

FINAL  
ENVIRONMENTAL STATEMENT  
FES 79 - 30

Proposed  
COLORADO RIVER MANAGEMENT PLAN  
GRAND CANYON NATIONAL PARK  
ARIZONA

Prepared by  
Grand Canyon National Park  
National Park Service  
Department of the Interior



Director, National Park Service

## SUMMARY

( ) DRAFT      (X) FINAL      ENVIRONMENTAL STATEMENT

United States Department of the Interior, National Park Service, Western Region

1.      Type of Action: (X) Administrative      ( ) Legislative

2.      Brief Description of Action: A river management plan for the Colorado River between Lees Ferry and Pierce Ferry (277 miles) within Grand Canyon National Park, Mohave and Coconino Counties, Arizona. The plan proposes to phase out motorized craft; to increase total use of the river; increase noncommercial allocations; increase use of the river in the winter season; and establish measures for resource protection.

3.      Summary of Environmental Impact and Adverse Environmental Effects: Elimination of motorized craft will enhance the river-running experience for most visitors; those preferring a motorized trip will be disappointed. Both private and commercial parties will receive larger use allotments. Extension of the river-running season and longer average stays in the river corridor will allow greater opportunities for interpretation and education. Scheduling and increased regulations will protect sensitive resources, but may inconvenience some users.

4.      Alternatives Considered:

- a.      No action
- b.      Increase the visitor use levels
- c.      Reduce visitor levels by 50 percent
- d.      Provide exclusive periods for non-motorized use
- e.      Eliminate motorized use in the Lower Gorge
- f.      Allocation options

5. Comments Have Been Requested From the Following:

(See page ii for listing)

6. Date Final Statement Made Available to EPA and the Public:

Draft Statement: December 8, 1977

Final Statement: July 31, 1979

\*Advisory Council on Historic Preservation  
Department of Agriculture  
\*Forest Service

Department of the Interior  
\*Bureau of Indian Affairs  
\*Bureau of Land Management  
\*Bureau of Outdoor Recreation  
\*Bureau of Reclamation  
\*Fish and Wildlife Service  
\*Geological Survey

Department of Transportation  
\*Coast Guard  
\*Federal Aviation Administration  
\*Environmental Protection Agency  
\*Arizona State Clearinghouse  
\*Arizona State Historic Preservation Officer  
\*Northern Arizona Council of Governments

Havasupai Tribal Council  
\*Hopi Tribal Council  
\*Hualapai Tribal Council  
Navajo Tribal Council

\*Comments received and attached

# TABLE OF CONTENTS

## SUMMARY

I.	DESCRIPTION OF THE PROPOSAL	I-1
A.	MANAGEMENT OBJECTIVES	I-2
B.	SPECIFIC ELEMENTS OF THE PLAN	I-3
1.	Phase Out Motorized Boats	I-3
2.	Annual Use	I-7
	a. Summer Season (April 1 through September 30)	I-8
	b. Winter Season (October 1 through March 31)	I-8
3.	Allocation of Use for Commercial and Noncommercial Use	I-11
4.	Commercial Permit Management	I-14
5.	Noncommercial Permit Management	I-16
6.	Launches From Diamond Creek	I-17
7.	Launches Between Lees Ferry and Diamond Creek	I-17
C.	ENVIRONMENTAL MANAGEMENT	I-17
1.	Fires	I-17
2.	Human Waste Disposal	I-18
3.	Trash, Litter, Soap	I-18
4.	Trails	I-18
5.	Historical and Archeological Resources	I-19
6.	Monitoring and Continued Research	I-20
	a. Sociological	I-21
	b. Biological	I-21
	c. Other	I-21
D.	GENERAL GUIDELINES	I-22
1.	Plan Review and Revision	I-22
2.	Education of Commercial Guides, Noncommercial Trip Leaders, and Visitors	I-22
3.	Boating and Safety Requirements	I-23
4.	Guide and Trip Leader Standards	I-23
5.	Special Transportation Regulations	I-24
	a. Helicopters	I-24
	b. Mules and Horses	I-24
	c. Hiking	I-24
6.	Health and Sanitation	I-24
E.	INTERRELATIONSHIP WITH OTHER PLANS AND PROPOSALS	I-25
1.	National Park Service	I-25
2.	Havasupai Reservation	I-26
3.	Bureau of Reclamation	I-26

II. DESCRIPTION OF THE ENVIRONMENT	II-1
A.    GENERAL	II-1
1.    Access	II-1
2.    Adjacent Lands and Jurisdictions	II-3
a.    Bureau of Reclamation	II-3
b.    Glen Canyon National Recreation Area	II-4
c.    Navajo Indian Reservation	II-4
d.    Havasupai Indian Tribe	II-4
e.    Hualapai Indian Reservation	II-5
f.    Lake Mead National Recreation Area	II-5
B.    GEOLOGY	II-6
C.    SOILS	II-6
D.    WATER RESOURCES	II-11
1.    The Colorado River	II-11
2.    Water Quality	II-12
a. Levels of Contamination by Total Coliform	II-14
b. Concentrations of Specific Trace Elements	II-14
c. Total Dissolved Salt Concentration	II-17
d. Concentration of Biotic and Abiotic Parameters that Could Lead to Hypereutrophication	II-17
e. Known Levels of Pollutants Added by Direct or Indirect Human Contact	II-17
E.    CLIMATE	II-18
F.    AIR QUALITY	II-20
G.    NOISE	II-20
H.    VEGETATION	II-22
1.    Pre-Dam Riparian Vegetation	II-23
2.    Post-Dam Vegetation	II-23
3.    Vegetational and Topographic	II-24
4.    Ecologically Sensitive Areas	II-26
I.    WILDLIFE	II-27
1.    Amphibians and Reptiles	II-27
2.    Birds	II-27
3.    Mammals	II-30
4.    Fishes	II-31
5.    Insects	II-32
J.    RARE, ENDANGERED, AND THREATENED SPECIES	II-33
1.    Animals	II-33
2.    Plants	II-34
K.    THE CULTURAL RESOURCES	II-35
1.    Archeology	II-35
2.    History	II-36
L.    RIVER RECREATION	II-37
1.    User Days and Allotments	II-38
2.    Levels and Distribution of Use	II-42
3.    Lower Gorge	II-44

M.	THE NATURE AND EFFECT OF EXISTING USE PATTERNS	II-44
1.	Beaches	II-46
2.	Off-River Use and Attraction Sites	II-48
3.	Partial Trips	II-50
4.	Fire	II-50
5.	Sanitation	II-52
6.	Fishing	II-54
N.	SOCIAL FACTORS	II-54
1.	Commercial Passengers	II-54
2.	Private or Noncommercial Passengers	II-55
3.	Lower Gorge Users	II-55
4.	Visitor Perceptions and Preferences	II-55
a.	Mode of Travel	II-55
b.	Crowding	II-57
c.	Visitor Safety	II-57
O.	ECONOMIC FACTORS	II-58
1.	Local and Regional Economy	II-58
2.	Concessioner Services, Visitor Satisfaction	II-60
P.	PROBABLE FUTURE OF THE ENVIRONMENT WITHOUT THE PROPOSAL	II-61
III.	ENVIRONMENTAL IMPACT OF THE PROPOSED ACTION	III-1
A.	IMPACT ON SOILS AND VEGETATION	III-1
B.	IMPACT ON WILDLIFE	III-7
C.	IMPACT ON WATER QUALITY	III-8
D.	IMPACT ON AIR QUALITY	III-9
E.	IMPACT ON CULTURAL RESOURCES	III-9
F.	IMPACT ON VISITOR GROUP CHARACTERISTICS	III-11
G.	IMPACT ON VISITOR OPTIONS	III-12
H.	IMPACT ON THE VISITOR EXPERIENCE	III-14
1.	Contact and Crowding	III-15
2.	Trip Character	III-17
3.	Interpretation and Education	III-19
4.	Esthetics	III-20
5.	Safety	III-21
I.	ECONOMIC IMPACT	III-21
1.	Visitors	III-21
2.	River Guides	III-22
3.	Other Interests	III-22
4.	Regional Economy and Concessioners	III-23
5.	Park Management	III-23
J.	OUTSIDE INFLUENCES	III-23
1.	Noise	III-23
2.	Water Flow	III-23
IV.	MITIGATING MEASURES INCLUDED IN THE PROPOSED ACTION	IV-1
A.	MITIGATION OF IMPACTS ON NATURAL AND CULTURAL RESOURCES	IV-1
B.	MITIGATION OF IMPACTS ON SOCIOECONOMIC FACTORS	IV-3

C.	MONITORING AND RESEARCH REQUIRED	IV-4
D.	COMPLIANCE WITH THE NATIONAL HISTORIC PRESERVATION ACT AND THE ENDANGERED SPECIES ACT	IV-6
1.	National Historic Preservation Act	IV-6
2.	The Endangered Species Act	IV-6
V.	ANY ADVERSE IMPACTS THAT CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED	V-1
VI.	THE RELATIONSHIP BETWEEN LOCAL, SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY	VI-1
VII.	ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED	VII-1
VIII.	ALTERNATIVES TO THE PROPOSED	VIII-1
A.	NO ACTION (STATUS QUO)	VIII-1
1.	Impacts on Natural Resources	VIII-1
2.	Impacts on Cultural Resources	VIII-2
3.	Socioeconomic factors	VIII-2
B.	INCREASE THE VISITOR USE LEVEL	VIII-4
1.	Impact on Natural and Cultural Resources	VIII-4
2.	Impact on the Visitor	VIII-5
3.	Economic Factors	VIII-6
C.	REDUCE VISITOR USE LEVEL BY APPROXIMATELY 50 PERCENT	VIII-6
1.	Impacts on Natural and Cultural Resources	VIII-7
2.	Impacts on the Visitor	VIII-7
3.	Economic Factors	VIII-8
D.	PROVIDE EXCLUSIVE PERIODS (January 1 through June30) FOR NONMOTORIZED USE	VIII-9
1.	Impact on Natural and Cultural Resources	VIII-9
2.	Socioeconomic Factors	VIII-9
E.	ELIMINATE MOTORIZED USE IN THE LOWER GORGE FROM DIAMOND CREEK (MILE 225.6) TO GRAND WASH CLIFFS (MILE 277)	VIII-10
1.	Impact on Natural and Cultural Resources	VIII-10
2.	Socioeconomics Factors	VIII-10
F.	ALLOCATION OPTIONS	VIII-12
1.	Individual Application	VIII-12
2.	Equal Commercial Allocations	VIII-13
3.	Educational and Organized Group Allocation	VIII-13

IX.	CONSULTATION AND COORDINATION WITH OTHERS	IX-1
A.	CONSULTATION AND COORDINATION IN THE DEVELOPMENT OF THE PROPOSAL AND IN THE PREPARATION OF THE DRAFT ENVIRONMENTAL STATEMENT	IX-1
1.	Public Input	IX-1
2.	Coordination with Other Organizations	IX-2
3.	Consultation During Development of the Plan	IX-4
B.	COORDINATION IN THE REVIEW OF THE DRAFT ENVIRONMENTAL STATEMENT	IX-4
C.	PUBLIC COMMENT ON THE PLAN AND DRAFT ENVIRONMENTAL STATEMENT	IX-7
D.	RESPONSE TO COMMENT ON THE DRAFT ENVIRONMENTAL STATEMENT	IX-17
1.	Comments received from Federal Agencies	IX-17
2.	Comments Received from State and Associated Agencies	IX-44
3.	Comments Received from Indian Tribes	IX-72
4.	Comments Received from County and City government	IX-77
5.	Comments Received from Organizations and Associations	IX-91
6.	Comments Received from Individuals	IX-141
X.	REFERENCES	

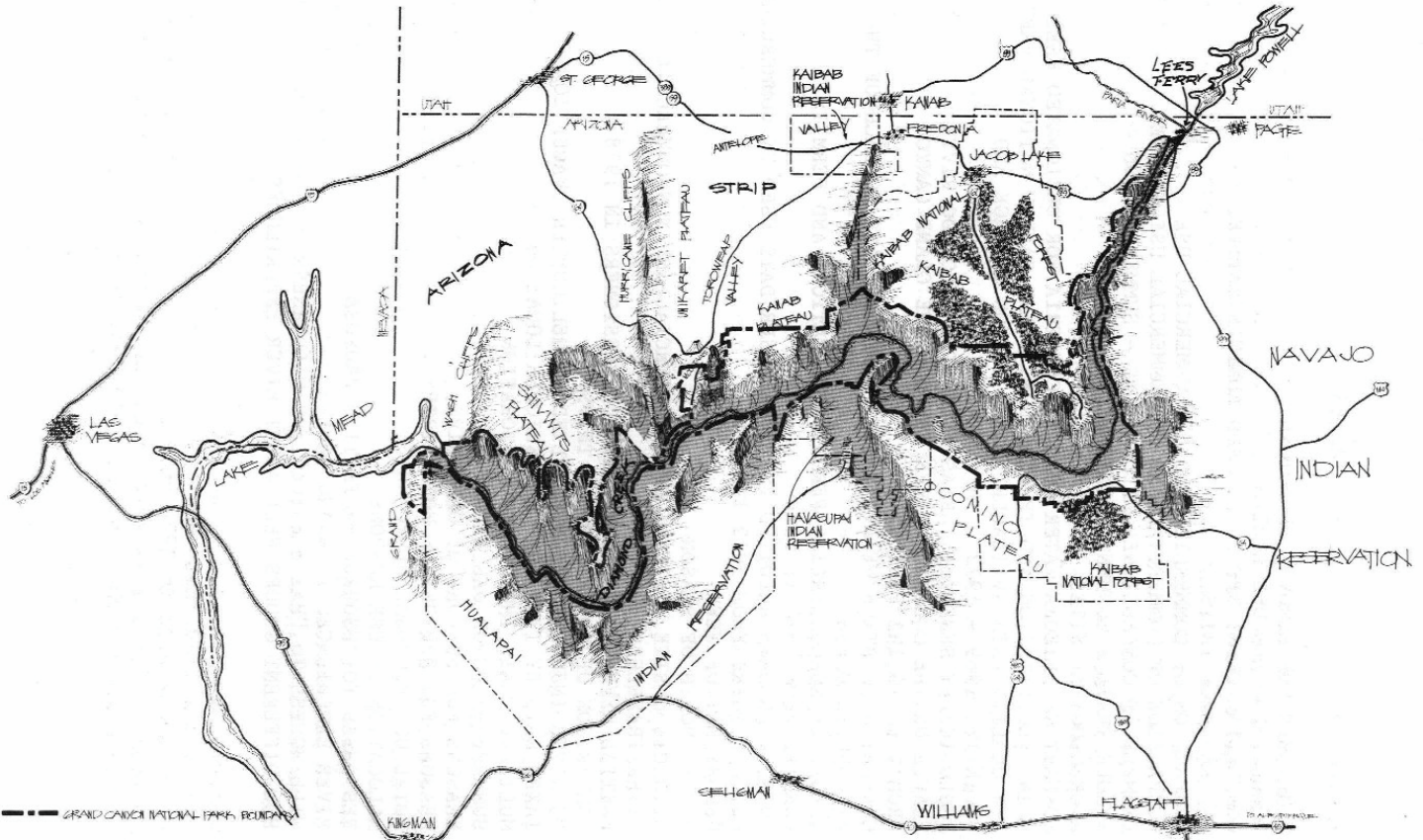
#### APPENDIXES

A.	COLORADO RIVER RESEARCH PROGRAM	A-1
B.	PRIVATE TRIP AFFIDAVIT	B-1
C.	HEALTH AND SANITATION GUIDELINES	C-1
D.	1980 OPERATIONAL REQUIREMENTS	D-1
E.	BREEDING BIRDS OF THE COLORADO RIVER FROM LEES FERRY (MILE 0) TO DIAMOND CREEK (MILE 225)	E-1
F.	MAMMALS OF THE COLORADO RIVER AREA	F-1

#### ILLUSTRATIONS

THE GRAND CANYON REGION	ix
COLORADO RIVER CORRIDOR	I-4
WILDERNESS PLAN, GRAND CANYON NATIONAL PARK	I-27
CIRCULATION SYSTEM, GRAND CANYON NATIONAL PARK	II-2
GENERALIZED GEOLOGIC SECTION AT GRAND CANYON VILLAGE	II-7
STRUCTURAL DIVISIONS OF THE GRAND CANYON DISTRICT	II-8
POST-DAM TERRACE SOIL STRUCTURE AND GEOMORPHOLOGY	II-10
TOTAL COLIFORM COUNTS IN THE COLORADO RIVER	II-15
TOTAL COLIFORM COUNTS IN TRIBUTARIES OF THE COLORADO RIVER	II-16
PRE-DAM AND POST-DAM RIPARIAN VEGETATION	II-25
FOOT TRAFFIC ON BEACHES	II-47
CHARCOAL AND DEBRIS ON BEACHES	II-47
EXAMPLES OF MULTIPLE TRAILING	II-49
RESULTS OF WILDFIRE STARTED BY RIVER RUNNER	II-51
ILLEGAL FIRE - NO FIREPAN	II-51
NANKOWEAP - MULTIPLE TRAILING	III-3





**THE GRAND CANYON REGION**  
 GRAND CANYON NATIONAL PARK

119 / 40,041  
 JUN 76 / DSC

## TABLES

1.	TIMETABLE FOR REMOVAL OF MOTORS	I-7
2.	CURRENT AND NEW USE LIMITS	I-9
3.	COMMERCIAL CREW, NPS PATROL AND ADMINISTRATIVE, AND RESEARCH TRIPS	I-11
4.	COMPARISON OF COMMERCIAL AND NONCOMMERCIAL USE	I-13
5.	COMPARISON OF COMMERCIAL AND NONCOMMERCIAL USE CHANGES	I-13
6.	EXAMPLE OF CONCESSIONER ALLOCATIONS - SUMMER SEASON	I-15
7.	SINGLE TRAIL ALIGNMENT LOCATIONS	I-19
8.	ARCHEOLOGICAL SITES	I-20
9.	SUMMARY OF ARIZONA WATER QUALITY CRITERIA FOR DESIGNATED USES	II-13
10.	MEAN PRECIPITATION AND TEMPERATURE, GRAND CANYON NATIONAL PARK	II-19
11.	AIR QUALITY DATA AVAILABLE, GRAND CANYON VILLAGE AND VICINITY, 1969 - 1972	II-21
12.	ECOLOGICALLY SENSITIVE AREAS ALONG THE COLORADO RIVER	II-28
13.	TRAVEL ON THE COLORADO RIVER THROUGH THE GRAND CANYON FROM 1867 TO THE PRESENT	II-39
14.	CURRENT ALLOCATION OF AVAILABLE PASSENGER DAYS TO EACH OF THE 21 CONCESSIONERS	II-41
15.	NUMBER OF NONCOMMERCIAL PERMIT APPLICATIONS AND PERMITS GRANTED FROM 1972 TO 1978	II-43
16.	TOTAL USER DAYS ALLOTTED VS. TOTAL USER DAYS USED BY COMMERCIAL RIVER RUNNERS FROM 1972 TO 1978	II-43
17.	USE BY DAY OF WEEK	II-45
18.	USE BY MONTH OF SEASON	II-45
19.	ATTRACTION SITE VISITATION BY COMMERCIAL AND NONCOMMERCIAL RIVER TRAVELERS	II-48
20.	PARTIAL RIVER TRIPS TAKEN WITH CONCESSIONERS IN 1978	II-50
21.	COMPARISON OF MOTOR AND OAR TRIPS	II-56
22.	ON RIVER INJURIES WHICH RESULTED IN HELICOPTER EVACUATION	II-58
23.	TAXES PAID BY TYPE AND CONCESSIONER LOCATION	II-59
24.	MULTIPLE TRAIL IMPACT AND RESTORATION	III-4
25.	SUMMARY OF MOTOR OAR INPUT	IX-8
26.	REASONS FOR SUPPORT OF OAR TRIPS	IX-9
27.	REASONS FOR SUPPORT OF MOTOR TRIPS	IX-9
28.	TOTAL USE PROPOSAL RESPONSE	IX-10
29.	ALLOCATION OF USE RESPONSE	IX-11
30.	RESPONSES TO RESOURCE PROTECTION PROPOSAL	IX-11
31.	RIVER EXPERIENCES IN GRAND CANYON	IX-13
32.	WILLINGNESS TO "PAY A PRICE" FOR WILDERNESS	IX-14
33.	HOW DIFFERENT GROUPS FEEL ABOUT RIVER EXPERIENCES	IX-16

## I. DISCRIPTION OF THE PROPOSAL

"The Colorado Plateau is a vast tableland that covers nearly one hundred fifty thousand square miles in northern Arizona and New Mexico, western Colorado, and eastern Utah. In this area is concentrated some of the outstanding scenery on the continent: the awesome Grand Canyon, the pinnacles of Bryce Canyon, the towering cliffs of Zion, Monument Valley, and Mesa Verde. The Grand Canyon of the Colorado River is located in the southwestern portion of the Colorado Plateau. The river runs 1,450 miles from Colorado to the Gulf of California including 277 miles through the Grand Canyon. A Colorado River trip through the Grand Canyon provides a unique and popular river-running experience for thousands of people each year.

Management of the Colorado River corridor and the riparian ecosystems has become an issue of major importance in recent years. The number of persons floating the river increased dramatically between 1967 and 1972 (from 2,099 to 16,432 visitors). By 1973, 22 commercial boating companies were operating on the river. As visitation increased, it became apparent that the canyon resources were deteriorating, but the degree or severity of change was unknown. To provide a firm basis for future management of the river corridor and to quantify the kind of impact inflicted on the resources, a comprehensive research program, including 29 separate studies, was initiated in 1973 and completed in June, 1976 (see Appendix A for the complete list).

The Grand Canyon National Park Master Plan contains some specific statements concerning management of the Colorado River which have had a direct influence on the development of the river plan.

". . . preservation of the Grand Canyon natural environment is the fundamental requirement for its continued use and enjoyment as an unimpaired natural area. Park management looks first to the preservation and management of the natural resources of the park. The management concept is the preservation of total environments, as contrasted with the protection of only a single feature or species.

The goals for management of the Colorado River in Grand Canyon will be to perpetuate the wilderness river-running experience and to attempt to mitigate the influences of man's manipulation of the river."

In addition, several major issues were raised by the public during hearings on the wilderness proposals for Grand Canyon National Park and during workshops held in 1976 on the future management of the river. The following major issues were identified during the course of the research studies and the public involvement process:

1. Mode of travel (motorized versus non-motorized watercraft)
2. Total use capacity
3. Allocation of use to commercial and noncommercial river runners
4. Allocation of use among commercial operators
5. Permit systems
6. Disposal of human waste
7. Use of cooking and camping fires
8. Multiple trails and site damage
9. High visitor density and congestion at attraction and camping sites
10. Lack of adequate education/interpretive programs
11. Need for research and monitoring programs

A. MANAGEMENT OBJECTIVES

In order to achieve the management goals and resolve the resource impact problems outlines above, a specific set of objectives must be established. These detailed objectives must further define what a quality wilderness experience consists of and the nature and extent of resource protection measures. These detailed objectives for river management have been developed through consideration of the management framework stated above, public input and research data provided by the 29 research projects completed in 1976.

1. -perpetuate a wilderness river-running experience in which: the natural sounds and silence of the canyon can be experienced relaxed conversation is possible the river is experienced on its own terms
2. -phase out the use of motorized watercraft between Lees Ferry and Separation Canyon.
3. -reduce high visitor density and congestion at points of interest.
4. -establish a total human use capacity and associated limitations on use of the river.
5. -allocate use equitably between commercial and noncommercial users.
6. -provide commercially guided trips.
7. -establish an equitable and efficient method of assigning noncommercial permits.
8. -protect and preserve the river corridor environment within the National Park Service's ability to do so considering the uncontrollable effects of Glen Canyon Dam.

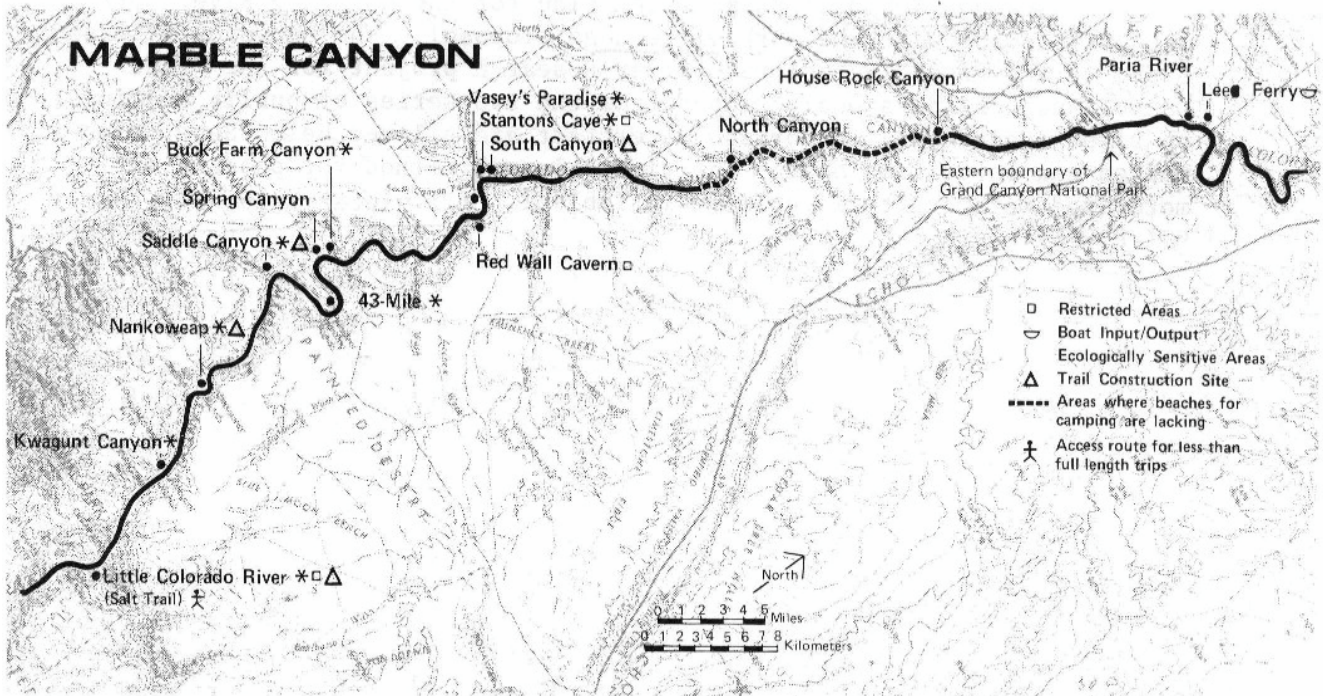
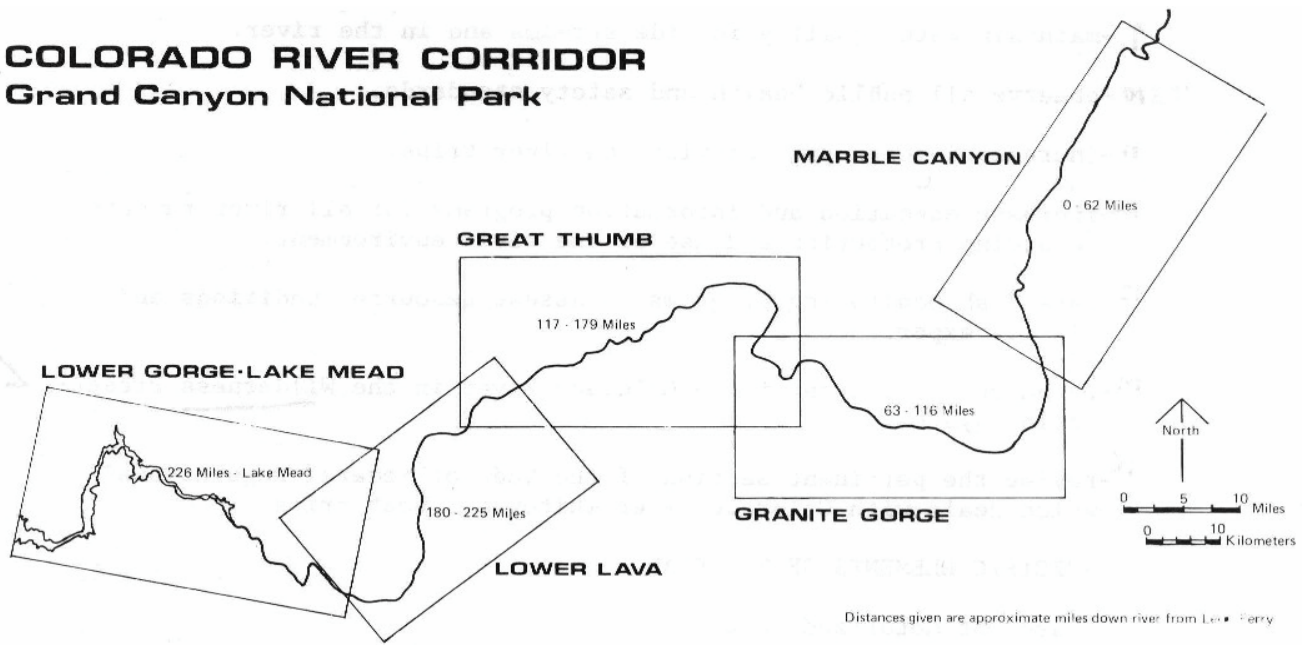
9. -maintain water quality in side streams and in the river.
10. -observe all public health and safety standards.
11. -increase interpretive services on river trips.
12. -increase education and information programs for all river runners regarding protection and use of the river environment.
13. -establish monitoring programs to assess resource conditions and visitor experiences.
14. -recommend inclusion of the Colorado River in the Wilderness Preservation System.
15. -revise the pertinent section of the Code of Federal Regulations which deals with Colorado River whitewater boat trips.

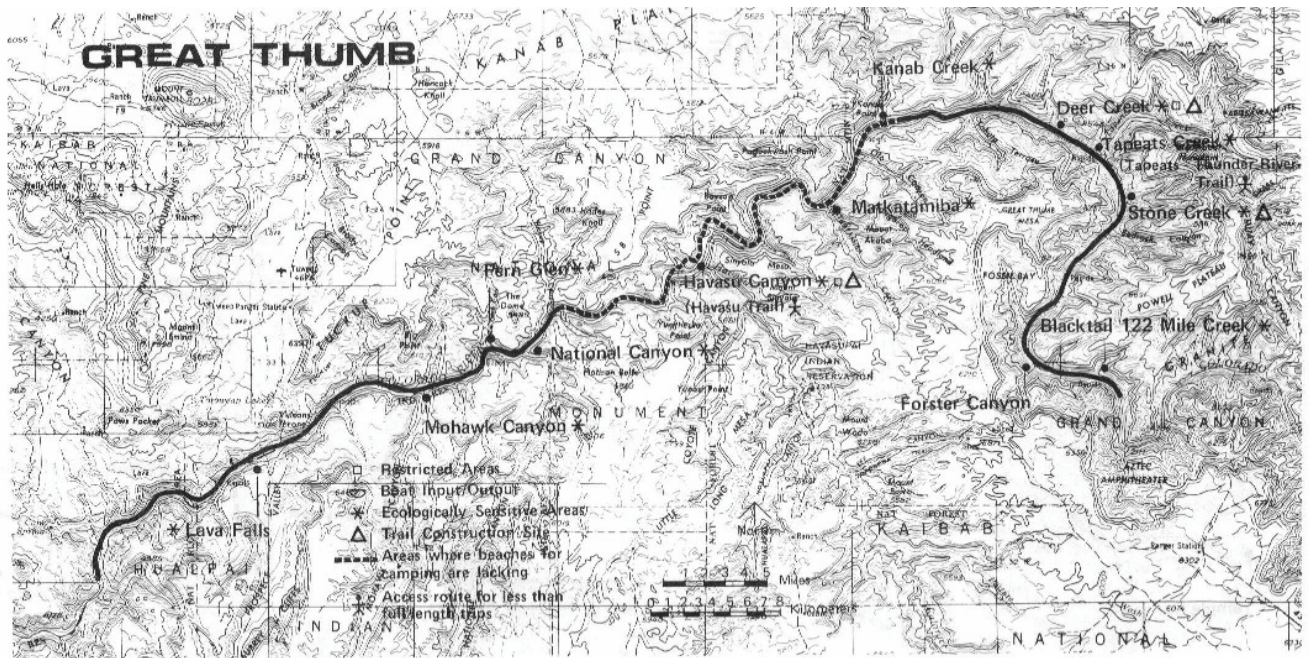
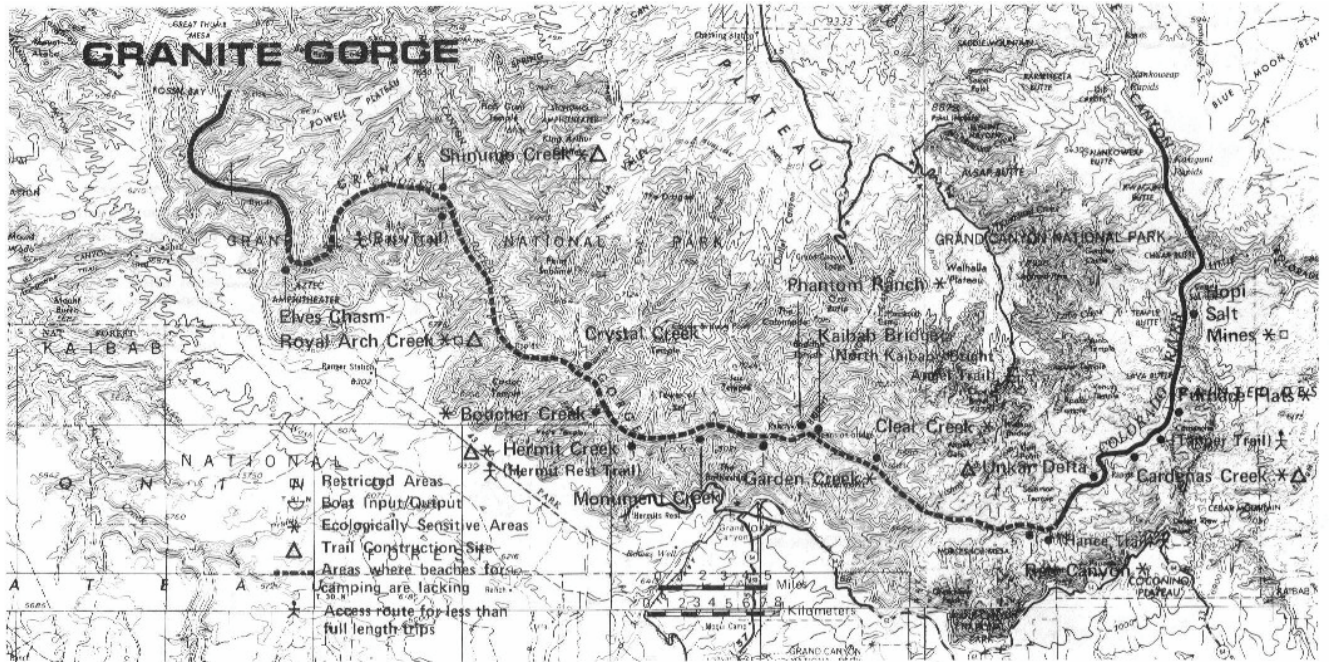
B. SPECIFIC ELEMENTS OF THE PLAN

1. Phase Out Motorized Boats

Use of motorized watercraft between Lees Ferry and Separation Canyon will be phased out over a 5-year period. This will achieve the objective of this plan to make available the high quality wilderness river-running experience which is inherently offered by the unique nature of the Colorado River through the Grand Canyon. This is also the objective of the Grand Canyon National Park Master Plan for the Colorado River Corridor, and corresponds with the park wilderness proposal. The decision is also based on the extensive Colorado River Research project for the Grand Canyon and considers public input from the two series of public meetings on river management. Motorized watercraft are allowed below Separation Canyon and on to Lake Mead. The timetable and method for phasing out motorized watercraft is outlined in Table 1. All winter trips will be oar powered

# COLORADO RIVER CORRIDOR Grand Canyon National Park





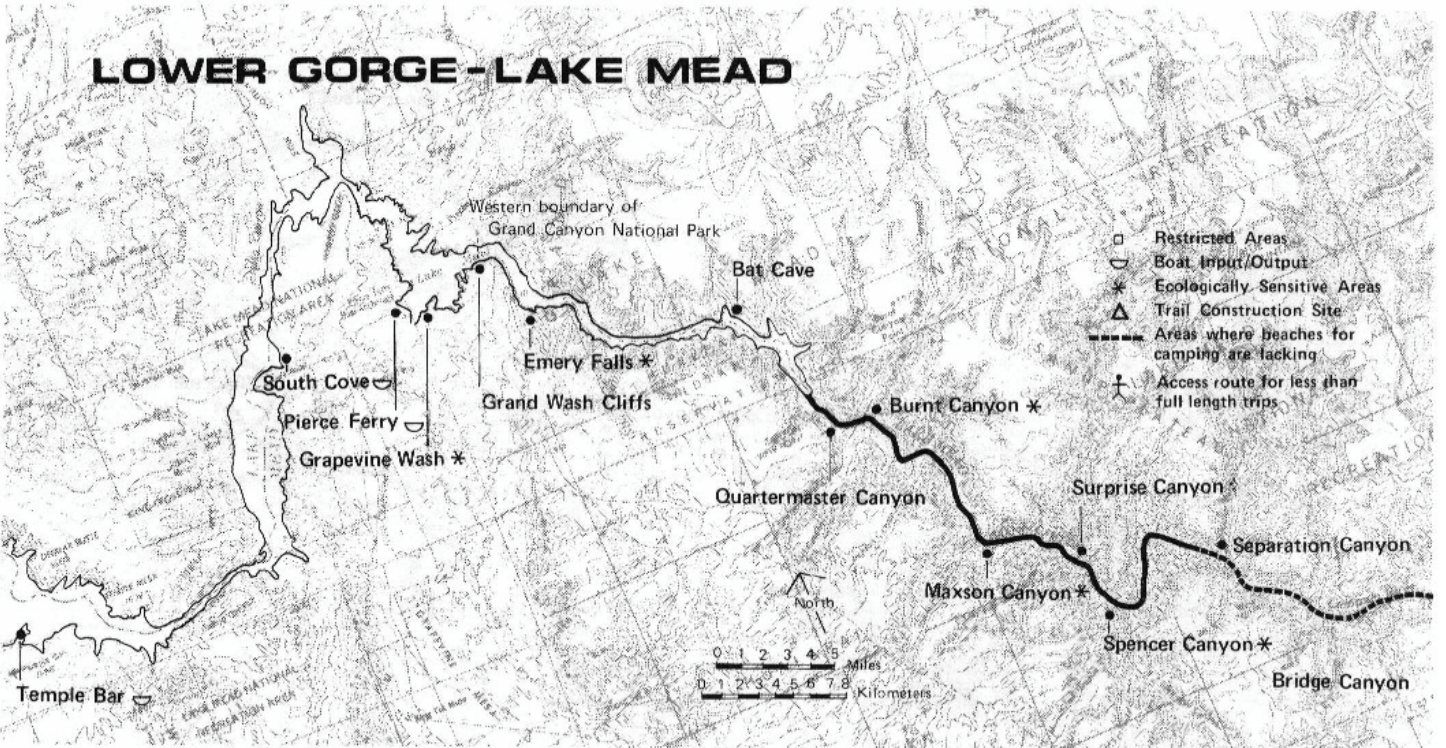
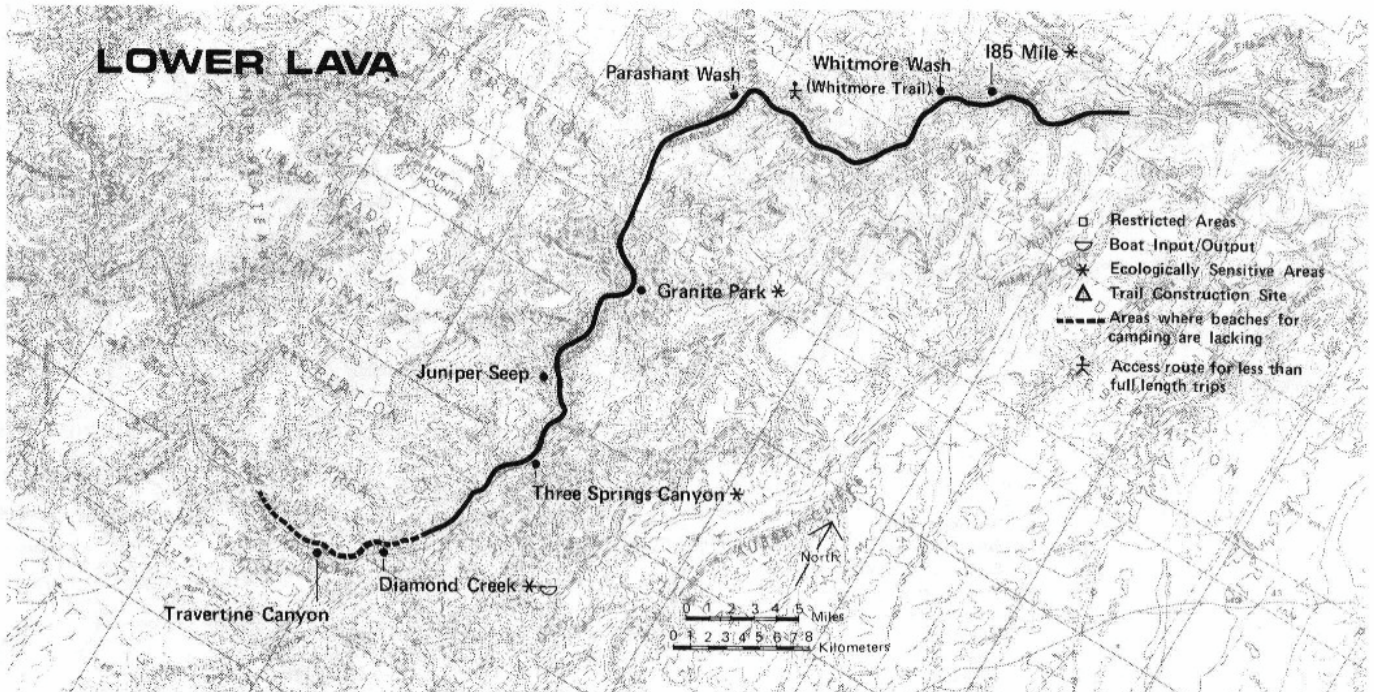




TABLE 1. TIMETABLE FOR REMOVAL OF MOTORS

	April	May	June	July	August	September
1979	Motors/ Oars	Motors/ Oars	Motors/ Oars	Motors/ Oars	Motors/ Oars	Motors/ Oars
1980	Oars	Motors/ Oars	Motors/ Oars	Motors/ Oars	Motors/ Oars	Motors/ Oars
1981	Oars	Motors/ Oars	Motors/ Oars	Motors/ Oars	Motors/ Oars	Oars
1982	Oars	Motors/ Oars	Motors/ Oars	Motors/ Oars	Oars	Oars
1983	Oars	Motors/ Oars	Motors/ Oars	Motors/ Oars	Oars	Oars
1984	Oars	Motors/ Oars	Motors/ Oars	Motors/ Oars	Oars	Oars
1985	Oars	Oars	Oars	Oars	Oars	Oars

2. Annual Use

Total annual use is increased both in numbers of people and user days. This is accomplished primarily by lengthening the summer season and allowing winter use.

A review of the river-runner contact research indicates that contacts, between river trips is the most important single factor leading to crowding and congestion and resulting negative impacts on the environment and trip experience. Therefore, it is essential to limit the number of groups allowed to launch. The summer season is lengthened from 4 to 6 months to allow use during times when little or no use is currently being made. Also summer use is redistributed to reduce crowding in peak midsummer months. Individual group size is important in enhancing the quality of the wilderness river-running experience. Therefore, maximum group size for commercial and noncommercial trips is established. Trip length has some bearing on trip experience as well as use levels. Minimum trip length is set to enhance trip quality and maximum trip length is set to maintain reasonable overall use levels. Average trip lengths used in this plan for commercial and noncommercial trips are estimates based on past experience and judgements as to what is likely to happen.

User days are not the key limiting factor in this plan as they have been in the past. Rather, the number of daily launches from Lees Ferry and trip size are the key factors in limits and distribution of use. A maximum annual total user day limit is established in this plan but is much higher than expected levels. Expected user day levels are based on average trip lengths.

a. Summer Season (April 1 through September 30)

In order to reduce crowding and congestion, keep related resource impacts at an acceptable level, and provide a quality river-running experience, the number of people launching is set at a fixed level of 65 per day for the summer season of 183 days. This includes two groups of 25 commercial passengers and one group of 15 noncommercial trip participants.

