

GLEN CANYON NATIONAL RECREATION AREA  
FY95 GLEN CANYON ENVIRONMENTAL STUDIES  
MONITORING OF ARCHAEOLOGICAL SITES  
FROM GLEN CANYON DAM TO THE PARIA RIFFLE

AUGUST 1, 1995

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## ABSTRACT

As part of the ongoing Glen Canyon Environmental Studies (GCES) program in Glen Canyon National Recreation Area (NRA), this report summarizes the FY95 archaeological monitoring effort. On various days between March 9 and June 23, 1995, 23 monitoring episodes were conducted to record erosional and human impacts at 21 locations between Glen Canyon Dam and the Paria Riffle. Glen Canyon NRA personnel included Archaeologists Tim W. Burchett, Katherine McCraley, and Karen Wigglesworth.

The FY95 work plan is presented. The overall trends and relationships between several environmental and impact variables are explored. The analysis suggests that surface erosion, gullies, eolian/alluvial erosion, and animal caused erosion are probably not related to river fluctuations or dam operations, whereas arroyo cutting, bank slumpage, and side canyon erosion probably are related. For those monitor locations associated with river-based streams, there has been a considerable increase in almost all impact types since the last monitoring episode in FY94, whereas at the monitoring locations associated with terrace-based streams there have been relatively few increases in erosion. An increase in human impacts is indicated at sites with artifact scatters and at sites with roasters/hearths.

Site-specific summaries of previous monitoring results and the results of the FY95 monitoring effort are provided to illustrate the ongoing impacts present. A management summary includes a variety of recommendations. Eighteen monitoring locations are recommended for some form, or combination of, remedial action. These methods include retrailing, obliterating trails, planting vegetation, installing check dams, and stabilization.

Four measures suggested to protect site integrity are: mapping, surface collection of the entire site, subsurface testing, and excavation. Some form, or combination of, data collection is recommended at 32 monitoring locations.

The FY96 work plan includes monitoring activities, site mapping, continuing terrestrial photogrammetry, and remedial actions. For FY96, 54 locations will be monitored. Fifty-two locations will be monitored once and two locations will be monitored twice. Monitoring activities are scheduled to begin in October FY95 following the end of the visitor season. The two locations to be monitored on a semi-annual basis will be inspected in the fall following the visitor season and then again in the spring prior to high visitor season.

Five more sites have been chosen for total station mapping. Film retrieval and replacement every 34 days at two camera locations will continue. A remedial action plan identifying a limited number of sites most appropriate for immediate remedial action and including field methods will be submitted to all signatories. A short assessment of the effectiveness of the monitoring program since its beginning is provided.

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## I. INTRODUCTION

The preparation of an Environmental Impact Statement (EIS) on the effects of the operation of the Glen Canyon Dam on the downstream environmental and ecological resources and historic properties of Glen Canyon and Grand Canyon was ordered by the Secretary of the Interior. The goal of the EIS is to determine specific options that could be implemented to minimize adverse impacts on the downstream environmental and cultural resources and Native American interests in Glen and Grand Canyons.

To reach these objectives a joint effort among several agencies was designed to identify and evaluate the cultural resources present within Glen and Grand Canyons. A survey gathered information on the numbers, types, location, National Register eligibility, physical condition, and extant and potential impact agents (Fairley et al. 1991:1) of 475 cultural properties (Fairley et al. 1991:268).

A monitoring and remedial action plan was developed for managing the effects of Glen Canyon Dam operations on historic properties within the Area of Potential Effects (APE) and for carrying out remedial actions to address the effects of continuing identification, inspection, analysis, evaluation and remedial protection actions, as necessary, for the preservation of the cultural properties within the river corridor.

Pursuant to that monitoring and remedial action plan, this document reports the results of the FY95 monitoring activities conducted in Glen Canyon National Recreation Area (NRA) in Reach 0 from Glen Canyon Dam to the Paria Riffle. Section II presents a scope of work including site selection criteria, field monitoring methods, total station mapping program, and continued terrestrial photogrammetry for FY95. Section III presents some overall trends in natural and human impacts to the cultural resources.

