tribal Historic Preservation Office
TMDL	Total Maximum Daily Load
TOS	Total Dissolved Solids
UDT	User Discretionary Time
USDI	U.S. Department of Interior
USFWS	U.S. Fish and Wildlife Service, U.S. Department of Interior
USGS	U.S. Geological Survey, U.S. Department of Interior
VOC	Volatile Organic Compounds
WSC	Wildlife of Special Concern (by State Department)

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United States Department of the Interior • National Park Service

As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historic places, and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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