Total use and allocation is based on the maximum number of launches and maximum group sizes. For example, total maximum number of commercial passengers to launch from Lees Ferry for the summer season will be based on 50 passengers per day X 183 days which equals 9,150 passengers per season. However, in order to provide flexibility for concessioners to make up for cancellations and no shows, group size will be allowed to vary up to 30 passengers and the number of commercial trip launches per day may increase up to 3 on certain days.

b. Winter Season (October 1 through March 31)

Winter season use is restricted to no more than three trips and an average of 60 people per week. This will keep use at levels low enough to allow the natural cleansing of beaches to continue and provide for a wilderness river trip where the likelihood of encountering other trips is remote. It has been well documented by researchers (Carothers, et al., 1976) that heavily used beaches are significantly cleaner when visited in the spring than when last visited in the fall. However, little is known about the details of this cleansing process. Until the natural processes contributing to this cleansing are investigated, winter use will be kept at a relatively low level.

TABLE 2. CURRENT AND NEW USE LIMITS

<u>COMMERCIAL</u>	<u>1978 Limits</u>		<u>This Plan</u>	
	Summer	Winter	Summer	Winter
Average Miles Per Day	40	40	30	30
Minimum trip length (days)	6	6	8	8
Maximum trip length (days)	no limit	no limit	21	18
Average trip length (days)	9	9	12	12
Passengers per day (max)	150	150	50	50
Launches per day	no limit	no limit	1	2
Launches per week	no limit	no limit	up to 3	14
Passengers per group	40	40	25	25
Number of People	11,335	*	9,150	975
Number of Trips	491	*	366	39
Projected User Days	89,000	*	109,800	11,700
Maximum User Days	89,000	*	164,700	20,475
 <u>NONCOMMERCIAL</u>				
Minimum trip length	no limit	no limit	no limit	no limit
Maximum trip length (days)	no limit	no limit	18	21
Average trip length (days)	19	19	16	18
Launches per day	1	1	1	1
Launches per week	**	**	7	7
Participants per group	15	15	15	15
Number of People	395	***	2,745	585
Number of Trips	37	***	183	39
Projected User Days	7,600	***	43,920	10,530
Maximum User Days	7,600	***	49,410	12,285

\* The previous number of people, trips, and user days for commercial river running was allocated annually with no distinction as to season. Therefore, winter use is included in the summer use figures.

\*\* Launches per week was limited by the number of people that could launch each day, and the annual limit.

\*\*\* The previous annual noncommercial use allocation of 7,600 user days has worked out to about 40+ trips each year. No more than 1 noncommercial trip could launch each day. Theoretically, 7 trips could launch each week. This rarely occurred because of the overriding limit of about 40 trips each year, based on the annual user day limit.

The previous number of people, trips, and user days for noncommercial river trips was allocated annually with no distinction as to season of use. Some winter use is included in the 1978 summer use figures.

It is important to understand that maximum user day levels will not be allowed to happen. In order for maximum user day levels to occur, every trip would have to be at maximum group size and trip length. It is very unlikely that this would occur within the framework of the use limits outlined in Table 2. However, additional limits will be placed in effect if use levels at any time appear to be escalating beyond an acceptable level. Acceptable level of use is that amount shown in Table 2 as the average user day level. The average user day level is based on the total number of people allowed in a given season multiplied by average trip length. The river monitoring studies will provide data to assist management in adjusting future use levels.

For the summer season, commercial use will be based on and may not exceed 9,150 passengers launching from Lees Ferry. As outlined in Table 2, the desired group size for these trips is 25 passengers. The desired number of commercial trip launches is two each day. Based on the past several years experience it is recognized that there will be last minute cancellations and no shows on many trips. To compensate for this, concessioners will be allowed flexibility in numbers of trips and group size. Each concessioner will be allowed from two to four (depending on base allocation) makeup trips or up to 30 passengers on some trips for makeup purposes. Makeup trips will be limited to no more than three each week to keep the number of launches within acceptable limits. This flexibility is provided for makeup purposes only, and concessioners may not pre-schedule such trips.

Makeup trips will not be available for noncommercial river runners in 1980. The availability of makeup trips for noncommercial use depends primarily upon the success of the information and education program to improve noncommercial trip participants' observance of regulations pertaining to the protection of the canyon. Concurrently, some experimenting with noncommercial river-trip permit processing will be necessary to determine how to handle makeups or no shows.

The number of commercial passengers allowed to launch from Lees Ferry is 9,150 during the summer season and 975 during the winter season. However, the number of individual passengers is expected to increase by approximately 3,000 through partial river trips. Concessioners are encouraged to provide partial canyon trips as they have done in the past.

Interest in partial canyon trips is high. In 1978, there were 3,997 people who took out at Lava Falls, and an additional 3,900 people who put in or took out at other locations. Of the 3,900 people, there were 3,481 who hiked in or out of the canyon in connection with their partial river trip. Section II, Table 20 shows the number of people who took partial trips with concessioners in 1978.

In addition to the noncommercial trip participants and commercial passengers outlined in Table 2, there are commercial crew members, and National Park Service patrol, administrative, and research trip personnel. The number of commercial crew on each trip varies from company to company and trip to trip depending on type of boats used and the type of trip offered. Generally, the more specialized trips require more crew. Crew members are not counted against concessioner allocations and are in addition to the 25 passengers per group. National Park Service patrol and administrative trips are not under a use limit but will normally be approximately 12 in the summer season and 6 during winter. These trips will generally be small groups of 10 or less people. There will be generally less than 10 research trips each year. Research trips are usually small groups of about 10 people. Table 3 provides information on the extent of this use and completes the total use picture.

Table 3  
COMMERCIAL CREW, NPS PATROL & ADMINISTRATIVE,  
AND RESEARCH TRIPS

	1978		This Plan	
	No. of People	User Days	No. Of People	User Days
Commercial Crew	2626	24,105	3,000	30,000
NPS Patrol & Admin.	100	800	180	2,500
Research	50	700	50	700

Total use including commercial passengers, commercial crew, noncommercial trip participants, National Park Service patrol, administrative, and research trips, in terms of user days based on projected trip lengths is 209,150. Total maximum use (which will not be allowed to happen based on maximum trip length and maximum group size on every trip would be 304,070 user days.

### 3. Allocation of Use for Commercial and Noncommercial Trips

Commercial companies currently provide river trips for those without the expertise, time, or equipment to run the Colorado River themselves. A commercial trip, then, is defined as one where services are afforded to the visitor for a fee. These services include operating the boats, preparing meals and setting up camp, as well as providing educational opportunities to learn more about the area. These are currently both motorized and non-motorized trips. Passengers on either type of trip do not operate the boats; therefore, an oar-powered commercial trip is no more strenuous than a motorized commercial trip. Commercial river companies offer river trips only if they have a current concession permit issued by Grand Canyon National Park.

Noncommercial trips, on the other hand, consist of a private group organized to run the river and are participatory in nature. The group members share the responsibilities and cost of operating the boats, along with meals and camp duties. No fees are paid for guide services or collected above the actual cost of the trip. School and other non-profit groups may qualify for these trips (see Private Trip Affidavit, Appendix B).

The allocation between commercial and noncommercial use outlined in Table 2 is based on the best available information on the demand for commercial and noncommercial trips. Figures on potential passengers turned away by commercial concessioners may count individuals more than once as they are turned away by successive companies. When certain dates are full, some companies issue brochures indicating this fact. There is no way to count potential passengers turned away in this manner. Figures on the demand for noncommercial trips are complicated by duplicate applications, false applications, failure of interested but discouraged river runners to apply, etc. Concessioners reported that in 1978, they turned away approximately 12,000 people that they were unable to accommodate on river trips. By contrast, there were approximately 4,700 people who were included on noncommercial river trip permit applications that were not granted permits. While these figures are not entirely reliable, there is some indication that the errors are at least to some degree offsetting. This does provide some insight into relative demand for commercial compared to noncommercial river trips. From this comparison it appears that the relative demand by people who wanted river trips but were not able to take one was 72 percent commercial and 28 percent noncommercial. The proposed allocation based on number of people is 75 percent commercial and 25 percent noncommercial and does appear to be reasonable close to the demand based on 1978 information. This ratio will be reviewed and adjusted as more reliable information becomes available.

allocation ratio for commercial and noncommercial river running varies, depending upon whether one is considering the number of trips, number of people, or user days.

Table 4  
COMPARISON OF COMMERCIAL AND NONCOMMERCIAL USE

	<u>1978</u>				<u>This Plan</u>			
	<u>Commercial</u>		<u>Noncommercial</u>		<u>Commercial</u>		<u>Noncommercial</u>	
	No.	%	No.	%	No.	%	No.	%
Participants	11,335	96.6	395	3.4	10,125	75	3,330	25
Number of Trips	491	93.0	37	7.0	405	65	222	35
Projected User Days	89,000	92.0	7,600	8.0	121,500	69	54,450	21

User day figures in Table 4 are based on projected 12-day average trip lengths for commercial and 16 days for noncommercial trips. These projected trip lengths are based on five years of actual experience in observing trip lengths. During this time, no maximum limit existed for either commercial or noncommercial trips. The minimum trip length for commercial trips was a limit of not averaging more than 40 miles per day. Maximum trip length was allowed to fluctuate at the discretion of the concessioner and noncommercial trip participants.

The plan provides for significant increases in noncommercial participants, number of trips and user days, there will be minor decreases in the number of commercial trips passengers and the number of trips but considerable increase in commercial user days. The percentage changes are outlined in Table 5.

Table 5  
COMPARISON OF COMMERCIAL & NONCOMMERCIAL USE CHANGES

	<u>Participants</u>	<u>Trip Numbers</u>	<u>Projected User Days</u>
Commercial	10.7% decrease	17.5% decrease	137% increase
Noncommercial	843% increase	600% increase	718 increase

Information based on verbal and written reports indicates that noncommercial river runners are less likely to comply with operating regulations. During patrol trips in 1977 and 1978, National Park Service rangers recorded more incidents of noncompliance with regulation on the part of noncommercial river runners. Noncommercial use will be phased in to allow time to implement the information and education program for these river runners. Half of the noncommercial allocation will be allowed and monitored in 1980 and 1981. The remainder of noncommercial user days will be granted in 1982, if monitoring indicates that resource impacts are within acceptable limits by the end of the 1981 summer season.

#### 4. Commercial Permit Management

It is essential that concessioner guided river trips be available for that segment of the public who do not have the expertise, equipment, or interest to run the river on their own. Riverrunning concession permits will be granted for a 5-year period beginning January 1, 1980, and ending December 31, 1984. When granting permits, preference will be given to those companies who have provided satisfactory service over the term of their existing permits. This is required by the Concession Policy Act of October 9, 1965 (P.L. 89-249; 79 Stat. 969; 16 U.S.C. 20):

"SECT. 5. The Secretary shall encourage continuity of operation and facilities and service by giving preference in the renewal of contracts or permits and in the negotiation of new contracts or permits to the concessioners who have performed their obligations under prior contracts or permits to the satisfaction of the Secretary. To this end, the Secretary, at any time in his discretion, may extend or renew a contract or permit, or may grant a new contract or permit to the same concessioner upon the termination or surrender before expiration of a prior contract or permit. Before doing so, however, and before granting extensions, renewals or new contracts pursuant to the last sentence of Section 4 of this Act, the Secretary shall give reasonable public notice of his intention to do so and shall consider and evaluate all proposals received as a result thereof."

As indicated in the Concession Policy Act, public notice will be given of the intention to renew permits. Anyone who so desires may submit a proposal for a permit with the assurance that it will be evaluated.

Table 6 shows the proposed method of allocating use among concessioners. This is based on historical user day allocations converted to number of passengers and trips launched.



Table 6  
EXAMPLE OF CONCESSIONER ALLOCATIONS -- SUMMER SEASON

Concessioner	1978 User Day Allocations	Percent of User Days	Number of Passengers This Plan	Trip Launches This Plan
Company A	10,000	11.2%	1,025	41
Company B	8,500	9.6%	875	35
Company C	7,000	7.9%	650	26
Company D	4,000	4.5%	400	16
Company E	2,500	2.8%	250	10
Company F	1,500	1.7%	150	6
Company G	1,000	1.1%	100	4
etc.	etc.	etc.	etc.	etc.
Totals	89,000	100.0%	9,150	366

Actual river companies were not used in the example of Table 6 to avoid charges of preselection bias. "Etc." was placed at the bottom of each column to indicate that there would likely be more than seven companies. In fact, 21 companies for full-canyon trips, plus the Hualapai Tribe for Lower Gorge trips, is the maximum number that will be granted permits under this plan. Based on the past five years of operation, the National Park Service believes that from 15 to 18 companies would be preferable. This would maintain the variety of trip offerings desired and yet provide an opportunity for those existing small companies to increase their operations to the point of being more economically viable. With fewer than 15 companies, the variety of services offered would decrease significantly. However, any reduction in number of companies will occur through natural attrition.

There are 39 winter trips available to concessioners with group size of 25 passengers per trip and up to 21-day trip lengths. Each concessioner will be given the opportunity for at least one winter trip. The remaining trips will be available on a first-come, first-served basis. If there are any concessioners who do not want a winter trip, their trip will be made available to other concessioners on a first-come, first-served basis.

Scheduling of trip launch dates will be handled on a first-come, first-served basis. Concessioners will send proposed trip launch schedules for a given season to the National Park Service by July 1 of the previous year. The National Park Service will confirm launch schedules upon receipt of the proposed schedules. Any company who sends launch schedules in late will be assigned the closest launch date available to those it proposes.

If a company ceases operation, its use allocation will be reallocated at the discretion of the National Park Service. The National Park Service reserves the right to adjust or reallocate use allocation.

Concession permits will be assigned through a bid procedure, after considering the proposals submitted by all applicants. River-running concession permits cannot be transferred without prior written approval from the National Park Service.

National Park Service policy requires that all concessioners be evaluated at least three times annually. Therefore, all river-running concessioners will be routinely evaluated as required by policy. Evaluations will include on-river activities as well as compliance with permit conditions such as insurance, annual financial reports, etc. On-river evaluations will be conducted both by NPS personnel accompanying concessioner river trips and by NPS patrol personnel visiting and contacting trips on river, at attraction sites, and at camps. These contacts will be low key.

#### 5. Noncommercial Permit Management

Noncommercial permits will be granted on a first-come, first-served basis. A waiting list will be maintained. A beginning date for receiving noncommercial permit applications will be established. It is expected that the number of applications received on the beginning date under the new plan will be more than can be accommodated during the first season. A lottery will be operated for this first block of applications. As applications are drawn, they will be granted permits until all launch dates for the first season are filled. The lottery will be continued for all initial applicants, and as they are drawn they will be placed on a waiting list for subsequent season(s). Thereafter, applications will be accepted in the River Unit Office at any time and placed first-come, first-served at the end of the waiting list.

In submitting an initial application, the applicant need not include a list of participant names. A trip participant list will be required when the applicant's name comes to the top of the waiting list and is granted a permit. If any persons on the participant list are also applicants on the waiting list, their names will be removed from the waiting list. After the trip is completed, participants may again apply for a river trip permit and be placed at the end of the list.

When a trip application comes to the top of the list, the applicants are assigned, as nearly as possible, a launch date of their choice. If they cannot meet the assigned launch date, they will have the choice of any unassigned launch dates for the remainder of the season. If there are no available dates, the permittee is placed on the top of the waiting list to be assigned the next available launch date. Cancellations will be filled by the next available person on the list until three weeks

prior to launch date. The waiting list is periodically up-dated through the mailing of interest cards. If no response is received from the interest card, the permittee's application is removed from the file. Permits and launch dates will be assigned in February for the summer season and in August for the winter season.

#### 6. Launches from Diamond Creek

A special river-running permit is required for any noncommercial parties launching at Diamond Creek. A quota and reservation system will not be established at this time, but the permit system will make boaters aware of equipment requirements, safety procedures, and environmental considerations. It also allows the National Park Service to monitor visitor use levels. These river-running permits are issued by the River Unit or the Pierce Ferry ranger prior to a trip leaving Diamond Creek. Commercial and noncommercial river runners must meet all operational requirements for river trips as outlined in this plan. All commercial trips launching at Diamond Creek must have a current concession permit with Grand Canyon National Park.

#### 7. Launches Between Lees Ferry and Diamond Creek

Any noncommercial river trip launching between Lees Ferry and Diamond Creek is required to obtain a permit through the system outlined in B.5. All commercial river trips launching at any point within the canyon must have a current concession permit or contract with Grand Canyon National Park.

### C. ENVIRONMENTAL MAGEMENT

#### 1. Fires

Use of fires on river trips is limited because of the environmental impacts this activity causes. Those impacts are the buildup of charcoal and ash on beaches, and stripping of native trees and shrubs for firewood due to the lack of natural driftwood.

Fires are limited to esthetic and warming purposes during the summer season. Wood must be carried into the canyon for summer fires. Driftwood from along the river may be used for winter fires. Gas stoves must be carried for most cooking purposes. Charcoal briquettes may be used for dutchovens, grilling meat, etc. All wood or charcoal must be contained in a fire pan. No fires are allowed when away from the river corridor.

The annual operating requirements contain specific details for the use of fires, fire pans, stoves, etc.

## 2. Human Waste Disposal

All river trips are required to haul out human waste generated by their group. This procedure is necessary due to the potential health hazard to the park visitor, impact on natural resources, esthetic impacts (sight and smell) and the potential destruction of irreplaceable archeological resources resulting from burial of waste in the canyon. National Park Service experience indicates that human waste can be removed at an acceptable cost and with little inconvenience to the visitor. The procedure is outlined in Appendix C.

## 3. Trash, Litter, Soap

All trash and litter must be carried out of the canyon. Use of soap is not allowed in side streams. Any soap used must be biodegradable. Specific details may be found in the 1980 Operational Requirements, Appendix D. IV.

## 4. Trails

Single trails are to be designated and maintained from the river to points of interest and other environmentally sensitive areas. To continue the present haphazard multiple trail system is unacceptable. Closure of existing trails and areas presently visited would not be feasible as it would require more effort to effectively patrol the closures than is reasonable. Reduction of visitor use would not accomplish desired goals since this, along with other trampling damage, is not a function of numbers of people as much as of where they walk. Establishing or designating single trails may require occasional minor amounts of construction.

A total of 12.1 miles are to be defined and maintained at the specific locations outlined in Table 7.

TABLE 7  
SINGLE TRAIL ALIGNMENT LOCATIONS

Area	River Mile	Miles of New Trail	Total Miles of Trail Maintenance
South Canyon	32 (N)	0.5	1.5
Saddle Canyon	47 (N)	1.0	2.5
Nankoweap	52 (N)	1.5	2.0
Little Colorado	61.8 (S)	1.5	3.0
Cardenas Creek	72 (S)	1.0	2.0
Unkar Delta	72.5(N)	0.5	2.0
Hermit Creek	95 (S)	2.6	4.0
Shinumo Creek	108 (N)	0.5	0.5
Elves Chasm	116 (S)	0.5	0.5
Stone Creek	132 (N)	0.5	2.0
Tapeats Creek	134 (N)	0.5	3.0
Deer Creek	136 (N)	1.0	7.0
Havasus Creek	157 (S)	<u>0.5</u>	<u>1.5</u>
		12.1	31.5

#### 5. Historical and Archeological Resources

Specific religious Indian sites are closed to hiking and/or camping. These sites are identified in the operating requirements, Appendix D. No archeological or historic site may be disturbed. No artifact may be removed from the canyon.

The archeological sites listed in Table 8 are subject to heavy visitation and will be monitored, evaluated, stabilized, and protected as necessary to preserve their values in compliance with mandates of the National Historic Preservation Act and following consultation with the Advisory Council on Historic Preservation.

TABLE 8  
ARCHEOLOGICAL SITES

Site Number	Type of Site	Work Needed
1. C:5:1	Pueblo Ruins	Stabilization
2. C:5:3	Stanton's Cave*	Repair Fence
3. C:9:1	Pueblo Ruins	Stabilization
4. C:13:4	Prehistoric Midden*	Test Excavation
5. C:13:66	Rock Shelter*	Full Excavation
6. C:13:2	Pueblo Ruins	Stabilization
7. C:13:10	Pueblo Ruins*	Test Excavations
8. C:13:11	Masonry Granary	Stabilization
9. B:16:3	Pueblo Ruins	Stabilization
10. B:15:1	Pueblo Ruins	Stabilization
11. B:10:4	Pueblo Ruins	Stabilization
12. B:10:1	Pueblo Ruins	Stabilization
13. A:16:1	Pictographs*	Test Excavations
14. G:3:3	Rock Shelter*	Test Excavations

\* Regular inspection of sites with research potential may show that active preservation or data recovery measures (stabilization or emergency excavation) may be necessary.

The following historic sites will be preserved through evaluation, protection and/or stabilization:

Name of Site

1. Brown Inscription
2. Cave Springs Rapid Historic Site
3. Bert Loper's Boat
4. Grave's of Peter Hansbrough (1889) and Boy Scout (1946)
5. Grave of Willie Taylor
6. Beamer's Cabin
7. Tanner Mining Camp
8. Hance Cabin
9. Asbestos Canyon Mining Camp
10. Bass' Winter Camp and Cable Crossing
11. Hakatai Canyon Mining Camp

6. Monitoring and Continued Research

Data from research projects completed in 1976 has been used in evaluating impacts of current visitor use levels and patterns, and in developing the management plan. It is recognized that much additional data is needed. Continued effort will be required in the following areas.

a. Sociological

Further refinement of information regarding relative demand by the public for noncommercial and commercial trips is essential. Existing data has provided groundwork for setting initial allocations. However, a more reliable process is needed to accurately assess the demand for commercially guided trips, taking into account the number of turn-downs and cancellations, and the effect of advertising activities.

Analysis of noncommercial permit demand is needed to determine duplicate applications, false names, and number of people that do not apply due to the tremendous competition for permits. The data can then be compared and a more responsive allocation made.

It must be recognized that demand for commercial vs. noncommercial trips is not static. Continual monitoring and adjustments in allocations will be required.

Monitoring of contacts and crowding under the new management scheme is essential. Also important is continued assessment of visitor perception of the trip experience.

b. Biological

There is need for further data and the monitoring of ecological changes to ensure that the resource is being protected and to assess the effects of changing use patterns.

The environmental health of campsites and points of interest must be monitored. The data gathered will be used to adjust visitor use levels to mitigate longer term resource impacts.

c. Other

Monitoring of economic impacts on concessioners and visitors resulting from the restrictions, limitations, and requirements established by the plan is also necessary.

To comply with Executive Order 11593, it is imperative to evaluate cultural and historic resources within the river corridor and related use areas that are or may be affected by river travelers, and to monitor impacts on these resources resulting from river runners. Protective measures will be taken as required.

## D. GENERAL GUIDELINES

### 1. Plan Review and Revision

It is expected that periodic modifications to the plan will be necessary. Future modifications will be based on data and information from monitoring studies and public input. Normally, specific detailed requirements concerning boat types, boat capacities, safety and emergency equipment, safety and emergency procedures, trip leader and guide standards, resource protection procedures, public health standards, etc., will be reviewed and modified where needed on an annual basis. Use, allocation, scheduling, and related matters will normally be modified on a longer term basis of from three to five years. However, in any situation where a critical need for modification arises, the Superintendent reserves the right to make such a modification whenever it is necessary.

The procedure for modification will include:

- Conducting research and evaluating data.
- Determining alternate management directions.
- Considering public review and comment.
- Notifying all river-running permit holders of proposed changes
- Notifying the general public through local and/or Federal Register publication.

### 2. Education of Commercial Guides, Noncommercial Trip Leaders and Visitors.

It is essential that commercial guides, trip leaders, and passengers are fully educated as to river management requirements. The educational provisions are listed below:

- Annual written operating requirements for every guide and trip leader.
- An audio-visual program on resource protection for all commercial and noncommercial river passengers.
- Commercial guide and trip leader training programs in minimum impact behavior, safety, sanitation and interpretation. A minimum of two 1-week commercial boatman training sessions per year will be planned, providing funds and manpower are available to the National Park Service. Commercial guides and trip leaders should attend at least one of the 1-week sessions during the first year of employment. Alternate methods and sources of training guides may be arranged by concessioners. Ability, knowledge, and willingness to impart information gained through training or other sources to passengers will be noted on concessioner evaluations. All noncommercial trip leaders must attend a one-day training session at Lees Ferry.



Commercial guides and noncommercial trip leaders must ensure that members of their group follow all applicable National Park Service rules, regulations and guidelines.

### 3. Boating and Safety Requirements

Based on past experience, current boating and safety requirements have been found to be adequate and will be continued. A summary of those standards are outlined below and a complete description found in Appendix

There are specific types of watercraft and corresponding load capacities (numbers of people) that are allowed to run the river. Exception to the rules outlined in the annual operating requirements must be approved by the National Park Service.

Wearing of U.S. Coast Guard approved life jackets in all whitewater areas of the river is required. Continued wearing of life jackets in calm water sections of the river is highly recommended. However, flexibility is allowed to the concessioner and noncommercial river runner to allow life jackets to be taken off on flat water, depending on the type of watercraft and other conditions. Types of life jackets and other floatation devices to be worn or used by commercial passengers, boatmen, and noncommercial river runners are described in Appendix D.

All river trips are required to carry first aid supplies and equipment. Recommended supplies and equipment are found in the Appendix. In the event of an emergency medical or other situation arising on the river all trips are required to carry some emergency communications and signaling equipment. Other emergency repair and spare parts are required on all trips, such as extra oars or paddles, boat patching kits, pumps, ropes and maps.

### 4. Guide and Trip Leader Standards

Standards for commercial trip leaders and guides have been established. These include sufficient previous experience on whitewater rivers, including the Colorado in Grand Canyon, to ensure that a person has the skill to successfully negotiate the rapids, as well as to provide information and interpretation for the visitor. In addition, the guide must be able to: meet and cope with first aid situations and emergency evacuation procedures, deal with boat maintenance and repair, and be especially knowledgeable and actively work to protect the canyon's resources. A commercial trip leader must have had at least six trips through the canyon (as a guide) in the type of craft being used. A guide must have had three trips through the canyon in the type of craft to be run, having run all rapids in the river in this craft at least twice.

Standards for noncommercial trip leaders are less stringent regarding previous experience on the river in Grand Canyon, but it is essential that they attend a one-day training session to learn the proper procedures regarding resource protection, safety and emergency evacuation, as well as some interpretation (see Appendix D. III. for details).

5. Special Transportation Regulations

a. Helicopters

Helicopters used to transport passengers to and from the river must operate on lands outside the boundaries of Grand Canyon National Park. Commercial river-running companies will be required to schedule passenger exchanges at designated times and places specified by the National Park Service. These flights will be coordinated with commercial outfitters and those in control of the lands being used.

b. Mules and Horses

The park will arrange for a concessioner to provide mule takeouts at two points in the canyon. These areas will be Whitmore Wash and Phantom Ranch. This will be done through the existing or a new mule concession permit. These concessioners will provide transportation for passengers and baggage to and from river trips.

River concessioners must make arrangements with mule concessioners. Up to 10 mules a day will be available, by prior arrangement, for river passengers at Phantom Ranch. Up to 30 mules or horses will be available, by prior arrangement, at Whitmore Wash.

c. Hiking

Visitors may hike in or out of the canyon to meet or leave a river trip. However, overnight hiking trips require a permit obtainable from the Backcountry Reservations Office through the River Unit Manager.

6. Health and Sanitation

The proper storage and handling of food on river trips is important so as to minimize the spread of communicable disease. Personal cleanliness of food handlers, proper type and temperature of storage boxes, cleanliness of cooking equipment, and washing dishes properly are some of the most important items. Further details are found in Appendix C.

Applicable Federal, State and local government laws and regulations will govern health and sanitation procedures on all river trips.

## E. INTERRELATIONSHIP WITH OTHER PLANS AND PROPOSALS

### I. National Park Service

The final environmental statement for the Grand Canyon Master Plan (FES 75-97) was made available for public review in November 1975. The final master plan was approved in June 1976. The plan provides a framework for the development and management of visitor facilities on the rims and the use of the backcountry and river corridor. The river management plan has been prepared in conjunction with the master plan and takes into consideration visitor use within the transcanyon corridor (Phantom Ranch) and that of the backcountry adjacent to the river.

Certain lands within Grand Canyon National Park have been studied and evaluated for incorporation in the National Wilderness Preservation System. The proposed Wilderness Classification for Grand Canyon, Draft Environmental Statement (DES 76-28) recommends that the river corridor be placed in wilderness at such time as the lands so qualify. The total area of the river unit, including the water surface, would be approximately 17,000 acres. Existing use of motorized craft is inconsistent with the wilderness criteria of providing outstanding opportunities for solitude and for a primitive and unconfined type of recreation.

The backcountry management plan is the river management plan's counterpart in the management of the park's roadless area. The river plan is designed to be a workable document compatible with the standards, requirements, and limits for use established in the backcountry management plan.

A natural resource management plan has been developed for Grand Canyon. This plan is complementary and considers portions of the river environment as well as the rest of the park lands. The plan contains research proposals coinciding with river management actions pertaining to endangered fish species and exotic plant removal.

A cultural resource management plan is being prepared for the protection of all historic and archeological resources within the park. This plan will detail those specific sites within the river corridor needing stabilization and/or preservation and will describe how those particular activities will be accomplished.

A study of aircraft overflights and the related problem of noise is currently in progress. The results of this study will be incorporated into a proposed draft management plan and the submission of proposed rules to the Federal Aviation Administration to mitigate resulting impacts on park visitors and resources.

As a result of the 1972 Water Pollution Control Act (Public Law 92-500), a water quality inventory and biological analysis plan has been written and approved for all Grand Canyon National Park waters. This plan

provides for continued monitoring of the condition of significant water sources within the park.

A combined burro management plan and draft environmental statement was released to the public in January 1979. The plan evaluates the effects of burro populations on natural and cultural resources along the river corridor and proposes measures to control burro numbers and reduce adverse impacts. The final plan is scheduled for completion in the fall of 1979.

The park's Search and Rescue Plan provides procedures for the emergency search and rescue of park visitors including river runners.

A general management plan and wilderness proposal have been prepared for Glen Canyon National Recreation Area. The river management plan will affect operations within the national recreation area at Lees Ferry. Glen Canyon personnel will undertake added responsibilities due to the expanded education/interpretive programs proposed in the plan. These programs and personnel will be provided by the national recreation area.

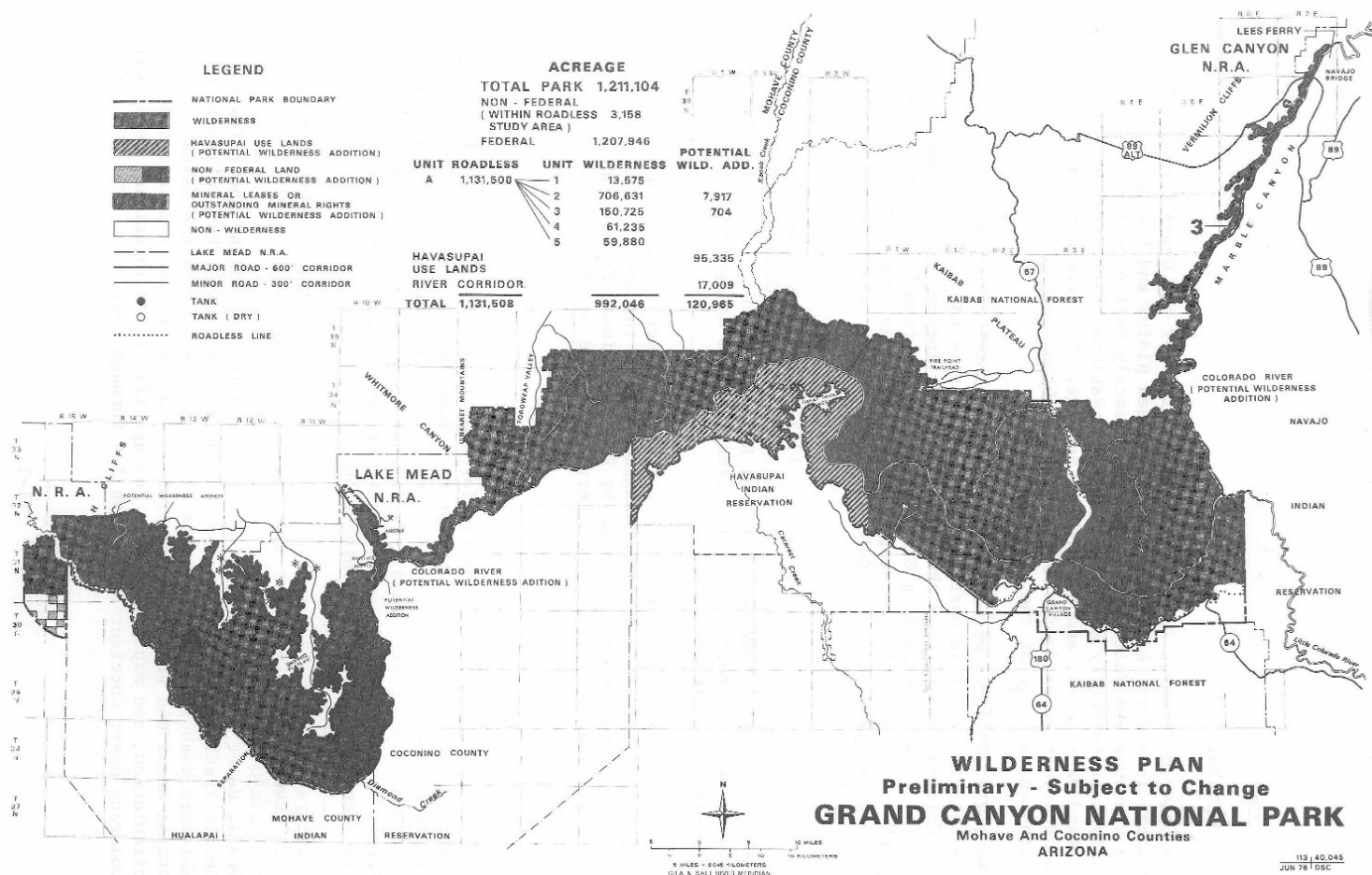
A revised wilderness proposal for Lake Mead National Recreation Area has recently been made available for public review, DES 79-12. Although lands immediately adjacent to Grand Canyon, such as the Shiviwits Plateau and those in the Whitmore Canyon area are considered for wilderness, such designation would not affect river-running activities. Visitors do leave the float trips at Whitmore Canyon and travel through national recreation lands via a jeep road, but this access road would remain open to permit other uses such as grazing.

## 2. Havasupai Reservation

A study of the traditional use lands, consisting of 95,335 acres within the national park boundary is currently being headed by the Bureau of Indian Affairs, together with the Havasupai Tribe and the National Park Service. The study will determine what traditional uses were made of the area below Great Thumb on the south slope of the Grand Canyon to the high water line of the river. These lands are within Grand Canyon National Park and are managed by the National Park Service, but are also available for traditional uses of the Havasupai. Of primary importance is the coordination of off-river hiking in Havasu Creek.

## 3. Bureau of Reclamation

The Bureau of Reclamation has prepared an environmental assessment for the operation of Glen Canyon Dam. The amount of water released from the dam affects the river-running activities in Grand Canyon, as well as the natural resources along the river corridor. The volume of water released at any given time will depend upon water and power demands in the region. Coordination has been established between the Bureau of Reclamation and National Park Service personnel to obtain water flow predictions.



## II. DESCRIPTION OF THE ENVIRONMENT

### A. GENERAL

The Colorado Plateau is the regional setting for the Grand Canyon. The plateau is a vast, semi-arid land of raised plains and basins typical of the Southwestern United States. Approximately half of the land on the plateau is federally administered by the National Park Service, Bureau of Land Management, and U.S. Forest Service. The remaining land is owned primarily by Native Americans. The Grand Canyon lies on the south-central edge of the plateau.

The 1,218,375 acres within Grand Canyon National Park are adjacent to the Colorado River in northern Arizona. Within the park is 277 miles of the Colorado River, from the Paria River confluence to the Grand Wash Cliffs. The 277-mile-long Grand Canyon ranges from 1 to 25 miles in width and is up to 1 mile deep. Elevations range from 1,200 feet at the western boundary where the Colorado River enters Lake Mead, to 9,165 feet on the North Rim.

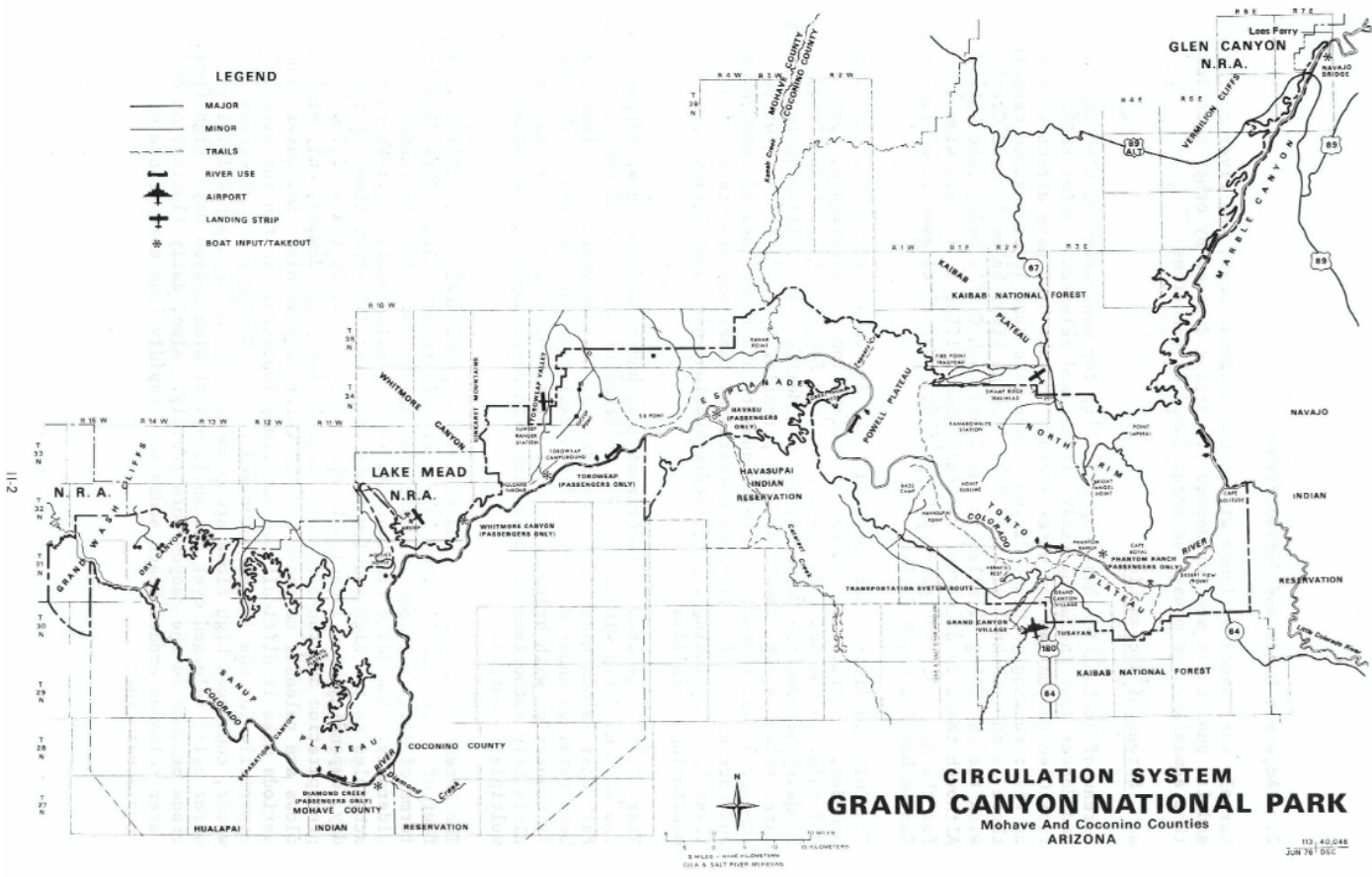
Public Law 93-620, dated January 3, 1975, incorporated Marble Canyon National Monument; Grand Canyon National Monument; Grand Canyon National Park; portions of Lake Mead National Recreation Area, the Kaibab National Forest, national resource lands (Bureau of Land Management); and other lands into the present park.

The park is bounded on the north by Kaibab National Forest and the Arizona Strip (Bureau of Land Management), on the east by the Navajo Indian Reservation, on the south by Kaibab National Forest and the Havasupai and Hualapai Indian Reservations, and on the west by Lake Mead National Recreation Area.

#### 1. Access

The Colorado River is accessible for boat launching and takeouts in only a few places. Lees Ferry, the primary boat launch site, is accessible from U.S. Highway 89A. Diamond Creek, a primary takeout location, is accessible by a gravel road from Interstate 40 at Peach Springs. Pierce Ferry, South Cove, and Temple Bar which are the remaining takeout locations are accessible from Interstate 40 and 15.

Visitors may also hike or ride a mule into the canyon to meet or exit from river trips. At least nine trails are available: Salt Trail from the Navajo Indian Reservation to the Little Colorado River, Tanner Trail, Hance Trail, North and South Kaibab Trails, Bright Angel Trail, Hermit Trail, Bass Trail, Tapeats-Thunder River Trail, Havasu Trail, and Whitmore Wash Trail. Mule rides are available only on the Kaibab, Bright Angel and Whitmore Wash Trails. For major access points and circulation, see map page II-2. For specific river locations, refer to Colorado River Corridor map, pages I-4 through I-6.



## 2. Adjacent Lands and Jurisdictions

Largely surrounded by lands within the national park, the river corridor and its public use are influenced to varying degrees by other agencies that administer or manage adjacent lands or resources.

### a. Bureau of Reclamation

Bureau of Reclamation has responsibility for management of Glen Canyon and Hoover Dams including water storage and releases. Water releases from Glen Canyon Dam and water storage in Lake Mead have direct effect on river running in Grand Canyon. When Lake Mead is at maximum capacity, there is only about 5 miles of free-flowing river below Diamond Creek, with the remaining 42 miles to the Grand Wash Cliffs being lake waters. Although there is a current to Grand Wash Cliffs, it is very slow and for the most part not perceptibly moving. Water releases from Glen Canyon Dam fluctuate daily.

The Colorado River Front Work and Levee System Act of March 3, 1925, as amended, authorizes the Bureau of Reclamation to investigate, operate, and maintain the Colorado River from Lees Ferry to the International Boundary between the United States and Mexico. In addition to regulating water releases, the Bureau studies potential hydroelectric and water storage sites, investigates water quality and techniques of improvement, and carries out miscellaneous operational functions associated with river flow, including gaging, sedimentation, side wash inflow, and monitoring rockslides.

There is a large area of riverfront land under Reclamation withdrawal in the Arizona Strip within the 1975 Enlargement Act of Grand Canyon National Park that is administered by the National Park Service. This land has been retained under Reclamation's jurisdiction for potential future uses in connection with hydroelectric or water storage projects as may be ultimately authorized in connection with development of the Nation's multiple resources.

The Bureau of Reclamation has released approximately 8.23 million acre-feet of water annually from Lake Powell in recent years. This flow in terms of daily releases in cubic feet per second (cfs) fluctuates considerably. The daily fluctuations require adjustments in river-running schedules as the high and low flows arrive at different times of the day, depending upon location in the canyon. Also in years of low precipitation and run-off, when there is low power demand, only minimum flows are released to store as much water as possible. Low water flow periods make it difficult and sometimes impossible to run the river, especially for the larger motorized boats. During years of excess water, continued high flows are common, with the future possibility of water being released over the spillways of Glen Canyon Dam. High flows erode beaches in the canyon more rapidly. Also, daily fluctuation of water releases erodes beach sands more rapidly than more stable or consistent flows.



Coordination with the Bureau of Reclamation is necessary to keep river runners informed on water release rates from Glen Canyon Dam and the level of Lake Mead. The Bureau of Reclamation will also be advised on the effects of water releases on the Grand Canyon environment and river running activities.

b. Glen Canyon National Recreation Area

Most Grand Canyon river trips launch just above the mouth of the Paria River at Lees Ferry within Glen Canyon National Recreation Area.