Section IV presents site-specific results and recommendations of the monitoring effort including previous impact evaluations, current impact evaluations, and recommendations for continued monitoring, remedial actions, and data recovery. Section V is a management summary and includes sections on site specific measures to reduce impacts and to protect site integrity. A FY96 work plan and an assessment of the monitoring program conclude the report.

## II. FY95 SCOPE OF WORK

The objectives of the FY95 monitoring season were based on the results and recommendations of the FY91 survey and FY92-94 monitoring activities. They included: 1) continued monitoring of erosional and human impacts and updating the monitoring data base for the sites in Reach 0 from the Glen Canyon Dam to the Paria Riffle; 2) detailed site mapping using total station equipment; and 3) continued terrestrial photogrammetry. The FY95 scope of work includes site selection criteria, monitoring field methods, site mapping, continuing terrestrial photogrammetry, and participation in a stabilization workshop.

### Site Selection Criteria for Monitoring

The intent of the Monitoring Plan is for sites to be visited to the minimal extent necessary in order to identify and prevent erosional processes and human impacts. Given the monitoring data base generated to date, patterns of continuing impacts have been established at sites, and based on that patterning, beginning in FY95, recommendations concerning the cycle of monitoring at specific sites were adhered to. The recommendations include monitoring only sites that are actively eroding or receiving human impacts based on FY94 observations and on the results of a consultation trip conducted on July 25, 1994 with representatives from the Navajo Nation Historic Preservation Department concerning sites on Navajo Nation lands. But, the Monitoring Plan holds that there is flexibility in cases of site impacts such as intense local seasonal monsoon rains and debris flows caused by them.

Glen Canyon NRA has developed site selection criteria that justify five desired monitoring schedule categories for our monitoring locations. They are based most importantly on whether erosional impacts are related to river fluctuations and/or dam operations. Lesser issues for site selection include erosion not related to the river or dam, visitor impacts such as graffiti on rock art panels, visibility of the sites from the river or trails, and proximity of sites to heavy use areas. The Glen Canyon NRA GCES monitoring program includes 69 monitoring locations in all. The monitoring schedule categories and the number of sites assigned to each category follow:

**Semi-annual Monitoring.** Two sites are being impacted by extensive visitor traffic, over 40,000 people per year. A semi-annual monitor schedule, twice per year, is recommended. Episodes will be conducted prior to and following the visitor season;

**Annual Monitoring.** Sites (N=21) that are currently being impacted by river fluctuations or dam operations will be monitored annually;

**Biennial Monitoring.** Sites (N=31) that are being impacted by erosion not related to river fluctuations or dam operations will be monitored biennially, every 2 years. Included are sites containing recent graffiti, sites visible from the river or trails, and sites near visitor impact areas;

Monitoring 3-5 Years. Sites (N=14) that are stable or not being impacted by river fluctuations, dam operations, other erosion, or visitor impacts will be monitored every 3 years initially, and if warranted, less frequently in the future;

Discontinue Monitoring. Past monitoring episodes have shown that one location does not need to be monitored. This feature is the concrete Bureau of Reclamation Gauging Station at Lee's Ferry.

Table 1 lists all 69 locations monitored by Glen Canyon NRA and their monitoring schedule. For FY95, 23 locations were monitored. Twenty-one locations received one monitoring episode and two locations received two episodes.

#### Monitoring Field Methods

Sites are accessible by boat on day trips. The day trips are opportunities for any signatories wishing to travel between Lee's Ferry and Glen Canyon Dam. The monitoring form developed in FY94 is being used. It greatly increases the efficiency in recording impacts. Photographic recording using GLCA archival procedures will continue.

In FY94, 1 x 1 meter recording units were placed on sites with more than 25 artifacts to document changes in artifact counts and movement. Fourteen sites were treated thusly. These recording units were inspected to document erosion/displacement of artifacts.

Reporting includes completing the monitoring and photographic record forms, updating computer files, and submission of this annual report synthesizing FY95's monitoring results.

#### Total Station Mapping Program

A detailed site mapping program was conducted at 5 selected sites using total station equipment and Bureau of Reclamation personnel. The 5 sites are located on Ferry Swale Camps terrace and include AZ C:2:71, C:2:73, C:2:75, C:2:77, and C:2:79.