Until 1929, Lees Ferry was the only regularly used river crossing between Hite, Utah, and Pierce Ferry, Arizona. There are several historic ranch and ferry buildings at the site which are visited by river runners and other tourists. Many fishermen launch at Lees Ferry and fish upstream as far as the dam.

The most significant activity at Lees Ferry is launching Colorado River trips destined to run through the Grand Canyon. On a typical summer day, the area is filled with passengers, noncommercial river runners, and logistical personnel who drive shuttle cars, buses or trucks, and assemble and launch boats.

There is a permanent National Park Service ranger stationed at Lees Ferry with additional seasonal personnel at various times. All Grand Canyon river trips launching at the ferry are checked by the ranger to ensure compliance with the requirements of the Superintendent of Grand Canyon National Park.

c. Navajo Indian Reservation

The 12.5-million acre Navajo Indian Reservation borders the east bank of the Colorado River in the Marble Canyon section of the park from River Mile 0 to River Mile 61.8 at the confluence of the Little Colorado River. The area from the river to the rim is a tribal park and is also within the authorized boundary of Grand Canyon National Park. These lands may be added to the park through the consent of the Navajo Tribe. The primary land use on the reservation adjacent to the park is livestock grazing and the sale of native arts and crafts to tourists.

River runners using this area occasionally explore side canyons and hike into and out of the canyon via the Little Colorado River gorge and the Salt Trail.

d. Havasupai Indian Tribe

The Havasupai Traditional Use Lands in Grand Canyon National Park are located between the south bank of the Colorado River from River Mile 116 to River Mile 165 and 1/4 mile back from the canyon rim around Great Thumb Mesa from Royal Arch Creek to National Canyon. Use of these lands

by the Havasupai is subject to agreement between the Havasupai Tribe and the National Park Service. The National Park Service regulates all public use. Many river trips exchange passengers at Havasu Creek. Hiking into or out of Havasu Canyon to meet or leave the trip necessitates an overnight stay. A hiking permit and reservation must be obtained from the National Park Service at Grand Canyon in order to camp on traditional use lands.

On the Havasupai Indian Reservation, a fee is charged for crossing tribal lands. In addition, there is a per person, per night camping fee. All arrangements should be made with the Havasupai Tourist Enterprises, Supai, Arizona. No camping is allowed in Havasu Canyon National Park lands, which extends about four miles back from its confluence with the Colorado River. It is also possible for a person to day hike either into or out from a river trip through Havasu Canyon. The National Park Service informs the Havasupai Tourist Enterprise of river runners planning ingress or egress through Havasu Canyon.

e. Hualapai Indian Reservation

The Hualapai Tribe occupies a 992,000-acre reservation bounded on the east by the Havasupai Reservation and on the north by the river from River Mile 165 near National Canyon on the south bank to River Mile 273.

Diamond Creek at River Mile 225, located on the reservation, provides the first road permitting vehicle access to the river below Lees Ferry. This road is used by a majority of river users, especially non-motorized parties, as a takeout point. It is also a launching point for trips running only the Lower Gorge. The Hualapai Tribe charges a fee for river takeouts at Diamond Creek and helicopter landings on tribal land above Diamond Creek. This fee is subject to change and will be published yearly along with the operating requirements.

All river runners will be notified in permit conditions or operating requirements that the Hualapai Tribe owns the land within the Grand Canyon above the river high water line on the south bank to the south rim between River Mile 165 and River Mile 273. Any hiking, camping or other use of the Hualapai Tribal lands must be approved by the Hualapai Tribal Council. Helicopter landings for river trip takeouts on Hualapai Tribal lands require prior approval of the Tribal Council.

f. Lake Mead National Recreation Area

Lake Mead National Recreation Area is located adjacent to the lower end of the Grand Canyon and is administered by the National Park Service. When filled to capacity, Lake Mead backs into Grand Canyon National Park about 47 miles. There is considerable boating and fishing on these waters. Many of the river-running expeditions continue through the Lower Gorge into Lake Mead and terminate at Pierce Ferry about three miles beyond the Grand Wash Cliffs. Some trips go on to South Cove or

Temple Bar. Use of launch ramps and facilities at Pierce Ferry, South Cove, Temple Bar by river runners requires close coordination with the National Park Service at Lake Mead. Management activities that change river runner use levels of Lake Mead or their need for more or less logistical facilities will be communicated to Lake Mead National Recreation Area in a timely manner.

A National Park Service ranger resides at Meadview near Pierce Ferry, and patrols the Lower Gorge of the Grand Canyon. This ranger is responsible for visitor protection, law enforcement, search and rescue, and visitor use statistics. The rangers for Lake Mead National Recreation Area and Grand Canyon National Park maintain close liaison and coordinate patrol efforts.

## B. GEOLOGY

The Grand Canyon is the deepest and most extensive canyon found in the plateau country and is a world-renowned scenic spectacle. The exposed rock layers represent all of the eras of geologic time and contain evidence of the evolution of life through more than 600 million years of earth history. The oldest dated rocks in the canyon approach 2,000 million years in age and, thus, the observer comes metaphorically face to face with the beginnings of time.

All of the individual plateaus within the Plateau Province are elongated in a north-south direction and bounded on the east and west by sharp structural breaks and folds. These major zones occur at intervals ranging from 15 to 40 miles apart across northern Arizona. The Grand Canyon is an east-west cross section through several of these plateaus, providing a window through which the geologic history of the region may be viewed.

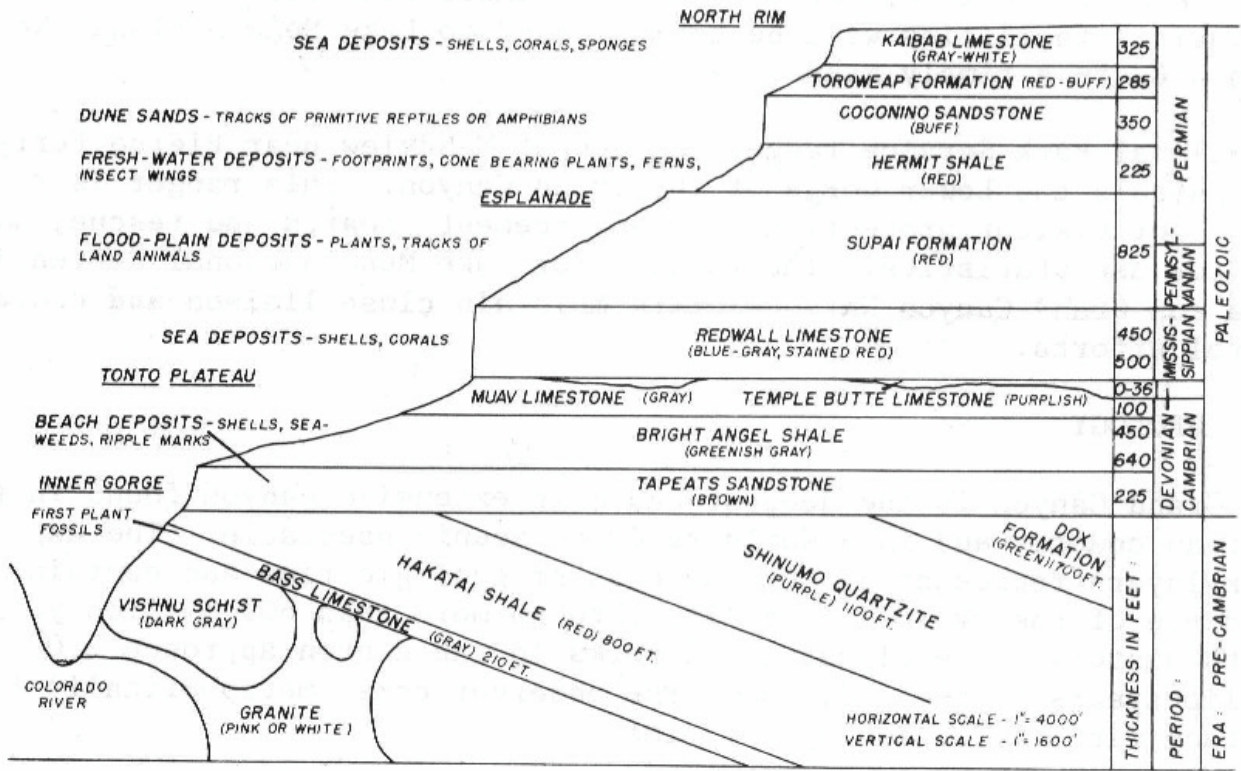
Chemical weathering is minimal in the semi-arid climate of the canyon, and horizontal strata erode into a series of alternating steep slopes and near vertical cliffs. The metamorphic rocks of the inner gorges present a relatively uniform face to erosion and form nearly unclimbable cliffs and steep, jagged slopes.

A generalized geological cross section of the canyon is illustrated on page II-7 and the structural divisions of the canyon on page II-8.

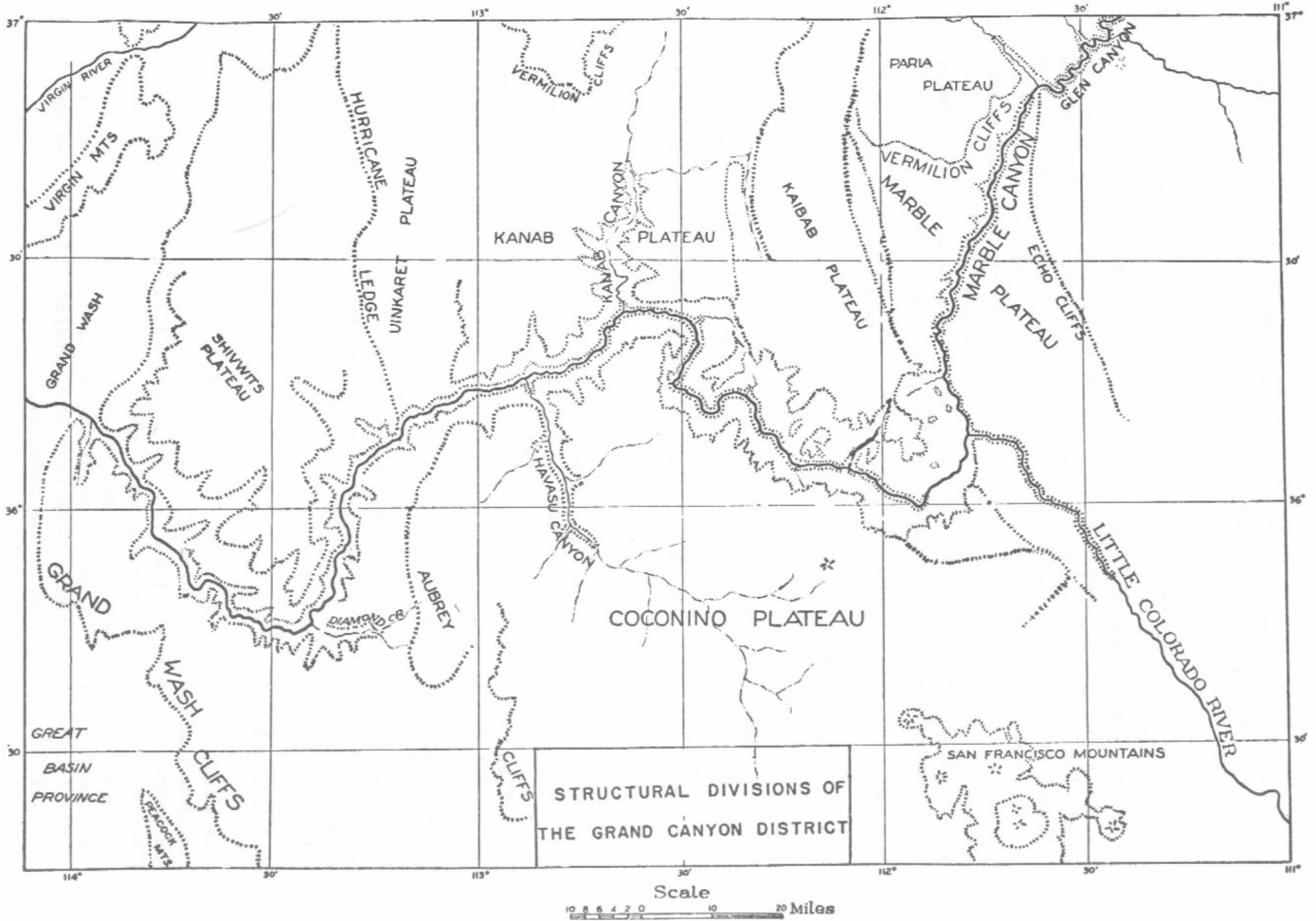
## C. SOILS

Few areas within the park have well developed soil profiles. A shallow skin of dirt, covering bedrock, appropriately describes the soils throughout the area.

Alluvial deposits along the Colorado River combine with colluvial deposits to form the major transported soils of the Inner Canyon. The large areas of bedrock, shallow soils, and relatively sparse vegetative



GENERALIZED  
GEOLOGIC SECTION  
AT GRAND CANYON VILLAGE



cover provide an ideal situation for sheet wash, flash flooding, and high erosion potential. Once disturbed, the soils erode easily and regenerate slowly.

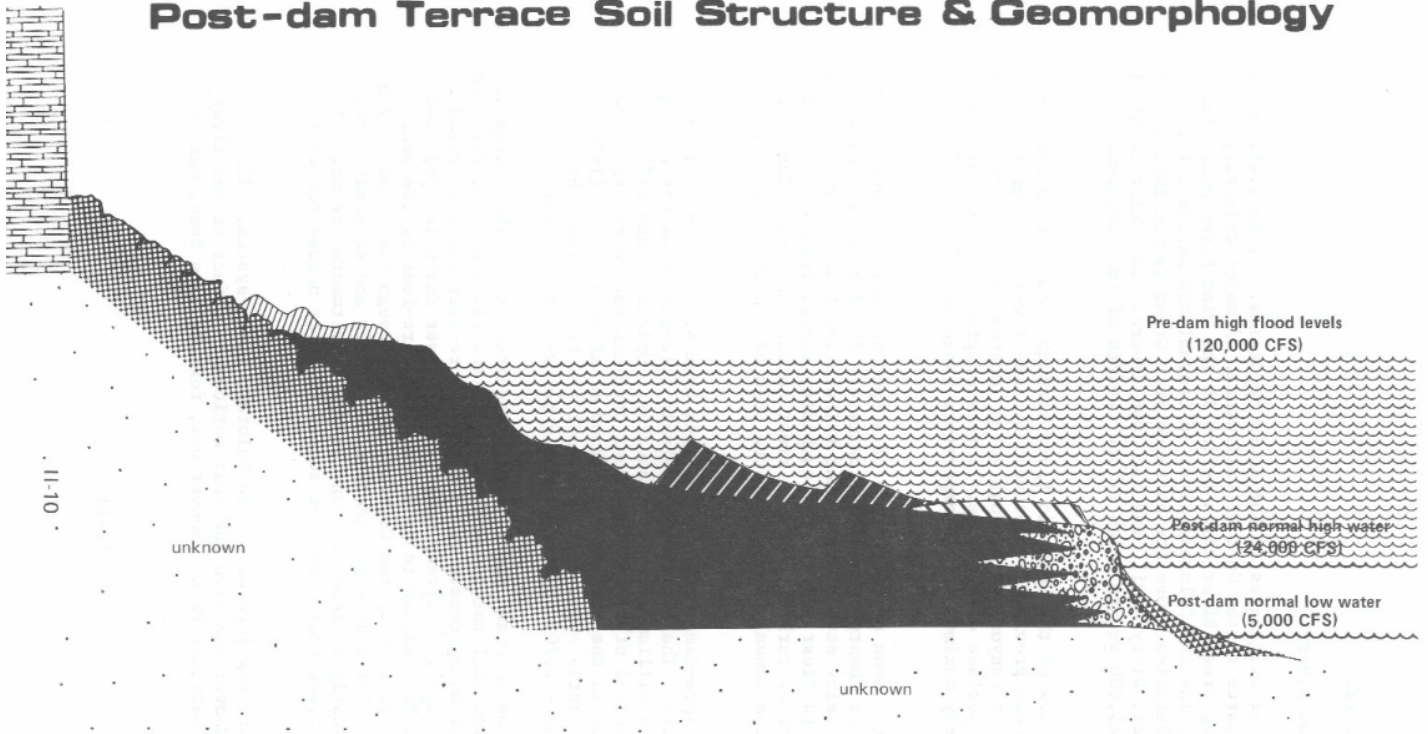
The areas in immediate association with the river are characterized by fine-grained fluvial terraces (beaches), coarse-grained cobble bars, and tributary fan deposits. The fine-grained deposits found on the terraces of the river may be classified according to age of deposition (pre- or post-Glen Canyon Dam), agent of deposition (floods, aeolian action or fluvial reworking in the zone below present normal high water), and grain size (cohesive silts, predominantly silt with a small percentage of clay; silt-sand, with about 30 percent silt content; and sands, with negligible silt). The normal spatial relationships of the various deposits are shown on page II-10. These deposits respond differently to environmental stresses induced by post-dam conditions and human impact.

1. Pre- and post-dam flood terraces are usually silt-sand.
2. Pre-dam aeolian deposits are but little coarser than the flood terraces from which they are derived.
3. Pre-dam cohesive silt was deposited by mild summer floods resulting from summer runoff carrying high percentages of clays and silts. These deposits seldom extend more than a few feet above present high water levels and, because of the abundance of water and the fine substrate, have been covered to a great extent by a dense vegetative growth since the dam.
4. Post-dam beach deposits, reworked by wash and current from pre-dam terraces and bed material, are predominantly sand, with noticeable silt content only along the wide, quiet sections of the river. These deposits are well sorted and are the predominant source for post-dam aeolian deposits, which are likewise coarse grained.

Measurements made using an 8-year aerial photographic record (Howard and Dolan, 1976) indicate an average rate of back wasting (erosion of beach surface) of about 0.9 feet per year along the river. It has been determined, however that the lateral erosion caused by the clear post-dam river is not uniform along the fine-grained beaches. Input of sediment from the Paria River and the Little Colorado River, and other tributaries below Lees Ferry may be sufficient to sustain a temporary equilibrium between sediment supply and removal.

The relatively low rates of lateral erosion by the Colorado River suggest that abundant fine-grained beaches will remain for several tens of years, but a few beaches will gradually disappear. After several decades, dam related erosion may result in a virtual lack of sandy beaches. This erosional process could be accelerated if the Bureau of Reclamation either (a) adds capability at Glen Canyon Dam for additional water releases to provide peaking power, and/or (b) releases water over the spillways and through the penstocks.

# Post-dam Terrace Soil Structure & Geomorphology



- |  |                                   |  |  |
|--|-----------------------------------|--|--|
|  | <b>Bedrock</b>                    |  | <b>Pre-dam silt-sand eolian deposits</b> |
|  | <b>Talus</b>                      |  | <b>Post-dam flood silt-sands</b>         |
|  | <b>Pre-dam cohesive silts</b>     |  | <b>Post-dam eolian sands</b>             |
|  | <b>Pre-dam silt-sand terraces</b> |  | <b>Post-dam beach sands</b>              |

(after Howard and Dolan, 1976)

## D. WATER RESOURCES

### 1. The Colorado River

The Colorado River originates in the Rocky Mountains. It is 1,450 miles long from its source to the Gulf of California. A major tributary is the 720-mile-long Green River which begins in the Wind River Mountains of Wyoming and joins the Colorado River in Canyonlands National Park. Other major tributaries above its entrance into Grand Canyon include the Gunnison, Dolores, Dirty Devil, and San Juan Rivers. The Colorado River system drains 245,000 square miles or one-twelfth of the continental United States.

The mainstream flow of the Colorado River through Grand Canyon Park is water that has been previously impounded by Lake Powell. Water is released from Glen Canyon Dam through gates located about 200 feet below the fluctuating surface of the lake. Waters originating from this depth result in a yearly maximum water temperature range of 42°F to 48°F at Lees Ferry.

At Lees Ferry, the mean concentration of suspended sediment ranges from 2 to 124 mg/l. At Phantom Ranch, approximately 87 river miles below Lees Ferry, and below several important tributaries (Paria River, Little Colorado River and Clear Creek), the turbidity ranges from 6 to 47,100 mg/l. The amount of turbidity of the river through the Grand Canyon is dependent upon the annual runoff into the Colorado River below Lees Ferry.

Historic virgin (pre-dam) flows have ranged from 4.4 to 21.9 million acre-feet annually. The 10-year mean virgin (pre-dam) flow has ranged from 11.6 to 18.8 million acre-feet annually. Opinions thus differ concerning the period of record that best predicts future runoff. The significance lies in the fact that a period of about 25 years (1906-1930) of predominantly above-average runoff has been followed by a 40 year period (1931 - 1970) of predominantly below-average runoff.

Article III of the Colorado River Compact requires that, "The States of the Upper Division will not cause the flow of the river at Lees Ferry to be depleted below an aggregate of 75 million acre-feet for any period of ten consecutive years." Current usage in the Upper Basin is projected by the Bureau of Reclamation to be 5.8 million acre-feet by the year 2000. Although the flow of the Colorado River through the Grand Canyon is assured by the Colorado River Compact, the daily and seasonal flows may fluctuate greatly as reservoir and energy commitments are met. A minimum flow of 3,000 cubic feet per second (cfs) is needed for whitewater boating.

Ten major dams are now located on the Colorado River system. Glen Canyon Dam and Hoover Dam have the most noticeable effect on the river in Grand Canyon National Park. Hoover Dam, forming Lake Mead, has



backed water to Mile 240 or for 37 miles into the park. This portion of the river has changed from a stream to a lake system.

Before Glen Canyon Dam, the flow at Lees Ferry varied from 700 cfs to 200,000 cfs. The average silt load was 500,000 tons per day at Phantom Ranch. The pre-dam river temperature varied from near freezing to 80°F. Its tributaries, the Paria River and the Little Colorado River, are the principal contributors of silt. Present flows through dam vary between 1,000 cfs to 32,000 cfs at Lees Ferry. The present silt load is about 80,000 tons per day, less than one-sixth the pre-dam load. The Colorado River flows at an average 4.5 miles per hour (mph) with velocities up to 30 mph in the rapids. The total descent of the river from Lees Ferry to the Grand Wash Cliffs is approximately 2,200 vertical feet or about 7 feet per mile.

## 2. Water Quality

In addition to the Colorado River, other major water sources in the canyon are the following springs or tributaries: Paria River (River Mile 0); Vasey's Paradise (River Mile 32); Little Colorado River (River Mile 61.8); Bright Angel Creek (River Mile 87); Shinumo Creek (River Mile 108); Royal Arch Creek (River Mile 116); Tapeats Creek (River Mile 134); Deer Creek (River Mile 136); Kanab Creek (River Mile 143); Havasu Creek (River Mile 157); Diamond Creek (River Mile 225); and Spencer Creek (River Mile 246). All of these water sources are easily accessible, and some are frequently used for drinking water by river runners and hikers.

The water quality of the Colorado River, its tributaries and associated springs and seeps, can be evaluated on the basis of five major criteria: (a) levels of contamination by total coliforms; (b) concentrations of specific trace elements; (c) total dissolved salt concentrations; (d) concentrations of biotic and abiotic parameters that could lead to hypereutrophication (nutrient enrichment and rapid growth of undesirable organisms); and (e) known levels of pollutants added by direct or indirect human contact.

The State of Arizona has established water quality standards for surface waters. The standards for the primary uses of full and partial body contact, domestic supply, cold and warm water fishery, aquatic life and wildlife uses are applicable to Grand Canyon National Park (see Table 9).

Recent investigations on the water quality in Grand Canyon National Park indicate that, in general, unpolluted conditions exist (Cole and Kubly, 1976; Czarnecki et al., 1976; Decon and Baker, 1976; and Sommerfeld et al., 1976). However, during certain periods of the year, during peak flood flows or at specific tributary sites, contaminants are in excess of U.S. Public Health Service (USPHS) standards for human drinking water. These potential problem areas and situations are discussed below under each of the major criteria used for evaluating the water quality of the system.

TABLE 9  
SUMMARY OF ARIZONA WATER QUALITY CRITERIA FOR DESIGNATED USES

Standard	Full Body	Partial Body	Domestic & Industrial Water	Cold Water	Warm Water	Agri-culture &	Aquatic Life &
	Contact	Contact	Supply	Fishery	Fishery	Industry	Wildlife
<b>FECAL COLIFORMS</b> (No. 1100 ml.)							
Geometric Mean	200	1000	1000	1000	1000	1000	1000
90% value (for 5 samples over 30 days)	400	2000	2000	2000	2000	2000	2000
Range	6.5-8.6	6.5-8.6	None	6.5-8.6	6.5-8.6	None	6.5-8.6
Maximum change	+0.5	+0.5	None	+0.5	+0.5	None	+0.5
<b>TURBIDITY (JTU)</b>							
Streams	Lowest practical value		None	10	50	None	Lowest practicable value
Lakes	Lowest practical value		None	10	25	None	Lowest practical value
<b>DISSOLVED OXYGEN (mg/l)</b>							
Minimum	None	None	None	6.0	6.0	None	None
<b>TEMPERATURE (OF)</b>							
Maximum change	5°	5°	None	2°	5°	None	No temperature Interference
Maximum	93°	93°	None (winter)	55°	93°	None	No temperature Interference
			(summer)	70°			
<b>TOXICS (mg/l)</b>							
Arsenic	0.050	0.050	0.050	0.050	0.050	None	0.050
Barium	1.000	1.000	0.100	0.500	0.500	None	0.500
Boron	None	None	None	None	None	1.000	None
Cadmium	0.010	0.010	0.010	0.010	0.010	None	0.010
Chromium (hexavalent)	0.050	0.050	0.050	0.050	0.050	None	0.050
Copper	1.000	1.000	0.100	0.050	0.050	None	0.050
Cyanide	0.200	0.200	0.200	0.100	0.100	None	0.100
Mercury	0.005	0.005	0.005	0.005	0.005	None	0.005
Lead	0.050	0.050	0.050	0.050	0.050	None	0.050
Phenol	0.001	0.001	0.001	0.001	0.001	None	0.001
Selenium	0.010	0.010	0.010	0.010	0.010	None	0.010
Silver	0.050	0.050	0.050	0.050	0.050	None	0.050
Zinc	5.000	5.000	5.000	0.500	0.500	None	0.500
<b>RADIOACTIVITY (pCi/mg)</b>							
Combined Radium 226 & 228	None	None	5	None	None	None	None
Gross alpha particle activity	None	None	15	None	None	None	None
Tritium	None	None	20,000	None	None	None	None
Strontium 90	None	None	8	None	None	None	None

a. Levels of Contamination by Total Coliform

U.S. Public Health Service standards for water for human consumption recommend that coliform levels not exceed 1 coliform (c) /100 ml. The desirable criteria set by the Federal Water Pollution Control Administration (U.S.D.I., 1968) for raw surface waters is less than 100/ c/100ml., and the permissible limit is 10,000 c/100ml. Both "desirable" and "permissible" waters can be used for human consumption if treated.

Total coliform concentration levels of the Colorado River and the 11 most popular tributaries and springs for four sampling periods in 1975 are presented on pages II-15 and 16.

The total coliforms found in the Colorado River and the tributaries and springs are extremely variable, ranging from nondetectable to more than 400 c/100ml.

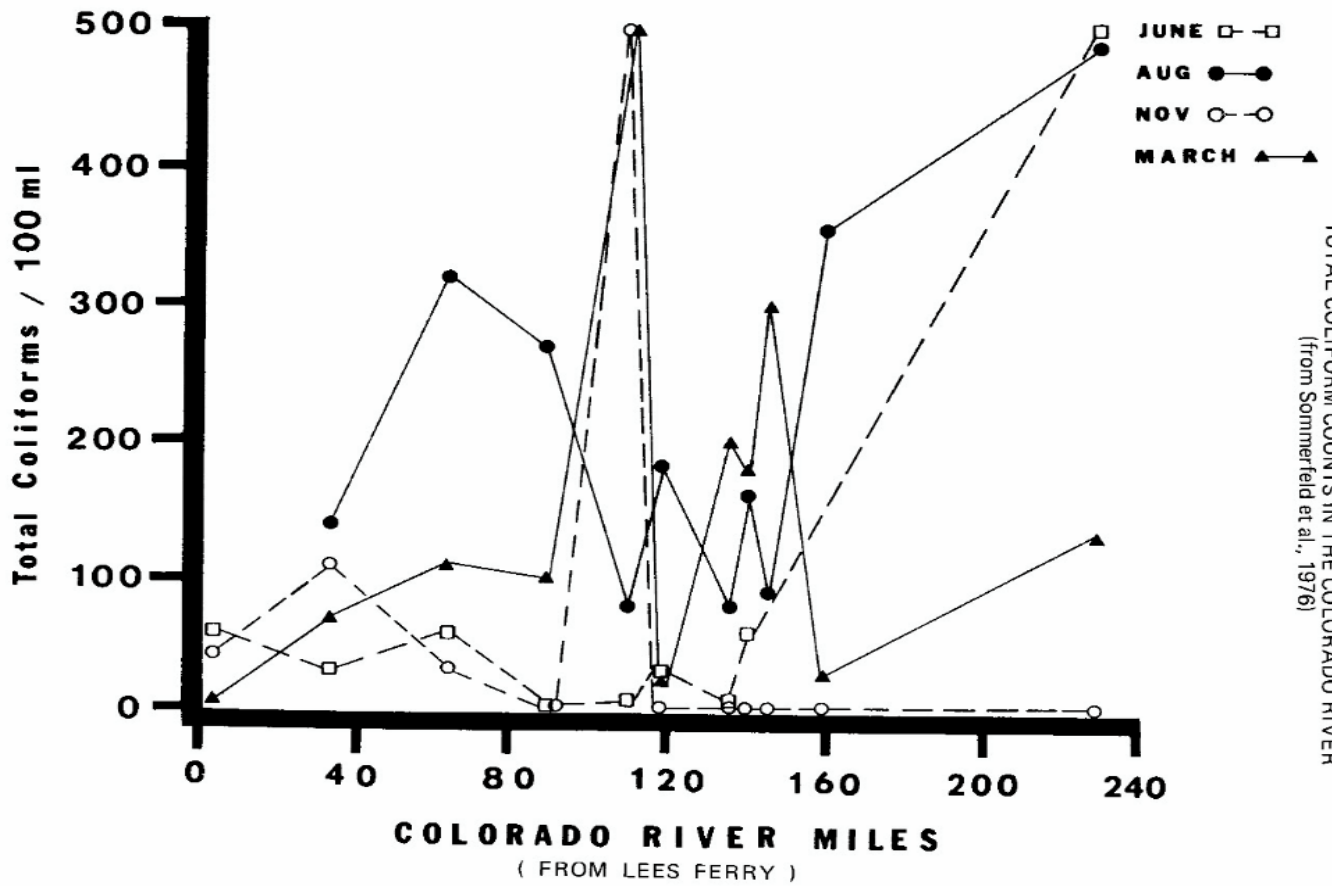
Indications of pollution occasionally occur under special conditions.

- Paria River, Bright Angel, Shinumo, Havasu, and Diamond Creeks show occasional presence of pollution-indicator algal associations (Blinn et al., 1976).
- Potential health hazards may exist at some river campsites in the form of high total coliform counts, possibly due to seepage from porta-potty disposal (Deacon and Baker, 1976).
- Total viable coliform bacterial numbers exceeded desirable water quality standards at several river sampling sites and in most of the tributaries throughout the year (Sommerfeld et al., 1976).
- Heavily used tributaries generally had total coliform numbers that exceeded desirable water quality criteria (Sommerfeld et al., 1976).

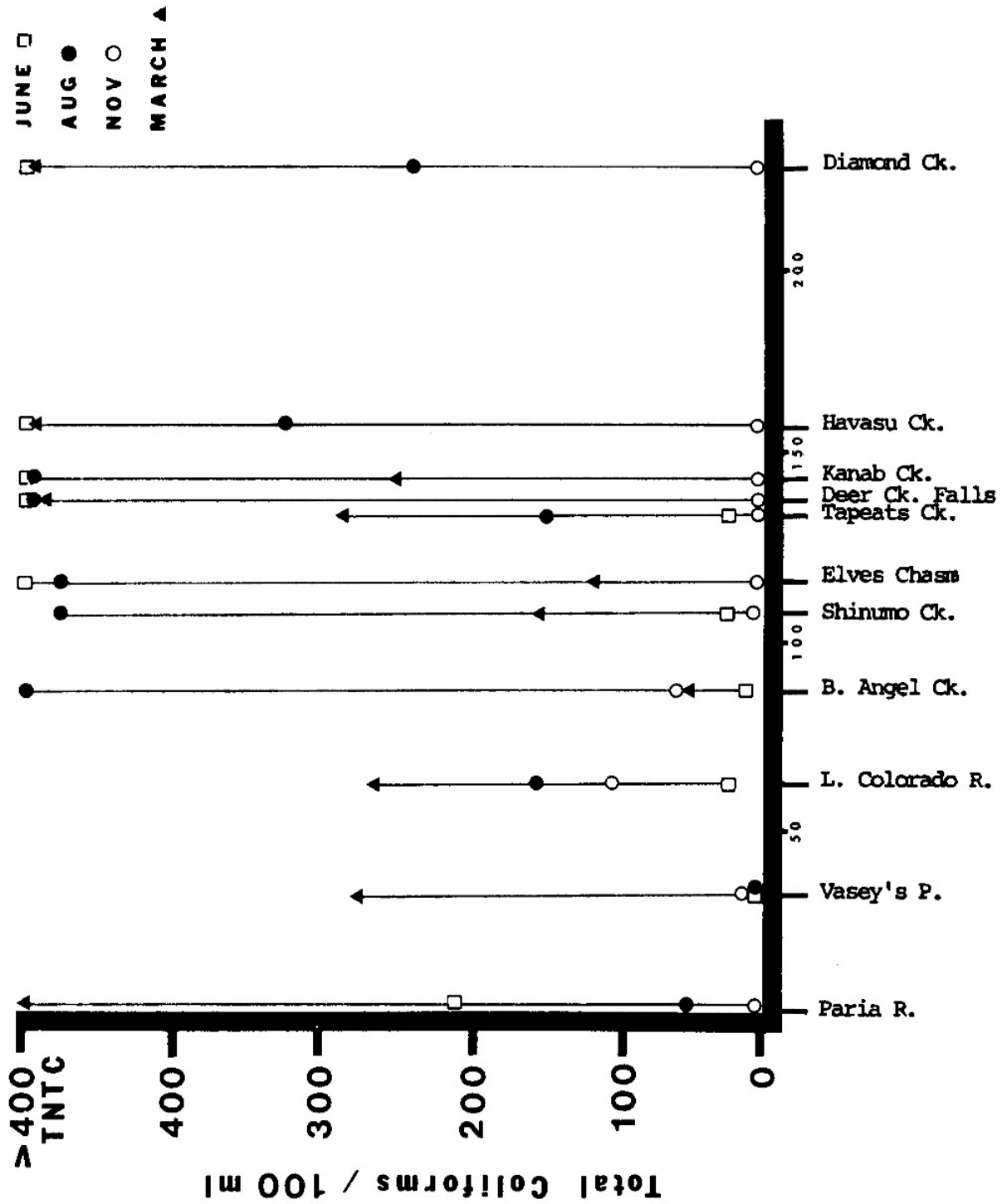
No data are available on fecal coliforms within the Colorado River or its tributaries within the Grand Canyon. Therefore, it cannot be determined whether or not these waters are within Arizona water quality standards. From available data it does not appear that there are any significant problems with State standards relative to specific element concentrations within these waters.

b. Concentrations of Specific Trace Elements

Natural surface waters contain dissolved minerals that reflect the type of substrata the waters have contacted and the duration of that contact. Streams may reflect the chemical characteristics of surface runoff, as well as ground water that enters the springs or seep.



TOTAL COLIFORM COUNT IN THE TRIBUTARIES OF THE COLORADO RIVER  
 (from Sommerfeld et al., 1976)



Of fifteen elements surveyed, (boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, potassium, sodium, and zinc), only two, iron and manganese, were ever found to exceed recommended drinking water standards (EPA Water Quality Criteria, 1972). These elements were found in excess of the standards only in the Little Colorado River drainage during high and sustained floods. Neither iron nor manganese are known to be health hazards, particularly at these concentrations.

c. Total Dissolved Salt Concentration

The salinity of the Colorado River is in excess of present health standards (500 mg/liter) for sustained human consumption (US Public Health Service, 1962). The USPHS allows, however, a twofold increase in salinity for occasional consumption. The salinity levels found in the Colorado River range from 623 to 644 mg/liter, and thus fall within the criteria for occasional consumption. For the tributaries and springs, complete data are not available; however, it is known that the Little Colorado River is essentially a sodium chloride water. However, the normal, clear water flow of the Little Colorado River is insufficient to change the total salt concentration of the Colorado River.

d. Concentration of Biotic and Abiotic Parameters That Could Lead to Hypereutrophication

The Colorado River is rich in essential plant nutrients and has the potential to be a productive system (Cole and Kubly, 1976). Yet all the aquatic studies to date indicate that the entire system is relatively unproductive with low population densities of the primary producers (phytoplankton, etc.) (Sommerfeld et al., 1976). Reasons hypothesized for the low productivity are the low water temperatures and the high and variable degree of turbidity (Cole and Kubly, 1976; Deacon and Baker, 1976).

e. Known levels of Pollutants Added by Direct or Indirect Human Contact

Emissions from motorized watercraft on the Colorado River cause at least short-term water quality degradation. Oil and gasoline can be spilled into the Colorado River at Lees Ferry from boat servicing facilities. Ruptured gasoline tanks can also leak during motorized trips through the canyon. On the average, an estimated 20 to 35 percent of the fuel used in outboard motors is wasted in the exhaust. Laboratory studies of pollutants from outboard motor exhaust indicate that approximately 0.23 pounds of petroleum residue, as measured by non-volatile suspended solids, are wasted per gallon of fuel consumed. The turbulence caused by the propeller creates conditions ideal for dispersion of the waste material into the water.

It has been estimated that approximately 25,000 gallons of gasoline are used annually on the motorized trips. Therefore, approximately 5,750 pounds of petroleum residue are dumped in the Colorado River annually. However, even this amount when compared to the volume of water flow in the river has not been enough to be measurable.

A water quality monitoring program for the park is ongoing, to establish base data in reference to the Water Quality Standards for the State of Arizona. Details of this monitoring work are outlined in the Grand Canyon National Park, 208 Water Quality Project Plan of Action.

#### E. CLIMATE

The Grand Canyon has many climates depending primarily on the elevation. Average annual precipitation varies from more than 25 inches along the forested North Rim (9,000 feet) to less than 9 inches on the desert of the Inner Canyon (2,400 feet). About 16 inches per year fall on the South Rim (7,000 feet). The North Rim receives more precipitation in winter than in summer. The South Rim and the Inner Canyon receive about equal amounts during the two seasons. The spring and fall are relatively dry in all three areas. Summer precipitation is usually received from thunderstorms that form over the heated canyon almost every afternoon from early July until the end of August. Although these storms are capable of producing locally heavy downpours, they rarely last more than 30 minutes and usually cease completely shortly after sundown.

Winter precipitation varies greatly from year to year in both amount and frequency. It is associated with middle latitude storms moving eastward from the Pacific Ocean and normally falls in gentle to moderate showers which may persist for several days. However, severe storms with heavy snow and strong winds can strike. Most of the winter precipitation on the North and South Rims occurs as snow. Snowfall is a rarity in the Inner Canyon and averages less than 1 inch per year.

As a general rule, the temperature increases as one descends into the canyon. However, during the winter months there are short periods of temperature inversion when clouds fill the canyon and cold air drains into and is trapped within the canyon while the rims are being warmed by sunshine. Based on an elevation gradient of 4,800 feet and a dry adiabatic lapse rate of 5.4°F/1,000 feet, the average adiabatic temperature change between the rim and the river is approximately 26°F. The air in the canyon is considered to be conditionally stable in August and September; statically unstable in June and July and statically stable for the rest of the year. The hourly temperatures at the rim and the river approach each other to within a few degrees in the hour just preceding sunrise.

The data in table 10 summarizes the annual temperatures for the Grand Canyon area. In addition to the river canyon data, temperatures are also presented for the North and South Rim and the Desert View weather

TABLE 10  
MEAN PRECIPITATION AND TEMPERATURE  
GRAND CANYON NATIONAL PARK

Months	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MEAN MAXIMUM TEMPERATURES (°F)												
Inner Canyon	56	62	71	82	92	101	106	103	97	84	68	57
Tuweep 49	50	61	68	79	89	95	92	85	74	61	49	
Desert View	40	43	49	57	69	79	84	81	73	61	49	39
South Rim	41	45	51	60	70	81	84	82	76	65	52	43
North Rim	37	39	44	52	62	73	77	75	69	58	45	40
MEAN MONTHLY TEMPERATURES (°F)												
Inner Canyon	46	52	59	69	77	86	92	89	83	72	57	47
Tuweep	38	40	47	54	64	73	80	78	71	60	48	39
Desert View	30	33	38	44	56	65	71	69	61	50	39	30
South Rim	30	33	38	46	54	64	69	67	61	50	39	31
North Rim	26	28	34	40	48	56	62	60	54	45	35	30
MEAN MINIMUM TEMPERATURES (°F)												
Inner Canyon	36	42	48	56	63	72	78	75	69	58	46	37
Tuweep	26	30	34	40	49	58	65	63	56	46	35	29
Desert View	21	23	27	31	42	51	59	56	59	39	30	21
South Rim	18	21	25	32	39	47	54	53	47	36	27	20
North Rim	15	18	24	28	34	40	46	45	39	31	24	20
MEAN PRECIPITATION (Inches)												
Inner Canyon	.72	.73	.79	.48	.31	.28	.79	1.31	.88	.69	.51	.82
Tuweep	1.10	.90	1.25	.73	.40	.40	1.28	1.97	.79	.80	.77	1.31
Desert View	1.00	.94	1.52	.75	.50	.32	1.29	1.34	.99	1.39	.80	1.72
South Rim	1.32	1.53	1.37	.92	.65	.46	1.87	2.28	1.50	1.21	.95	1.61
North Rim	3.28	3.17	3.12	1.67	.97	.76	1.86	2.53	1.81	1.50	1.44	2.62



stations. Comparison of this data dramatically demonstrates the marked differences in temperatures from rim to river.

#### F. AIR QUALITY

Natural dust particles, water vapor, chemicals given off by growing plants, and the refraction of light all combine to form a haze which is a natural part of the Grand Canyon environment. The predominant wind direction above the rims is from the southwest. Below the rims, there is little large-scale horizontal air movement; the deep, narrow configuration of the canyon forms a relatively closed air system of over 5,000

Available information indicates that dustfall and sulfation rates, as well as the levels of sulphur dioxide, nitrogen oxides, lead, benzene, organics, and total oxidants are all low to very low (see Table 11).

Because of its almost pristine purity, the air in Grand Canyon can be degraded by introducing pollutant levels which would be considered negligible in metropolitan areas. Visible ranges often exceed 190 kilometers (118 miles) in the exceptionally clean atmosphere above the canyon. Very small increases in atmospheric pollutants can significantly decrease visibility through air of this clarity and thus degrade the esthetic values of the park. Because of this, the area has been established as a Class I area under Public Law 95-95, the Clean Air Act Amendment of 1977. Air visibility measurements are being taken to monitor any changes relative to current visibility.

The air moves primarily up and down canyon at very low velocities, making the potential for removal of air pollutants very low. Most of the higher wind velocities encountered in the canyon are not due to the exchange of canyon air with air above the rims, but rather the movement of a limited volume of local air back and forth within the canyon. The slow circulation of air and low dispersive capabilities increase toward the level of the Colorado River. Each night within the canyon inversion layers or stable environmental lapse rates increase the stagnation of air circulation.

#### G. NOISE

A sound survey made on Labor Day in 1971 at points along the South Rim, by Dr. Charles H. Black of Northern Arizona University, reported that the drone of aircraft engines could be heard almost continuously. The aircraft were a mixture of fixed-wing and helicopter tour planes, private planes, military aircraft, and high altitude commercial craft. Automobile noises were the most pervasive at overlooks and within Grand Canyon Village.

Black found that in general the ambient noise levels ranged from about 45 to 50 decibels (dBA) in remote backcountry areas, to around 70 dBA in late afternoon on the front steps of the El Tovar Hotel.

TABLE 11 -- AIR QUALITY DATA AVAILABLE GRAND CANYON VILLAGE  
AND VICINITY  
1962 — 1972

<u>Pollutant</u>	Grand Canyon EPA Mean	Annual Phoenix Mean	Grand Canyon Waither 's Data	EPA Standard-1 <sup>1</sup>	EPA Standard-2 <sup>2</sup>	Arizona Standard
Total particulates 34 (n = 56)		108-265	18	75 <sup>3</sup>	60 <sup>3</sup>	60 <sup>3</sup>
Dustf all ug/cm <sup>2</sup> /day	-	11.5	5.3	-	-	-
Sulphur Dioxide ug/m <sup>3</sup>	10	ca10	ca10	80 <sup>4</sup>	-	50 <sup>4</sup>
Sulfation rate ug/cm <sup>2</sup> /day	-	1.75	0.38	-	-	-
Nitrogen Dioxide ug/m	21 (n-58)	168	22	100 <sup>4</sup>	100 <sup>4</sup>	100 <sup>4</sup>
Total oxidants ug/m <sup>3</sup>	-	17.5	10.4	160 <sup>5</sup>	160 <sup>5</sup>	80 <sup>5</sup>
*Lead ug/m <sup>3</sup>	0.15	3.12	-	-	-	-
Benzene soluble organics ug/m <sup>3</sup>	1.0	-	-	-	-	-
Benzopyrene ug/m <sup>3</sup>	0.11	-	-	-	-	-

- \* 1969 data. n = number of data points
1. Level of pollutant which, if exceeded, endangers "public health"
  2. Level of pollutant which, if exceeded, endangers "public welfare"
  3. Annual geometric mean
  4. Annual arithmetic mean
  5. Maximum 1-hour concentration

While the sounds from motor vehicles and aircraft are the most disruptive along roadways, at overlooks and in the developed areas of the park, the sounds from aircraft and outboard motors are the most disruptive in backcountry and river areas. Outboard motor noise was studied in 1973 by Drs. D. N. Thompson, A. J. Rogers, Jr., and F. Y. Borden of the University of Pennsylvania. They found that sound pressure and levels of the motors, measured at head level in the boatman's station, ranged from 83 to 89 dBA, compared with background levels of 35 to 45 dBA. This borders on, but does not exceed, present health standards, although it can cause significant shifts in the hearing threshold. In the presence of motor noise, natural environmental sounds or the almost unnatural lack of sound in the canyon can rarely be sensed by river runners. The study concluded that outboard motor noise was a deterrent to normal, relaxed conversations that one should expect in such an environment, a safety hazard in motorized raft operation, and a potential health hazard to boatmen.

## H. VEGETATION

Along both banks of the Colorado River exists a dynamic riparian (streamside) community. The riparian habitat includes all the vegetation from the river's edge, outward toward the canyon walls. Riparian vegetation may be defined as "those species of plants which are there only because of the presence of the river." Glen Canyon and Hoover Dams have strikingly influenced the structure and integrity of this habitat in Grand Canyon.

Prior to the construction of Glen Canyon Dam, the Colorado River was a silt-laden river, warm in summer and cold in winter; the river's flow could fluctuate anywhere from almost no flow during dry summers to an excess of 200,000 cfs during spring floods (Fenneman, 1931). Now the river, as it originates from the bottom of Lake Powell, is clear and perpetually cold (42-48°F) and diurnally tidal, as water releases are based on power demands; rarely does the flow fluctuate outside a range from 1,000 cfs to 32,000 cfs. As a result, the natural biotic system of portions of the riparian zone has been severely altered and subsequently replaced by a new, "exotic" system.

Prior to and during the construction of Glen Canyon Dam, numerous studies were undertaken to provide a data base and to determine what resources would be lost by the inundation of Glen Canyon (Woodbury et al., 1959). Unfortunately, there were no studies undertaken on what changes would occur in Grand Canyon. By using data gathered during a brief pre-dam botanical study of the river environs (Clover and Jotter, 1944) and through analysis of pre-dam habitat photographs, Karpiscak (1976) has been able to reconstruct what was present along the banks of the Colorado River prior to the influence of the dam (Carothers et al., 1977)

## 1. Pre-Dam Riparian Vegetation

Before the dams, there existed three distinct zones of vegetation which paralleled the river from Lees Ferry to the Grand Wash Cliffs (see illustration, page II-25). The zone closest to the river (Zone 3), and hence subjected to annual flooding, was composed partially of many ephemeral herbaceous species that were adapted to periodic disturbance, and partially of some mesophytic woody plants such as seep willow and desert broom (Baccharis spp.), and the true willows (Salix spp.), that would make a futile attempt to become established before the next scouring flood. Above the ephemeral zone was a belt of vegetation whose lower boundaries were delineated by the high water line of major floods which would periodically scour away all vegetation growing below the zone. Typical plant species of this high water line zone (Zone 2) were Apache plume (Fallugia paradoxa), redbud (Cercis occidentalis), hackberry (Celtis reticulata), honey mesquite (Prosopis juliflora), and acacia (Acacia greggii). On the talus slopes (Zone 1) above this zone lived desert species that were not influenced by the river environment below; e.g., brittle bush, Encelia farinosa; various cacti, creosote bush (Larrea tridentata), Mormon tea, (Ephedra trifurca spp.).

## 2. Post-Dam Vegetation

The construction of Hoover Dam inundated the two lower vegetational zones and much of the desert vegetation of the upper zone upstream from the dam to River Mile 240. Within a few years, however, a new zone consisting almost exclusively of saltcedar (Tamarix chinensis) appeared at the edge of Lake Mead.

The significant reduction in high flood waters in the Colorado River below Glen Canyon Dam has permitted the development of a new riparian community that extends from Lees Ferry (River Mile 0) to the backwaters of Lake Mead (River Mile 240). This rapidly proliferating community (Zone 4) is composed of saltcedar (Tamarix), arrowweed (Pluchea sericca), coyote willow (Salix exigua), four species of baccharis, and hundreds of species of herbaceous plants. In most areas, this new community occupies all of the former ephemeral zone (Pre-dam Zone 3), while in other locations, particularly where the bedrock has always been close to the river, there are no discernible changes between the pre- and post-dam vegetational patterns. Above the new riparian community and below the high water line community is now found another distinct zone (Zone 3) of ephemeral plants; red brome (Bromus rubens), tansy mustard (Descurainia pinnata), fescue (Festuca spp.), and the composite Chaenactis fremontii, to mention only a few. Two exotic species, Russian thistle (Salsola kali) and camelthorn (Alhagi camelorum) also proliferate in this zone. The majority of campable beaches are within this zone and many of the species typical of this zone are indicators of disturbed areas.

Preliminary investigations indicate that the woody vegetation particularly Apache plume, redbud, hackberry, and mesquite of Zone 2 is beginning to

die back. Although the high water floods of pre-dam days only rarely reached the lower limit of this zone, it may have been of sufficient frequency to provide nourishment. The high water flows now never approach the lower limits of this community, and each year more and more of the plants appear to be dying.

The vegetation in Zone 1 remains unaffected by the changes in flow of the river. This zone is characterized by hackberry trees, brittle bush, Mormon tea, yucca, century plant, blackbrush, various cactus and many grasses and forbs in the upper canyon. The vegetation expression of this zone changes in the lower canyon largely due to the drop in elevation to creosote bush, ocotillo cactus, large barrel cactus, but still includes blackbrush, brittle brush, Mormon tea, and a variety of grasses and forbs.

### 3. Vegetational and Topographic Habitats

Within the inner gorge, six topographical and eight vegetational habitat types have been delineated as follows:

Rocky Outcroppings, Cliff Faces, and Upper Talus Slopes: These areas generally provide as nesting areas the minimum of essentials for the survival of many animals.

Lower Talus Slopes and Bench: This type exists above the historic floodline, and can be divided into talus and bench as separate entities. Erosion of upper areas provides sufficient soil for sparse plant growth, which is limited by the lack of enduring moisture within the root zone.

Upper Terraces: Commonly called "benches," these pre-dam fluvial deposits just below the old high water line are no longer eroding due to the absence of flooding. They provide one of the most fertile habitats in the canyon. These areas show high incidence of invasion by native and exotic plant species.

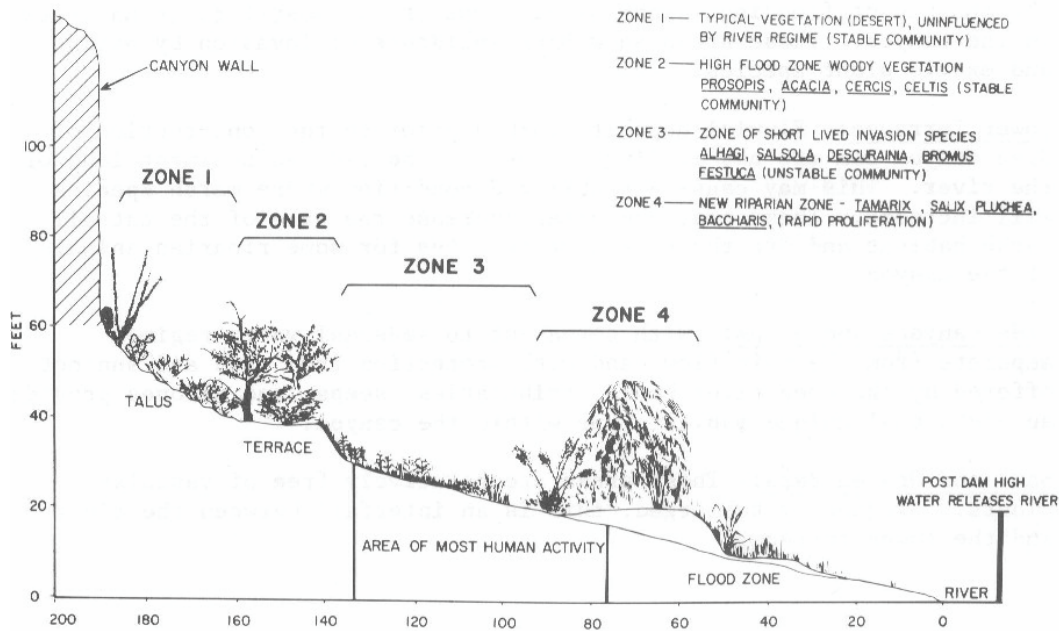
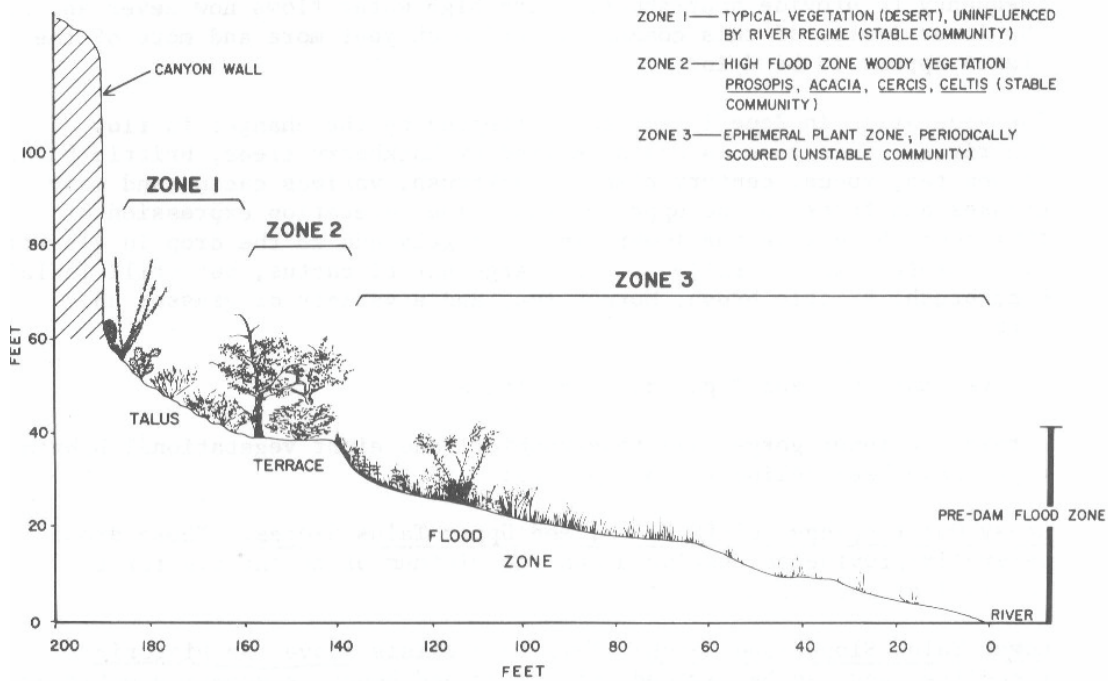
Lower Terraces: Fluvial deposits formed prior to the construction of Glen Canyon Dam are now eroding because of the reduced sediment load of the river. This may cause a stabilized condition where marsh species will increase. These post-dam areas increase the size of the cattail marsh habitat and are the sole nesting sites for some riparian animals of the canyon.

Side Canyons and Seeps: With permanent to seasonal water regimes separate from the main flow, and with protection from wind and sun not offered by the open river banks, tributaries, seeps, and alcoves provide an additional unique habitat type within the canyon.

Sand and Gravel Bars: These areas are relatively free of vascular plants. Frequently submerged, this is an interfall between the river and the lower terraces.

# PRE-DAM AND POST-DAM RIPARIAN VEGETATION

(from Carothers et al., 1976)



The vegetational habitats which may be found in association with the topographical habitat types are as follows:

Sparse Vegetation: This type is characterized by rock outcroppings, cliff faces, upper talus, and sand and gravel bars.

Deciduous Forest: Found in side canyons, seeps and upper and lower terraces. Characterized by mature cottonwood (Populus fremontii), box elder (Acer negundo), willow and redbud. Dense to sparse ground cover occurs as an herbaceous understory.

Evergreen Scrub: Found in side canyons, seeps, lower terraces, and upper terraces characterized by arrowweed, seep willow (Baccharis spp.), with immature willow and saltcedar often in dense stands.

Deciduous Scrubs: Found in upper terraces and lower talus slopes and benches with acacia, mesquite, Apache plume, and closed ground cover.

Deciduous Dwarf Scrubs: Found in upper talus, lower talus, and benches, with brittle brush, Mormon tea, cheat grass (Bromus tectorum), and the composite Chaenactis.

Seasonal Marsh: Often found in a transition between the river and lower terrace includes scarlet monkeyflower (Mimulus spp.), cattail (Typha spp.), and horsetail rush (Equisetum spp.).

Evergreen Savanna: Found in upper talus slopes, lower talus slopes, and benches characterized by yucca (Yucca spp.), agave (Agave spp.), cholla (Opuntia spp.), barrel cactus (Ferocactus); sparse to moderate ground cover.

Desert Scrub: Found in upper talus slopes, lower talus slopes, and benches, are creosote bush, bur-sage (Franseria spp.), blackbush (Coleogyne ramosissima), and ocotillo (Fouquieria splendens) are found here along with a sparse ground cover (Carothers et al., 1976).

A complete catalogue of the plant species known to occur within the inner gorge includes 807 species of vascular plants representing 92 families. A number of species, such as saltcedar, camelthorn and Russian thistle have been introduced from the eastern hemisphere and are termed exotics. Others are endemic, (known only from the area) such as Schribner's needle grass (Stipa scribneri) and bittercress (Cardamine parviflora). Most representative species are of wide geographic distribution and are plants common to the upper and lower Sonoran life zones and their related riparian communities (Carothers and Aitchison, 1976).

#### 4. Ecologically Sensitive Areas

Ecologically sensitive areas within the river corridor can be defined as "areas with high density and/or diversity of plant and animal life

and/or areas that provide a unique element required for the reproduction and survival of indigenous plant and/or animal populations." Ecologically sensitive areas that have been identified to date are presented in Table 12. They represent biotic resources that are unique to the Grand Canyon riparian system. (Also, refer to map, pages 1-4 through I-6.)

## I. WILDLIFE

### 1. Amphibians and Reptiles

Amphibians are not well represented in the Inner Canyon. The arid surface conditions that almost exclusively pervade the entire area, preclude high densities and wide distributions. The amphibians that are present demonstrate a high degree of specialization for desert environments.

Reptiles, especially lizards, appear to flourish in the riparian habitats of the Grand Canyon. The abundance of saltcedar seems to benefit the populations of such species as the desert spiny lizard (*Sceloporus magister*), western whiptail (*Cnemidophorus tigris*), and western rattlesnake (*Crotalus viridis*).

Common reptiles and amphibians known from the immediate river environs are:

Red-spotted toad	<u><i>Bufo punctatus</i></u>
Woodhouse's toad	<u><i>Bufo woodhousei</i></u>
Chuckwalla	<u><i>Sauromalus obesus</i></u>
Desert spiny lizard	<u><i>Sceloporus magister</i></u>
Side-blotched lizard	<u><i>Uta stansburiana</i></u>
Western whiptail	<u><i>Cnemidophorus tigris</i></u>
Gopher snake	<u><i>Pituophis melanoleucus</i></u>
Common kingsnake	<u><i>Lampropeltis getulus</i></u>
(Grand Canyon) Western rattlesnake	<u><i>Crotalus viridis abyssus</i></u>

(after Carothers and Aitchison, 1976, Suttkus et al., 1976)

### 2. Birds

Approximately 284 species of birds have been recorded in the Grand Canyon region (Brown, et al., 1978), an area encompassing not only Colorado River and its riparian habitat, but also the wide variety



TABLE 12  
 ECOLOGICALLY SENSITIVE AREAS ALONG THE COLORADO RIVER

Name	Mile	Side of River or Location
House Rock Marsh	17.5	South
Stantons Cave	31.8	North
Vasey's Paradise	31.9	North
Buck Farm Canyon	40.8	North
Spring Canyon	41.2	North
43-Mile	43.2	South
Saddle Canyon	47.5	North
Nankoweap	52.0 - 53.0	North
Kwagunt Canyon	56.0	North
Little Colorado River	61.5	South
Hopi Salt Mines	52 - 64	South
Furnace Flats	65.6	South
Cardenas Marsh	71.0	South
Red Canyon	46.6	South
Clear Creek	84.0	North
Phantom Ranch	87.5	North
Garden Creek	89.0	South
Monument Creek	93.5	South
Hermit Creek	95.0	South
Boucher Creek	96.5	South
Shinumo Creek	108.8	North
Elves Chasm-Royal Arch Creek	116.5	South
Blacktail 122 Mile Creek	122.0	North
Stone Creek	132.0	North
Tapeats Creek Thunder River (Mi. Tapeats and Thunder River Caves)	133.7	North
Deer Creek	136.2	North
Kanab Creek	143.5	North
Matkatamiba	147.9	South
Havasut Canyon	156.8	South
National Canyon	166.5	South
Fern Glenn	168.0	North
Mohawk Canyon	171.5	South
Lava Falls	179.5	South
185-Mile	185.5	North
Granite Park	208.6	South
Juniper Seep	215.0	North
Three Springs Canyon	216.0	South
Surprise Canyon	248.4	South
Maxson Canyon	252.4	South
Burnt Canyon	259.3	North
Spencer Canyon	246.0	South
Emery Falls	274.4	South
Rampart Cave	275.0	South
Grapevine Wash	279.0	South

(Taken from Carothers and Aitchison, 1976)

habitat types found throughout the Grand Canyon area. The riparian habitat of the Inner Canyon contains its distinct assemblage of breeding birds, yet during the non-breeding or migratory season, the riparian areas are frequented by birds that breed in all Grand Canyon habitats and some that breed elsewhere throughout the United States and Canada. The riparian habitat of the Inner Canyon provides a natural corridor for migratory movements of birds on their way to or from breeding grounds.

The very depth and size of the entire Grand Canyon system provide for striking climatic differences between canyon bottom and canyon rim. Generally, the spring and fall weather along the Colorado River is much more hospitable than that of either rim. The deciduous riparian vegetation enjoys a longer growing season providing insects with a longer period of food, which in turn provides a predictable food source for some migrating birds.

A total of 41 species are known to breed within the river corridor. Of these, 27 species utilize the riparian vegetation as nesting habitat. The remaining 14 species nest in association with the surrounding desert scrub, the vertical cliffs or the loose talus slopes of the inner gorge.

The riparian vegetation is preferred by 74 percent of the total population of breeding birds in the inner gorge; only two bird species are permanent residents. Thus, it may be generalized that the summer resident species of the Inner Canyon are almost exclusively restricted to the narrow belt of riparian vegetation along the river, while the permanent residents are restricted to or prefer the desert scrub, talus or vertical steep cliffs adjacent to the riparian habitat. The species most dramatically affected by the new stabilized vegetative community are: Willow flycatcher (*Empidonax traillii*), Bell's Vireo (*Vireo bellii*), yellow warbler (*Dendroica petechia*), common yellowthroat (*Geothlypis trichas*), yellow-breasted chat, (*Icteria virens*), northern oriole (*Icterus galbula*), brown-headed cowbird (*Molothrus ater*), and blue grosbeak (*Guiraca caerulea*). These species account for about 14 percent of the total breeding bird population along the Colorado River. They will continue to increase in density as long as the vegetation below the old high waterline continues to proliferate. They probably did not occur with significant frequencies along the river during the pre-dam era. Other species that are equally dependent upon this green vegetation such as the lazuli bunting (*Passerina amoena*) and indigo bunting (*Passerina cyanea*) might be expected to begin utilizing this vegetation along the banks of the river as well as the heavily vegetated tributaries in which they are now found (Carothers et al., 1976).

The most common breeding bird of the river corridor is the Lucy's warbler (*Vermivora luciae*) accounting for almost 20 percent of the total population of breeding birds. The house finch (*Carpodacus mexicanus*) is the second most common species (15 percent) followed by the canyon wren (*Catherpes mexicanus*) (11 percent) whose distinctive song is commonly heard by river runners. See Appendix E for a summary of breeding bird

species known to occur in the river corridor, their preferred habitats and relative densities.

The exotic house sparrow (*Passer domesticus*) and common starling (*Sturnus vulgaris*) breed in the Inner Canyon but almost always in association with human habitation, e.g., Phantom Ranch, Indian Gardens and Havasu Village. Recent exception to this restricted distribution was the occurrence of a breeding pair of house sparrows at Deer Creek Falls Campground, River Mile 136. This campsite is one of the most heavily used areas by river runners (Carothers et al., 1976).

### 3. Mammals

Within the riparian zone of the Colorado River approximately 22 species of terrestrial mammals and 18 species of bats are known to occur. The most common mammals are the rodents, with 13 species inhabiting the riparian, semi-riparian or desert habitats. On the beach and terrace habitats rodents are the most common mammals, comprising an average density of about 20 individuals per acre (Carothers and Aitchison, 1976). The bats have been little studied, and are present in very high densities, utilizing rock cliffs for roosting sites, the river for drinking, and the insects associated with the riparian habitat for food. Carnivorous mammals; i.e., bobcats (*Lynx rufus*), coyotes (*Canis latrans*), foxes (*Urocyon* spp.), and mountain lions (*Felis concolor*) are uniform in distribution, but extremely rare. Spotted skunks (*Spilogale putorius*) ringtails (*Bassariscus astutus*), and rock squirrels (*Spermophilus variegatus*) are common scavengers throughout the canyon but especially concentrated in popular camping areas. The rock squirrels have reached such high population densities in some campgrounds; e.g., Indian Gardens, that they have become pests, robbing food from backpackers and destroying camping gear. The larger mammals are represented by the mule deer (*Odocoileus hemionus*) and the bighorn sheep (*Ovis canadensis*).

The most conspicuous exotic animal within the Inner Canyon is the feral ass or wild burro (*Equus asinus*). This animal was introduced into the canyon area during the late 1800's by early explorers and prospectors. When the mineral exploration subsided and national park status precluded further mineral exploitation in the canyon, the animals were released. Since 1923, resource managers have attempted to reduce or eliminate the feral burro from the Grand Canyon, but direct reduction was halted in the late 1960's. The impact inflicted on the native ecosystem by this feral equine has been determined to be extensive (Carothers et al., 1976). Feral horses (*Equus caballus*), owned by Havasupai Indians, are known to occur in central Grand Canyon. They are not found along the Colorado River corridor.

See Appendix F for a summary of the mammals known to occur in the river corridor, their preferred habitats and relative abundance.

#### 4. Fishes

The Colorado River has only a few native fish species. Because of the post-dam changes in the river environment, the Colorado River squawfish (*Ptychocheilus lucius*) and the humpback chub (*Gila* spp.) may possibly be nearing extinction. These native fish depended on the seasonal fluctuation of water temperatures to breed; cold, stabilized temperatures now limits breeding to warm side streams.

Known fish species of the Colorado River in Grand Canyon and its tributaries are:

##### Native Species

Flannel mouth sucker	<u><i>Catostomus latipinnis</i></u>
Bluehead sucker	<u><i>Pantosteus discobolus</i></u>
Bonytail chub	<u><i>Gila elegans</i></u>
Humpback chub	<u><i>Gila cypha</i></u>
Colorado squawfish	<u><i>Ptychocheilus lucius</i></u>
Speckled dace	<u><i>Rhinichthys osculus</i></u>

##### Exotic Species

Threadfin shad	<u><i>Dorosoma petenense</i></u>
Rainbow trout	<u><i>Salmo gairdneri</i></u>
Brown trout	<u><i>Salmo trutta</i></u>
Cutthroat trout	<u><i>Salmo clarki</i></u>
Eastern brook trout	<u><i>Salvelinus fontinalis</i></u>
Coho salmon	<u><i>Oncorhynchus kisutch</i></u>
Carp	<u><i>Cyprinus carpio</i></u>
Fathead minnow	<u><i>Pimephales promelas</i></u>
Red shiner	<u><i>Notropis lutrensis</i></u>
Channel catfish	<u><i>Ictalurus punctatus</i></u>
Black bullhead	<u><i>Ictalurus melas</i></u>
Rio Grande killifish	<u><i>Fundulus zebrinus</i></u>
Green sunfish	<u><i>Lepomis cyanellus</i></u>
Large mouth bass	<u><i>Micropterus salmoides</i></u>
Bluegill	<u><i>Lepomis machrochirus</i></u>
Golden shiner	<u><i>Notemigonus crysoleucas</i></u>
Mosquito fish	<u><i>Gambusia affinis</i></u>

(after Suttkus et al., 1976)

Carp and various chubs, shiners, minnows, bullheads, bass, and other fish have been introduced to the Colorado River in varying quantities. Rainbow, brook, and brown trout have been introduced into Bright Angel, Clear, Shinumo, Garden, and Tapeats Creeks. Plantings have been made as recently as 1967 in cooperation with the Arizona Game and Fish Department. Earlier efforts to establish trout in Havasu Creek were not successful.

Stocking still occurs at Lees Ferry, Arizona, where five to seven inch rainbow trout are planted from one to two times a year. Lees Ferry is less than 1 mile from the park boundary on the Colorado River. Trout are known to migrate along the length of the Colorado River in the park. Being carnivorous, they place pressure on the young of the endangered native species, but the impact of this factor is not known at this time.

Stocking has also occurred and will continue at Lake Mead. Coho salmon (*Oncorhynchus kisutch*), rainbow trout, striped bass (*Morone saxatilis*), and walleye (*Stizostedion vitreum*) have been stocked since 1968. Coho salmon, rainbow trout, smallmouth bass (*Micropterus dolomieu*), walleye, and striped bass all move from the lake into the lower park, and as the river continues to alter from the pre-dam system, they will probably increase in abundance. There is no quantitative data on fish densities in

## 5. Insects

Canyon habitats support a great diversity of both aquatic and terrestrial insect species. To date more than 260 families of insects have been recorded along the river corridor and tributaries.

The post-Glen Canyon Dam cold waters of the Colorado River have prevented an influx of aquatic species in the usually clear-running mainstream. Thus far, only two families of Diptera (Simuliidae and Cnironomidae) are commonly found in the main channel. The aquatic Hemiptera and Coleoptera which are occasionally found along the banks of the river may best be considered litoral, as are several dipteran families. Tributaries provide most of the habitat for aquatic species in the Inner Canyon but differences between tributaries are great. Ion concentrations, pH, water temperature, turbidity, water flow, isolation, elevation, and tributary location within Grand Canyon all affect aquatic insect populations, and as yet insufficient data have been gathered to present a composite description of the distribution of insect species.

Terrestrial species are concentrated in the riparian vegetation between Zone 2 and the river, with a great deal of activity in the recently stabilized Zone 4. The population dynamics of some insect species in Zones 3 and 4 appear to be changing irregularly, apparently in adjustment to the post-dam invasion of plant species. Climax balance or regularity in population fluctuations remains to be shown for certain species of Orthoptera, Hemiptera, Coleoptera, Neuroptera, Lepidoptera, and Diptera. Climax balance of these species of insects is apparently closely related to exotic plant species such as saltcedar and camelthorn which are undoubtedly undergoing a gradual incorporation into the overall community. Lately, certain Acrididae (most notably *Schistocera shoshoni*), Cicadellidae and Buprestidae species have expanded their use of saltcedar.

Formicid species (*Pogonomyrmex* spp.) and various dipteran species are among the more commonly encountered insects in beach areas, their

concentrations being related in part to human use. While bothersome, they do not pose a significant health hazard.

Almost no information exists on the population levels of poisonous arthropods other than insects, though two families of Scorpionida and black widow spiders (Latrodectus spp.) are quite common in Zones 1 through 3 throughout the canyon.

Diversities and densities of insects in the xeric Zone 1 are lower and probably more stable than those in the riparian zones.

The obsolete viceroy (Limenitis archippus obsoletus) found in Grand Canyon is being considered for inclusion on the list of endangered species. The monitoring program will continue to evaluate its status. (Carothers et al., 1976; Cole and Kubly, 1976).

#### J. RARE, ENDANGERED, AND THREATENED SPECIES

Along the river corridor, the bald eagle (Haliaeetus leucocephalus), the American peregrine falcon (Falco peregrinus anatum), brown pelican (Pelecanus occidentalis), the humpback chub (Gila spp.) and the Colorado River squawfish (Ptychocheilus lucius) are on the list of endangered fauna, maintained by the Secretary of the Interior.

The status of the three endangered bird species in the national park has recently been reviewed (Carothers and Johnson, 1975). Peregrine falcons are permanent residents of the canyon, although few in numbers. They utilize the river corridor for hunting, primarily preying on waterfowl and swifts. The other two are either transient (bald eagle) or accidental (pelican).

The endangered fish species are "endangered" because of the drastic changes in their habitat that have taken place since the impoundment Lake Powell by Glen Canyon Dam. These changes include the increases non-native fish populations, which are believed to be competing with native fishes for necessary resources (Minckley and Blinn, 1976). The Colorado River squawfish may, in fact, already be extinct in Grand Canyon, as none were encountered during exhaustive searches in 1974, 1975, 1976, 1977, and 1978. The humpback chub is now restricted in distribution to the mouth of the Little Colorado River.

The spotted owl (Strix occidentalis) and the prairie falcon (Falco mexicanus), known occupants or visitors to the river corridor, were considered "threatened" species by the U.S. Fish and Wildlife Service in the 1973 edition of "Threatened Wildlife of the United States." They have not, however, been recorded as threatened species in the official Fish and Wildlife Service list of "Endangered and Threatened Wildlife and Plants," Federal Register, July 14, 1977.

The prairie falcon is an occasional resident of the Grand Canyon area and its numbers in the park seem to be declining in keeping with the national trend (Carothers and Johnson, 1975).

Several other species exist along the Colorado River in Grand Canyon whose status in Arizona may be in jeopardy in the near future (Arizona Game and Fish Department, 1976). These include the following:

Desert bighorn sheep	( <u>Ovis canadensis</u> )
Snowy egret	( <u>Egretta thula brewsteri</u> )
Black-crowned night heron	( <u>Nycticorax nycticorax hoactli</u> )
Osprey	( <u>Pandion haliaetus carolinensis</u> )
Bonytail chub	( <u>Gila elegans</u> )
Desert tortoise	( <u>Gopherus agassizi</u> )
Gila monster	( <u>Heloderma suspectum</u> )

It is believed that river otter (Lutra canadensis) at one time frequented the Colorado River in Grand Canyon. However, there have been no sightings of this animal in the Grand Canyon for many years.

The fish and reptile species listed above, encountered during the research projects, are susceptible to disturbances initiated by increased human use of the riparian zone. The National Park Service and the U.S. Fish and Wildlife Service have jointly recommended the bonytail chub for endangered status and the razorback or humpback sucker for threatened status under the Endangered Species Act of 1973.

## 2. Plants

A number of endangered or threatened species of plants are known from Grand Canyon National Park. Species endemic to the area or species much diminished in range or habitat and listed as Endangered in House Document 94-51, "Report on Endangered and Threatened Plant Species of the United States," are:

Goldenweed	<u>Haplopappus salicinus</u>
Draba	<u>Draba asprella</u> var. <u>kaibensis</u>
Plains cactus	<u>Pediocactus bradyi</u>
Scouler catchfly	<u>Silene rectiramea</u>
Milkvetch	<u>Astragalus cremnophylax</u>
Phacelia	<u>Phacelia filiformis</u>
Wild buckwheat	<u>Eriogonum darrovii</u>
Wild buckwheat	<u>Eriogonum zionis</u> var. <u>atwoodi</u>
Wild buckwheat	<u>Eriogonum zionis</u> var. <u>coccineum</u>
Primrose	<u>Primula hunnewellii</u>
Mustard	<u>Sisymbrium kearneyi</u>

The following plants in Grand Canyon National Park are recommended for consideration as a threatened species in House Document 94-51:

Paint-brush	<u>Castilleja kaibabensis</u>
Prickle-poppy	<u>Argemone arizonica</u>
Crossosoma	<u>Crossosoma parviflorum</u>
Beavertail cactus	<u>Opuntia basilaris</u> var. <u>longeareolata</u>
Fleabane	<u>Erigeron lobatus</u>
Goldenweed	<u>Haplopappus subintegra</u>
Actinea	<u>Hymenoxys subintegra</u>
Draba	<u>Draba asprella</u> var. <u>stelligera</u>
Phacelia	<u>Phacelia serrata</u>
Agave	<u>Agave utahensis</u> var. <u>kaibabensis</u>
Flowering ash	<u>Fraxinus cuspidata</u> var. <u>macropetala</u>
Milkvetch	<u>Astragalus troglodytus</u>
Primrose	<u>Primula specuicola</u>
Wild buckwheat	<u>Eriogonum densum</u>
Wild buckwheat	<u>Eriogonum ovalifolium</u> var. <u>vineum</u>
Columbine	<u>Aquilegi desertorum</u>
Wild rose	<u>Rosa stellata</u>
Palmer amsonia	<u>Amsonia palmeri</u>
Clematis	<u>Clematis hirsutissima</u> var. <u>arizonica</u>
Cymopterus	<u>Cymopterus newberryi</u>
Encelia	<u>Encelia frutescens</u> var. <u>resinosa</u>
Nama	<u>Nama retrorsum</u>
Scurf-pea	<u>Psoralea epipsila</u>

Very little is known regarding the distribution and abundance of the endangered and threatened species of plants in Grand Canyon National Park. The bulk of the available information has come from recent ecological studies performed throughout the river corridor (Carothers and Aitchison, eds., 1976). Although more complete information on these species and their critical habitat is not available, it is possible that human interference in the form of river recreation is not significantly adversely effecting the survival of these plants.

## K. THE CULTURAL RESOURCES

### 1. Archeology

Archeological resources in Grand Canyon constitute a primary scientific and historic value. The more than 1,200 known Indian ruins within the national park indicate and represent the adaptation of man to his environment over the past 4,000 years in the Grand Canyon region. The initial occupation of the canyon began about 4,000 years ago, and is represented by the Grand Canyon Split-Twig Figurine Complex occupation of dry caves. These deposits contain split-twig figurines which are found only in a few other locations in the southwest. An apparent lull in human occupation followed, with primary occupation in the canyon occurring between



A.D. 700 and 1200. During this time, Anasazi to the north and east, and Cohonina to the south and west, used the plateaus for their agriculturally based way of life. The Anasazi occupied the depths of the canyon as well. In the historic period, Hualapai, Havasupai and Paiute evidenced the only use of the canyon by the surrounding Indian tribes. These various cultures all left evidence of their life styles upon the land.

Archeological surveys of the river corridor were completed in 1978 (Euler, 1979).

At the present time, over 50 prehistoric archeological sites have been recorded adjacent to the Colorado River from Lees Ferry to the Grand Wash Cliffs and Lake Mead. In addition to the presence of sites adjacent to the river, other important cultural resources have been located in tributary canyons. Dozens of ruins have been identified in virtually every major drainage of the Colorado River system. Many of these sites are undergoing rapid and irreversible impact, some due to natural erosive forces, but in other instances considerable impact is due to visitor activities. Nineteen commonly visited archeological sites include a number of pueblo ruins, rock shelters, pictographs, masonry granaries, caves, and sacred Indian sites.

Sites in danger of disturbance by natural forces (erosion through flash flooding) or by the trampling activities of the feral ass are located throughout the lower Grand Canyon. Many of these sites are within the river corridor.

Although 10 archeological sites are eligible for nomination to the National Register of Historic Places, no sites within the river corridor are presently listed on the register. Site evaluation and preparation of nomination forms is now underway. Compliance with Executive Order 11593 is expected within the next few years.

## 2. History

Although the archeological record indicates a very early human interaction with the Grand Canyon, it has been only during the past 75 years that extensive organized activity has occurred. The historic resources of Grand Canyon relate primarily to the establishment and development of the national park.

Recorded history of the Grand Canyon began with its discovery in 1540 by Don Lopez de Cardenas, one of Coronado's captains, and 12 followers who were seeking the fabled wealth of the Seven Cities of Cibola. Fathers Dominguez and Escalante crossed the Colorado River in Glen Canyon in 1776 and in that same year Francisco Tomas Garces visited the Havasupai Indians during a traverse south of Grand Canyon. American fur traders made forays into the Grand Canyon region during the early 19th century.

After the war with Mexico, the United States acquired the region in 1848 by the Treaty of Guadalupe Hidalgo. The first comprehensive report on Grand Canyon resulted from the work of a War Department expedition of 1857-58 headed by Lieutenant Joseph C. Ives. His mission was to ascend the Colorado River and report on its navigability.

Major John Wesley Powell and nine companions won lasting fame as a result of their daring descent by boat of the Colorado River in 1869. Their trip began at Green River, Wyoming, and ran the river through the Grand Canyon. Powell repeated the trip again in 1871-72, as far as Kanab Creek. These scientific explorations gathered worthwhile information in spite of the hardships involved. A U.S. Army expedition led by Captain George Wheeler passed immediately south of the canyon in 1871 as they were mapping potential railway routes.

Along the river corridor there are no historic sites that are presently on the National Register of Historic Places. Below is a list of currently known sites within the river corridor which require historic evaluation. Some of these sites may meet the national register criteria when they are more fully evaluated.

Name of Site

Brown Inscription  
Cave Springs Rapid Historic Site  
Bert Loper's Boat  
Grave of Peter Hansbrough (1889) and Boy Scout (1946)  
Grave of Willie Taylor  
Beamer's Cabin  
Tanner Mining Camp  
Hance Cabin  
Asbestos Canyon Mining Camp  
Phantom Ranch  
Bass' Winter Camp and Cable Crossing  
Shinumo Canyon Mining Camp  
Hakatai Canyon Mining Camp  
Havasus Canyon Mines

Other sites, not immediately adjacent to the Colorado River but easily accessible to river runners and backcountry users that need investigation, include Hermit Camp, Boucher Camp, and Bat Cave Guano Mine.

L. RIVER RECREATION

The Colorado River through Grand Canyon is one of eight stretches of recreation rivers on the Colorado-Green River system. It is one of more than 44 stretches of recreational rivers in the western United States.

In Grand Canyon, the Colorado River has unique characteristics which set it apart from other rivers. It is the longest stretch of river for

recreational use entirely within a national park. It is surrounded by more than 1 million acres of land with little human development. Some of the world's most difficult and exciting white water occurs here. The Colorado River's isolation in the mile deep gorge of Grand Canyon gives it wilderness qualities which enhance in addition to river running, off river hiking, climbing, sightseeing, and solitude.

Prior to the early 1960's, there was little need to be concerned with resource impacts along the river. Most park visitors were concentrated on the South Rim of the canyon, and to a lesser extent, the North Rim. Relatively few visitors entered the canyon, and when they did it was usually on the Kaibab and Bright Angel Trails. Few visitors hiked in the backcountry or ran the river, and attention to these activities was minimal.

In 1963, the gates of Glen Canyon Dam were closed, forming Lake Powell, and river management problems began to appear. In addition to changing the biotic regimen of the Colorado River and its associated habitats, Glen Canyon Dam also drastically altered the maximum and minimum flow of the river and the silt concentrations. The dam also changed the timing of flows. Pre-dam flows were so high during spring run-off that river running was difficult. On some years, flow volume dropped so drastically that by September there was too little water for river running. The more consistent flows and clear water resulted in the Colorado River below Glen Canyon Dam becoming one of the most sought after whitewater recreation rivers in the Western Hemisphere. Simultaneously other factors encouraged growth in river running: emerging interest in wilderness experience, increased mobility and leisure time, expanding numbers of people with river-running expertise, and an increased amount and variety of, as well as improvement in equipment.

In late 1969, the National Park Service became concerned with the increase in river running activity. Before 1953, fewer than 200 people had run the Colorado River through The Grand Canyon (Johnson and Martin, 1976). In 1967, 2100 people ran the river and river running was becoming a thriving business. By 1973, 22 commercial boating companies and noncommercial river runners carried over 15,000 people down the river, an increase of almost 700 percent in 6 years (see Table 13). The number of river runners in 1972 alone exceeded the total number for the 100 years from 1869 (Powell trip) through 1968. Twenty one of the commercial river running operations are authorized to run the river from Lees Ferry to Pierce Ferry and other points on upper Lake Mead. The Hualapai Tribe is authorized to run only from Diamond Creek to Pierce Ferry and other points on upper Lake Mead.

#### 1. User Days and Allotments

For 1973, a ceiling was placed on the number of user days (one user day equals one person on the river for one day), to allow time to determine what the effect this use was having on the resources and on the visitor's experience.

The commercial allotment for 1972 was 105,000 user days. Of these, only 88,135 were used, so for 1973 the allotment was set at 89,000, an overall reduction of 16 percent. This level has been maintained to the present time. Noncommercial river runners used 7,600 user days in 1972 and that level has been their ceiling to the present time. These use limits and allocations for commercial and noncommercial river running were for that section of the river from Lees Ferry to Diamond Creek. There were no use limits established for the Lower Gorge below Diamond Creek. User days are not counted against allocations for those trips continuing on below Diamond Creek.

The number of user days allocated to individual concessioners was based on their actual levels of use in 1972. Most concessioners concessioners allotment was reduced by 16 percent in 1973 from the 1972 allotment figure (see Table 14). The Hualapai Tribe are not included in Table 14 since they are not under a user day limit because they operate only in the Lower Gorge below Diamond Creek.

Table 13  
TRAVEL ON THE COLORADO RIVER THROUGH THE GRAND CANYON  
FROM 1867 TO THE PRESENT (AFTER NASH, 1976)

<u>Year</u>			
1867	1 <sup>1</sup>	1957	135
1869-1940	73	1958	80
1941	4	1959	120
1942	8	1960	205
1943	0	1961	255
1944	0	1962	372
1945	0	1963-1964	44 <sup>2</sup>
1946	0	1965	547
1947	4	1966	1,067
1948	6	1967	2,099
1949	12	1968	3,609
1950	7	1969	6,019
1951	29	1970	9,935
1952	19	1971	10,385
1953	31	1972	16,432
1954	21	1973	15,219 <sup>3</sup>
1955	70	1974	14,253
1956	55	1975	14,305
		1976	13,912
		1977	11,830
		1978	14,356

1. Some contend that James White, a trapper fleeing from Indians, floated the Grand Canyon on a makeshift log raft two years before the expedition of John Wesley Powell.
2. Travel on the Colorado River in these years was curtailed by the completion of Glen Canyon Dam upstream and the resultant disruption of flow.
3. The downturn in visitation was the result of the institution by management of a quota system. The numbers applying for the available private permits continued to rise annually.