#### Terrestrial Photogrammetry

Film retrieval and replacement every 34 days at the camera locations continued. This effort is recording on a daily basis terrace cutbank erosion at sites C:2:38 and C:3:10.

Table 1. Sixty-nine locations are monitored by Glen Canyon NRA in Reach 0. Fifty-three archaeological sites are present from Glen Canyon Dam down to River Mile 1.6 Right Bank below Lees Ferry. Fifty-one sites have 1 monitoring location, site C:2:11 has 12 monitoring locations, and site C:2:60 has 6 monitoring locations. NN = Navajo Nation, GLCA = Glen Canyon NRA. Fifty-four sites are scheduled to be monitored in FY96 (\*).

AZ Site Number, Feature	FY95 Monitor	Monitoring Schedule	Land Owner
C:2:11, Feature 1		3-5 years	GLCA
Feature 3 *	x	Annual	GLCA, NN
Feature 4 *	x	Annual	GLCA
Feature 5 *		Biennial	NN
Feature 6 *	x	Annual	NN
Feature 11		3-5 years	GLCA
Feature 12 *	x	Annual	GLCA
Feature 13		3-5 years	GLCA
Feature 14 *	x	Annual	GLCA, NN
Feature 17 *		Biennial	GLCA
Feature 20		3-5 years	GLCA
Feature 21 *		Biennial	GLCA
C:2:12		3-5 years	NN
C:2:13 *	x	Annual	GLCA
C:2:32 *	x	Annual	GLCA
C:2:33 *		Biennial	GLCA
C:2:35 *	x	Annual	GLCA
C:2:36		3-5 years	GLCA
C:2:37 *		Biennial	GLCA
C:2:38 *	x	Semiannual	GLCA
C:2:39 *		Biennial	GLCA
C:2:40 *		Biennial	GLCA
C:2:41		3-5 years	NN
C:2:48 *		Biennial	NN

AZ Site Number, Feature	FY95 Monitor	Monitoring Schedule	Land Owner
C:2:50 *	x	Annual	GLCA
C:2:53 *		Biennial	GLCA
C:2:56		3-5 years	GLCA
C:2:57 *		Biennial	NN
C:2:58 *		Biennial	GLCA, NN
C:2:59		Discontinue	NN
C:2:60, Feature 1 *		Biennial	NN
Feature 2 *	x	Annual	NN
Feature 4		3-5 years	NN
Feature 6		3-5 years	NN
Feature 7		3-5 years	NN
Feature 8 *	x	Annual	NN
C:2:70 *		Biennial	GLCA
C:2:71 *		Biennial	GLCA
C:2:72 *	x	Annual	NN
C:2:73		3-5 years	GLCA
C:2:74 *		Biennial	GLCA
C:2:75 *	x	Annual	GLCA
C:2:76 *		Biennial	NN
C:2:77 *	x	Annual	GLCA
C:2:78 *	x	Annual	NN
C:2:79 *	x	Annual	GLCA
C:2:80 *		Biennial	GLCA
C:2:81 *	x	Semiannual	GLCA
C:2:82 *		Biennial	NN
C:2:83 *	x	Annual	NN
C:2:84 *		Biennial	GLCA
C:2:86 *		Biennial	NN

AZ Site Number, Feature	FY95 Monitor	Monitoring Schedule	Land Owner
C:2:87 *		Biennial	NN
C:2:88 *	x	Annual	GLCA
C:2:90 *		Biennial	NN
C:2:91 *	x	Annual	NN
C:2:95 *		Biennial	GLCA
C:2:99 *		Biennial	NN
C:2:100 *	x	Annual	NN
C:2:102		3-5 years	GLCA
C:2:103		3-5 years	GLCA
C:2:104 *		Biennial	GLCA
C:2:105 *		Biennial	GLCA
C:2:106 *		Biennial	NN
C:2:108 *		Biennial	NN
C:3:3 *		Biennial	GLCA
C:3:4 *		Biennial	GLCA
C:3:6 *		Biennial	GLCA
C:3:10 *	x	Annual	GLCA
Totals	23	Discontinue - 1 Semiannual - 2 Annual - 21 Biennial - 31 3-5 years - 14	GLCA=40 NN=26 GLCA, NN=3

### Stabilization Workshop

Part of the long-term monitoring program includes the implementation of management assessments and recommendations to protect and preserve site information. To facilitate the recommendations, a stabilization workshop for the application of remedial actions such as traditional erosion control methods was planned for spring FY95. Following the training, a remedial action plan identifying a limited number of sites most appropriate for immediate remedial action and including field methods is to be submitted to all signatories.