Table 14  
CURRENT ALLOCATION OF AVAILABLE PASSENGER  
DAYS (PD) TO EACH OF THE 21 CONCESSIONERS

Company	1972		1973		1976	1977	1978	# Trips
	P/D Allot	P/D Use	P/D Allot	P/D Use				
WEST	12000	13125	10080	10052	10153	8455	10086	50
HATCH 12000	11689	10080	10034	8297	6761	9746	70	
SAND	12000	10636	10080	10039	10011	9302	10496*	52
ARTA	11000	9775	9240	9096	9241	7577	9155	41
GRCE	10000	11000	8400	8347	9470*	6290	8458	24
CROS	8000	3560	6720	5297	4349	3343	5156	40
WHIT	4500	4589	3780	3765	3476	3114	3758	21
TOUR	4500	4515	3780	3734	3755	3524	3593	25
CANY	4000	2893	3360	3344	3409	2876	3304	23
GRCD	3600	2329	3025	2979	2944	3416*	4117*	16
ARIZ	3000	3050	2600	2609	3078	2600	2924*	18
WILD	3000	721	2520	2526	2478	2470	2542*	9
FORT	2600	1391	2200	2213	2054	1844	2377*	12
MOKI	2400	1241	2050	1466	2190	2200*	2312*	14
GEOR	2300	1414	2000	1988	2015	1974	2365*	7
COLO	2000	1879	1800	1819	1951*	1916*	1876	17
HARR	2000	975	1680	1570	1580	1565	1506	11
KENS	2000	600	1680	1449	1629	1457	1700*	8
OARS	1600	1218	1600	1589	1603	2518*	1617*	10
OUTD	1200	738	1200	1215	1206	1129	1209	7
GRCY	<u>1300</u> 105000	<u>784</u> 88135	<u>1125</u> 89000	<u>1134</u> 86264	<u>1117</u> 85006	<u>1469</u> 75800	<u>1105</u> 89362	<u>6</u> 481

Any significant departures in excess of allocated use were covered by borrowing or was deducted from the following year allocation.

The 7,600 user days allocated for noncommercial river runners sector has been dispensed by a variety of methods. In 1972 and 1973, user days were assigned on a first-come, first-served basis. In 1974-75, postmark priority and a no-repeat rule was tried. In 1976, the no-repeat rule was dropped and a lottery was established. Considerable controversy has pervaded the decision on both commercial and noncommercial disbursements since 1972, becoming more intense and widespread in 1976 and continuing to the present.

The percentage of user days allocated between commercial and noncommercial user days has generated much controversy, including two lawsuits that are still pending. The following tables show the allocation of use between commercial (92 percent) and noncommercial (8 percent) river runners. Table 15 presents the number of noncommercial user days and table 16 the allocated and actual user days used for all 22 commercial outfitters from 1972 and 1976.

Commercial use did not reach the total allotment level until 1978. However, the data indicate clearly that some concessioners could use more user days than they are currently allotted while others do not use their total allotment. At the same time, 81,448 user days were denied the noncommercial applicants in 1976. National Park Service files contain many complaint letters from unsuccessful noncommercial applicants, but none from people indicating they could not book a commercial trip. The data on applications received and user days issued to noncommercial river runners are not realistic. For example, there were over 1200 application blanks sent out for 1977, with 507 completed applications submitted and 37 permits issued. Some of those who requested applications desired a trip, but did not submit an application due to the limited chance of drawing a permit, and other related reasons. Also, duplicate applications were included in the 507 submitted. The demand for noncommercial trips appears to be greater, but the data are inadequate to determine the extent of demand.

Commercial use was increasing at a rapid rate prior to 1973 when the ceiling was imposed. There is no question that this use would be at a much higher level today had it been allowed to operate in a free market situation where concessioners were allowed to increase trips freely in response to demand. How much higher use might have been is entirely speculative.

In summary, it appears that noncommercial user interest is most intense at this time, but comparative demand, noncommercial to commercial, cannot be accurately assessed.

## 2. Levels and Distribution of Use

The maximum commercial user days allotted each month cannot exceed 25 percent of the concessioner's annual allotment. A maximum of 150 commercial

Table 15  
 NUMBER OF NONCOMMERCIAL PERMIT APPLICATIONS  
 AND PERMITS GRANTED FROM 1972 THROUGH 1978

Number of Number of Year	Number of User Days Applications	Permits Requested	Number of User Granted	Days granted	
1972	47	7,611	47	7,611	
1973	74	14,193	49	7,833	
1974	84	17,115	41	7,638	
1975	173	33,569	42	7,679	
1976	425	89,084	36	7,636	
1977	507	86,862	40	7,766	
1978	370	73,834	37	7,477	
1979	441	86,346	47*	7,600*	

\* Estimates

Table 16  
 TOTAL USER DAYS ALLOTTED VERSUS TOTAL USER DAYS  
 USED BY COMMERCIAL RIVER RUNNERS FROM 1972 TO 1978

Number of Days Year	Number of Days Allotted	Number of Days Used	Number of Days Not Used
1972	105,000	88,135	16,865
1973	89,000	86,264	2,736
1974	89,000	84,159	4,841
1975	89,000	84,709	4,291
1976	89,000	85,006	3,994
1977	89,000	75,800	13,200*
1978	89,000	89,362	----

\* Extremely low water year



passengers, and one party of up to 15 private users (average in 1978 was 11.2), is permitted to depart from Lees Ferry on any single day. The maximum number of commercial passengers per type of boat ranges from 6 to 20, and the maximum number of passengers per commercial trip is 40 (average in 1978 was 21.4). Commercial trips are not permitted to average more than 40 river miles per day.

Current use levels range from 80 to 940 people leaving Lees Ferry each week with up to 200 people launching on a single day (including crew, research, and administrative personnel). The majority of river trips launch Mondays and Tuesdays, and most of the allotments are used in June through August (see Tables 17 and 18). Little use occurs between October and March.

### 3. Lower Gorge

The use levels and allotments discussed above apply only to the first 225 miles of the river. The portion of river from Diamond Creek to Grand Wash Cliffs is currently not under use allotment.

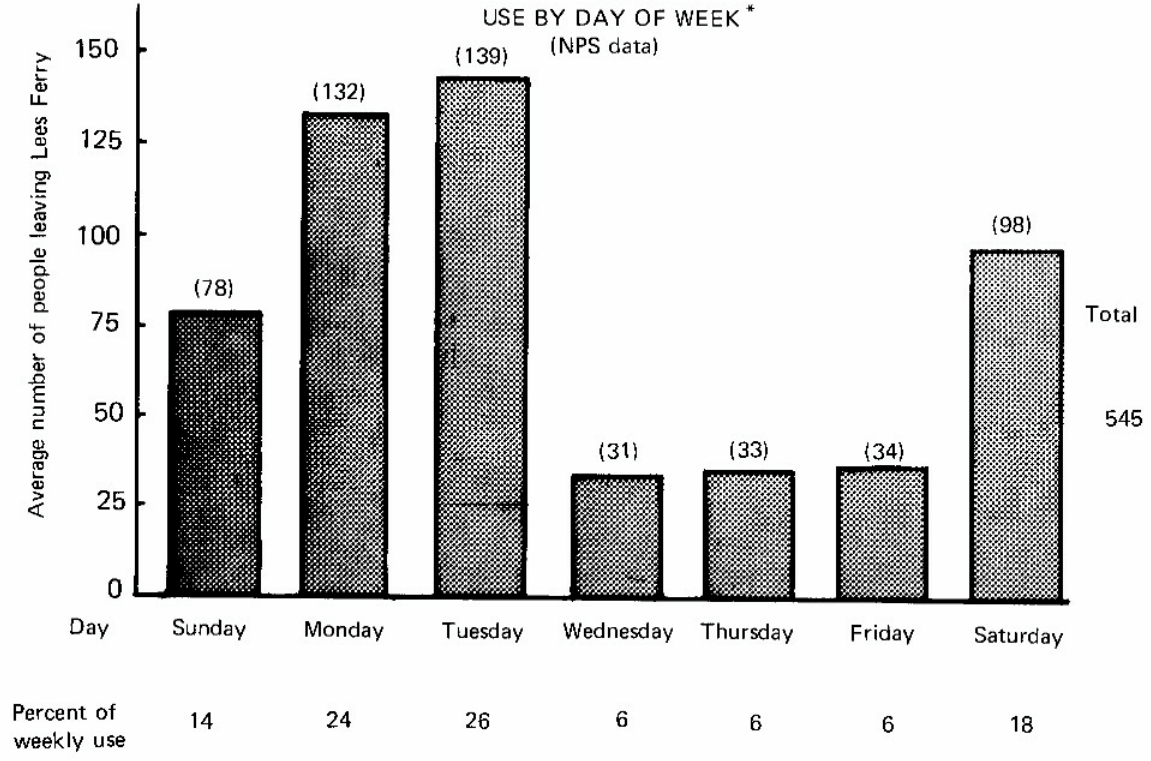
This section of the river was added to the park in January 1975 (Grand Canyon National Park Enlargement Act, P.L. 93-620) and has a history of use and management that is substantially different than upstream from Diamond Creek. In 1978, (under permit from NPS and auspices of the Hualapai Tribe) an estimated 500 passengers took trips from Diamond Creek to Lake Mead. In addition, approximately 6,000 commercial passengers who annually start their trip at Lees Ferry continue past Diamond Creek down river to Lake Mead. There are no data available on the numbers of noncommercial passengers that float from Diamond Creek to Lake Mead, but an estimated 100 trips launch at Diamond Creek annually.

Motor boats also run upriver to Diamond Creek at the present time, but are not permitted to continue beyond this point. Fishing and water skiing also occur below Separation Rapids (Mile 240). This area is considered to be a portion of Lake Mead, and approximately 12,000 persons, other than river runners, engage in lake recreation yearly.

### M. THE NATURE AND EFFECT OF EXISTING USE PATTERNS

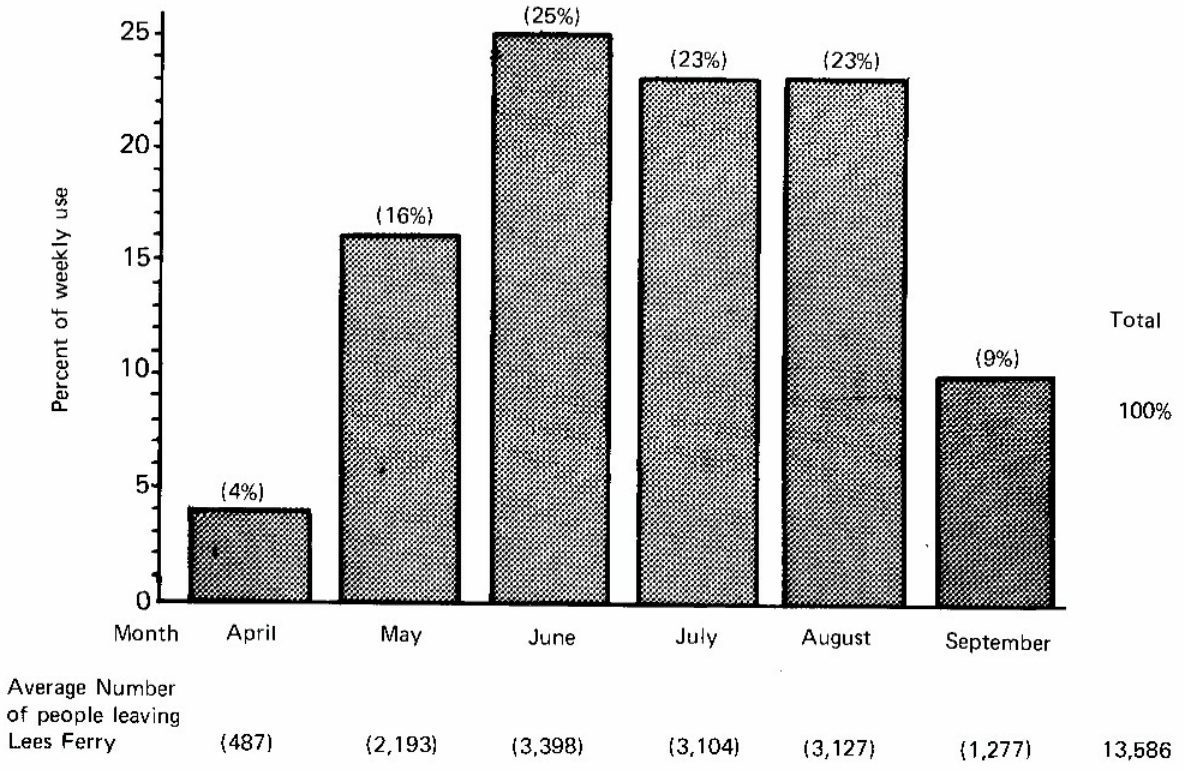
Rapid irreversible physical and ecological changes are occurring in the riparian resources of the Colorado River as a result of the present visitor use levels and patterns. The irreversible changes are not necessarily a simple function of the total number of visitors, but more importantly, of use patterns and activities (Carothers and Aitchison, 1976).

TABLE 17  
 USE BY DAY OF WEEK\*  
 (NPS data)



\*April through September only

TABLE 18  
 USE BY MONTH OF SEASON\*  
 (NPS data)



\*April through September only

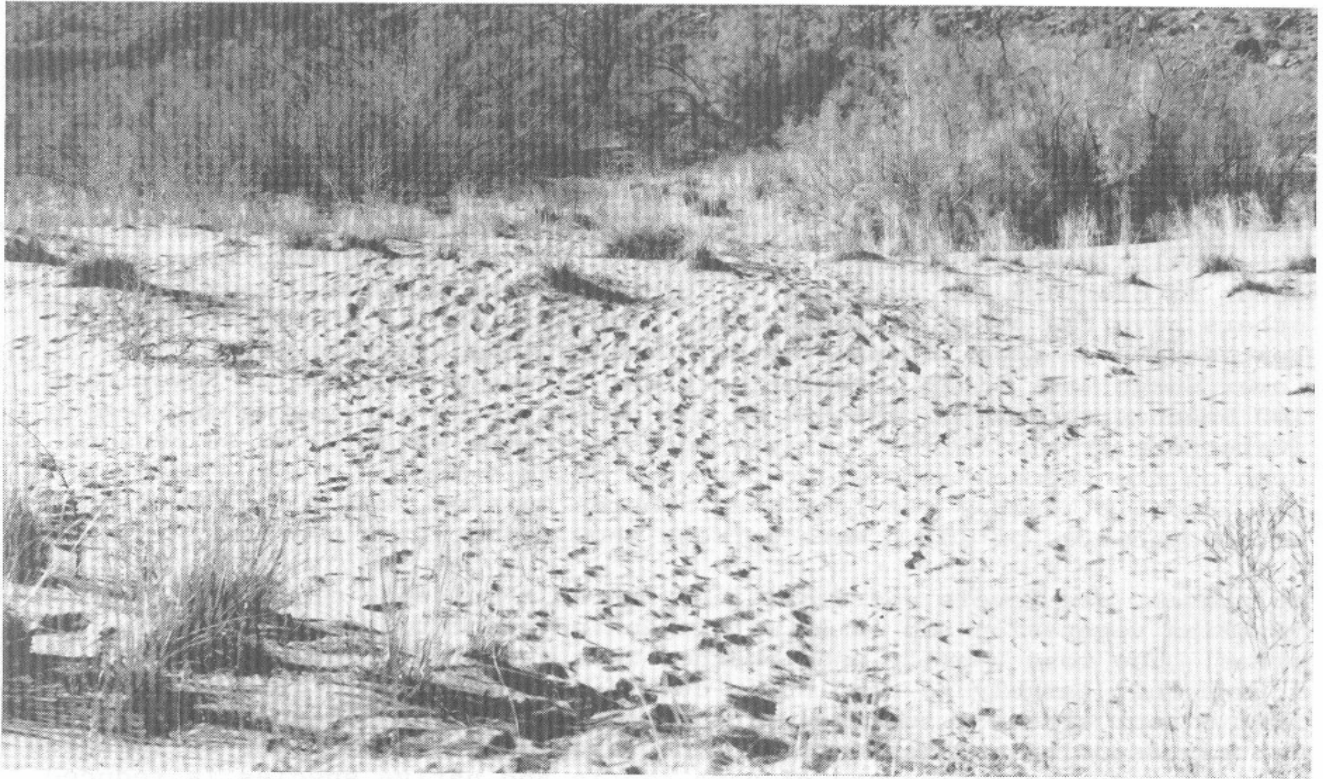
## 1. Beaches

From Lees Ferry to Grand Wash Cliffs (277 river miles), about 400 campsites are available for an average of 1.4 per mile. However, most beaches occur in clusters and portions of the river have abundant camps while others have few or no camping areas. The critical sections with few beaches are in upper Marble Canyon, Granite Gorge, Marble Gorge, and Lower Gorge (see River Corridor sections, pages I-4 to I-6). Fewer than 100 beaches receive 75 percent of all camping activity during one season (Carothers et al., 1976). At the more desirable sites 30 to 40 persons camp on the beaches each night during a 3- to 4-month season. Most of the campable beaches are less than 5 acres in size, and 20 to 30 campsites with capacities of 20 or more persons show impact from overuse.

At present use levels and densities, there is evidence of impact on the riparian vegetation and soils within and adjacent to popular beach areas. The most heavily used beaches have areas of 2,500 to 10,000 square feet largely to completely devoid of vegetation. This results from direct stress associated with people walking on the unstable sedimentary deposits and vegetation. The vegetation is sometimes so impacted by visitors that the spread of both exotic and native species is reduced or eliminated. This may be either through destruction of the plants themselves or by foot traffic disturbing the soil structure. However, without some visitor activity, many campable areas would become overgrown and not suitable for camping (Howard and Dolan, 1976; Carothers and Aitchison, 1976).

Most of the foot traffic on the prime camping beaches is concentrated within 100 meters of the mooring sites and decreases outward exponentially with distance. Use is concentrated along pathways that radiate outward from the main campsite. These pathways are commonly .75 to 1.25 meters deep. The foot traffic to and from boats and camps dislodges beach material downslope and roughens beach material which increases turbulence at bed surface. Both of these factors accelerate erosion of beach material (Howard and Dolan, 1976). Human debris (food particles, plastic, pop-tops, etc.) is being incorporated into the sand/silt deposits at rates that exceed the purging capacities by natural processes, causing beaches to look and smell like sandboxes found in heavily used public parks.

Also significant has been the rate of incorporation of charcoal and ash into beach deposits, despite current regulations for fire pans. The charcoal has spilled out of the pan or thrown into the river and redeposited on downstream beaches or transported by wind up and onto campsites (Howard and Dolan, 1976).



Foot Traffic on Beaches



Charcoal and Debris on Beach

## 2. Off-River Use and Attraction Sites

Off-river activities are important factors in the visitor's experience. Many spectacular side canyons, river overlooks, and historical and archeological sites are easily reached from the river. Heavy visitation has resulted in resource impacts and visitation to some restricted areas.

Variable rates of travel, trip length, number of people leaving Lees Ferry, and type and amount of off-river activities such as hiking and camping contribute to resource impacts directly related to congestion and crowding at attraction sites.

On commercial motorized trips of 7 days or less in length, little time is spent off-river. On longer commercial motorized trips or on oar powered trips an average of one-third of each day is spent hiking to attraction sites. Also, some groups hike overnight to off-river sites.

Private trips average 17.5 days per trip. As many as 15 days are spent hiking to off-river sites. Currently, there is no limit for length of off-river use or maximum length of river trip, except that no more than two nights may be spent in any one location.

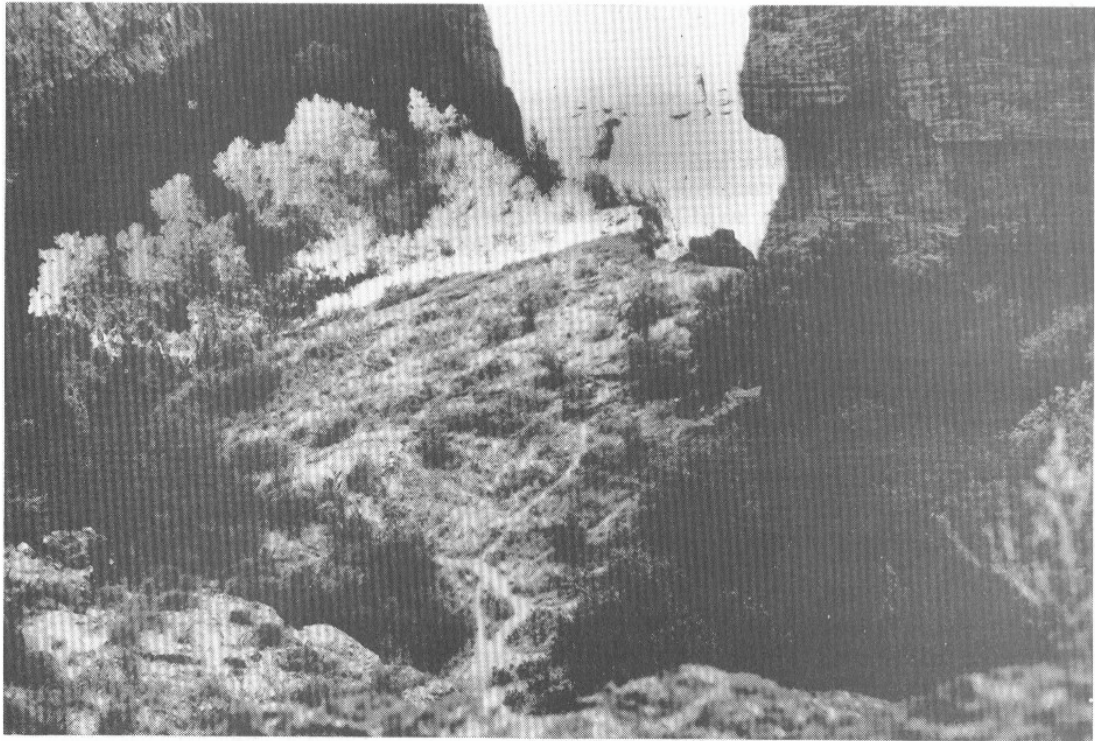
Noncommercial users visit more off-river attraction sites than commercial users, but commercial oar trips spend more time at particular sites. Table 19 presents data on the relative differences in attraction site visitation for commercial (oar and motor) and noncommercial (virtually all oar) river trips.

Table 19  
 ATTRACTION SITE VISITATION BY COMMERCIAL  
 AND NONCOMMERCIAL RIVER TRAVELERS

	Commercial		Noncommercial
	<u>Motor</u>	<u>Oar</u>	<u>All Trips</u>
Total number of sites visited	12.1	17.0	21.3
Average length of visit (hours)	1.3	6.0	3.9

(after Shelby and Nielsen, 1976)

High visitor densities at prime attraction sites impact both the physical and biological resource as well as visitor satisfaction. For example, two or three river parties (40 to 60 persons) may meet and congregate at such popular sites as the Little Colorado River, Elves Chasm, Deer Creek Falls, or Havasu Creek. Encounters with other parties occur at about



Multiple trails are visible on this steep slope, illustrating the impact of multiple trail use on the environment.



Examples of Multiple Trailing

half of all other sites visited. When groups arrive at attraction sites at the same time, they tend to use different access routes from the river to and from the site to avoid inter-group contact. The chaotic patterns of foot traffic to side canyons, attraction sites, and beaches have resulted in severe vegetation damage and soil disturbance. Multiple trails, trampled vegetation and aeolian erosion are evident at all prime attraction sites.

### 3. Partial Trips

There are currently a considerable number of commercial passengers taking partial river trips. Most partial trips end or begin at Phantom Ranch. Many people take what amounts to a partial trip by taking out at Lava Falls. This trip is generally advertised as a full-canyon trip even though it takes out two thirds of the way through the canyon. In 1978, there were 3,481 people who hiked in or out from river trips. Table 20 shows the number of people who took partial river trips in 1978 and the locations they began or ended their river trip.

Table 20  
PARTIAL TRIPS TAKEN WITH CONCESSIONERS 1978

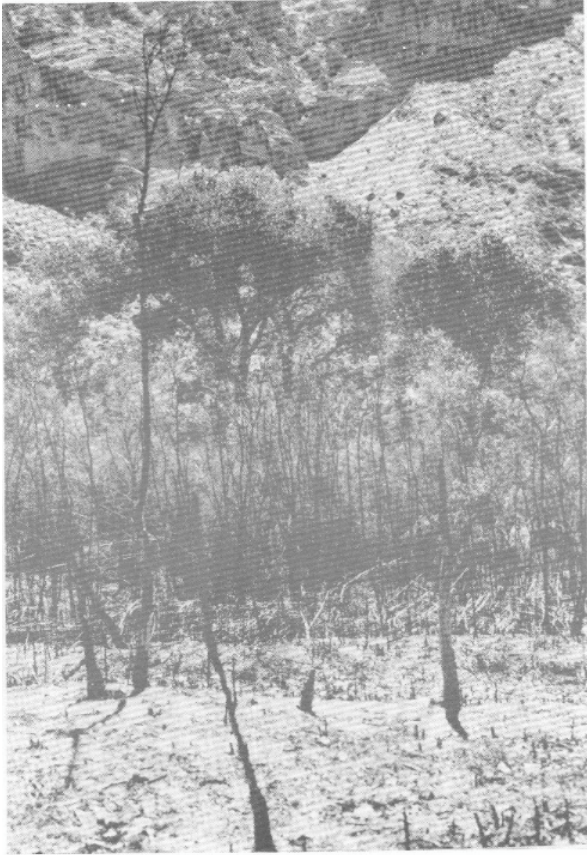
	<u>Passengers In</u>	<u>Passengers Out</u>
Lees Ferry	11,335	
Phantom Ranch	1,271	1,251
Little Colorado	10	1
Hance	17	0
Tapeats	0	13
Havasu	89	56
Lava Falls	419	3,097
Whitmore Wash	109	664

Exchanges at Lava Falls involve the use of a helicopter to get to or from the river. The helicopter operates from lands just outside the park boundary.

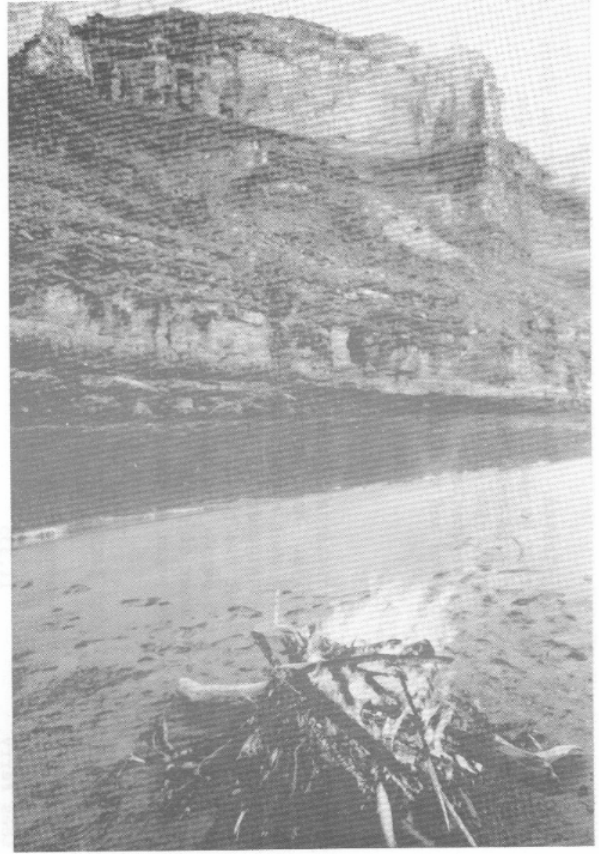
### 4. Fire

The use of wood fires for cooking, recreation (campfire talks, etc.) and warmth has been a common practice of river runners during all seasons of the year. Research findings indicate that major resource management problems were associated with this use of fire, such as:

- Depletion of the firewood supply (driftwood) occurring at a rate exceeding the natural replenishment rates.
- Removal of driftwood piles affects certain wildlife resources (particularly reptiles).



Results of wildfire started by River Runner



Illegal Fire - No Firepan



- The ash and charcoal resulting from combustion of the firewood being incorporated into the beaches at a rate that far exceeded the natural purging processes that clean beach sands.
- Standing and fallen dead trees native to the canyon were being used for firewood.
- Brush fires have been caused by the careless incineration of toilet tissue.

Although the previous regulations regarding the use of fire were designed to prevent resource impacts, these regulations were (a) not always followed, (b) difficult to enforce, and (c) not adequate for the variety of situations that developed during river trips.

## 5. Sanitation

The primary sanitation problem that existed as a result of the river recreation practices was the disposal of human waste. Past regulations required that all organic and inorganic garbage be carried out of the canyon, but allowed for the burial of human body waste. Under existing visitor use levels, approximately 20 tons of fecal materials were buried.

National Park Service river regulations required that all river trips carry a portable toilet or other means of containerization of human waste, and that these wastes be buried at least 200 feet from any area normally used for camping, 6 feet above the normal high water mark at least 50 feet from the riverbank, and the hole itself be at least 2 feet deep.

At many popular camping areas, it was physically impossible to bury the wastes according to regulation; in fact, 18 sites were placed off limits to sewage burial because they were not 200 feet long or wide, and there were no areas, other than the immediate camping area, where a burial site could be located. Under this situation, river parties were instructed to carry their waste products to another site downstream where burial according to regulations was possible. These regulations were often not observed, frequently resulting in waste burial sites being located in the center of a camp.

Burying waste products resulted in potential health and actual esthetic problems. Because of colloidal interactions between feces, beach sand, and water, some burial sites do not drain adequately, resulting in feces being buried only a few inches below the soil surface rather than 2 feet down in the burial hole. Wind would uncover the feces, resulting in noxious smells and visual impacts on visitors. The actual pathogenic hazard potential of the burial sites is relatively short-lived. Sartor Lynch and Phillips (1976) determined that 99.98 percent of the viable fecal coliforms perished within the first month of burial and that it is

unlikely that contamination from this source could persist from one season to another. Nevertheless, with some of the more popular camping areas used almost every night during the height of the river running season, potential health problems existed. Recent research (K. Johnson, 1976 and Knudsen, 1976) indicates the following:

- The health of river runners was potentially endangered due to the numbers of fecal coliform bacteria and associated pathogens which were found capable of surviving up to 11 months of burial in porta-potty dump sites located on or near camping beaches.
- Fecal contaminants were not restricted to the actual porta-potty dumpsite, but have been found to migrate up to 8 inches away from the dumpsite.
- Random sand samples taken from sleeping, eating, and cooking areas at some campsites contained viable fecal coliform bacteria.
- The disinfectant chemicals used in porta-potties do not provide for total disinfection of pathogens associated with fecal wastes.
- Viable fecal coliform bacteria have been isolated from the top 3 to 6 inches of porta-potty dumpsites.

Under past use levels and patterns, over 5,000 human waste burial sites annually were dug in the beaches of the Colorado River. At the more heavily used campsites, it was not uncommon for a boatman to unearth the remains of the previous group's fecal dumpsite when attempting to bury wastes. Many of these campsites, for example the Deer Creek Camp (River Mile 136, left), were receiving up to 150 separate dumps each river season in an area of less than 5 acres.

Associated with improper disposal of the fecal wastes was the improper disposal of toilet tissue, sanitary napkins and tampons which, along with raw feces, could be found in surface beach deposits at most of the heavily used sites. In some cases, they were not associated with portable toilet dumps. These materials are not always placed in the present carry out containers.

There is also a serious esthetic and possible infectious contamination problem associated with human waste disposal in all backcountry areas of the Grand Canyon where visitors congregate. This problem is accentuated by allowing indiscriminate disposal of fecal materials when the parties are away from the river.

It should be noted that the proposed action of requiring all river runners to carry out their human waste was implemented in the 1978 season. The river monitoring studies conducted in 1978 showed significant improvement in beach cleanliness.

## 6. Fishing

Fishing has not been a major activity. However, interest in trout fishing is increasing because rainbow trout of 5 to 8 lbs. are commonly being caught and some up to 18 lbs. have been caught recently. This has the potential for developing considerable interest in fall and winter trips when fishing success is highest. Fishing occurs along the river and in some of the major tributaries; e.g., Bright Angel and Tapeats Creeks. The common fish are rainbow trout, channel cat, carp, striped bass, walleye, and occasionally brook trout and Coho salmon. All these fish have been introduced to the river through stocking at Lake Mead, Lees Ferry, Diamond Creek, and the major tributaries within the park. The humpback chub is an endangered species occasionally caught on hook and line.

Fishing in the backwaters of Lake Mead is a popular activity in the lower gorge. For approximately half of the 12,000 lake recreationists, fishing is either a main or an incidental pursuit.

## N. SOCIAL FACTORS

### 1. commercial Passengers

The commercial passengers that annually make passage of the Colorado river through Grand Canyon are a select socioeconomic group.

Commercial river-running passengers in Grand Canyon have above average income levels, with over half the people reporting family incomes over \$24,000. Education level is also high, with 78 percent having at least some college and 53 percent possessing a bachelor's or more advanced degree.

Average age of river runners is 33, 43 percent are married, and half are woman. The majority (64 percent) currently live in large cities or suburban areas. Only 22 percent belong to an outdoor club or conservation organization, and for a sizable portion (31 percent), the Colorado River trip represents their first wilderness expedition and for the overwhelming majority (91 percent) the river trip represents their first float down the Colorado (Shelby and Nielsen, 1976).

It has been reported in the "Congressional Record" that restricting river travel to non-motorized craft only, would eliminate a particular socioeconomic/demographic group of park visitors traveling the Colorado River. Studies show, however, that this appears unlikely (Shelby and Nielsen, 1976). Although the demographic characteristics indicate that the commercial passenger is from a fairly select group, there are only minor pre-trip background differences between passengers that select motorized trips and non-motorized trips. That is, the social demographic factors which act to "select" river travelers in general are the same for passengers on all commercial trips, regardless of mode of river craft locomotion.

## 2. Private or Noncommercial Passengers

There are differences in the socioeconomic/demographic characteristics between noncommercial and commercial river trip passengers (Shelby and Nielsen, 1976). Noncommercial river runners in Grand Canyon have slightly lower incomes (half report incomes over \$16,000), are more predominately male (77 percent), are generally slightly younger in age, and are less likely to live in cities. Noncommercial users are more likely to belong to *outdoor* groups, and have had more wilderness experiences and began having them at an earlier age. The noncommercial user also has more experience running rivers and is more likely to have had prior experience on the Colorado River; about 70 percent of 1977 applicants have been on at least one and some have been on as many as 100 Colorado River trips (Grand Canyon National Park data).

## 3. Lower Gorge Users

Visitor characteristics in this zone are of two types. Those continuing their trip from Lees Ferry would have the characteristics described for that area. The remainder can be described by the Arizona Statewide Comprehensive Outdoor Recreation Plan (1975). They have incomes between \$10,000 and \$15,000, and the median size family is 2.21 members. Most of the visitors come for active water-based recreation, such as water skiing and motorboating.

## 4. Visitor Perceptions and Preferences

### a. Mode of Travel

There are a number of structural differences between the usual motor and oar trips. Motor trips are larger, have more people per boat, have a higher passenger/guide ratio, have more contact with other parties each day, spend less time in the canyon, make fewer and shorter side stops, and make more adjustments for crowding (Shelby and Nielsen, 1976). Adjustments for crowding are defined as occurring whenever trips went farther or faster than planned, slowed down, changed the location of a planned campsite, or passed up attraction sites because of the presence of others.

Table 21  
COMPARISON OF MOTOR AND OAR TRIPS

Average	Group Size	Boat Size	Number of Boats	Persons Per Boat	Trip Length	Number of Boatman
Motor Trip	30	30 - 37 ft.	2	15	7	2
Oar Trip	24	15 - 22 ft.	5	5	14	5
Noncommercial Groups (mostly oar)	12	small/varied	6	2	17	0

Sixty-one percent of those on motor trips and 1 percent of those on oar trips prefer motorized travel. Experimental trips were conducted in the summer of 1975 to further define the motor-oar differences. The procedure involved a combination trip in which one group of passengers spent the first half of their trip in oar-powered boats, while another group traveled in motorboats. The oar-powered boats left two days ahead, and were met by the motorboats about halfway through the canyon; passengers then switched boats. This provided data from a group of people with both motor and oar experience. This procedure was carried out twice, once in July and once in August. Passengers on combination trips, who had experience with both motor and oar travel in the canyon, preferred the oar trip. In response to four different items, 79 to 91 percent chose oar travel and 4 to 6 percent chose motor travel (Shelby and Nielsen, 1976).

The most frequently expressed explanations for preferring the nonmotorized trip involved the slower, more relaxed pace; the opportunity to become aware of the natural sounds and water movements without the drive of the engine; the smaller, more comfortable social groupings; and the feeling of a more sensitive, esthetic experience. People described the motorized trip as speedy, hurried, rushed, noisy, loud, crowded, big, and wet, but also as fun and exciting. By contrast, non-motorized travel was described as leisurely, slow, lazy, relaxing, peaceful, quiet, silent, natural, friendly, individualized, intimate, and again fun and exciting.

Additionally, it has been determined that passengers on non-motorized trips know more about the canyon; i.e., natural history, geography, special attraction sites, etc., than do passengers on motorized trips. This may be due to increased learning opportunities related to mode of travel (motor noise is detrimental to normal relaxed communication between the guide and passengers), length or speed of the trip, or a difference in knowledge before the trip.

b. Crowding

The vast majority (91 percent) of river travelers define their river trip as a wilderness experience and most do not perceive the canyon as crowded.

"Thirty percent of the visitors see the canyon as crowded, but this is unrelated to the number of people they saw during their trip. The lack of relationship between contacts, perceived crowding, and satisfaction is attributed to the lack of agreement about how crowded the canyon 'should' be. Most river runners are making the trip for the first time; over half didn't know what to expect in terms of contacts with other groups, and there was little consensus among those who had some expectations." (Shelby and Nielsen, 1976)

Most people (65 percent) prefer two or less contacts per day and 90 percent prefer to camp away from others. Small travel groups are considered most appropriate, with 57 percent preferring groups of 20 or less and another 29 percent favoring groups of 20 to 30 persons (Shelby and Nielsen, 1976).

The noncommercial river runners differed from the commercial river runners in their preference for meeting other parties. They preferred fewer contacts each day and they were more likely to perceive the canyon as crowded and more impacted by the presence of man. They were also more likely to complain that they met too many people during their river experience (Shelby and Nielsen, 1976).

The combination of unregulated upstream and downstream use in the Lower Gorge area often creates congestion. This area is immediately adjacent to Lake Mead National Recreation Area and many lake travelers do not know they are in Grand Canyon National Park. Thus, the atmosphere of a recreation area is accepted and complaints of crowding are not frequent. The nature of the use of high-speed motorboats makes contacts with other groups insignificant because it is an accepted part of this type of recreation.

c. Visitor Safety

The rapids of the Colorado River are a potential safety hazard to the park visitor. Safety regulations and boat operator qualification standards have minimized accidents. In 1974, 20 accidents occurred; in 1975, 21. Of this total of 41, 15 occurred on boats, the remaining 26 occurred on hiking trips or during camp activities. The injury rate on boats is, then, one in every 2,000 passengers. The injury rate was not significantly different on oar, motor, commercial or noncommercial river trips.

The following table shows the comparative differences for on-river injury rates for both motor and non-motorized trips from 1971 to 1978.

Table 22  
ON-RIVER INJURIES WHICH RESULTED IN HELICOPTER EVACUATION

Type of Craft*	YEAR								Total Injuries
	1971	1972	1973	1974	1975	1976	1977	1978	
Motorized	6	6	5	6	5	8	5	5	46
Non-Motorized	1	0	1	1	3	1	2	0	9

\*The number of passengers carried on motorized and non-motorized craft during this period was about 80 and 20 percent, respectively. Motorized trips with 80 percent of the passengers had 83 percent of the injuries whereas the non-motorized trips with 20 percent of the passengers had 17 percent of the injuries. Although these data tend to indicate that non-motorized trips are safer, the difference is not statistically significant.

The motor and oar trips were perceived as equally safe by combination trip passengers (those who experienced the river trip by both motor and oar). Twenty-five percent considered the oar trip safer, 25 percent the motor, and 46 percent felt there was no difference (Shelby and Nielsen, 1976).

Accidents do occur as uninformed users attempt to run the rapids in the Lower Gorge. Though accident rates are not exceptionally high, a potential for serious problems exists if use increases and visitors are not informed of river trip hazards.

O. ECONOMIC FACTORS

1. Local and Regional Economy

The float trip concessions in Grand Canyon National Park represent a multi-million dollar industry.

The annual gross income for the 21 concessioners in recent years was:

1976	4,461,239.00
1977	4,585,455.00
1978	5,643,849.00

The effect that the river-running industry has on the local and regional economies of the Grand Canyon region has been summarized by Parent and Robeson (1976). The 22 concessioners represent 16 different base locations in four states. Data for the Parent report was taken from concessioner annual financial reports as to total taxes paid in their respective states. Letters of input to the draft environmental statement from a few concessioners indicate that the total amount paid in taxes of various kinds in the states from which they operate was actually higher than reported by Parent. Even if the amount paid were double or more it would not represent a significant proportion of the total economy those respective states involved.

Table 23  
TAXES PAID BY TYPE AND CONCESSIONER LOCATION (PARENT, 1976)

Location by State

<u>Taxes</u>	<u>Arizona</u>	<u>California</u>	<u>Nevada</u>	<u>Utah</u>
Real:				
State	0	423	0	0
Local	0	16	0	422
Sales:				
State	8,772	1,306	4,389	12,627
Local	0	1,275	0	0
Personal Property:				
State	1,263	119	45	0
County	368	1,363	0	7,839
Amusement Tax	0	0	0	0
License Fees	603	4,410	53	1,730
No. of Concessioners				
Reporting	5	6	1	9

---

Kane County, Utah is the base for 40 percent of the concessioners, and in Kane County the float trip concessions account for 7.4 percent of the retail sales. Although the total float trip contribution to the economy of this county is less than 1 percent of the receipts in the county, the monetary benefits could be important to that small community.

In 1975, the Hualapai Tribal river runners received revenues from transporting paying passengers from Diamond Creek to Pierce Ferry.

Visitors exiting at one of the marinas on Lake Mead contribute to the incomes of local small businesses in that area. It is assumed that persons who stay on Lake Mead make up the majority of the business for these firms, thus river travel does not significantly affect the regional or local economy centered around upper Lake Mead.



The river-running industry employs a limited number of people on a full-time basis (other than officers and managers). The majority of the employees are seasonal guides, hired to escort the paying passengers down the river. The normal river-running season is about four months long (May to August), and the majority of guides are either students or employed in other occupations during the off-season. An average river guide does not earn a total wage equal to or greater than the equivalent of a minimum yearly poverty level wage as suggested by the Arizona Department of Economic Security.

There are approximately 200 regular seasonal guides. Most of them live in other locations during the winter season. During the summer when they are on the river, they do not live predominately on the local economy (Parent and Robeson, 1976).

As a hypothetical situation, the economic impact of eliminating all commercial river trips in Grand Canyon was explored. The research results indicate that the elimination of all commercial river trips would not have a major economic impact on most communities in which these companies are based.

## 2. Concessioner Services, Visitor Satisfaction

Concessioners offer a wide variety of trips in terms of services offered, trip length and cost. For the 1979 season, river trips are available from 1 day at \$120 to 22 days at \$1,075. The highest priced trip is an 18-day oar trip at \$1,350. The average cost of a full-length 13-day oar-powered trip to at least Diamond Creek for 1979 is \$649 compared to an 8-day motor-powered trip to at least Diamond Creek is \$571. The difference between these two average costs is \$78 with the oar trip providing 4 more days on the river for this price. A wide variety of trip services are included in some of these prices in terms of food, extra equipment, special interpretation, shuttle service, motel rooms before and/or after the trip, etc. However, some of the trip prices listed do not include some of these services making direct comparison

The overwhelming majority of commercial passengers on Grand Canyon river trips feel they are getting their money's worth (Shelby and Nielsen, 1976). This is further substantiated when the average daily rate of Grand Canyon river trip concessions is compared with that charged for other recreation oriented activities at destination recreation resort areas (Parent and Robeson, 1976). The average daily rate for Grand Canyon river trips is generally less than that of other similar type activities elsewhere.

There is, however, evidence of some dissatisfaction in that 32 percent of the respondents surveyed by Shelby and Nielsen said they were willing

to pay \$100 more for a trip which made fewer contacts with other trips. There is also an indication that the demand for higher priced trips appears to be greater than for lower priced trips. The company offering the highest priced trip used nearly 96 percent of its allotment. In general, passengers are able to choose from among several different products and prices, and since "values" are individually and personally perceived, there is a greater likelihood that they are being met than dictated when there is such diversity (Parent and Robeson, 1976).

#### P. PROBABLE FUTURE OF THE ENVIRONMENT WITHOUT THE PROPOSAL

Without the proposed plan, management of the river would continue under the present allotment and scheduling system. River recreationists would continue to float the river and experience the canyon. Negative impacts would also continue to occur on the natural, cultural, and sociological resources of the river environment.