### III. IMPACTS TO CULTURAL RESOURCES

In general, the monitoring efforts in FY95 document the continuing degradation of archaeological resources by a number of natural and human impacts.

#### Natural Impacts

The FY95 monitoring program resulted in 23 monitoring locations being inspected. Of the 23 monitoring locations, 48% (N=11) have received impacts since the last monitoring session. Natural impacts include surface erosion, gullies, arroyo cutting, bank slumpage, eolian/alluvial erosion, side canyon erosion, animal-caused erosion such as trailing and burrowing, and other impacts such as spalling and root/plant growth.

Table 2 lists the presence, absence, and increase of these natural impacts. The table shows that 65.3% (N=15) of the monitoring locations exhibit surface erosion, and another 26.0% (N=6) exhibited an increase in surface erosion since the last monitoring episode. Gullying is impacting 52.2% (N=12) of the monitoring locations, and at 13.0% (N=3) of the monitoring locations, gullying has increased since the last monitoring episode.

Arroyo cutting occurs at 43.5% (N=10) of the monitoring locations, and it has increased at 13.0% (N=3) of the locations since the last monitoring episode. The same trends are true for bank slumpage, eolian/alluvial erosion, and side canyon erosion. There is a general increase in the amount of erosion since the last monitoring episode. Only animal-caused impacts and other impacts such as that caused by spalling and root/plant growth show no increases.

Table 3 presents the various natural impacts at the 11 monitoring locations inspected in FY95 within Glen Canyon NRA that contain structures and/or storage features. All types of erosion are present, but there is no indication of an increase in erosion. Surface erosion effects 90.9% (N=10), while arroyo cutting, bank slumpage, and side canyon erosion effect only 9.1% (N=1). These last three impacts, thought to be most closely related to river fluctuations and/or dam operations, effect relatively few structures and/or storage features, while surface erosion, eolian/alluvial erosion, and animal-caused erosion effect more structures and/or storage features. This is probably because these kinds of features are located in relatively protected topographic situations, next to the cliff face away from the river and/or in rockshelters or overhangs.

Table 4 presents the natural impacts at the 15 monitoring locations with artifact scatters inspected during FY95. The table indicates that surface erosion, gullying, arroyo cutting, and eolian/alluvial erosion are impacting a relatively high number of sites when compared to bank slumpage, side canyon erosion, and animal-caused erosion. Two of these latter three, bank slumpage and side canyon erosion, appear to be related to river fluctuations and dam operations. Surface erosion has increased in more sites than any other impact type, but all impact types excluding animal-caused erosion and other natural impacts have increased.

Table 2. Natural impacts at 23 monitoring locations inspected during FY95 within Glen Canyon NRA.

	Present	Increase	Decrease	Absent	Totals
Surface Erosion (0-10 cm)	15/65.3	6/26.0	0/0.0	2/8.7	23/100.0
Gullying (10-100 cm)	12/52.2	3/13.0	0/0.0	8/34.8	23/100.0
Arroyo Cutting (> 1 m)	10/43.5	3/13.0	0/0.0	10/43.5	23/100.0
Bank Slumpage	5/21.8	6/26.1	0/0.0	12/52.1	23/100.0
Eolian/Alluvial Erosion/Deposition	16/69.6	3/13.0	0/0.0	4/17.4	23/100.0
Side Canyon Erosion	5/21.7	2/8.7	0/0.0	16/69.6	23/100.0
Animal-Caused Erosion (Trailing, Burrowing)	6/26.0	0/0.0	0/0.0	17/74.0	23/100.0
Other Natural Impacts (Spalling, Roots)	2/8.7	0/0.0	0/0.0	21/91.3	23/100.0

Table 3. Natural impacts at the 11 monitoring locations with structures and storage features inspected during FY95 within Glen Canyon NRA.

	Present	Increase	Decrease	Absent	Totals
Surface Erosion (0-10 cm)	10/90.9	0/0.0	0/0.0	1/9.1	11/100.0
Gullying (10-100 cm)	3/27.3	0/0.0	0/0.0	8/72.7	11/100.0
Arroyo Cutting (> 1 m)	1/9.1	0/0.0	0/0.0	10/90.9	11/100.0
Bank Slumpage	1/9.1	0/0.0	0/0.0	10/90.9	11/100.0
Eolian/Alluvial Erosion/Deposition	7/63.6	0/0.0	0/0.0	4/36.4	11/100.0
Side Canyon Erosion	1/9.1	0/0.0	0/0.0	10/90.9	11/100.0
Animal-Caused Erosion (Trailing, Burrowing)	4/36.4	0/0.0	0/0.0	7/63.6	11/100.0
Other Natural Impacts (Spalling, Roots)	2/18.2	0/0.0	0/0.0	9/81.8	11/100.0

Table 4. Natural impacts at 15 monitoring locations with artifact scatters inspected during FY95 within Glen Canyon NRA.

	Present	Increase	Decrease	Absent	Totals
Surface Erosion (0-10 cm)	10/66.7	5/33.3	0/0.0	0/0.0	15/100.0
Gullyng (10-100 cm)	11/73.4	2/13.3	0/0.0	2/13.3	15/100.0
Arroyo Cutting (> 1 m)	9/60.0	3/20.0	0/0.0	3/20.0	15/100.0
Bank Slumpage	4/26.7	4/26.7	0/0.0	7/46.6	15/100.0
Eolian/Alluvial Erosion/Deposition	10/66.7	3/20.0	0/0.0	2/13.3	15/100.0
Side Canyon Erosion	4/26.7	2/13.3	0/0.0	9/60.0	15/100.0
Animal-Caused Erosion (Trailing, Burrowing)	4/26.7	0/0.0	0/0.0	11/73.3	15/100.0
Other Natural Impacts (Spalling, Roots)	0/0.0	0/0.0	0/0.0	15/100.0	15/100.0

Nine monitoring locations inspected in FY95 have roasters, hearths, or thermal features. Table 5 presents natural impacts at those locations. A similar pattern to that indicated for artifact scatters is noted here. Surface erosion, gullyng, arroyo cutting, and eolian/alluvial erosion are impacting relatively more sites than bank slumpage, side canyon erosion, and animal-caused erosion. Again, two of the latter three impact types, bank slumpage and side canyon erosion, are though to be related to dam operations and river fluctuations. Finally, there has been an increase in the amount of most erosion since the last monitoring episode in FY94.

During FY95, 3 monitoring locations within Glen Canyon NRA contained rock art or historic inscriptions. They are all effected by erosion to the panel surfaces through wind and rain, and one is effected by animals. There are no increases in natural impacts at these sites. It appears that rock art and inscription panels are effected relatively less by impacts directly related to river fluctuations or dam operations, such as arroyo cutting, bank slumpage, and side canyon erosion.

Of the 23 monitoring locations inspected in FY95, 65.2% (N=15) have river-based streams, draining to the Colorado River. Erosion of terrace-based streams occurs at 17.4% (N=4) of the monitoring locations. These have no relation to regulated flows since they do not reach the river, rather their effective base level is usually well above the river emptying onto a higher terrace. Both types of streams adversely impact archaeological sites, however.

Table 5. Natural impacts at 9 monitoring locations with roasters/hearths inspected in FY95 within Glen Canyon NRA.