Further deterioration of the riparian resources can be expected due to present use activities. Based on research and previous examples of misuse or unguided use, many adverse changes could eventually alter the character of the river corridor. Some of these changes are summarized below.

- Impacts related to human waste problems of the past are mitigated for the most part since the proposed carry out method has already been implemented.
- Impacts related to improper use of fires have been mitigated through the fact that the proposed fire use restrictions have been implemented.
- Impacts from multiple trailing will be partially resolved since single trail alignment has been initiated. However, full mitigation requires rescheduling of launches to reduce crowding and congestion and social trailing tendencies. Without the proposed action, crowding and congestion will continue.
- Demand for quality wilderness, the search for solitude, and the popularity of river running is expected to increase. All potential users cannot be accommodated within the river corridor, and restrictions on user allocation and numbers of visitors will continue. However, disappointment on the part of the noncommercial river runners would intensify under the past allotment ratios.
- Impacts related to operation of Glen Canyon Dam will continue and human use will accelerate some of those impacts. According to Dolan (1976), rapids are becoming more severe, beaches are eroding and human activity accelerating that erosion. Beaches are eroding more rapidly in the upper reaches of the canyon than in the lower portion, and while tributaries below the dam mitigate this process by replacing lost sediments, the long-term trend is toward loss of camping beaches.

### III. ENVIRONMENTAL IMPACT OF THE PROPOSED ACTION

#### A. INPACT ON SOILS AND VEGETATION

Several elements of the plan will directly reduce existing impacts on the soils and vegetation of the river corridor. The portion of the riparian community most affected by camping and mooring boats are the dam-dependent Zones 3 and 4. Zone 3 contains short-lived invasion of species such as red brome, tansy mustard, fescue, Russian thistle, and camelthorn. Zone 4 is composed mainly of saltcedar, arrowweed, coyote willow, and many herbaceous plants. Zones 1 and 2 are affected by off-river use (hiking, attraction sites) and represent the original pre-dam communities (desert and woody vegetation). Refer to Section II. C. and H. for the description of soils and vegetation and to Section II. H. for visitor use activities.

Until recently, both beach soils and vegetation had been severely damaged by the practice of digging waste disposal holes. Twenty tons of human fecal material were buried in the beach sands annually, requiring 5,000 disposal holes on less than 100 beaches. Each dumpsite contributed to further destruction of the soil profile and the microbiology of the beaches. Vegetation was trampled or uprooted, and disturbance of the soil profile inhibited natural germination processes. The practice of burning toilet paper had resulted in brush fires, which caused accelerated erosion on unstable slopes.

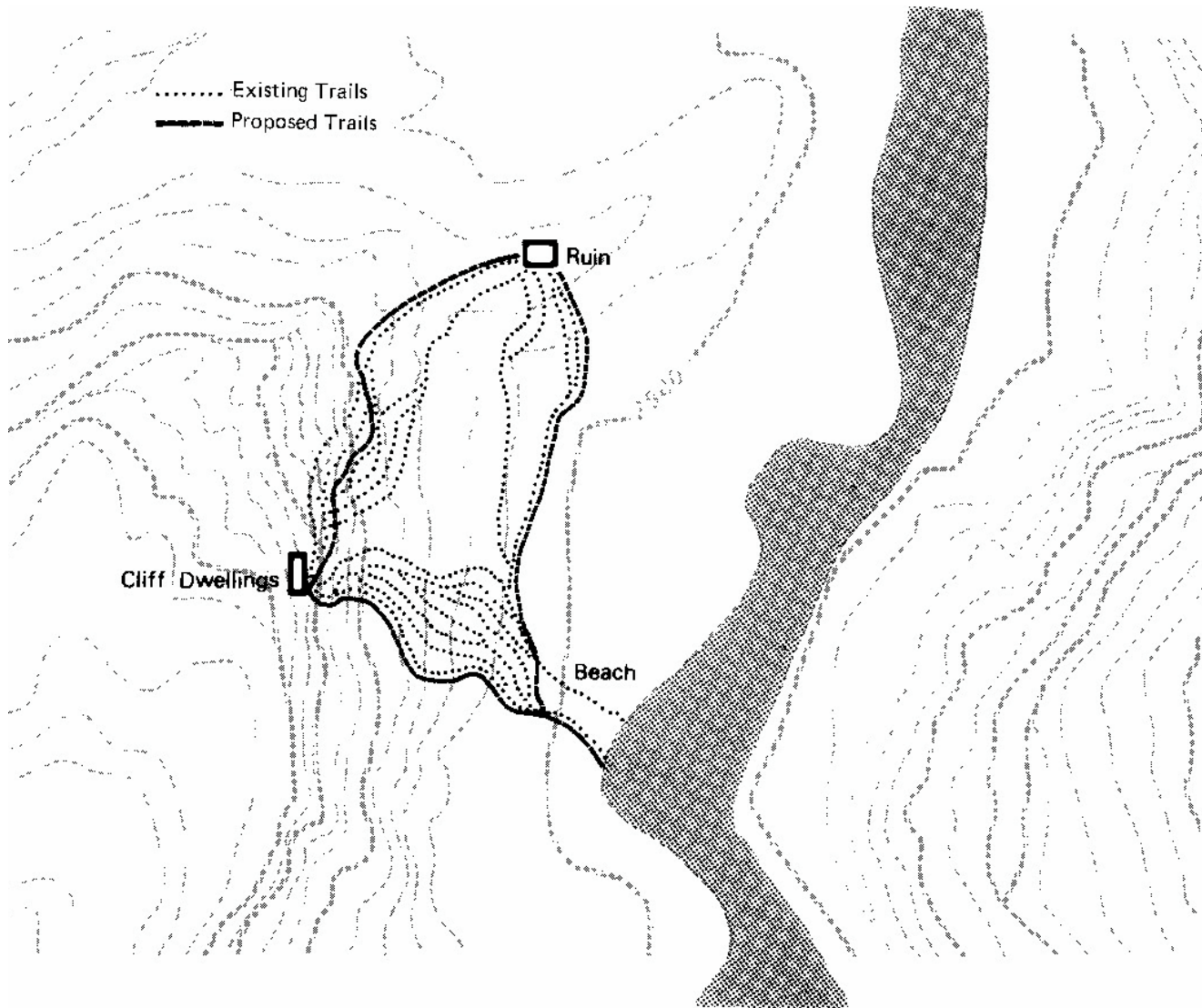
The proposal to require all river runners to haul out solid human wastes was implemented in 1978. This requirement has already significantly improved cleanliness of the beaches. The digging activities and subsequent soil and vegetation disturbance on some 250 acres of beaches has been halted. The deposition of human wastes on beaches has been reduced to occasional itinerant cases of people who refuse to adhere to the requirements. The haul out system is not fully effective since the units are not set up at lunch stops and attraction sites. This impact is fairly minimal and will be the point of further experimentation with methods and procedures to resolve the situation. Natural decomposition and cleansing processes of the river ecosystem will require several years to restore beach areas to an acceptable condition that have been impacted by past burial activities. The past use of wood fires for warmth, cooking, and recreation and the practice of collecting driftwood have contributed to soil and vegetation disturbance. Charcoal and ash have been incorporated into beaches at rates that exceed the purging capacities of the river systems. The disposal of waste charcoal and ash in the main current of the Colorado River causes further deterioration of beach soils. The charcoal residue is carried downstream to the next beach area, where it is re-deposited on the beach face and transported by wind onto campsites.

The gathering of wood for fires has in some parts of the canyon led to the denuding of standing trees both alive and dead. Driftwood is a byproduct of vegetative growth that originates primarily outside the Grand Canyon. From the late 1960's through mid-1970<sup>1</sup>s, there was a sharp decline in the available driftwood supply. Use of driftwood during that time exceeded the capacity of the system to replenish itself.

The proposal to eliminate wood fires (except for those built with imported firewood for esthetic purposes and supplemental cooking), and driftwood collecting during the summer season (April 1st to September 31st) and the requirement to haul out charcoal and ash was implemented in the 1978 season. The amount of charcoal and ash incorporated into beach sands was perceptibly reduced in the 1978 season and is expected to be minimal in the future. Wood fires will be allowed from October 1st to March 31st using natural driftwood supplies, with the requirement to haul out residue charcoal and ash. It is expected that the incorporation of charcoal and ash into beach sands during the winter season will be reduced to an acceptable level with the requirement that these materials be hauled out. Reducing the use of fires will allow natural replenishment of driftwood which should meet the demand for firewood during the winter river-running season. Minor soil and vegetation impacts will continue due to minor spillage of charcoal and ash from fire pans and failure to properly deposit and carry out fire residues. Minor trampling of soils and vegetation will occur due to driftwood collection during the winter season.

Other activities and patterns of use that result in natural resource impacts are overuse of popular beaches and crowding and congestion at attraction sites. Soils and vegetation have been severely impacted at both beach and attraction sites, due largely to foot traffic and subsequent trailing and trampling of vegetation. Soil disturbance, accelerated erosion, and changes in vegetation are apparent in heavily used areas where multiple trails, all with the same beginning and same end, are maintained by large numbers of people. For example, at Nankoweap (see following illustration), more than fifteen trails have developed between three points. Much of the native stream bank growth in the larger tributaries such as Clear Creek, Hermit Creek, Tapeats Creek, and Havasu Canyon, also shows heavy damage because of foot traffic.

The proposal to establish single trails (a total of 12.1 miles) at thirteen attraction sites will serve to delineate an appropriate walkway to each site and discourage uncontrolled access to areas of interest. The number of areas with multiple trails will be reduced and approximately 4,700 acres of disturbed soil and vegetation will be allowed to recover (see Table 24). Trail construction itself will result in short-term effects.



Some minor cut and fill will be required and ground disturbance can be expected within four feet of the trail alignments. Due to construction in sedimentary deposits and on unstable slopes minor erosion will occur. However, the rate of erosion from wind and water is expected to be far less after trail development than under present conditions. Trail alignment work was initiated in the 1978 season and has proven to be substantially successful.

Table 24  
 MULTIPLE TRAIL IMPACT AND RESTORATION  
 Estimated Acreage Improved\*\*  
 Through Trail Designation

Existing*	Approximate	Estimated Acreage Improved** Through Trail Designation
<u>Disturbance</u>	Acreage	or Construction
South Canyon	160	75
Saddle Canyon	1200	300
Nankoweap	1000	600
Little Colorado	200	50
Cardenas Creek	320	160
Unkar	1200	700
Hermit Creek	1200	600
Shinumo Creek	1200	300
Elves Chasm	640	160
Stone Creek	640	160
Tapeats Creek	1000	550
Deer Creek	640	350
Havasu	<u>1200</u>	<u>700</u>
Total	10,600	4,705

\* Existing disturbance encompasses both direct impact and radiating effects within a given area. Direct impact (multiple trails, gullying, erosion, compaction) affects approximately 25 to 40 percent of each area. Marginal impact entails occasional trailing, soil disturbance, and vegetation damage. Some areas, such as Nankoweap, contain beaches, ridge overlooks, cultural sites and tributary streams, which are included in total acreage of disturbance.

\*\* It is estimated that 25 to 60 percent of each site will be improved through trail construction. Until trail designs are developed and recovery rates monitored, exact acreage for restored areas cannot be given.

Other actions that will indirectly serve to prevent further visitor impact at beach and attraction sites involve daily, weekly and seasonal scheduling, as well as the more uniform rate of travel through the canyon due to the elimination of motors. At present, more than 150 persons per day and as many as 940 per week leave Lees Ferry. Trip length through the canyon varies from 5 to 11 days by motor and from 12 to 18 days by oar power. The uneven dispersal of use and varying rates of travel, especially during the months of May, June, July, and August, cause overuse of certain beaches, and crowding and high density at attraction sites.

Proposed scheduling of trips will reduce the total number of persons leaving Lees Ferry per day by 50 percent. Use will be more uniformly dispersed throughout the summer season and extended into the winter season. With fewer people on the river at any given time, the probability of congestion and crowding at attraction sites will be reduced, thereby alleviating resource impacts.

Beach use will also be more evenly dispersed throughout the season which will eliminate the heavy three-month impact.

It is probable that the most heavily used beaches will continue to be the most popular throughout the year, and soils and vegetation will continue to receive impact. Furthermore, the longer trips require each person to camp more nights in the canyon. This, coupled with the proposed increase in user days (from 122,600 to 209,150) will increase beach use. However, oar trips generally carry fewer persons per party than do motor trips, 24 persons as opposed to 30 persons. With fewer people camping per night at each beach and total use spread more evenly throughout the canyon, overall resource impacts per beach are expected to be less than at present. Rotation, restriction, or scheduling of campable beach areas will not be attempted unless future monitoring indicates an impact level that is unacceptable.

The increased allocation to noncommercial users (from 7,600 to 54,450 user days) may result in greater impact on beach and off-river resources. Although there is no concrete evidence, it has been suggested that noncommercial river runners may be more damaging to the natural resources than commercial parties despite the fact that the noncommercial people were more knowledgeable about natural features and geography in the canyon at the end of a trip. This observation is generally shared by researchers (Carothers and Aitchison, 1976) and National Park Service patrol personnel. This is not to say that noncommercial river runners cause all the damage, but that they may be less inclined to follow the requirements or less knowledgeable of the special techniques for protection of the natural resources. Adverse impacts could include soil and vegetation disturbance caused by using or creating multiple trails, burial of garbage of human waste, and improper use of fires.

The above probable effects, however, are expected to be reduced under the proposed plan. All noncommercial river trip leaders will be required to have adequate knowledge of the regulations and to attend an education orientation program before running the river. All noncommercial river runners will be afforded the opportunity to gain the knowledge necessary to prevent resource damage. The possibility that commercial or noncommercial river runners may inadvertently or purposely disregard resource protection measures will continue to exist to some minor degree.

The selection of concessioners at the time of permit renewal will allow park managers to consider all responses from any company desiring to operate river-running services through Grand Canyon. Companies with the proper background and knowledge in resource protection will be chosen. This will serve to aid in control of visitor patterns of use, lessening impact on natural resources.

Until very recently, the Lower Gorge section of the river has not had sufficient management attention to properly protect the resources or provide adequate visitor services. This has resulted in deterioration of natural resources, esthetic qualities, sanitation and safety. There are clear and definable differences in attitudes, equipment, experience, and resource conservation consciousness between the commercial and noncommercial river runners and lake recreationists. Clearly, the commercial river-running interests are more prepared to take proper care of the natural resources in that they are continually exposed to National Park Service resource protection indoctrination. The lake recreationists are at the opposite end of the scale. This is evidenced by the fact that below the Diamond Creek area, accumulated litter on beach areas dramatically increases. Strictly enforced and publicized regulations geared to the needs of the lake recreationists will reduce resource impacts along the lakeshore. The new plan requires all downstream river runners to have a National Park Service permit with requirements for environmental protection. This will improve the above problems considerably.

However, since the requirement to carry out all solid human wastes will not apply to lake recreationists using powerboats, unavoidable adverse impacts resulting from human waste disposal in beach areas and attraction sites would continue.

Although off-river hiking and camping is not a significant use of the lake and river in the Lower Gorge, several sites show high use. These areas include: Travertine Grotto, Spencer Canyon, Quartermaster Canyon, Bat Cave, Rampart Cave, and Emory Falls. Use impacts, such as uncontrolled foot traffic, erosion, and vandalism would continue. Misuse of these and other areas can be correlated to two main factors: lack of patrol and lack of education. Increased interpretation and education, as well as added patrols should reduce overall resource impacts to an acceptable level



The known candidate threatened or endangered plant species, for the most part, are found above the current high water line in Zones 1 and 2, and to some degree in Zone 3. Primary impacts on these species would occur through trampling related to camp activities and hiking to attraction sites. Some impact will occur to individual plants, but it is not expected to significantly affect the overall population of any species because the plants are fairly well distributed throughout the canyon.

In summary, the overall effects of the plan will significantly reduce disturbance to soils and vegetation in the riparian zones of the river corridor, and to some extent in the lake area below Separation Canyon. Direct actions, such as elimination of human waste dumpsites, the reduction in wood fires, and trail construction, will have a positive effect on 250 acres of beach area and approximately 4,700 acres of soils and vegetation at the 13 major attraction sites. Moderate visitor use impacts will continue at popular beaches and in areas of off-river camping, hiking, and special interest sites. Visitor related impacts on the resource are caused largely by existing practices, patterns, and activities rather than by the total number of persons allowed on the river (Carothers and Aitchison, 1976). Therefore, with certain practices changed or eliminated, and patterns and activities modified, the riparian ecosystems are expected to receive less impact and remain relatively unimpaired.

## B. IMPACT ON WILDLIFE

In general, no serious adverse effects on terrestrial fauna are evident under present use levels. Visitor use activities can, however, cause shifts in animal behavior patterns and populations. Actions that presently disrupt animal or fish species include intentional or unintentional feeding, improper human waste and garbage disposal, habitat destruction through trampling, pruning, or collection of vegetation, and use of soap in side streams or tributaries.

At heavily used campsites intentional feeding and improper garbage disposal encourage high concentrations of campsite scavengers such as the ringtail cat, spotted skunk, and common raven. The harvester ant has become a problem, and increases in the densities of flesh flies and blow flies has been associated with the improper disposal of fecal materials. The digging of waste disposal holes may also interfere with the normal activities of ground dwelling and burrowing animals. A reduction in lizard populations has been noted due largely to the decrease of driftwood on which lizards rely for shelter, displaying, and foraging.

Plan actions that will alleviate wildlife disruptions include proper disposal of human wastes and garbage outside the canyon, reduction of driftwood collection, increased education of all river travelers regarding wildlife, and the continued regulation against use of soap in the tributaries. The numbers of scavengers and campsite pest insects will be

reduced, and the adverse effect of digging on ground burrowing animals would be eliminated. Impacts on wildlife (especially lizards) that are associated with removal of driftwood piles, will be reduced.

Three species of endangered birds, the bald eagle, the peregrine falcon, and the brown pelican (occasional to this area) are known to utilize the Grand Canyon environs. The present use levels have no apparent effect on these birds and no adverse impacts are foreseen due to proposed use levels and allocations.

The endangered Humpback Chub, largely restricted in distribution and breeding population to the mouth of the Little Colorado River, is occasionally caught by visitors on hook and line. To protect this species, restricted use at the mouth of the Little Colorado will remain in effect. No camping or fishing will be allowed within one-half mile of the stream's confluence with the Colorado River. Although there will be increased use during the spring and fall months, no significant disturbance of wildlife populations is anticipated.

The obsolete viceroy (*Limenitis archippus*) is a butterfly considered for inclusion on the endangered species list. Because of its widespread distribution, this species' habitat in Grand Canyon is not considered critical or determined to be affected by these management proposals.

### C. IMPACT ON WATER QUALITY

The present use levels and patterns have minimal effect on the quality of water in the Colorado River and its associated tributaries in Grand Canyon. The existing impacts come from the production of hydrocarbons from outboard motors, seepage from human waste dumpsites, the incorporation of camp waste water, and the use of detergents.

The current use of outboard motors results in the consumption of approximately 25,000 gallons of gasoline per year during float trips on the Colorado River. Pollutants added to the river as a result of motorized travel include approximately 5,750 pounds of petroleum residue annually, as well as gasoline from leaking tanks and oil spills. The elimination of motor use on the river will prevent incorporation of oil and gasoline products and generally enhance water quality of the river.

The potential for localized pollution adjacent to campsites or along tributaries will be eliminated when all human fecal material is removed from the canyon. In the event of an accidental spill of containerized waste into the river, other downstream trips will be notified. If an accidental spill occurs on a beach, the material will be cleaned up.

Waste water from cooking and washing activities in camping situations will continue to be disposed of in the river. The use of soaps and other detergents in the river will continue to be permitted; however, using soaps in the tributaries is and will not be permitted. The amount

of phosphates released to the main stream are probably insignificant. Nevertheless, use of low phosphate soaps is required (CFR 40, Section 120).

The amount of all pollutants added to the river by visitor activities will probably be insignificant due primarily to the high dilution factor related to the volume of water in the river.

Therefore, the above actions will slightly improve, but not significantly change the overall water quality of the river and its tributaries.

#### D. IMPACT ON AIR QUALITY

The present use patterns have a minimal effect on the quality of the air in the Inner Canyon area. The existing impacts result from the production of outboard motor exhaust pollutants and the particulates generated from cooking and recreation fires.

The current use of outboard motors results in the consumption of approximately 25,000 gallons of gasoline per year during the float trips on the Colorado River. The hydrocarbons generated by gasoline combustion will no longer enter the atmosphere when motorized travel is eliminated.

The combustion of wood at present levels has only a slight local and temporary effect on overall air quality along the Colorado River. Reducing the number of fires will improve on this situation.

Local impacts due to odors caused by motor exhaust and gasoline while on the river or at mooring sites will be eliminated when motorized travel is eliminated. Also the noxious odors associated with improperly buried fecal material will no longer impair air quality in beach camping areas.

Pollutants added to the air through river-running activities are local and temporary. Actions of the proposed plan will have a positive effect on air quality of these localized areas, but no measurable effect on overall quality of the air within the Inner Canyon.

#### E. IMPACT ON CULTURAL RESOURCES

The gathering of firewood and the disposal of human waste along the river corridor are two activities that can cause direct destruction of cultural resources. Firewood collecting has become particularly damaging to some of the archeological and historical resources in the canyon. The present use patterns have resulted in such a shortage of firewood at heavy use campsites that the river runners are frequently forced to halt other activities in the early afternoon and specifically gather firewood wherever it is available and haul it by boat to that night's campsite. None of the heavily used campsites have an adequate supply of firewood now. During their firewood foraging activities, the river runners occasionally come in contact with the remains of some previous occupation

(e.g., Hance Cabin, Bert Loper's boat, etc.). The result has been that these structural resources are disappearing. In addition, the gathering of firewood on some of the beach terraces may cause the disturbance of surface archeological remains. The digging of waste disposal holes can also cause serious disturbances to the irreplaceable archeological resources in areas of the canyon where sites are known to be abundant, such as Nankoweap and Unkar, and other locations.

The reduction of and limitations on use of wood fires and the removal of all human waste from the canyon will serve to protect the remaining cultural resources. The deterioration of historic structures due to firewood gathering practices and the potential for digging into an archeological site for a waste dump hole will be eliminated.

Although vandalism results in a certain amount of destruction under existing use patterns, the principal impacts result simply from visitation to the historic and archeological sites. The proposed plan will lengthen the visitor's stay on the river and, therefore, increase day-use visitation of the cultural sites. However, the high-density use patterns and related congestion at attraction sites will be modified, serving to lessen the deterioration of sites caused by crowding and uncontrolled use. Increased annual visitation could accelerate the rate of deterioration of these areas and, without mitigation, could result in the loss of valuable non-renewable resources.

To ensure preservation of cultural resources at the proposed use level, all archeological sites within the river corridor will be evaluated and will receive protective treatment, if needed (stabilization, testing, or excavation). There will be a minor loss of scientific data due to stabilization, testing, or excavation, in that any removal of material from its cultural context reduces the amount of information available for future archeological research (see I. C. 5 for specific sites).

Historic remains within the river corridor will be evaluated for historic significance, and those meeting the criteria for the National Register of Historic Places will be nominated. Eleven historic sites will be preserved through protective devices for stabilization.

Other sites, not immediately adjacent to the Colorado River but easily accessible to river runners and backcountry users that will be investigated include: Hermit Camp, Boucher Camp, and Bat Cave Guano Mine.

Another action that will serve to offset visitor use impacts and reduce deterioration of cultural resources includes the implementation of education/orientation programs for commercial trip leaders and guides and noncommercial river runners.

In summary, both direct and indirect adverse impacts on cultural resources will be reduced through the reduction of firewood collecting, the removal of human waste from the canyon, and the modification of high-density

user levels. Inadvertent harm and deterioration due to greater visitation will be reduced through direct preservation or protection, and interpretation and education. No serious impacts on cultural resources are expected to occur as a result of the proposed actions.

#### F. IMPACT ON VISITOR GROUP CHARACTERISTICS

Under the present use levels, the river-running public represents a select socioeconomic/demographic group. A change in total use levels would not be expected to have any effect on this overall pattern. Similarly, the removal of motorized craft would not significantly affect any one socioeconomic/demographic group utilizing the river between Lees Ferry and Separation canyon (see Section II. N. for discussion). Since both oar and motor trip passengers possess essentially the same education, economic and urban backgrounds plus such characteristics as age, marital status and number of children, the shift from motors to oars will not alter the overall composition of the commercial river-running group.

Motorized traffic and upriver travel will be eliminated from Diamond Creek (Mile 225.6) to Separation Canyon (Mile 239.5), but will be allowed to continue on downstream from Separation Canyon to Grand Wash Cliffs (Mile 227). This will adversely impact those boaters who now make upriver runs in the rapids above Separation Canyon. This will also impact the Hualapai Tribe commercial river-running operation. The Tribe has not run motorized trips between Diamond Creek and Separation for the last two seasons (1977, 1978). They did run motor trips in prior years, and any plan to run motorized trips in future years would be precluded by this decision.

No change is expected in characteristics of the visitor who participates in a recreational activity in the Lower Gorge section of the canyon below Separation Canyon. The people in this part of the canyon come for different experiences than the participants in the upper 240-mile river trip. Present visitors are primarily interested in water-based recreation, the use of powerboats, and the scenery, for short weekends or one-day experiences. It can be assumed that these people will continue to visit the backwaters of Lake Head and will not be affected by proposed management actions above Separation Canyon.

The proposed allocation of use between commercial and noncommercial parties could change the socioeconomic/demographic characteristics of the total river-running population. The research results, summarized below, indicate the potential shift under present use conditions.

The private and commercial groups differ in demographic characteristics, so alterations in the percentage of use allocated to each group would affect the demographic composition of the overall river-running population. If the percentage of private use were increased, more people who are young, male, of slightly lower income, and from less urbanized areas would be running the river. If total number of people remained constant,

an increase in private use would mean a decrease in commercial use, and consequently a decrease in the number of persons with "commercial" characteristics (e.g., older persons, women, etc.). The magnitude of these shifts are not expected to be large, since correlations of trip type with demographic variables are fairly low. For example, a change to 50 percent private, 50 percent commercial would be expected to change the average age of river runners from 32.4 to 30.3. Private users also have more outdoor and river-running experience, so an increase in private use would probably cause an increase in the number of river runners with such experience (Shelby and Nielsen, 1976).

Under the proposed plan, approximately one of every four river runners will be a noncommercial user as compared to one of every 20 under status quo or one of every two as indicated in the above example. Commercial use will increase by a few thousand persons (including those taking partial trips) and noncommercial use will increase by approximately 2,900 persons; overall visitor characteristics are expected to shift slightly, but not to a significant degree.

In summary, the proposed elimination of motors above Separation Canyon and the allocation of use will not alter the overall composition of the river-running groups to any great degree.

#### G. IMPACT ON VISITOR OPTIONS

The removal of motors, the allocation of use, increased use throughout the year, and scheduling will have an effect on the range of options available to the river recreationist.

With the elimination of motorized float trips, park visitors who prefer only motorized travel may forego the river-running experience through the Grand Canyon. Research data obtained during the sociological studies indicates that 98 percent of those on commercial oar trips and 15 percent of those on commercial motor trips prefer to run the river on an oar trip. Of those who had the opportunity to experience both types of travel, approximately 5 percent preferred motorized craft. Assuming this group represents the river-running population, only 566 of the 11,335 people who ran the river in 1979 would be adversely affected by the change from motors to oars. It would have been desirable to repeat the combination trip experiment to strengthen the statistic reliability of the data. However, the information from this research is sufficiently reliable to indicate that when people have had the opportunity to experience both modes of travel the majority will choose oar-powered trips.

There is strong indication that almost all those who have had the opportunity to experience both motor and oar trips prefer oar trips over motor trips. However, most river runners are on their first river trip and do not have the experience of either type of trip. For these people, the choice is limited by what information they can obtain from the concessioner as to relative merits of the two modes of travel. Concessioners

will naturally sponsor the type of watercraft best suited to their operation. People with time constraints and money limitations will generally choose the shorter, less expensive trip. The shorter, less expensive trip at present is the motorized trip. There was some public input to the effect that shorter, less expensive full-length motorized trips should be retained. Those who want this type of trip will be impacted due to its loss under the proposed action. Those who do choose the shorter, less costly trips will not experience a full-length trip.

The elimination of motors in the Lower Gorge from Diamond Creek to Separation Canyon (15 miles) will reduce visitor options, in that motorboat trips down river with the Hualapai will be eliminated, and visitors will have to make that distance in rowing craft. Also visitors will lose the option of up-river runs in the rapids of the Colorado River in Grand Canyon.

However, most of those canyon visitors who come by boat from Lake Head National Recreation Area will be relatively unaffected by this action. Most of the lake boating occurs well below Separation Canyon. Some boaters do go up the canyon as far as the first rapids usually (Mile 237), and their option to do so will be restricted by this action, to only going as far as Separation Canyon (Mile 239.5).

Those users continuing a trip from Lees Ferry past Diamond Creek, or beginning a trip from Diamond Creek, would still have the option of motoring across the lake slackwater below Separation Canyon.

Options involving length of trip and off-season use will differ to some extent from the opportunities available under existing conditions.

The exclusion of motorized craft would lengthen the minimum amount of time required to traverse the Grand Canyon by river from 6 to 11 or 12 days. Motorized trips average 8 days in length, non-motorized trips average 12.5 days in length. The option of a short 6- to 10-day trip through the entire canyon will no longer be available. However, there will be partial trips available beginning or ending at Phantom Ranch. In addition, trips ranging from 1 day to 12 or more days will be possible, but will involve hiking into or out of the canyon or both. Examples are provided below:

<u>Trail In</u>	<u>On River</u>	<u>Trail Out</u>
Hance	1 day	Bright Angel
Kaibab	1 day	Hermit
Kaibab	2-3 days	Tapeats-Thunder River
Tanner	3-4 days	Havasu
Little Colorado	6-8 days	Whitmore Wash
Kaibab	8-10 days	Pierce Ferry

The maximum length of trip will be limited to 18 days in the summer season and 21 days in the winter season. Visitor options in terms of maximum length of stay will remain about the same. Noncommercial parties will forego the opportunity to spend an unlimited amount of time in the canyon during both summer and winter seasons.

Noncommercial passengers will have greatly increased options due to both the increase in user days (from 8 to 30 percent), and the more even dispersal of commercial use during the peak summer months. Some commercial users, on the other hand, will be inconvenienced due to reduced numbers of float trips during the peak months of June, July, and August. However, oar-powered trips allow more time for the visitor to experience the various points of interest within the canyon. Trips of up to 18 days in the summer season and 21 days in the winter season will provide a variety of options for off-river use, including the opportunity to visit more attraction sites or unique canyon features, to hike, and to camp. Average trips of 12 days would provide 5 to 6 additional days for off-river hiking or scenic viewing in the summer. In the winter, up to 10 additional days would be available for off-river use.

Within the portion of the public desirous of a river trip a variety of user interests exist. These segments exist in unequal sizes, and their satisfaction is a function of the type of trip and options offered. Not all people want a long trip, or want to do extensive hiking. Amount and length of stays off river and on river would be factors considered in selection of concessioners. Concessioners will be granted flexibility in adjusting trip length to meet public demand. By choosing companies offering a variety of trips, a wide range of visitor options would be made available.

In summary, the proposed changes will not significantly alter the range of options presently available to the river-running public. Commercial passengers may choose trip lengths ranging from 1 to 18 days, and opportunities for off-river use will be greater. Options for the noncommercial passengers will increase, providing a wider variety of choice. Those river recreationists preferring motorized travel will be adversely affected. The option of a short, speedy trip through the canyon will be denied a small percentage of the river-running public.

#### H. IMPACT ON THE VISITOR EXPERIENCE

Providing a high quality river-running experience is a concern of both concessioners and National Park Service managers. Although the quality of experience is hard to define, there is some general agreement that two major factors have an important effect on the visitor's river trip experience: the amount of use encountered on the river and the kind of trip taken (whether motor or oar). Other important aspects include interpretation and education.



## 1. Contact and Crowding

Elements of the plan that serve to reduce the resource impacts that result from crowding and congestion at attraction sites will also operate to reduce contacts while on the river, and contact and congestion at off-river areas of interest. These include less variable rates of speed due to the removal of motors, the smaller trip size, coupled with restricted launch scheduling.

At present, commercial trips leaving Lees Ferry travel at different speeds and take 6 to 18 days to traverse the canyon. Fast trips, then, may encounter people who left several days before them, while slower trips are passed by those leaving later. A typical river trip during the 1975 or 1976 season met between three or four other trips on the river each day and spent about 40 minutes per day in sight of other parties. By eliminating the use of motors, the speed variable is reduced considerably. This coupled with daily and weekly launch restrictions, is expected to reduce on-river encounters below present contact levels. Trips would also be scheduled in such a manner as to allow an average of approximately 6.25 miles between groups. Overall, contacts on the river and at attraction sites would be within the range preferred by the majority of the river-running public, which is lower than at present (see Section II. N. 4 for visitor preferences). The variables of trip length, time spent at attraction sites, and length of off-river hiking will continue to influence the probability of contact. Although more total boats will be on the river at any one time fewer groups will be involved. Since trips generally travel in groups, there will be fewer intergroup contacts.

Two elements of the proposed plan could increase the probability of higher contact levels--the allocation of noncommercial use and the short trip to or from Phantom Ranch.

Noncommercial river trips spend more time off river and in the canyon than do commercial trips. The average length for noncommercial trips in 1978 was 19 days. The increased number of noncommercial users staying longer within the canyon could influence contact levels. This potential effect is not, however, considered significant. Noncommercial users prefer even less contact than do commercial users, and will tend to avoid crowded areas.

The more even dispersal of use will also offset the contact or crowding potential of increased noncommercial use.

Because non-motorized craft take longer to traverse a given section of the river, the demand for partial trips to or from Phantom Ranch is very likely to increase. Partial trips would increase the overall number of people who are to take river trips. The amount of increased numbers would be difficult to predict at this time. It might seem at first glance that this activity would increase disproportionately, causing

river congestion and greater use of hiking and camping facilities in this major passenger transfer area. However, there are certain built-in and natural limiting factors. Those factors are:

There is a campground limit of 75 people at the Bright Angel Camp at Phantom Ranch. This will limit the number of people who would hike down to the river or out with an overnight stay.

The commercial accommodations at Phantom Ranch have a limited capacity of about 75 people per night which also limits the number of people who could hike in and stay overnight or stay overnight and then hike out.

There is a limit on the number of mules allowed on the Bright Angel Trail which limits the number of people who could ride a mule in or out. This limit will include the additional mules to be provided for river travelers who cannot hike in or out of the canyon.

Most people hiking into or Out from a river trip do so under present conditions in less than a day. In 1978, 3,900 people took partial river trips involving a hike into or out of the canyon. It is expected that the number of people who choose this type of trip will increase in the future by at least 3,000 annually. This increase is not expected to adversely affect contact levels nor create undue congestion or crowding in the Phantom Ranch area. An increase of this amount is not significant when compared to the some 250,000 to 300,000 people who each year hike the South Kaibab and Bright Angel Trails. Also, not all partial trip participants would ingress or egress at Phantom Ranch. Finally, the reduced party size and the smaller number of persons per boat on the oar-powered river trip will decrease off-river congestion and more nearly approximate visitor preferences. The majority of commercial users favored a small party size of 20 persons or less, and 80 percent preferred to run the river with a party of 30 or less. Most visitors also preferred to meet smaller parties on the river and at attraction sites.

In summary, with the more even dispersal of use during a longer season, daily and weekly launch schedules and small party size, the number of contacts per day and the number of persons encountered off river should be reduced. The visitors' river-running experience, in terms of the amount of use encountered on the river, is expected to increase in quality.

The combination of upstream and downstream use in the remaining 37 miles of river corridor would continue, as would the probabilities of contact and congestion. Because the Lower Gorge is adjacent to a recreation area, the use of high-speed motorboats and greater contact levels are accepted as part of the lake experience. However, the transition from the quiet oar trip to the motorized crossing of the lake will adversely

affect the quality of the visitors experience, in that the feeling of wilderness will abruptly end at Separation Canyon.

## 2. Trip Character

The proposal to convert from motorized to oar-powered river craft will significantly affect the type and character of the river trip available to the visitor. Each of the following changes will, to a lesser or greater degree, affect the overall quality of the visitor's experience.

Large motorized craft will be replaced by smaller craft.

There will be more craft per party and fewer people per boat

River guides per party will increase

River parties will spend more time in the canyon

River parties will visit more sites and stay longer off river

Motor noise will be eliminated

The fast, short trip will be eliminated

Research has indicated that non-motorized trips are more pleasing to the visitor (see Section II. N. 4 for discussion). Reasons given suggest that oar travel is seen as more consistent with a natural or wilderness experience. Passengers who had experience with both motor and oar trips preferred the oar trip. They enjoyed the slower pace, could relax; they became more aware of natural sounds in the canyon; and they were able to observe more closely the unique features along the river and more easily ask questions of their guide. Smaller social groupings appear to influence feelings of comfort, friendliness, and camaraderie. On oar trips, the passengers could gain a greater knowledge and appreciation of the canyon.

Other factors that may alter trip character and thereby affect the visitor's experience to a minor degree are season of use and new regulations. The slower oar trip allowed more time at a site, visits to a greater number of attractions, and provided passengers an opportunity to see and explore features of interest at their own pace. Oar passengers showed greater knowledge of the canyon and gained a fuller appreciation of canyon resources.

Clearly, the mode of travel, smaller parties, length of time spent in the canyon and lack of noise contribute to the character of the river trip. This type of trip, in turn, influences the overall human experience which includes social interaction, the learning process, satisfaction, and awareness.

In summary, because the oar trip appears to contribute substantially to the quality of the river-running experience, no significant adverse effects on the visitor experience are anticipated due to the proposed change in trip character. However, disappointment and minor inconveniences may be felt by a small percentage of people due to their preference for a faster more active motorized experience. Also, those visitors who cannot spend the amount of time required to travel the entire river by oar, may choose the half-canyon or other less than full-length trip, but experience disappointment in not seeing the whole canyon. Although the quality of the river trip to or from Phantom Ranch would remain the same, the time restraint felt by the individual could adversely affect his or her river-running experience.

Other factors that may alter trip character and thereby affect the visitor's experience to a minor degree are season of use and new regulations.

Climate and temperature impose varying constraints on river runners throughout the year. For instance, cooler temperatures during the winter months require additional clothing for warmth, and summer thunderstorms on many afternoons during July and August can either bring relief from high temperatures or discomfort if caught in the rain.

The extended river-running season will have both advantages and disadvantages depending upon the month of year and the expectations of individual visitors. The spring and fall months, now underutilized, potentially provide the better trip experience; the temperatures are not extreme, rainfall is rare, and natural elements are of more interest. Spring and fall are the times of natural change: bird migrations, nesting activities, desert floral displays, and bighorn lambing. Adverse effects on the visitor experience can occur when the individual prefers the character of a summer trip, but must choose either late spring or early fall to run the river, due to proposed regulation of trip launches affecting the peak summer months.

Fall and winter river trips will provide excellent opportunities for fishing in connection with river running. Rainbow trout in the 6 to 8 lb range are commonly caught, with larger catches up to 18 lbs. Rainbow trout spawning begins in late September and continues through December during which time fishing is excellent. Fishing remains good through most of the winter.

The winter river trip requires a "hardier outlook" on the part of river travelers choosing this season. Winter trips offer more solitude but colder temperatures. River running in the winter presents additional preparation requirements. Where minimal clothing for summer includes cut-off trousers, bathing suits, and light weight shirts, winter travel will require warm, waterproof clothing and, possibly, wet suits. Additional preparations for warmer sleeping gear are also needed. Constant awareness and remedial action to prevent or correct hypothermia is

necessary. If preparations are made and proper precautions taken, winter trips can be very rewarding and are no more difficult or dangerous than other winter sport activities. Night temperatures are usually below freezing during only December and January and daytime temperatures are usually pleasant.

The total river-running experience for most visitors will not be adversely affected by the character of the trip during any particular season. In general, those preferring the summer season trip would be accommodated as would those favoring the winter trip. The overwhelming experience of the canyon itself usually far outweighs the minor inconveniences brought about by climate or temperature.

Similarly, new regulations and restrictions could cause minor inconvenience, but not to the degree that the visitor's experience would be adversely affected. As implied in the previous discussion, the regulation of daily and weekly trip launches reduces the number of persons allowed on the river during the months of highest demand. Some adjustment in terms of selecting a day of the week or month in the season for trip departure will be unavoidable (see Section II, Tables 17 and 18). In 1978, approximately 2,700 persons per month leave Lees Ferry during June, July, and August. The proposed trip scheduling will permit only about 2,000 per month during these 3 months; therefore, 2,100 persons or 18 percent of the total number of visitors leaving Lees Ferry (11,895) during the summer season must choose other months for their trip departure.

The inconvenience of carrying in summer firewood and the carryout of ash could affect some people, however, allowing fires for esthetic purposes should mitigate this inconvenience.

The regulation that human solid waste material is taken from the canyon will affect noncommercial users more than commercial passengers, since waste disposal is already an accepted part of the commercial operation. Private river parties must make their own arrangements for proper waste disposal equipment. Although technically simple, carrying and hauling out wastes could be considered a hindrance by some river runners.

### 3. Interpretation and Education

As indicated previously, the length of trip, party size, and motor noise influence the type and amount of knowledge gained by the visitor. The interpretive value of the river trip was increased significantly for the people who took oar trips over those who took motorized trips. Communication between 1 guide and 5 people in the relative quiet of the canyon is significantly improved over communication between 1 guide and 15 people masked by motor noise.

The average trip length of 12 days and reduced speed, as well as reduced party size, and an average passenger to guide ration of 1 to 5 will serve to increase interpretive potential. The removal of motor noise

should increase the information available to visitors, and will foster guide/passenger relations and communications, an important factor in their perception of the canyon.

The interpretive value of the river trip has a direct bearing on the quality of the visitor's experience. Interpretation not only fulfills the desire of people to know about various geological, natural, or historical features, but serves to educate an individual unfamiliar with river-running conditions within the canyon. The reason for safety regulations or visitor restrictions must be understood before they can be readily accepted. Visitors who feel they have learned a great deal about the canyon and have gained an understanding of river-running procedures in relation to safety, sanitation and resource protection, tend to give their trip experience a high rating.

Pre-trip education of commercial trip leaders and guides and noncommercial trip leaders is one of the most important factors influencing the interpretive value of the river trip for both commercial and noncommercial passengers. The proposal to expand the orientation/information/ interpretive training program for commercial guides, and to develop a pre-trip program of a similar nature for all noncommercial trip leaders, is viewed as a positive measure that can only increase the quality of the river-running experience. Some noncommercial trip leaders may, at first, feel inconvenienced having to attend a program before floating the river, but the requirement should enhance rather than impair the quality of their trip.

#### 4. Esthetics

The plan contains elements that will improve the esthetic aspects of the canyon. Disposal of human wastes outside the canyon improve the quality of the visitor's experience by removing a current source of esthetic displeasure, the noxious visual and olfactory impacts associated with improper waste burial sites. In addition, potential health hazards are removed by discontinuing the burial of wastes in the beaches.

Restrictions on the use of fire and proper disposal of charcoal residues prevent the "bathtub" effect on beach areas. Darkened patches of beach sand or rings of charcoal created by wave action will no longer impair the visual quality of the beaches.

Elimination of motorized watercraft will reduce noise throughout the river corridor. Motor noise is primarily disturbing to the river-running visitors, but also adversely impacts other backcountry users hiking or camping in areas adjacent to the river. Research has shown that a large portion of river users (44 percent) felt their wilderness experience would improve if motors were banned.

The only development proposed by the plan that could impair the esthetic quality of the canyon or that of lands adjacent to the river for the

visitor is trail construction. New trail alignments that require minor cut and fill, erosion control measures, and other devices to direct runoff could be considered intrusions in natural areas. The proposed single trails to attraction sites will replace 12 to 15 multiple trails in some areas. After obliteration of old trail scars and restoration, the appearance of such areas will be considerably improved.

## 5. Safety

There are no actions in the plan that would adversely affect the health and safety of the river-running public. The removal of motorized craft will not affect the safety of the river trip. Table 22, (Section II.N. 4. c.) indicates that non-motorized craft have fewer accidents requiring NPS evacuation, but this difference is not statistically significant.

Research indicates that noise levels of motors near boat pilots (83 to 89 dba) approach the national health standard's maximum allowable limits (90 dba). There exists the potential for permanent hearing loss for guides on motorized craft. Motor noise levels may also adversely affect the operator's performance resulting in potential safety hazards. The removal of motorized craft will eliminate the possibility of hearing injuries and provide a potentially safer trip for the visitor. However, during the motor phase out period, concessioners and boatmen involved with motorized craft should be aware of and take steps to mitigate impacts of motor noise on boatmen hearing and passenger safety.