	Present	Increase	Decrease	Absent	Totals
Surface Erosion (0-10 cm)	7/77.8	2/22.2	0/0.0	0/0.0	9/100.0
Gullyng (10-100 cm)	5/55.6	2/22.2	0/0.0	2/22.2	9/100.0
Arroyo Cutting (> 1 m)	6/66.7	1/11.1	0/0.0	2/22.2	9/100.0
Bank Slumpage	2/22.2	3/33.3	0/0.0	4/44.5	9/100.0
Eolian/Alluvial Erosion/Deposition	6/66.7	2/22.2	0/0.0	1/11.1	9/100.0
Side Canyon Erosion	2/22.2	1/11.1	0/0.0	6/66.7	9/100.0
Animal-Caused Erosion (Trailing, Burrowing)	2/22.2	0/0.0	0/0.0	7/77.8	9/100.0
Other Natural Impacts (Spalling, Roots)	0/0.0	0/0.0	0/0.0	9/100.0	9/100.0

Is there a relationship between stream type and the kinds of erosion impacting the sites? Table 6 is a cross tabulation of stream type versus the various kinds of erosional impacts. This tables suggest that surface erosion, gullyng, arroyo cutting, and eolian/alluvial erosion are impacting more monitoring locations associated with river-based streams than are bank slumpage, side canyon erosion, animal-caused erosion, and other natural impacts. The table also indicates that for those monitor locations associated with river-based streams, there has been a considerable increase in almost all impact types since the last monitoring episode in FY94, whereas at the monitoring locations associated with terrace-based streams there have been relatively few increases in erosion.

Table 6. Natural impacts versus stream type at the 23 monitoring locations inspected in FY95 within Glen Canyon NRA. The numbers in brackets indicate the number of sites showing an increase in the kinds of erosion specified.

Frequencies	Stream Type	
	River-based (N=15)	Terrace-based (N=4)
Surface Erosion (0-10 cm)	15 [6]	3
Gullying (10-100 cm)	13 [3]	2
Arroyo Cutting (> 1 m)	12 [3]	1
Bank Slumpage	9 [5]	2 [1]
Eolian/Alluvial Erosion/Deposition	13 [3]	3
Side Canyon Erosion	6 [1]	0
Animal-Caused Erosion (Trailing, Burrowing)	5	0
Other Natural Impacts (Spalling, Roots)	1	0

## Human Impacts

Table 7 indicates that sites with structures or storage features; artifact scatters; roasters/hearths; and rockart/inscriptions are being impacted by visitation. An increase in the impacts is indicated at sites with artifact scatters and at sites with roasters/hearths.

Human impacts of concern include collection piles, trailing, on-site camping, and vandalism. There was a collectors pile recorded at 1 site, onsite camping is noted at 1 site, and there is 1 noted incidence of criminal vandalism. New human impacts are noted at 4 sites, and at 2 sites, the impacts have increased.

Trails are present at 13 of the 23 sites monitored; at 2 sites the trail impacts have increased, and at 1 site, trail impacts have decreased. Trailing is one of the most devastating human impacts. For example, the trail to the Petroglyph Panel, C:2:38, passes through C:2:81, a lithic scatter. Continued visitation has cut the trail deep into the terrace through the site, and recent summer thunderstorms have exacerbated the problem, cutting the trail to 1 m deep through C:2:81.

This trail is now a terrace-based stream, and another terrace-based stream is nearby. These two drainages could join and develop into a river-based stream. A trail rehabilitation project, Glen Canyon NRA Compliance No. 94026, is planned for fall FY95 to upgrade and stabilize the trail. A recent testing program (Burchett 1995) was conducted at C:2:81 to recover materials prior to that project, which when completed will halt the erosion of the trail and its development into a river-based stream.

Table 7. Visitor impacts related to various cultural resources.

	Present	Increase	Decrease	Absent	Totals
Structures/Storage	3/30.0	0/0.0	0/0.0	7/70.0	10/100.0
Artifacts	1/8.0	2/16.0	0/0.0	10/76.0	13/100.0
Roasters/Hearths	2/22.2	1/11.1	0/0.0	6/66.7	9/100.0
Rockart/Inscriptions	1/33.3	0/0.0	0/0.0	2/66.7	3/100.0

#### IV. SITE-SPECIFIC RESULTS AND RECOMMENDATIONS

This section briefly describes the site type, land ownership, physiographic position, stability, natural and human impacts observed during previous monitoring episodes are provided along with current evaluations of site impacts. A determination of whether the impacts are related to river fluctuations or dam operations is given. Site specific characteristics, tribal considerations, and management and remedial action recommendations are included.