The elimination of wood fires during the summer season reduces the number of injuries (burns) associated with improper use or supervision of fires.

Existing regulations concerning sanitation, food preparation, water use, and boating safety will continue to be in effect, with increased emphasis.

Other than cold weather from mid-November to mid-February, there are no added safety problems during the winter months. Water flow during winter is sometimes lower than summer, but is adequate for oar trips.

Powerboating accidents will continue in the Lower Gorge area due to the retention of powerboating and up-river travel from Lake Head.

## I. ECONOMIC IMPACT

### 1. Visitors

Overall trip costs are not expected to increase significantly due to the implementation of the river management plan. The range of prices offered the visitor will probably remain the same except for inflationary increases, although some increases depending upon the commercial company may be expected, due to changes in the type of trip offered and status of the economy at any given time.

At present, there is little difference between the average cost of an oar-powered trip and a motorized trip. For the 1979 season, river trips are available from 1 day at \$125 to 22 days at \$1,075. The highest priced trip is an 18-day oar trip at \$1,350. The average cost of a full-length 12-day oar-powered trip to at least Diamond Creek for 1979 is \$649 compared to an 8-day motor-powered trip to at least Diamond Creek is \$571. The difference between these two average costs is \$78 with the oar trip providing 4 more days on the river for this price. It is expected that costs for oar powered trips could increase from \$100 to \$150 for full length trips.

Not all visitors want the same experience, nor do all people want to pay the same for their canyon experience. The allocation of user days among concessioners will provide for a variety of prices from which the visitor may choose. Based upon the average socioeconomic background of the commercial user and the demand for higher priced trips, increased trip costs would not significantly affect this segment of the river-running population.

The noncommercial river runner will be affected by the new regulations. The cost of the private trip will increase due to equipment required for sanitation and cooking. These costs are not expected to cause undue financial hardship for this river-running group.

## 2. River Guides

Most of the current concessioners could accommodate an increase in use by simply extending their river-running season. This would affect the guides by providing approximately 6 to 7 months work rather than 4 to 5.

River guides operating and preferring motorized float trips may forego job opportunities when concessioners convert to oar-powered craft. The extended season and longer oar trips may increase income for some river guides. Opportunities for employment should be greater due to the increased passenger/guide ratio.

## 3. Other interests

The Hualapai Tribe operates river-running trips from Diamond Creek to Pierce Ferry. During the past couple of years (1977, 1978) their trips have been rowing to Separation Canyon and motor from Separation Canyon to Pierce Ferry. For their own commercial operation, they will have to continue using oar-powered equipment as far as Separation Canyon as they have done for the past couple of years. They then would have the option to continue rowing across Lake Mead or carry a motor to be put on and used from Separation Canyon to Pierce Ferry. The cost is not expected to create significant economic problems for this operation, since rowing craft is already used from Diamond Creek to Separation Canyon.



A positive economic effect, on the other hand, will likely occur at Diamond Creek. Removal of motors is expected to increase the revenues being paid to the Hualapai Tribe for the use of their road from Diamond Creek to Peach Springs because more companies will likely choose to take their boats out at that point. However, future use may be affected by the fees set by the Tribe and could drop if the fee increases significantly. Some concessioners have indicated that they would take out at Pierce Ferry rather than Diamond Creek if the fees are too high.

#### 4. Regional Economy and Concessioners

The river-running industry makes up such a small portion of the local and regional economies that increasing the total visitor use levels and allowing increased commercial allotments would not have any appreciable effect. The one exception to this would be Kane County, Utah (Kanab), where the river-running industry contributes measurably to the local economy. But, even in this case it is not a significant factor.

#### 5. Park Management

Management costs will increase considerably due to personnel needed for additional patrols, monitoring, and orientation/education/training programs. If additional personnel, equipment, and funding are not provided to properly execute the management plan, negative effects can be expected due to lack of effective orientation provided at Lees Ferry and lack of resource protection, regulation, and training to be provided by the Grand Canyon staff.

### J. OUTSIDE INFLUENCES

#### 1. Noise

Unnatural sounds will continue to intrude upon the quiet of the canyon and create a disturbance for many users. Noises from low-flying aircraft, helicopters, and subsonic and supersonic airplanes are superimposed upon and mask the natural sounds. The noise and general intrusion of helicopters being used for takeouts in the Lava Falls area from the Hualapai Tribal lands side of the river will continue. However, location and scheduling of this intrusive activity should minimize its impact on other river runners. Existing noise intrusions from other aircraft overflights which adversely affect the visitor experience will continue until research is completed and the control or scheduling plan is implemented. Further study and intensive coordination with commercial and noncommercial aircraft operators on this complex parkwide problem will be necessary before noise impact can be reduced.

#### 2. Water Flow

The release of water from Glen Canyon Dam will continue to affect river-running activities in the canyon. Water flow fluctuates daily depending

largely upon power demands in the region. When power demands are low, generally minimum flows are released to conserve as much water as possible; when power is needed, high volumes of water are usually released into the canyon (refer to Section II. A. 2 for previous discussions). Low flows are a serious problem. For example, in April 1977, approximately 90 boaters on eight float trips were stranded in the Marble Canyon section due to low water flows of about 1,000 cubic feet per second. The National Park Service and the Bureau of Reclamation worked together for additional water releases (approximately 6,000 cfs) to allow the stranded boaters to move down river to Phantom Ranch. Food had to be flown to passengers of one trip that had been stranded for 4 days. One boat, a 22-foot row boat, was not able to travel the low water flows and was helicoptered from the canyon at Phantom Ranch. Extremely low water flows make river running virtually impossible, except for trips with small rowing boats (18' or smaller). The April incident caused 31 commercial trips to be cancelled, and approximately 135 additional trips to be eliminated on the basis of low water flow for May and early June 1977.

During times of low precipitation, and especially during periods of drought, the following effects can be anticipated:

- River passengers may become stranded, depending upon their location in the canyon, the amount of water released during the week, and size of water craft.
- Oar-powered boats will encounter less problems during low water releases than do larger motorized trips at present.
- During minimal flows, only the small oar craft can be expected to negotiate the canyon.
- Trip cancellations and subsequent economic loss to the concessioners can be expected, but will be less when large motor trips are eliminated.
- Potential visitors will be disappointed if their trips are cancelled.

During periods of high precipitation or peak power demand, excess water may be released, resulting in the following effects:

- High flows that will not adversely affect the river-running industry.
- High flows that will allow the large boats to negotiate the canyon.
- Rapids can become hazardous, especially for inexperienced river runners, and accidents can increase.

High flows that, coupled with daily fluctuation, will continue to erode beach sands more rapidly than more stable or consistent flows.

Adjustments in scheduling and management of river trips will probably continue for both the National Park Service and river runners due to the regulation of Glen Canyon Dam. Efforts will be made to coordinate water releases for the benefit of the river-running public, but it is understood that the purpose of Glen Canyon Dam is to satisfy water and power demands of the region's growing population.

#### IV. MITIGATING MEASURES INCLUDED IN THE PROPOSED ACTION

##### A. MITIGATION OF IMPACTS ON NATURAL AND CULTURAL RESOURCES

To continue human use of the river corridor will cause resource impacts. Under the existing use levels of 96,600 user days (commercial passengers and noncommercial participants), irreversible impacts are being inflicted on the natural and cultural resources of the Inner Canyon area. The proposed action allows for an increase to 175,950 user days annually. (This figure does not include crew user days.)

Although the research findings demonstrate no clear correlation with absolute numbers of visitors and the rate and magnitude of resource damage, it is evident that unless the resource impacts are mitigated, an increase in the total user days would lead to an acceleration of the adverse impacts.

The direct measures included in the proposed action to alleviate this human impact on the natural and cultural resources are presented below.

Reduce Congestion at Attraction Sites: Congestion of visitors at attraction sites has been found to be a principal cause of resource impact. Too many people in an area at the same time accelerates impacts on resources. Limiting to 65 the maximum number of river runners that may launch daily at Lees Ferry will mitigate these potential impacts.

Impacts resulting from congestion will also be mitigated by more uniform rates of travel along the river. Full-length summer trips currently vary from 6 to 18 days. Under the proposal the majority of summer trips will vary from 8 to 18 days. This should reduce the potential for trips to overlap at attraction sites by about 25 percent.

Reduced Congestion On The River: The conversion of all the boats on the river to oars will increase the number of watercraft on the river. The reason for this is that the average oar boat holds less passengers than does the average motor craft. The factor contributing most to the visitors' perception of crowding is the numbers of trips they see on the river and not the number of boats they see. The increased boats will be in the visitors' own party and the perception of crowding should not increase. The overall contacts on the river between different groups will decrease from the current average level, thus maintaining or improving the visitors' experience. These contacts will be mitigated by the reduced launches at Lees Ferry and the spreading out of use over the season.

Establish Trail Systems at Attraction Sites: There are several attraction sites and side canyons along the Colorado River where multiple trail systems have evolved. The impacts that result include vegetation trampling, destruction of cultural resources and increased rates of erosion. These impacts will be minimized by constructing and maintaining trails.

In most cases an existing trail will be designated and made obvious. New trail construction will be minimal, generally limited to short sections of an existing trail. Topography, slope, unstable soils, and appropriate access will be analyzed before trails are developed. Special care will be taken to avoid visually obtrusive alignments. Each trail alignment will be designed to avoid unsightly cut and fill excessive erosion, and impact on cultural resources. All alignments will be cleared by an archeologist prior to construction and will be altered to avoid impact or disturbance of cultural resources.

Restrict Use Of Unique Resource and/or Ecologically And Culturally Sensitive Areas: Because of their unique features and/or sensitivity, the restricted areas shown on the maps on pages 1-4 - 6, will be closed to visitation and/or camping. Other areas or sites, including those proposed for archeological or historical evaluation and the ecologically sensitive areas, will be subject to closure or restriction should monitoring show unacceptable impact resulting from visitor use. Camping beaches may be closed on a rotational basis if resource impacts are not significantly reduced under the proposed actions.

Carry out Solid Human Waste: Human fecal and related wastes will be carried out of the canyon. This action has already been implemented successfully in 1978, resulting in significant improvement in the condition of beaches.

Cans, rubbish, wet garbage, cooking greases, and other refuse of any kind may not be discarded in the canyon. All refuse must be carried out of the canyon and placed in an acceptable disposal area. Any solids such as coffee grounds or food particles from dishwater must be strained and put in garbage containers before such liquid wastes are drained into the main river current. No waste liquids may be dumped on beaches or in eddy currents.

Restrict Soaps and Detergents: The use of detergents, soaps or any other form of cleansing agent is specifically prohibited in any side stream or spring or within 100 yards upstream or downstream of any live side stream. The use of soap is restricted to the Colorado River and low phosphate soap is required by 40 CFR, Section 120. It is the responsibility of the commercial guide or the noncommercial trip leader to ensure that members of his or her group follow the National Park Service guidelines on resource protection. It is the responsibility of the National Park Service that these guidelines are clearly and precisely stated and that each guide/trip leader is well versed in these regulations. These guidelines will have no protective import if they are not adequately communicated to the user.

Educate Guides, Trip Leaders and Visitors: Commercial guides and noncommercial trip leaders will be trained in minimum impact techniques and practices. The National Park Service will provide:

Copies of the operating requirements to every guide and trip leader prior to launching.

Audiovisual education programs on minimum impact practices to all commercial and noncommercial passengers prior to departure.

Guide/trip leader training programs in resource protection/safety/ sanitation/interpretation. The importance and necessity of a program of this design has been stressed by various research investigators (Johnson, 1977). This program will be the framework for a future guide/trip leader licensing program. Training sessions for commercial operators held twice yearly, spring and fall, for five days each, will include instruction on resource protection, review of operating requirements, safety and sanitation procedures, first aid and rescue, and natural history interpretation.

Increase National Park Service Patrols of the River Corridor: National Park Service patrols of the river corridor are imperative. Patrol duties include interpretation, first aid, rescue, trail patrol and maintenance, and enforcement of regulations. Approximately two patrol trips each month will be made from April 1 to September 30 and one trip each month the remaining months.

## B. MITIGATION OF IMPACTS ON SOCIOECONOMIC FACTORS

Accommodate visitors who desire a shorter, less expensive Grand Canyon River trip: Commercial trip concessioners will be encouraged to provide partial canyon trips to and from various locations along the river corridor. The primary partial trip ingress and egress location is expected to be Phantom Ranch. Egress at Lava Falls and Whitmore Wash is expected to increase. The primary mode of access to and from Phantom Ranch is by foot, but arrangements can be made for mule transport. Mule and/or horse transport in and out of the Canyon will also be available at Whitmore Wash, for those who desire this type of service. Helicopter takeouts in the Lava Falls area will likely continue. Helicopter services will operate outside the park boundary. Location and timing will be arranged with concessioners and owners of the adjacent lands being used for this purpose, to minimize helicopter impact on other river runners and canyon visitors.

Partial river trips will provide the opportunity for less expensive river trips for those who want them.

The provision of trips beginning at Phantom Ranch will also allow concessioners to increase the numbers of passengers taken down the river in a year. This will mitigate the impacts of the reduced commercial passenger launch from Lees Ferry during the midsummer months.

Motorized River Trips Provided On Other Western Whitewater Rivers:

Motorized whitewater river trips are currently available on other sections of the Colorado River system, as well as on other western whitewater rivers. Sections of the Colorado River and its tributaries on which motorized trips are available include Cataract Canyon (4 to 5 days), Desolation-Gray Canyon on the Green River (4 to 5 days), Westwater Canyon (1 to 2 days), San Juan River (3 to 5 days). It cannot be guaranteed that motorized trips will remain on all these whitewater river sections; however, draft river management plans are published for Cataract Canyon and Desolation-Gray Canyon that indicate motorized craft will be allowed to continue. Thus, shorter motorized trips are available within the region.

Continue Health and Safety Standards: Health and safety standards have been designed to reduce accidents, injuries, and health hazards. Continuing emphasis will be placed on adhering to these standards to further reduce incidents. (See Appendix C)

Commercial concessioners will be required to comply with the Health and Sanitation Section of the annual operating requirements.

Assess the River Management Plan: This plan will be assessed annually to evaluate the adequacy of launching schedules in relation to contact, crowding, and resource impact, to determine whether or not an equitable distribution of user days is being achieved; to determine if total numbers of people are within the resource capabilities of the river system; and to determine adjustments, if needed, in user days, types of trips, and service to the public.

Phase Out Motorized Trips: To mitigate economic impacts on motorized trip concessioners, motors will be phased out over a 5-year period. During this 5-year period a minimum of 50 percent of the summer season will be allocated to both motorized and non-motorized travel. This will allow concessioners to phase out the use of their motorized craft, amortize them, and train guides in the operation of oar-powered craft.

#### C. MONITORING AND RESEARCH REQUIRED

Present research projects on the Colorado River have delineated the status of the river system, as well as providing information on possible future biological and sociological trends. The physical and biotic

inventories have aided in pointing out areas in which future research and monitoring is desirable. Future research and monitoring will be instrumental in indicating the ecological responses brought about by changing management procedures or environmental conditions, as well as needs to monitor visitor satisfaction and shifting demands of interest groups and economic changes.

The monitoring of sociological trends regarding contacts, crowding, and, particularly, relative demand for commercial and noncommercial river trips is essential. The proposed action significantly modifies use patterns. Contact and crowding data provided from recent research was based on current use levels and patterns. Therefore, as this plan is implemented, there will be a critical need to monitor use patterns under changed conditions.

Also, there is very intense concern about the relative demand for commercial trips versus noncommercial trips. This is evidenced by two law suits that have been filed and are still pending (Wilderness Public Rights Funds vs. Kleppe et al. 1976; and Eiseman et al. vs. Andrus et al., 1977). Additional research is needed to aid in determining the relative demand. Monitoring of demand fluctuations is needed as well.

The various research projects have determined that severe impact is being inflicted on the natural system of the Colorado River corridor. These impacts will be alleviated, for the most part, by the mitigating measures that are included in the proposed action. However, the resource monitoring program must be continued to detect deterioration in the resource. The resource alterations that will or could take place over a period of sustained use (15 to 20 years) are unknown and can only be determined by careful continued monitoring of the system.

Of highest priority is a monitoring program that is designed to provide an annual assessment of the environmental health of the campsites. This program will consist largely of study areas consolidated in a single series of research sites along the river. These areas will have a high biotic resource rating, thus lending themselves to multidisciplinary investigations of fishes, terrestrial vertebrates, water quality, algae, vascular plants, beach erosion, etc. This would have the advantage of providing reasonably complete biological information on several areas as they undergo changes, enabling analysis of the complete system rather than individual aspects.

A great need exists for additional baseline data concerning the physical substrate. This would be provided by high resolution vertical color aerial photography. Field surveying in geomorphological, macrofloral and human impact studies is essential to establish detailed calibration data to correlate with photographic information. Aerial photography should be reflown at least once between 1980 and 1985 to provide a



documentation of all major changes taking place along the river. Resurvey of all beach profiles on the benchmark beaches should be undertaken sometime in the period of 1978 to 1981 to allow an accurate assessment of erosion and deposition rates.

Water quality monitoring will continue to assess any future changes in water quality in both the river and tributaries. This will provide human impact and habitat data regarding aquatic life, especially endangered fish species affected by alterations brought about by Glen Canyon Dam.

Further studies will be initiated to better define the relationships, both intra- and interspecific, of fish occurring in the region. This would include surveys of the river in addition to systematic surveys of selected tributaries and the collection of fish for analysis of food habits, general health and reproductive conditions. Benthic samples should be taken at each tributary to aid in identification of fish stomach contents, to help define key tributaries and to determine why they are utilized by certain fish. This will provide information concerning endangered fish species, particularly the genus Gila. Restoration of habitat is essential to the survival of Gila in the Grand Canyon area. Monitoring studies of both chub species should be carried on to determine population trends and spawning success.

#### D. COMPLIANCE WITH THE NATIONAL HISTORIC PRESERVATION ACT AND THE ENDANGERED SPECIES ACT

##### 1. National Historic Preservation Act

All actions in the proposed plan will comply with the Procedures of the Advisory Council on Historic Preservation (36 CFR 800) and National Park Service historic preservation policies.

In compliance with Executive Order 11593, a complete cultural resource inventory has been undertaken (Euler, 1978). Both pre-historic and historic sites will be evaluated for significance and those meeting the criteria will be nominated to the National Register of Historic Places in consultation with the Arizona State Historic Preservation Officer.

Repair or stabilization of cultural sites will be accomplished in accordance with Historic Structures Handbook, Part II, Ruins Stabilization, the National Park Service Administrative Policies (1978), the Act to Provide for the Preservation of Historic American Sites (49 Stat. 666), and the Act for Preservation of American Antiquities (34 Stat. 225).

The Advisory Council on Historic Preservation and the State Historic Preservation Officer have commented on the plan actions. Their comments are incorporated in Section IX. D.1. of this statement.

## 2. The Endangered Species Act

In compliance with the Endangered Species Act, measures are being initiated to protect the endangered humpback chub. The mitigating measures necessary to protect this species include continued enforcement of the existing regulations regarding the use of detergents in side streams, and closing this area to angling and seining. To effect maximum protection of this species, angling and seining has been prohibited for .5 miles above and below the confluence of the Little Colorado River and the Colorado and all of the Little Colorado River above the confluence, within the park.

The bonytail chub is believed to be decreasing in numbers and is currently being considered for status as a threatened species. The National Park Service has contacted the Fish and Wildlife Service and has completed the consultation process under Sec. 7 of the Endangered Species Act. Their evaluations are included in Section IX. D.I. of this document.

V. ANY ADVERSE IMPACTS THAT CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

The total number of river runners that annually traverse the canyon will increase by approximately 2,000 persons (from 11,730 to 13,455). The plan will result in an estimated 79,680 additional user days (from 96,600 to 175,950; crew, research and patrol trips not included). Although mitigation of resource impacts resulting from visitor use patterns is provided for in the proposed action, accommodating visitors in the system at all results in a certain amount of unavoidable resource impact. Foot traffic on beaches, side canyons, and attraction sites will continue to accelerate soil erosion and impact vegetation.

Minor soil and vegetation impacts will occur during the winter season due to driftwood collection and wood fires. Trail construction will result in short-term minor erosion until the affected areas are naturally stabilized.

Normal visitation to cultural sites will result in minor, but unavoidable deterioration. Vandalism or carelessness will also remain as potential unavoidable impacts.

An unavoidable adverse impact resulting from the proposed removal of motors will be that those persons favoring the use of motorboats will be disappointed. The loss of a fast, motorized trip from Lees Ferry to Diamond Creek cannot be completely mitigated.

There will be a slight shift in the overall visitor characteristics of the river-running population due to the greater allocation proposed for noncommercial river runners.

The elimination of all wood fires, except for esthetic purposes or supplemental cooking during the high use period, will result in impacts that cannot be avoided. All wood for summer season fires must be carried in and ashes carried out, causing the user to suffer some inconvenience. The use of wood for esthetic fires and charcoal briquets for cooking and use of driftwood for fires during winter will continue to be a small source of unavoidable beach pollution in that ashes will be occasionally incorporated into the beach soils due to spillage from fire pans.

Human waste carry out systems are set up at camp sites but are not set up during the day at attraction sites. As a result, there will be the unavoidable impact of a small amount of human body waste accumulation at attraction sites. Further work on method and equipment to resolve this problem is underway.

Approximately 3,000 persons will be adversely affected during the months of June, July, and August due to fewer trip launches and lower authorized

passenger departures. Rescheduling of trip launches from weekends to mid-week periods will require some people to adjust vacation schedules during the summer season. This is an unavoidable impact necessary to mitigate impacts of crowding and congestion caused by past heavy weekend launches.

Inconvenience due to time spent meeting specific regulations or attending an orientation program may prove adverse for some noncommercial river runners. Trip leaders will have to commit an extra day for training and orientation before running the river.

The noise from helicopters taking out passengers from river trips will be an unavoidable impact.

VI. THE RELATIONSHIP BETWEEN LOCAL, SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The unique combination of scenic, biotic, geological, archeological, and historic values within the river corridor of Grand Canyon will be perpetuated over the long term. However, use by 13,455 people each year will unavoidably alter or disrupt some elements of the riverine environment. Even though the process of natural biotic response to unnatural change has occurred within the riverine environment due to Glen Canyon Dam, human use should not adversely accelerate the process nor impair the new systems to the point of decreased productivity. Erosional forces of the river and other natural processes are intensified by human activities, such as camping and hiking. Short-term visitor enjoyment must be weighed against the relatively long-term adverse effects of use on the river environment.

Increased use proposed by the plan will continue to cause erosion and vegetative disturbance in some beach areas (250 acres). The removal of human wastes, kitchen debris, and ash and charcoal from the canyon will enhance the beach environment over the long term.

Multiple trailing at prime attraction and side canyon sites will be reduced. The proposal to construct or designate trails to prime sites will reduce high impacts such as compaction, gullying, and erosion. Approximately 5,000 acres will be maintained and enhanced over the long term. However, short-term visitor use and activities will continue to cause soil disturbance and some inadvertent loss of cultural materials, but the overall health of the ecosystems and the integrity of cultural resources are expected to be maintained.

Short-term adverse effects will be experienced by both the river-running public and the commercial operators. Restrictions, rules, regulations, and requirements are the adjustments that must be accepted if use is to be increased and a quality wilderness experience maintained. Rules, restrictions, and regulations may also be considered adverse over the long term. An added burden will be placed on managers, operators, and visitors alike. Some visitors resent regulations and feel they should not be restricted in any way.

However, the required training, orientation and minimum impact regulations will provide both immediate and long-term benefits. The prohibition of human waste burial in beach sands will remove both esthetic and environmental disturbance. The elimination of wood fires during the summer season will disappoint many river travelers, but the restriction mitigates the impact of dwindling supplies of driftwood in the river corridor. The natural and cultural resource impacts associated with this overuse will be significantly reduced. Both short-term and long-term resource protection gains are realized. Orienting river runners in minimum impact techniques will benefit the canyon environment in the long term.

Visitors may not always be able to run the river at times they prefer. Scheduling may become a short-term inconvenience. Regulation of river trips to achieve less contact and prevent congestion within the river corridor will allow more users to experience the canyon under conditions approaching wilderness solitude. Short-term visitor inconveniences were weighed against the short- and long-term benefits of maintaining a high quality river trip experience.

The elimination of motorized craft will disappoint and inconvenience a relatively small percentage of visitors and operators who prefer short, fast, river trips through the canyon. This loss was balanced against the higher quality oar trip experience that could be provided for the majority of present river users and perpetuated for future generations. The preservation of this quality experience seems imperative as the availability of "wilderness areas" dwindles before the demands of an expanding population.

The long-term productivity of the canyon in terms of maintaining environmental quality, social appreciation, and enjoyment of the visitor will be enhanced by the plan actions.

VII. ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

The proposals in the Colorado River Management Plan result in few irrevocable effects on the canyon's resources. The plan actions and the proposed mitigating measures are designed to lessen current detrimental trends and keep resource impacts at an acceptable level.

Any use of the resource will result in some loss of soils and vegetation in beach areas and at attraction sites. The proposed actions include the building of trails to minimize this impact; ironically, the trails themselves are commitments of the landscape over the long term. However, the area committed to random access will be reduced by approximately 5,000 acres by the plan.

Some loss of archeological and historical materials will occur due to visitor use, but if ruins are monitored, protected and stabilized this impact should be minimal.

There are no natural or cultural resources irreversibly or irretrievably committed to destruction or consumptive use by this proposal. There are no actions in the plan that would cause direct loss of historic or archeological sites, the elimination of wildlife habitat, or impairment of any threatened or endangered species.

## VIII. ALTERNATIVES TO THE PROPOSED ACTION

### A. NO ACTION (STATUS QUO)

Under the no action alternative, total use would be approximately 13,000 to 14,000 persons per year or 122,600 user days. This would include 89,000 commercial, 7,600 noncommercial, 25,000 crew, and 1,000 administrative user days. Length of trip would range from 7 to an unlimited number of days. Persons launched each day from Lees Ferry would continue to be 150 and higher, with up to 15 noncommercial passengers each day.

Use of motors would continue to be left to the discretion of each commercial operator or noncommercial river runner.

Allocation of use between commercial and noncommercial parties would remain 92 and 8 percent, respectively, and allocations among commercial concessioners would remain the same.

Subsequent to publishing the draft environmental statement, the requirement for human waste haul out and changes in requirements or use of fires have been implemented. These changes now represent the status quo. The changes have essentially mitigated the problems previously associated with human waste disposal and use of fires. Current regulations would continue to be in effect, except that patrols would be increased to monitor natural and cultural resources.

#### 1. Impacts on Natural Resources

Irreversible physical and ecological changes would continue to occur in the riparian zones of the river corridor as a result of present visitor use patterns and activities. Soils and vegetation at beach and attraction sites would receive heavy impact from visitor congestion and trampling and clearing of vegetation. Twenty-five percent of the beaches suitable for camping areas (250 acres) would continue to receive heavy impact from camping.

Existing resource impacts are discussed in Section II. M. The following recapitulation of research findings indicates the kinds of resource impacts that can be expected to continue under this alternative:

The physically and biologically fragile desert ecosystem cannot withstand the current uncontrolled patterns of off-river use. Therefore, the present chaotic patterns of foot traffic to side canyons, attraction sites, and beach terraces must be controlled (Carothers and Aitchison, 1976).

The interrelationship between trampling, impacted vegetation and aeolian erosion is evident at attraction sites and some heavily used camps (Carothers and Aitchison, 1976; Howard and Dolan, 1976).



The impact associated with multiple trails changes the plant community structure in the immediate vicinity of the trail (Carothers and Aitchison, 1976).

## 2. Impacts on Cultural Resources

Visitor congestion at archeological or historical attraction sites would continue to cause deterioration due to uncontrolled foot traffic, dislocation of cultural materials, and heavy use. Increased patrols, protective devices, educational programs or prohibiting visitation to most of these areas could prevent further resource deterioration in compliance with Executive Order 11593.

## 3. Socioeconomic Factors

The impact on the visitor under the no action alternative would be moderately beneficial for most commercial passengers, but adverse for noncommercial river runners in that use allocations for the two groups would remain at the present ratio.

Generally, most visitors are satisfied with their Grand Canyon river trip. Opportunities for the majority would remain the same under the status quo. However the character of the river trip and the quality of the experience would continue to be impaired for some and certainly not improved for the majority under the no action alternative. Motor noise, high contact levels, crowding at attraction sites, inadequate interpretation and education, and unsatisfactory esthetic conditions would persist. The following research conclusions are indicative of continuing and future effects:

The present use patterns of the river result in visitor satisfaction, with 85 percent of the visitors' rating their experience as "excellent" or "perfect" (Shelby and Nielsen, 1976).

The research findings show that the highest quality wilderness river experience is attained on non-motorized craft (Shelby and Nielsen, 1976; Thompson et al., 1975).

Most river travelers (80 percent) accompany large groups on motorized trips. Boatmen on these trips are less accessible either generally or for specific information (Shelby and Nielsen, 1976).

On motorized craft, pilot to passenger communication is possible, but the reverse is difficult or impossible when the motor is operating (Thompson et al., 1974).

Motor noise is detrimental to normal relaxed conversation and frequently affects interpretation of park resources (Thompson et al., 1974; Shelby and Nielsen, 1976; NPS).

Passengers on motorized trips are almost entirely denied the aural dimension of a wilderness during their on-river exposure to the resource (Borden, 1976).

Significant temporary hearing losses occur for pilots and some passengers on motorized craft (Thompson et al., 1974).

Oar trip passengers knew more names of places and features in the canyon than did motor trip passengers. There were no differences between the motor and oar passengers, however, in the percent who carried guide books or the number of books and articles they read about the canyon (Shelby and Nielsen, 1976).

A typical trip during the 1975 or 1976 season met between 3 and 4 other trips on the river each day and spent about 40 minutes per day in sight of them. The number of people on the trips seen each day amounted to about 70 people (Shelby and Nielsen, 1976).

A majority of users, 57 percent, said they would rather run the river with a small (20 persons or less) party (Shelby and Nielsen, 1976).

It can be assumed from the above that motor noise, large party sizes, and high contact levels would continue to affect a majority of the visitors. Eighty percent of those running the river would have a significantly reduced opportunity for interpretive and educational experiences due to motor noise and the size of the group. On the other hand, oar passengers (20 percent) seeking the wilderness-type trip would continue to be affected by noise intrusions, crowding, and high on- and off-river contacts. Education/interpretation programs would be unavailable to noncommercial river guides and passengers under this alternative.

Under the status quo management of the river, no significant adverse economic impact is anticipated.

The river trip concessions in Grand Canyon National Park represent a multimillion dollar industry. Most float trip concessions are earning healthy profits. This situation is expected to continue. Although the profitability of a concession is not significantly related to size (in sale of user days) of river trip concessions, the larger companies have a greater potential to maintain economic stability than do the smaller companies. The concessioner allocations would remain the same; therefore, some small companies that might require additional user days to remain economically viable would be adversely affected under the no action alternative.

## B. INCREASE THE VISITOR USE LEVEL

This alternative would increase the visitor use level to the absolute physical carrying capacity of the system. It is important to emphasize, however, that the quality of the visitor experience provided by this alternative is not as high as that anticipated under the proposed action.

The physical capacity of the river system is limited mainly by the availability of camp space within reasonable traveling distance each day. Reasonable spacing between groups is also a limiting factor. Within the above constraints and allowing for five groups per day to be launched (one group of 8, one of 20, and three groups of 40), the daily launch capacity would be 148. Assuming a 182-day season and 12 days to complete the trip, the annual capacity for this alternative is calculated as follows: 148 people/day x 182 days = 26,936 visitors per year x 11 user days per trip = 296,296 user days (Borden et al., 1976). Borden's study of carrying capacity uses 12 days as the basic trip length. However, since only 11 nights are spent in the canyon, he assumed that 11 user days are utilized on a standard trip, to arrive at total annual capacity of 296,296 user days. This is contrary to NPS assumption that a passenger day is counted for any passenger for any part of one day in the system and therefore capacity by this assumption is 323,232 user days, almost 2-1/2 times the present use level. Present use levels, however, appear to be moderate to high for a wilderness experience (Shelby and Nielsen, 1976).

Under a very tight scheduling system of launch days and times, campsite space assignments, structured river travel restrictions, time and area limitations at attraction sites, and a standardized trip length of 12 days, this alternative could increase the total visitor use level to approximately 27,000 visitors and the total number of user days to 323,232. This is an 85 percent increase in total visitors and a 242 percent increase in total number of user days over the status quo.

### 1. Impact on Natural and Cultural Resources

Section II. M. and the no action alternative address impacts on natural resources that are and will continue to result under current and use levels patterns. A pervading fact of the discussion on visitor related impacts is that the total number of visitors does not effect impacts as much as their activities and patterns of use.

By increasing the total use level by 85 percent, there will be no change in the kinds of impacts; however, the rate these impacts are inflicted on the resource is expected to increase, even with the mitigating measures in the proposed action, leading to an overall rapid deterioration of the natural resources. With this magnitude of use, crowding and

congestion will increase resulting in increased resource impacts. Unless campsite assignments were made, especially in the bottleneck areas of the canyon, overloading of camps would occur. The Park Service would have to increase staffing several times over to handle the noncommercial permit processing, commercial trip scheduling and evaluation, patrols, information and education programs, and monitoring.

This alternative would also increase visitation of the cultural sites in the canyon, unless limitations were placed on site visitation. Increased visitation would accelerate the rate of deterioration of these resources and, without mitigation, could result in the loss of nonrenewable resources.

Without intensive mitigation of the impacts associated with disposal of wastes, this alternative would increase the deterioration of the environmental and esthetic quality of the riparian corridor, as well as creating a greater potential for serious health hazards.

## 2. Impact on the Visitor

The visitor would be affected by trip length, strict regimentation, and amount of time allowed off river.

The length of both the private and commercial trips would be affected. Only 12-day trips would be possible. Currently, commercial trips average 8.7 days in length and noncommercial trips average 17.5 days in length. This would affect both the noncommercial and commercial river runners maximum and minimum trip length and significantly reduce options for trip variety and experiences. The option of taking 6-day trips to or from Phantom Ranch would continue to offer the visitor a river-running experience in a short period.

Under this alternative strict scheduling would be employed to reduce on and off-river contacts. At this level of use with outlined travel constraints, contacts would be at or above current numbers. Trips would be staggered to allow an average of 1.5 to 3 miles between. However, trips would overlap resulting in contacts, as they stopped at different places along the river. Selection of this alternative would also require regimentation and scheduling of all aspects of the visitor experience in order to provide for resource protection.

Due to the scheduling necessary to accommodate the increased number of visitors, off-river use would be limited to no more than 3 to 4 hours at a time. This alternative would eliminate virtually all overnight off-river camping. Ultimately, more off-river use would be concentrated at the attraction sites that are easily and quickly available from the river. Regimentation, scheduling and lack of options would detract from the quality of the visitor's experience.

This alternative would increase the need for interpretation and education of the visitor in minimum impact techniques. Some of the resource impact caused by increased use could be mitigated by teaching the visitor minimum impact techniques. In addition, the standard trip length of 12 days would increase interpretive services.

### 3. Economic Factors

Economic effects, under this alternative, would be beneficial to concessioners.

The river-running industry makes up such a small part of the local and regional economies that increasing the total use levels by 85 percent would not have a significant impact on these economies. The only exception to this would be Kane County, Utah, where the industry makes up a sufficiently important part of the local economy that such an increase would have a noticeable effect.

The river-running industry employs a limited number of full-time people. The majority of guides are seasonal due to the seasonal nature of the business. Most of the current concessioners could accommodate an increase in use by simply extending their running season with existing equipment and personnel. Significant additional employment, however, is possible under this alternative.

This increase in visitor use levels would have a considerable effect on park management. A detailed schedule of launch dates and times would have to be developed. An intricate scheduling of campsite assignments and times at camps and attraction sites would be necessary. All river runners, including commercial, noncommercial, and administrative trips would have to be intensively scheduled. This would require additional manpower and time, planning both pre-season and during the season for education and training. Additional patrols would be necessary to ensure that assigned campsites are being used at the right location by the correct party, requiring additional personnel and river-running equipment.

In summary, impacts on natural and cultural resources would increase. A greater number of visitors would be accommodated in the river corridor, but options would be severely limited and the river-running wilderness experience degraded due to regimentation and strict scheduling. Economic benefits would be accrued to the concessioners, but costs would increase considerably for park management.

#### C. REDUCE VISITOR USE LEVEL BY APPROXIMATELY 50 PERCENT

Reducing the use levels by 50 percent would result in a total of approximately 55,000 annual user days and, under patterns of current use, approximately 7,000 visitors. The 55,000 user day level is the original

use level as proposed in the final environmental statement of the 1973 wilderness recommendation for the Grand Canyon Complex. This proposal was not adopted due to the Grand Canyon Enlargement Act and restudy of the proposed wilderness areas.

#### 1. Impacts on Natural and Cultural Resources

With a 50-percent reduction in user days and total visitors, the rate of irreversible impacts may slow down, but the simple reduction in visitor use levels will not affect the magnitude of change nor stop impacts on the natural resources.

Off-river hikes to side canyons and other areas of historical, archeological, and scenic interest are an integral part of the river trip experience. A reduction in visitor use levels would not necessarily change the existing patterns of off-river use for the visitors. Again, patterns of use are more impacting than actual use levels.

The present impact on the cultural resources results from vandalism and direct visitation to the historical and archeological resources of the Inner Canyon that are neither stabilized nor protected. Reducing the visitor use levels by 50 percent will possibly slow down the rate of deterioration, but will not affect the magnitude of change nor solve or stop the problems of visitor-related impacts.

If, however, the reduction of visitor levels under this alternative were combined with the protective, regulatory and scheduling actions described in the proposal, natural and cultural resource impacts would be reduced far below those anticipated under the proposed plan. The natural purging capacity of the river system probably would not be exceeded and the potential for natural restoration would be greatest under this action.

#### 2. Impacts on the Visitor

The major adverse impact of this alternative is the reduction in the number of persons who could experience a river trip through the canyon. Approximately 7,000 persons per year would be denied the opportunity to visit a unique canyon wilderness; and the non-commercial visitor, under present allotments, would be severely restricted.

The issue of crowding as used in this document, partially reflects the ability of the visitor to perceive his or her experience along the Colorado River as a wilderness or recreation experience. The parameters that will affect the visitor's perception of the experience are as follows: (1) frequency of on-river encounters with other groups; (2) frequency of encounters at attraction sites; and (3) frequency of encounters at camping areas, mode of travel, and length of stay. At present use levels, 91 percent of the river runners define their river

trip as a wilderness experience (Shelby and Nielsen, 1976). Reducing the visitor use level by 50 percent would simply improve upon a situation that is generally satisfying. But such a reduction of user day levels will not, by itself, necessarily improve the character of the river trip or the quality of the wilderness river-running experience.

At present use levels, interpretation of the natural resources has been evaluated as less than desirable (Thompson, et al., 1975; Shelby and Nielsen, 1976). Reasons given for the "less than desirable" rating for current interpretive practices are (1) motor noise, (2) length of trip and (3) size of group. Reducing the current visitor use level by 50 percent would have no effect on the above items and thus have no effect on changing the interpretive experience of the visitor.

Substandard quality experiences that now result from visitor use patterns and activities can be mitigated by a combination of revised river-running regulations and/or education programs and scheduling, as well as conversion to oar-powered travel. The 7,000 persons who would be afforded the opportunity to run the river under this modified alternative would then have the fewest contacts, little or no esthetic intrusions, and a purer wilderness experience.

### 3. Economic Factors

Depending upon how allocation of this reduced use was made, especially among commercial concessioners, it could conceivably eliminate up to half or more of the existing 22 companies. Obviously this would cause financial hardship to those companies that are eliminated.

However, mergers or combinations could enable them to survive in a new form. The primary issue with 50 percent reduction is whether prices would increase. The cost of a trip would probably go up by as much as 30 to 40 percent, even 100 percent to clear the market. From data presented by Parent, 1976, it is hypothesized that the reduced level of use and a shift to higher priced trips (reduced commodity) would, therefore, narrow the availability of trips to visitors with higher income.

Employment would be affected to a moderate degree since there are currently about 200 river guides. The reduction of visitor use levels by 50 percent would result in fewer than 100 part-time jobs being lost.

Management of the river corridor under this alternative would be less costly than under the proposed action. Staffing needs would be reduced due to reduced river patrols and educational services. Informing passengers and guides of river-running procedures and regulations would be easier and less costly.

In summary, a simple reduction in visitor numbers would not necessarily improve existing environmental conditions, nor improve the quality of the visitor experience. Combining reduced visitor use levels with trip scheduling, resource protection requirements, and the elimination of motors would benefit both the visitor experience and the resources of the river corridor. However, a significant number of persons would be denied the river-running experience and approximately half of the concessioners would suffer economic hardships.

#### D. PROVIDE EXCLUSIVE PERIODS (JANUARY 1 THROUGH JUNE 30) FOR NON-MOTORIZED USE

This alternative would provide periods of time when only oar-powered trips would be available to all river runners traversing the canyon. During the periods wherein motorized use was allowed, the status quo would be maintained. The period of use split from January 1 to June 30, with a 10-day transition period from motors to non-motors, would result in a 50-50 user day split at present use levels.

##### 1. Impacts on Natural and Cultural Resources

Natural or cultural resources would not be affected to any significant extent by this alternative. Oar trips, due to less variable speeds and fewer people could, however, serve to lessen crowding and congestion at attraction sites and, thereby, reduce resource impacts during the first half of the year. Scheduling of daily and weekly trip launches, similar to that of the proposal, as well as waste disposal regulations would have to be implemented.

##### 2. Socioeconomic Factors

The effects on the visitor would vary depending upon the season of choice. During the motorized periods, this alternative would maintain the status quo in terms of a variety of trip lengths (5 days to 18 days). During the non-motorized periods, the short 5-day trip through the entire river corridor would not be available.

It has been demonstrated that non-motorized trips are esthetically more pleasing to the park visitor. This alternative would provide half the year with maximized esthetic satisfaction. During the period in which motorized craft were allowed, the lower quality esthetic potential (Status quo) would be maintained.

This alternative would probably have the greatest effect upon the commercial operator and the consumer. The January 1 to June 30 season could cause firms to invest in two types of equipment--oar and motor. The added investment could adversely affect profitability and increase the price to the consumer.



The impact of this alternative on the park management would be to require additional on-river monitoring to ensure that the motorized/non-motorized periods of use were being maintained.

#### E. ELIMINATE MOTORIZED USE IN THE LOWER GORGE FROM DIAMOND CREEK (MILE 225.6) TO GRAND WASH CLIFFS (MILE 277)

This alternative would remove all motorized traffic from Diamond Creek to Grand Wash Cliffs. Powerboating, including upriver runs in the Lower Gorge, would not be allowed.

##### 1. Impacts on Natural and Cultural Resources

The elimination of motorized craft and subsequent reduction in the numbers of persons engaging in lake recreation will significantly reduce overall resource impacts. The vegetation in the riparian zone below Diamond Creek is primarily dense stands of exotic saltcedar on silt deposits which were laid down during the periods when the level of Lake Mead was substantially higher. Certain beach areas show extremely heavy impacts from visitor use and, generally, the problems of litter and waste disposal increase between Diamond Creek and Lake Mead. With a reduction in both recreational activities and relatively heavy visitor use, impacts on beach soil (erosion) and exotic vegetation (removal and trampling) will be minimal. A reduction in wood gathering, boat mooring, foot traffic, and deposition of fecal material and food scraps into the soils would occur. However, due to the fact that a completely unnatural habitat has replaced the native and ephemeral riparian vegetation in the lake zones, the reduction of use impacts may not be considered as important as improvement of the riparian zones above Diamond Creek.

The reduction in lake recreation activities would also serve to diminish disturbance to archeological and historic sites. Off-river use and camping are not major activities in the Lower Gorge at present. These activities would be further reduced, thereby, lessening impact on sites such as Bat Cave and Rampart Cave, as well as important archeological sites adjacent to the river and the lake.

##### 2. Socioeconomic Factors

The elimination of motors would significantly reduce visitor options in the Lower Gorge area. A minimum of 12,000 visitors, other than river runners, would be affected. An estimated one-half of these visitors use powerboats to fish, either incidentally or primarily, in the Lower Gorge-Lake Mead area. Very few, if any, would continue to do so if motor boats were eliminated. The option of motorboat travel from Grand Wash Cliffs upstream into the park would be eliminated. There is no indication that any of the visitors currently traveling upstream would still make the trip if motors were eliminated. An additional portion of

the users who are continuing their river trip from Lees Ferry or who launched at Diamond Creek would not choose to travel by oar the 40 miles of lake backwater to Pierce Ferry. Total use could be reduced by as much as 75 percent in this zone under these restrictions.

The elimination of motors will change the characteristics of the visitor who participated in a recreational activity in the Lower Gorge section of the canyon. The people in this part of the canyon come for different experiences than the participants in the upper <sup>225</sup>.6-mile river trip. Present visitors are primarily interested in water-based recreation, through the use of powerboats, and the scenery for short weekends or one-day visits. It can be assumed that these people would be replaced by a different socioeconomic group interested in a more natural, non-motorized experience and willing to spend the extra time necessary to travel the lake. It can also be assumed that use levels would drop if powerboats are eliminated.

The elimination of motors would increase the time necessary to float the river from Diamond Creek to Grand Wash Cliffs by at least 1 day. It would increase the time necessary to travel from Grand Wash Cliffs upriver to Separation Canyon from 2 to 3 hours to 2 to 3 days. The option of traveling the 40 miles of slackwater in a short period of time would be precluded for both river runners and lake recreationists.

Those visitors wishing to travel beyond Diamond Creek to Lake Mead can expect increased trip fees due to removal of motors from the Lower Gorge area. The cost of a commercial river trip taking out on Lake Mead could be increased as much as \$35 to \$70 to meet the increased cost of the extra day necessary to make the trip across the backwaters of Lake Mead.

Elimination of motors would also affect about 50 percent of the trips now launching from Lees Ferry that end their trip on Lake Mead. This includes several companies who at this time travel the upper 240 miles by oar or paddle boat and use motors to propel them from Separation Canyon to Pierce Ferry (Mile 280). These companies would have to end their trip at Diamond Creek or spend at least 1 day longer traveling the lake. This would mean an added expense to the company for additional wages to travel to Pierce Ferry or for the use of the Diamond Creek Road.

The Hualapai Tribe presently benefits from the operation of motorized float trips. Conversion from motor to oar will adversely affect their trips, all of which launch at Diamond Creek. The economy of the operation could be affected since at least one extra day would be needed to travel the backwater to Lake Mead by oar. The extra cost may discourage commercial passengers. The income of this commercial operation could be significantly reduced.

A positive economic effect, on the other hand, would probably occur at Diamond Creek. Removal of motors could potentially increase the revenues being paid to the Hualapai Tribe for the use of their road from Diamond Creek to Peach Springs because few companies would choose to spend the extra day on the lake and would take their boats out at Diamond Creek.

Some minor impact on the economy of the marinas on the east side of Lake Mead might occur. This would be due to the reduction in the purchasing of gasoline and other supplies for trips upriver.

#### F. ALLOCATION OPTIONS

None of the following options would result in environmental or cultural impacts significantly different from those discussed under the proposal in Section III. These options will, however, affect the river-running public to varying degrees.

##### 1. Individual Application

This would provide that all persons or groups interested in a river trip would apply to the National Park Service for a river-running permit. Permittees would be selected by the National Park Service through a procedure such as a lottery or on a first-come, first-served basis. The successful applicants would then determine whether to book passage with a commercial concessioner or to purchase equipment and run the river as a noncommercial party.

At first glance, this appears to be a very fair method of allocation. This alternative is strongly proposed by many who are interested in noncommercial permits. The basic premise is that allocation would be set by the relative number of applications that come in from noncommercial applicants compared to those for commercial trips, thereby eliminating the need for the National Park Service to impose pre-set allocations.

This proposal while appearing to be more fair than current allocation methods may in fact result in being less equitable.

Commercial companies desire to maintain a sufficient number of user days to remain economically viable. Case studies have shown under very comparable situations that commercial companies artificially increase the number of applicants desiring concessioner guided trips through heavy advertising. Noncommercial applicants could not realistically compete with this sort of advertising and, therefore, would have less opportunity for a trip than persons applying for commercially guided trips.

A person or group desiring a commercially guided trip would not be assured of such a trip even if successful in obtaining a permit. There is no way to ensure that a commercial trip would be available on the

specific day and for the specific group size authorized by permit. Also, the specific type of trip, in terms of length, cost, type of boat, and other amenities may or may not be available.

Management of this system by the National Park Service would be very difficult. This is particularly so in reference to matching commercial trip permit holders with a trip.

Noncommercial applicants would have less opportunity for a river trip than commercial applicants and even less opportunity than under the present system. Commercial passengers who have obtained a permit could not be assured of a trip.

## 2. Equal Commercial Allocations

This option would provide an equal allotment of user days among the approved concessioners. If the number of concessioners remained at 21, this alternative would result in each concessioner receiving 4.76 percent of the total available user days, 5,526 user days or 18 trips per company. Therefore, some companies would have a smaller allotment than at present and others would receive an increase.

Not all companies would necessarily want as much use as would be available under this proposal. It is doubtful that the larger companies want to be reduced.

The variety of trip experiences available to the public would be reduced under this proposal as equal allocations are likely to result in stereotyped trips. This could result in narrowing the availability of trips to only a certain segment of the public.

## 3. Educational and Organized Group Allocation

This option would provide a special allocation of use to educational and other organized groups. Some of these groups believe they should have special standing due to their educational or social service attributes.

An exact definition of "educational trips" has never been established and, in fact, Shelby and Nielsen (1976) showed that all trips result in meaningful educational experiences.

The flow of money to trip organizations and leaders must be assessed, as many such organizations are commercial. By law and regulation, any commercial operation must obtain a commercial permit.

Educational and underprivileged youth groups have pressed for special allocations. They do not want to be considered as commercial even though some must be viewed as such due to their financial arrangements.

If educational and underprivileged youth groups are entitled to a special allocation, then any other organized group would have to be given equal opportunity. This could include religious, civic, Boy Scout, civil rights, conservation, and other organizations. In each instance of awarding special allocations for such groups, a determination of commercial or noncommercial status would have to be made and permits authorized accordingly.

Such an allocation would have a positive impact on those groups involved who would gain direct access to river trips. There appear to be more groups interested than could logically be permitted; therefore, selection of groups to gain permits would adversely affect those not selected.

Use allocation for the educational or organized groups would have to be taken from commercial and/or noncommercial allocations, thereby, adversely impacting those groups.

IX. CONSULTATION AND COORDINATION WITH OTHERS

A. CONSULTATION AND COORDINATION IN THE DEVELOPMENT OF THE PROPOSAL AND IN THE PREPARATION OF THE DRAFT ENVIRONMENTAL STATEMENT

1. Public Input

Public hearings on the preliminary wilderness proposal for lands within Grand Canyon began in May 1971. The most recent public review of a revised wilderness classification for the expanded park entailed both pre-planning public meetings in September and October 1975, and the distribution of the draft environmental statement (DES 76-28) in July 1976. The river corridor was an important issue during the 1971 hearings and the 1975 workshops, as well as in letters of comment responding to the draft statement. Over this 5-year period there was no significant fluctuation in public sentiment. Their input strongly favored the inclusion of the river and the surrounding land into a wilderness system, and included the elimination of motorized river craft, control of aircraft noise, and preservation of the canyon's natural ecosystems.

Six river management workshops were held in March 1976 in the following cities; Phoenix, Arizona; Grand Canyon, Arizona; Los Angeles, California; San Francisco, California; Salt Lake City, Utah; and Denver, Colorado. The workshops were attended by 365 participants. Over 100 clubs and organizations were represented as well as many concerned individuals. About 27 percent each came from Arizona, California, and Colorado; 14 percent from Utah; and 5 percent from eight other states. Ages of the participants ranged from 12 to 69, of which 43 percent were between 20 and 29, and another 23 percent were between 30 and 34.

The following is a list of issues raised and primary points of view taken in order of mentioning:

Allocation of Use. Most people were concerned with establishing a fair ratio or balance between private, commercial, and educational groups, basing it on demand figures. Most people recommended increasing private allocations.

Environment. Protection and conservation were the key words here. Issues included the necessity of fires, the impact of people on the environment, stopping aircraft flights over the canyon, sanitation, and maintaining the water quality in the canyon.

Motors vs. Oars. This concerned many people, and while views were mixed, the majority of input favored oar trips.

Permit Systems. Exactly how permits were to be issued brought varying responses. Some ideas were: issue all permits to individuals, then the permittee could decide whether to go privately or commercially, this was termed "hunting system;" keep the lottery system for private permittees as it is; do away with the lottery system and give priority to experienced private people.

Wilderness Designation. The majority were for designation of the river and surrounding areas into the wilderness system. The use of motors on boats in this designated wilderness was controversial. Some were for and some were against this use.

Disposal of Human Waste. If disposal of human waste is determined to be a health hazard, dumping stations and carrying waste out of the canyon was suggested.

Total Use. The ceiling on use was again controversial. Most agreed to limit use to protect the canyon and "wilderness experience." It was suggested that by encouraging off-season use, less overall feeling of crowding might occur, with even a possibility of increasing the overall use ceilings.

Commercial Use. Concern was expressed about the amount of commercial advertising. Many people were concerned that advertising may be creating an unnecessary demand. The desire was also voiced to increase boatman standards and interpretive programs.

Limitations. Smaller maximum limits on group size for commercial parties and longer minimum lengths for commercial parties were suggested. Equality of limits for private and commercial use was also discussed.

Regulations. More enforcement of existing regulations and education of all users, rather than establishing more regulations, seemed to be a consensus.

Dams. Some would like to get rid of the dams now on the river. Almost all were against additional dams.

Noncommercial Trips. Increased group size, the definition of noncommercial user, equipment criteria, criteria for noncommercial trip leaders, the necessity of support boats for kayaks, policy on equipment rental, and posting monetary bonds to insure compliance with rules were all discussed.

Education. A need for better and more interpretation and training programs was discussed.

Wildlife. Control of feral burros was a dominant concern. The protection of all other wildlife was also stressed.

Resource Monitoring. The establishment of a monitoring program was considered important to detect changes or problems as they occur.

## 2. Coordination With Other Organizations

Hualapai representatives meet regularly with park officials at river-running meetings held each year at Grand Canyon National Park. Close cooperation with the tribe is necessary since they maintain the only road access to the river between Lees Ferry and Pierce Ferry (Diamond Creek, Mile 225.6). Helicopter takeouts also operate from Hualapai Tribal land. The River Unit Manager met with the Hualapai Tribal Council at their regular monthly meeting in September of 1978, March of 1978, August of 1977, and August of 1976. At the annual fall meeting on October 16, 1978, the Hualapai Tribal Chairman was given time to discuss with river concessioners matters pertinent to takeouts at Diamond Creek. Routine telephone contact is made annually by the River Unit with the Hualapai to keep them informed of those river trips taking out at Diamond Creek and other related matters. Park officials will continue to maintain close relations with the Hualapai to ensure mutual understanding of the canyon and river-running procedures.

During the fall of 1975, park personnel met with the chairman, members of the Havasupai Planning Committee and the Bureau of Indian Affairs Planning Group. A workshop was also conducted by the Havasupai Tribal Council to discuss preliminary planning proposals for the Havasupai Land Use Plan. Discussions concerned backcountry use in the traditional use lands, trails crossing the reservation lands which may be needed by hikers to gain access to various portions of the national park, and a cooperative system for management of backcountry use in areas that border the Havasupai Reservation.

During the development of river policies, the concessioners have played an active role and have been contacted through several different avenues. Twice yearly, the Western River Guides Association meets, and representatives from Grand Canyon attend to include information on the current management of the Colorado River. Grand Canyon National Park sponsors an annual boatman training session to discuss operating requirements and to solicit ideas from those who run the river commercially. In March of 1978, a specific session was held to discuss the plan and river management.

The park also hosts an annual meeting, held in October, for all concessioners operating on the river. This year's meeting included discussions of the River Management Plan.

Other agencies have been involved in the process of developing river management. Grand Canyon Park Service representatives attend biannual meetings of the Interagency Whitewater Committee to gain insight into the river management situations confronting other Park Service areas,



the Bureau of Land Management, the U.S. Forest Service, the Coast Guard and other agencies involved in rivers with whitewater status.

3. Consultation During Development of the Plan

Individuals who were contacted in person or by telephone during the fall of 1976:

Biology and Ecology - Dr. Stephen Carothers, Museum of Northern Arizona provided direct input into the draft environmental statement.

Beach Erosion and Pollution - Dr. Robert Dolan, University of Virginia.

Economic Data - Dr. Michael Parent, Utah State University

Sociological Data - Dr. Joyce Nielsen and Dr. Bo Shelby, Human Ecology Research Service, Inc.

River Running Management - Middle Fork District Ranger, Challis National Forest, Forest Service, USDA

River Management Specialist, Utah State Office, Bureau of Land Management, USD1

Members of the Western River Guides Association. At the semiannual meetings of WRGA of 1976 and 1977, concessioners and other interested river runners were invited to provide input to the river management plan.

Members of the Sierra Club, Tucson, Arizona

Grand Canyon River Concessioners. At the annual fall concessioner meetings of 1976 and 1977, concessioners were encouraged to provide input to the development of the draft river management plan.

B. COORDINATION IN THE REVIEW OF THE DRAFT ENVIRONMENTAL STATEMENT

A copy of the Draft Environmental Statement (DES) was sent to each of the following for review and comment. Those who provided comment are indicated by an asterisk.

Advisory Council on Historic Preservation\*

Department of Agriculture

U.S. Forest Service\*

Department of the Interior

Bureau of Indian Affairs\*

Bureau of Land Management\*

Bureau of Outdoor Recreation\*

Bureau of Reclamation\*  
United States Fish and Wildlife Service\*  
United States Geological Survey\*  
Department of Transportation  
U.S. Coast Guard\*  
Federal Aviation Administration\*  
Environmental Protection Agency\*  
Arizona State Clearinghouse\*  
Arizona State Historic Preservation Officer\*  
Northern Arizona Council of Governments\*  
Havasupai Tribal Council  
Hopi Tribal Council\*  
Hualapai Tribal Council\*  
Navajo Tribal Council

Others receiving informational copies of the draft include:

Coconino County Board of Supervisors\*  
Coconino County Planner and Director  
Mohave County Planning and Zoning Commission  
Cocopai Resource Conservation Development Project  
City Manager, Kingman, Arizona  
City Manager, Williams, Arizona  
Mayor, Flagstaff, Arizona  
Mayor, Kanab, Utah  
Mayor, St. George, Utah  
Arizona Academy of Science  
Governor' 5 Commission on Arizona Environment  
Aircraft Owners and Pilots Association  
Arizona Conservation Council  
Arizona Desert Bighorn Sheep Society, Inc.  
Arizona Friends of the Earth\*  
Arizona Mountaineering Club  
Arizona Parks and Recreation Association  
Arizona Wilderness Coalition\*  
Arizona Wildlife Federation  
Arizona Wildlife Society  
Arizona-New Mexico Wildlife Society  
Arizonans for Quality Environment  
Citizens for a Best Environment  
Colorado Plateau Environmental Advisory Board  
Colorado River Wildlife Council  
Conservation Foundation  
Desert Protection Council  
DNA-People's Legal Services  
Environmental Conscience Corporation  
Federation of Western Outdoor Clubs\*  
Lord's Earth Committee  
Maricopa Audubon Society

Michigan Botanical Club  
Museum of Northern Arizona\*  
National Audubon Society\*  
National Parks and Conservation Association\*  
National Recreation and Parks Association\*  
National Wildlife Federation\*  
Nature Conservancy  
Navajo Tribal Museum  
Nevada Open Spaces Council  
Saguaro Conservation and Ecology Club  
S.A.V.E.  
Save the Grand Canyon Committee  
School of American Research  
Sierra Club, Palo Verde Group\*  
Southern Arizona Hiking Club  
Southern Nevada Resources Action Council  
Tucson Environment Center  
University of Colorado Environmental Center\*  
Wilderness Society\*  
American River Touring Association\*  
Arizona Cattle Growers Association  
Arizona Daily Star  
Arizona Daily Sun  
Arizona Public Service Co.  
Arizona River Runners, Inc.\*  
Babbitt Brothers Trading Co.  
Canyon Food Mart  
Canyon Squire Motel  
Canyoneers, Inc.  
Colorado River and Trail Expeditions, Inc.  
Cross Tours and Explorations, Inc.\*  
Flagstaff Chamber of Commerce\*  
Fort Lee Company\*  
Four Corners Regional Commission  
Fred Harvey Company  
Georgie's Royal River Rats\*  
Grand Canyon Airlines  
Grand Canyon Dories\*  
Grand Canyon Expeditions\*  
Grand Canyon Gas Company  
Grand Canyon Scenic Rides  
Grand Canyon Schools  
Grand Canyon-Tusayan Chamber of Commerce  
Grand Canyon Youth Expeditions, Inc.\*  
Harris Boat Trips  
Hatch River Expeditions\*  
Hughes Air West  
Kane County Record  
Moki Mac River Expeditions\*

Moqui Lodge  
O.A.R.S., Inc.\*  
Outdoors Unlimited\*  
Recreation Equipment, Inc.  
Red Feather Lodge  
Sanderson River Expeditions\*  
Scenic Airlines, Inc.\*  
Tour West, Inc.\*  
Tri-State Flight Operations  
Verkamps  
Western River Expeditions, Inc.\*  
White Water River Expeditions\*  
Wilderness World\*  
Williams Chamber of Commerce Williams News  
Wonderland Expeditions

C. PUBLIC COMMENT ON THE PLAN AND DRAFT ENVIRONMENTAL STATEMENT

The Draft Colorado River Management Plan and its accompanying draft environmental statement were released on January 8, 1978. In mid-February, six public meetings were held regarding the proposals, with one additional meeting held in Washington, D.C. in late March. The record for additional written or verbal input was held open until May 1, 1978.

In weighing public input, the primary consideration was the supporting rationale for the position taken by a person or group. It was very clearly stated at each of the public meetings that decisions would not be made on a vote count. However, the proportion of people either in favor of, or in opposition to, a particular proposal must be given some consideration along with their rationale. Much of the public input was a result of mass mailings and publicity and not based on actual review of the draft plan or DES.

Public interest in the Draft Colorado River Management Plan ran very high. Proposals in the plan were well publicized, both by environmental and recreational groups, mostly in favor of the plan, and commercial outfitters with motorized rafts, generally opposed to removal of motors. In all, 2,716 responses were received by the May 1 deadline. These included 215 persons who presented oral testimony at one or more of seven hearings held throughout the country and 2,442 persons who presented written comments. Additionally, 17 petitions were received with 739 signatures.

The proposal which elicited the most response was phasing out the use of motors on the Colorado River from Lees Ferry to Separation Canyon over a 3-year period.

Table 25 below summarizes the overall response to the question of motors and oars, by the combination of letters and testimony at public meetings,

letters alone, and testimony alone. The percentages in this table are reflective of only those who provided input on the question of motors and oars and not total input.

TABLE 25 SUMMARY OF MOTOR AND OAR INPUT

	<u>% Respondents</u>	<u># Respondents</u>	<u>Type Input</u>
For non-motorized trips	56	1476	Letters/Testimony
For motorized trips	44	1181	Letters/Testimony
For non-motorized trips	57	1388	Letters
For motorized trips	43	1054	Letters
For non-motorized trips	41	88	Testimony
For motorized trips	59	127	Testimony
Other		59	Letters

There were 27 people who wrote in protest only of a motor ban below Diamond Creek because they wish to continue upriver runs from Lake Mead to Diamond Creek in motorized craft. There were 59 people who commented on other aspects of the plan but did not state a preference for motor or oar trips. This accounts for the total letter and testimony input of 2,716 including 1,476 for oars, 1,181 for motors, (27 of these were for motors below Diamond Creek), and 59 with no comment on this point. Table 26 indicates the number of times particular reasons were given for support of phasing out the use of motors. These figures do not have any relationship to the number of letters or testimony received. A particular letter or testimony may have mentioned only one, perhaps 3, or possibly all of the items listed.

TABLE 26 REASONS FOR SUPPORT OF OAR TRIPS

	<u>Number of Times Commented On</u>	<u>Type Response</u>
Motors/wilderness incompatible	426	Letters & Testimony
Ban motors, would improve resources	219	Letters & Testimony
Eliminate noxious fumes	119	Letters & Testimony
Canyon too commercialized	91	Letters & Testimony

Table 27 shows the primary reasons given by those who prefer to see motorized trips retained. Again these figures are the number of times a particular point was mentioned.

TABLE 27 REASONS FOR SUPPORT OF MOTOR TRIPS

	<u>Number of Times Commented On</u>	<u>Type of Response</u>
Oar trips too long	693	Letters/Testimony
Hiking too		
Strenuous	191	Letters/Testimony
Eliminate the old,		
Infirm	497	Letters/Testimony
Too expensive by		
Oars	371	Letters/Testimony
Motors Safer	360	
Motor trips provide		
wilderness experience	221	Letters/Testimony
Noise no problem	88	Letters/Testimony

There was general support expressed for total use as proposed, provided that resource impacts could be kept within acceptable limits. Table 28 gives a summary of comments on the total use proposal. Again a letter or testimony may have mentioned only one or possibly several of the items listed. Therefore, there is no correlation between the number of letters or testimony received and the number of times a particular issue may have been raised.

TABLE 28 TOTAL USE PROPOSAL RESPONSE

	Number of Times Commented On	Type of <u>Response</u>
General support of the proposal	1110	Letters/Testimony
Specific support of this issue	29	Letters/Testimony
Against increased use	39	Letters/Testimony
For decreased use	18	Letters/Testimony
For status quo	15	Letters/Testimony
For winter use	20	Letters/Testimony
Against winter use	28	Letters/Testimony
For longer summer season	20	Letters/Testimony
For per day launch decrease	13	Letters/Testimony
Against per day launch decrease	13	Letters/Testimony
Self scheduling com mercial trips (status quo)	14	Letters/Testimony
Give more days to small companies	8	Letters/Testimony

---

The proposed use allocation was generally supported by those who commented on it. Only about half of those who provided input commented on this issue. The majority of those commenting on the allocation issue that were in support of increased allocation for privates were either private river runners or generally interested persons. The majority of those for the present allocation system were commercial outfitters or previous passengers on motorized trips. Table 29 is a summary of the input on the allocation proposal. The 1110 people listed as generally supporting the proposed allocation system did not specifically mention allocation. They simply stated that they supported the entire plan. The number of comments on a particular point listed does not correspond directly with the number of letters received. A letter or testimony may have listed only one point or it may have listed more than one.

TABLE 29 ALLOCATION OF USE RESPONSE

	Number of Times <u>Commented On</u>	<u>Type Response</u>
General support of proposals	1110	Letters/Testimony
Specific support of allocation proposal	171	Letters/Testimony
For a lottery system	111	Letters Testimony
For a 50/50 split	64	Letters/Testimony
Continue status quo	65	Letters/Testimony

---

Overwhelming support was expressed for measures proposed to protect the canyon resources. Some specific comments opposed particular methods or procedures required and others suggested alternate ideas for protecting resources. Table 30 shows a summary of input on the protection of the canyon.

TABLE 30 RESPONSES TO RESOURCE PROTECTION PROPOSAL

	Number of Times <u>Commented On</u>	<u>Type Response</u>
General support of proposals	1110	Letters/Testimony
Specific for waste removal	133	Letters/Testimony
Against proposals waste	8	Letters/Testimony
Against fires being banned	19	Letters/Testimony
For proposed fire regulations	92	Letters/Testimony
For trail alignment	67	Letters/Testimony
Opposed to trail alignment	8	Letters/Testimony

Comments were also made about the adequacy of the plan and draft environmental statement. A few (32) questioned the combined trip study, saying that the sample size was too small, that people were preselected in that those favoring an exclusively motorized trip would not go, and that the motorized trip portion was crowded and rushed. The Parent economic study was also criticized by some people who said that the concessioners and local Northern Arizona Government units were not consulted and that the plan would be damaging to local economies. It



should be noted that some people mentioned these same studies as rationale for their support of the plan (the number of responses was not counted).

A few suggestions for changing the plan were also included in the responses. Some of the suggestions regarding allocation of commercial versus private trips are mentioned above. Several elaborate allocation schemes were proposed. Another suggestion was to include a motorless season. Several suggestions were made regarding waste disposal: the National Park Service should construct outhouses at frequently used sites and waste disposal sites should be located at the end of the trip. While not specifically related to this plan, several people commented on the burros in the canyon, stating that burros should be eliminated and one stating that some should be allowed to remain.

It is significant that only four people making comment on the proposed plan were opposed to wilderness designation for the Colorado River corridor through the Grand Canyon.

An additional study was contracted with Dr. Bo Shelby to gather information on the question of wilderness from people attending the several public meetings held in February and March on the draft River Management Plan and DES. Dr. Shelby devised a questionnaire to gather this additional information. The questionnaire was handed out to people attending the public meetings and they were requested to fill it out and return it to those in charge at the end of the meeting. Filling out the form was announced as being strictly voluntary.

The questionnaire asked people to think of Grand Canyon in three different ways: wilderness--a place generally unaffected by the presence of man; semi-wilderness--the kind of place where complete solitude is not expected; and undeveloped recreation area -- the kind of place where a natural setting is provided but meeting other people is part of the experience. Most people (54%) think that river trips currently provide a semi-wilderness experience (see Table 31). However, 60% feel that river trips should provide a wilderness experience. It appears that people who attended the meetings, like people on the river, generally endorse the goal of providing wilderness.

TABLE 31 RIVER EXPERIENCES IN GRAND CANYON  
(ALL RESPONDENTS)

	<u>Wilderness</u>	<u>Semi-wilderness</u>	<u>Undeveloped recreation</u>
Which experience does a river trip <u>provide</u> now?	20% (80)	54% (215)	26% (103)
Which do you think a river trip <u>should provide</u> ?	60% (243)	34% (136)	6% (23)
What are <u>appropriate encounter</u> levels in terms of:			
River encounters per day	1	3	5
Hours in sight of others while on river	.5	1.5	3
Number of stops (Out of 10) with encounters	1	3	5
Chances of meeting 10-30 people at places like Havasu	15%	30%	50%
Number of nights (out of 10) camped near others	0	2	4

While most people endorse the wilderness concept, there were different definitions of what wilderness consists of in terms of encounters per day, time in sight of others, meeting other people at attraction sites and number of nights camped near others. The lower part of Table 31 shows how people defined their experiences in terms of encounter levels. Wilderness was defined as: 1 or fewer river encounters per day, less than one-half hour in sight of others on the river, meeting other parties at no more than 1 out of 10 attraction sites, a 15 percent chance of meeting others at the most popular stops, and camping away from other parties virtually all of the time. Appropriate contact levels are considerably higher for semi-wilderness and undeveloped recreation.

Are people willing to "pay a price" for wilderness? Results presented in Table 32 suggest that they are. Of all those responding (left hand column), 56 percent say they would pay \$100 more, 68 percent would wait a year longer to go on the trip, and 55 percent would take an off-season trip. Fifty-seven percent would rather do one of these things than settle for a "semi-wilderness" experience. Most private boaters, members of conservation groups and commercial oar passengers appear quite willing to pay more, wait longer, or take a winter trip in order to have a wilderness experience (see Table 32). Among these

TABLE 32  
WILLING TO "PAY A PRICE" FOR WILDERNESS

If you prefer wilderness, would you be willing to do any of the following things in order to accomplish this? Percent willing to:	All Respondents (n=434)	Private boaters (n=163)	Conservation group members (n=143)	Commercial oar passengers (n=10)	Commercial motor passengers (n=82)	Commercial boatmen (n=63)
Pay \$100 more for the trip.	56	57	66	80	46	46
Wait a year longer to go on the trip.	68	75	82	80	43	63
Go during winter season (Oct. thru March)	55	71	72	70	17	53
If you had to choose, would you rather:						
Do one of these things	57	73	72	80	34	46
Or						
Have a "semi-wilderness" experience.	43	27	28	20	66	54

groups, 70-80 percent would rather do one of these things than settle for a semi-wilderness experience. In contrast, a majority of commercial boatmen and two-thirds of commercial motor passengers would prefer a semi-wilderness experience rather than engage in such trade-offs. It appears that these two groups place less value on having a wilderness experience.

Several different interest groups were represented at the public meetings. Most groups feel river trips currently provide either semi-wilderness or undeveloped recreation (see Table 33). The only exception is commercial motor passengers, 45 percent of whom feel that trips offer a wilderness experience. A majority of all groups feel that river trips should provide a wilderness experience.

In summary, most respondents think the area should provide wilderness, most define the wilderness experience in terms of low numbers of encounters, and many are willing to "pay a price" for this experience. Data collected on the river (Shelby and Nielsen, 1976) suggest that the proposed 3 launches per day limit may result in contact rates higher than the wilderness norm outlined in the present report but this conclusion is unclear because the proposed limit will also change the distribution of use, and further monitoring will be necessary. In terms of interest groups, it appears that the wilderness norms of commercial motor passengers are different from those of other groups and that boatmen and motor passengers place less of a premium on wilderness.

TABLE 33  
HOW DIFFERENT GROUPS FEEL ABOUT RIVER EXPERIENCES

	All Respondents (n=434)	Private boaters (n=163)	Conservation group members (n=143)	Commercial oar passengers (n=10)	Commercial motor passengers (n=82)	Commercial boatmen (n=63)
Which experience does a river trip <u>provide now</u> ?						
Percent responding:						
Wilderness	20	16	16	0	45	20
Semi-wilderness	54	52	52	56	48	48
Undeveloped recreation	26	33	32	44	7	33
Which do you think a river trip <u>should provide</u> ?						
Percent responding:						
Wilderness	60	75	70	60	51	53
Semi-wilderness	34	21	27	40	38	44
Undeveloped recreation	6	5	3	0	11	3

D. RESPONSE TO COMMENT ON THE DRAFT ENVIRONMENTAL STATEMENT

A total of 2,716 comments were received during the public review period. Of these, approximately 400 comments were specifically in response to the draft environmental statement. Some agencies, groups, and individuals submitted more than one letter and some letters were signed by more than one individual. All written comments were analyzed and 72 representative letters are printed as part of this environmental statement.

All agency letters received have been included, and those organization or individual letters that best represent a range of issues or offer substantive comment on the draft statement have been selected for formal response.

The comments and responses for each letter are numbered in consecutive order. To facilitate this referral system, the letters are organized by category and placed in alphabetical order within each category.

1. Comments Received from Federal Agencies

Advisory Council on Historic Preservation

Council on Environmental Quality

Department of Agriculture

Forest Services (2)

Soil Conservation Service

Department of the Interior

Bureau of Indian Affairs (2)

Bureau of Land Management

Bureau of Outdoor Recreation (Heritage Conservation and Recreation Service)

Bureau of Reclamation

Fish and Wildlife Service

Geological Survey

Department of Transportation

Federal Aviation Administration

U.S. Coast Guard

Environmental Protection Agency

Aitchison, S. W. and S. W. Carothers, 1974. An ecological survey of the Colorado River and its tributaries between Lees Ferry and the Grand Wash Cliffs. Colorado River Research Technical Report #10, Grand Canyon National Park.

Blinn et al., 1976 (See Czarnecki et al., 1976). Borden et. al., 1976 (See Weeden et al., 1976).

Borden F. Y., 1976. Carrying capacity for river running the Colorado River in the Grand Canyon region. Colorado River Research Technical Report #9, National Park Service, Washington, D. C.

Bowman, E. G., 1975 and 1976. Survey of noise levels in Grand Canyon National Park. Unpublished Research Report, Grand Canyon National Park, Arizona.

Carothers, S. W. and S. W. Aitchison, 1976. An ecological survey of the riparian zone of the Colorado River between Lees Ferry and the Grand Wash Cliffs, Arizona. (Reports by S. W. Aitchison, S. W. Carothers, M. M. Karpisak, G. A. Ruffner, N. J. Sharber, P. L. Shoemaker, L. E. Stevens, H. E. Theroux, and D. S. Tomko.) Colorado River Research Technical Report #10, Grand Canyon National Park.

Carothers, S. W. and R. R. Johnson, 1975. Recent observations on the status and distribution of some birds of the Grand Canyon region. Plateau 47(4) :140-153.

Carothers, S. W., J. H. Overturf, D. S. Tomko, D. B. Wertheimer, W. Wilson, and R. R. Johnson, 1974. History and bibliography of biological research in the Grand Canyon Region and emphasis on the riparian zone. Unpublished Colorado River Research Report, Grand Canyon National Park, Arizona.

Cole, G.A. and D.M. Kubly, 1976. Recommendations following a limnology study of the Colorado River and its major tributaries in the Grand Canyon. Unpublished Colorado River Research Report, Grand Canyon National Park, Arizona.

Czarnecki, D. B., D. W. Blinn, and T. Tompkins, 1976. A periphyton microflora analysis of the Colorado River and Major tributaries in Grand Canyon National Park and vicinity. Colorado River Research Technical Report #6, Grand Canyon National Park, Arizona.

Deacon, J. E. and J. R. Baker, 1976. Aquatic investigations on the Colorado River from Separation Canyon to the Grand Wash Cliffs, Grand Canyon National Park. Colorado River Research Technical Report #15, Grand Canyon, Arizona.

Dolan, R., B. Hayden, A. D. Howard, and R. R. Johnson, 1976. Man's impact on the Colorado River fluvial deposits within the Grand Canyon. Paper for the First Conference on Scientific Research in the National Parks, New Orleans, Louisiana.

Dolan, R., A. Howard, and A. Galleson, 1974. Man's impact on the Colorado River in the Grand Canyon. *Amer. Sci.* 62(4):392-401.

Howard, A. D. and R. Dolan, 1976. Alterations of terrace deposits and beaches of the Colorado River in the Grand Canyon caused by Glen Canyon Dam and by camping activities during river float trips. Colorado River Research Technical Report #7, Grand Canyon, Arizona.

Johnson, R. R., 1976. The Colorado River Research Project, a multidisciplinary research project for management alternatives. Proceedings of visitor capacity symposium, NPS, Santa Fe, New Mexico.

Kilgore, B. M., 1973. A call for proposals: the river contact study. National Park Service, San Francisco.

Knudsen, A. B., 1976. A bacteriological analysis of portable toilet effluent at selected beaches along the Colorado River, Grand Canyon National Park, Arizona. Unpublished Colorado River Research Report, Grand Canyon National Park, Arizona.

Minckley, C. O. and D. W. Blinn, 1976. Summer distribution and reproductive status of fishes of the Colorado River and its tributaries in Grand Canyon National Park and vicinity during 1975. Colorado River Research Technical Report #14, Grand Canyon National Park, Arizona.

Shelby, B. and J. M. Nielsen, 1976. River contact study. Colorado River Research Technical Reports #1-4, Grand Canyon National Park, Arizona.

Sommerfeld, M. R., W. N. Crayton, and N. L. Crane, 1976. Bacteria, phytoplankton and trace chemistry of the Colorado River and tributaries in the Grand Canyon National Park. Colorado River Research Technical Report #12, Grand Canyon National Park, Arizona.

Suttkus, R. D., G. H. Clemmer, C. Jones, and C. R. Shoop, 1976. Survey of fishes, mammals, and herpetofauna of the Colorado River and adjacent riparian areas of the Grand Canyon National Park. Colorado River Research Technical Report #5, Grand Canyon National Park, Arizona.



Thompson, D., F. Y. Borden, and J. Rogers, 1974. Sound level evaluations of motor noise from pontoon rafts in the Grand Canyon. Unpublished Research Report, National Park Service.

U.S. Fish and Wildlife Service, 1973. Threatened Wildlife of the United States. Resource Publ. 114, U.S. Government Printing Office, Washington, D. C.

Weeden, H. A., F. Y. Borden, B. J. Turner, O. N. Thompson, C. H. Strauss, and R. R. Johnson, 1975. Grand Canyon National Park campsite inventory. Unpublished Research Report, National Park Service, Washington, D. C.

## APPENDIXES

- A. Colorado River Research Program
- B. Private Trip Affidavit
- C. Health and Sanitation Guidelines
- D. 1980 Operational Requirements
- E. Breeding Birds of the Colorado River
- F. Mammals of the Colorado River

## APPENDIX A

### COLORADO RIVER RESEARCH PROGRAM

#### Grand Canyon National Park

A series of research investigations relating to the natural resources the of Colorado River within Grand Canyon National Park and visitor recreation uses was initiated in 1973. These studies were conducted under contract with educational institutions and a professional research firm to provide scientific information to serve as the basis for a management plan for the Colorado River from Lees Ferry to Grand Wash Cliffs.

Final reports on all of these projects have been received by the National Park Service and have been professionally reviewed and analyzed. Basic findings and recommendations from each report will be consolidated into a synoptic report which the National Park Service managers responsible for the Colorado River will use in the implementation of the river management plan.

Each project is listed below with: the title of the project, the contract or purchase order number; the organization to which the contract was issued; the principal investigator, and the period covered by the study.

1. Ecology of the riparian zone of the Colorado River including (1) vegetation mapping, (2) interrelationships of visitors with plants and animals, (3) successional changes in plants as a result of Glen Canyon Dam, (4) population densities, home ranges and demography of important vertebrates, (5) impact of wild burros on beaches, (6) impact of burros on vegetation, (7) an inventory of insect species; CX821550007; Museum of Northern Arizona; Dr. Steve Carothers; FY 75 and 76.

2a. Sociological carrying capacity of the Grand Canyon-Colorado River area (commercial use); CX821040104; Human Ecology Research Services, Inc.; Drs. Eugene Haas, Joyce Nielsen, and Bo Shelby; FY 74 through FY 76.

2b. Sociological carrying capacity of the Grand Canyon-Colorado River area (private use); change order; Human Ecology Research Services, Inc.; Drs. Eugene Hass, Joyce Nielsen, and Bo Shelby; results incorporated into the final report of the commercial use; FY 75 - 76.

3. Grand Canyon National Park campsites inventory; CX000-3-0061; Penn. State University; Dr. F. Yates Borden; FY 75; Dr. Borden has completed a physical carrying capacity model.

4. Human waste disposal analysis (porta-potty) along the Colorado River; CX821060029; University of Arizona; Dr. Robert Phillips; FY 76.
5. Analysis of human waste disposal with special reference to public health and bacteriology; Dr. Bruce Knudsen and Grand Canyon National Park science staff; FY 75.
6. Sound level evaluations of motor noise from pontoon rafts in the Grand Canyon; CX0001-3-0061; Penn. State University; Don Thompson; FY 75.
7. History with bibliography of biological research in the Grand Canyon region with emphasis on the riparian zone; PX821040040; Museum of Northern Arizona; Dr. Steve Carothers; FY 74.
8. Riparian feasibility study; CX821050079; Museum of Northern Arizona; Dr. Steve Carothers; FY 74.
9. Number and distribution of burros in the Grand Canyon; PX821050830; Museum of Northern Arizona; Dr. Steve Carothers; FY 76.
10. Burro follow-up study; damage and recommendations for protection of the Grand Canyon ecosystem; PX821060722; Museum of Northern Arizona; Dr. Steve Carothers; FY 76.
11. Status survey of vertebrates and associated plants of the riparian area and Inner Gorge of the Grand Canyon, with emphasis on fishes; CX821060006; Tulane University; Dr. Royal Suttikus; FY 76.
12. Aquatic investigations on the Colorado River from Separation Canyon to the Grand Wash Cliffs; PX821060350; University of Nevada at Las Vegas; Dr. James Deacon; FY 76.
13. Survey of fish and their breeding status in the Colorado River; PX821060298; Dr. Royal Suttikus; FY 76.
14. Study of the status of fish in the Colorado River; collaborator; University of Michigan; Dr. Robert Miller; FY 76.
15. A preliminary survey of fishes of the Colorado River in the Grand Canyon (feasibility study); PX821050965; Dr. Royal D. Suttikus; FY 75.
16. Limnologic studies on the Colorado River in the gorge of the Grand Canyon, Grand Canyon National Park (feasibility study); PX821050862; Arizona State University, Dr. Gerald Cole; FY 75.

17. Continued studies on the limnology of the Colorado River in Grand Canyon National Park; PX821060263; Arizona State University; Dr. Gerald Cole; FY 76.
18. Periphyton microfloral analysis of the Colorado River-Lake Powell to Lake Mead; CX821060008; Northern Arizona University; Dr. Dean Blinn; FY76.
19. Analyses of periphyton and certain physico-chemical parameters from the Colorado River system between Lakes Powell and Mead (feasibility study); PX821050861; Northern Arizona University; Dr. Dean Blinn; FY 75.
20. Survey of phytoplankton, bacteria and trace chemistry of the lower Colorado River and tributaries in the Grand Canyon (feasibility study); PX821050863; Arizona State University; Dr. Milton Sommerfeld; FY 75.
21. Survey of bacteria, phytoplankton, and trace chemistry of the lower Colorado River and tributaries in the Grand Canyon; CX821060007; Arizona State University; Dr. Milton Sommerfeld; FY 76.
22. An annotated bibliography of limnologically related research on the Colorado River and its major tributaries in the region of Marble and Grand Canyons; PX821041350; Arizona State University; Dr. Gerald Cole; FY-74.
23. An inventory of large and small bird bones from Stanton's Cave PX821050967; University of Arizona; Dr. Amadeo Rea; FY 75 - FY 76.
24. Camelthorn control; no contract; NPS-GRCA; Dr. Roy Johnson.
25. The establishment of bench marks and GCNP techniques for measuring erosion along the Colorado River; PX821060262; University of Virginia; Dr. Alan Howard; FY 76.
26. Changes in fluvial deposits of the Colorado River in the Grand Canyon; continuation of Washington-funded project CX821060009; University of Virginia; Drs. Alan Howard and Robert Dolan; FY 76.
27. Hydrology and sedimentology of the Colorado River; CX821060030; University of Arizona; Dr. Emmett Larsen; FY 76.
28. Analysis of backcountry trail use in Grand Canyon National Park; CX821060027; Museum of Northern Arizona; Dr. Steve Carothers; FY 76.
29. Economic analysis of river companies running the Colorado River in Grand Canyon National Park; CX821060028; Utah State University; Dr. Michael Parent; FY 76.

APPENDIX B

NONCOMMERCIAL RIVER TRIP AFFIDAVIT

Your signature on this affidavit indicates that you have considered the permit conditions and that your trip is organized in the spirit, as well as the intent, of the following conditions (36 CFR 5.3, Business Operations; 36 CFR 7.4(h) Grand Canyon National Park, Colorado Whitewater Trips). Failure to abide by these conditions will jeopardize future applications and will result in permit cancellation.

1. A private river trip must be participatory. Trip preparation (including logistics food purchase, equipment assembly, transportation and vehicle shuttle) and conduct of the trip (including food preparation and sanitation) must be shared by members of the group. Collecting a set fee (monetary compensation), payable to an individual, groups or organization, for conducting, leading, guiding or outfitting a private river trip is not allowed. The trip leader should delegate responsibility (financial and otherwise) for various aspects of trip preparation and conduct.
2. The purpose of the trip must be for its recreational and/or educational values. The trip will not be conducted for monetary gain (either as a direct or indirect result of the trip) or acquisition of new equipment to the advantage of an individual, groups or organization or for the purpose of amortizing equipment.
3. Media or direct mail or other advertising is not permissible.
4. Estimated overall trip cost:  
\_\_\_\_\_ (based on \_\_\_\_\_ trip members)
5. A complete itinerary including off-river days and a list of boatmen, their experience, equipment, and other information ensuring compliance with the Appendix A of the permit application criteria must be provided at least sixty (60) days prior to trip launch. A National Park Service form will be provided for this purpose.

I have given complete and accurate descriptions and answers to all questions. I agree to comply with all park rules and regulations as stated in Appendix A of this application, and appropriate parts of the Code of Federal Regulations, AND ASSUME FULL RESPONSIBILITY FOR THE CONDUCT OF MY ENTIRE PARTY IN OBEYING THESE RULES AND REGULATIONS. To the best of my knowledge, my name and those of the trip participants appear on only one application and I understand that duplication of names or incomplete answers will make my permit application invalid. also acknowledge that I have read and agree with all terms in the above noncommercial river trip affidavit.

It is unlawful to knowingly and willfully falsify or conceal by any scheme or by any false, fictitious or fraudulent statements or representations or to make use of any false writings or documents knowing them to contain any false, fictitious, or fraudulent statement or entry. Violators will be subject to a fine of not more than \$10,000.00 or imprisonment for not more than five (5) years or both (18 U.S.C. 1001, 1970).

Applicant's Signature \_\_\_\_\_