Sixty-nine locations are monitored by Glen Canyon NRA in Reach 0. Fifty-three archaeological sites are present from Glen Canyon Dam down to River Mile 1.6 Right Bank below Lees Ferry. Fifty-one sites have 1 monitoring location, site C:2:11 has 12 monitoring locations, and site C:2:60 has 6 monitoring locations. Reported here are the results of the FY95 monitoring effort, which included monitoring 21 locations once and 2 locations twice.

##### AZ C:2:11, Feature 3

On the right bank of the Colorado River, on an alluvial terrace, Feature 3 includes the Main Ferry Site, and on the left bank, cable anchor posts are present on a steep talus slope above the Stanton Road. The Main Ferry Site includes 3 partially intact masonry structures, used from 1873-1928.

##### Previous Evaluations

The feature was monitored during the initial survey in FY91. Bank cutting is impacting the site directly, and bank slumpage and accelerated arroyo cutting have impacted the site indirectly. Surface erosion is also noted. More than two distinct trails are present, and camping evidence includes the rearrangement and clearing of rocks, recent trash, and concentrated soil compaction.

In FY94, masonry elements were added to the west corner of Structure 1, and the cable was moved along the trail. On Structure 2, collapse of a masonry element on both chimneys was noted. There was no change to Structure 3, although human waste and toilet paper were noted nearby. On the left bank near the cable anchor posts, bank slumpage and alluvial action will eventually wash away the cable at the bottom of the feature below the Stanton Road. There was a decrease in evidence of camping.

##### Current Evaluation

On the right bank of the river, there have been no changes to any of the structures at the main ferry site. The cable has been moved, however, indicating some visitation. There is no visible evidence of camping. On the left bank, there has been some bank slumpage below the Stanton Road.

## Recommendations

Both the left and right bank portions of this feature should be monitored annually, and instrument mapping should be conducted.

### AZ C:2:11, Feature 4

This is a dry laid sandstone corral located on the right bank of the Colorado River 240 meters upstream from Feature 3 on the same alluvial terrace.

## Previous Evaluations

The feature was monitored during the initial survey in FY91. Bank cutting impacts the site directly and bank slumpage and arroyo cutting impact the site indirectly. There is evidence of surface erosion. One distinct trail is noted, and other visitor evidence includes the rearrangement and clearing of rocks, recent trash, and concentrated soil compaction. In FY94, the trail bisected both sides of the corral wall, but the stone elements making up the remaining wall segments were in stable condition.

## Current Evaluation

Surface erosion is still evident, but the walls remain in stable condition. The trail through the walls is no more pronounced than during the last monitoring episode in FY94.

## Recommendations

Annual monitoring is recommended along with instrument mapping.

### AZ C:2:11, Feature 6

Located on the left bank of the Colorado River on the Navajo Nation, Feature 6 includes two enigmatic low masonry wall segments on Cable Crossing Hill. They probably date to the historic period.

## Previous Evaluations

The feature was monitored in FYs 91, 92, and 94. Surface erosion is noted, but the wall segments are in stable condition.

## Current Evaluation

There are no changes noted.

## Recommendations

This feature is on the same hill on which a stationary camera sets, and servicing of that camera occurs monthly. The site could be monitored annually with little effort or further trailing impacts.

## AZ C:2:11, Feature 12

The Charles H. Spencer Steamboat, on the National Register, is a feature of the Lee's Ferry Historic District that sank on the right bank of the Colorado River just above the Lee's Ferry boat launch in 1914. The steamboat is partially submerged in water and present-day shoreline/fluviial deposits.

## Previous Evaluations

The feature was monitored in FYs 91, 92, 93, and 94. Overall, the Spencer appears in better condition underwater. Extensive river fluctuations continue to cause wet-dry cycles to the bow of the steamboat. Moss and algae in the center of the boat, growing up from the river bottom and on the port side, is not as abundant as in FY92. Underwater silt buildup in and around the vessel has increased noticeably since FY92 and the amount of algae and vegetation growth has decreased.

Human impacts have apparently reduced since FY92, when during low water, visitors have been known to stand on the boiler of the boat to fish. This was not observed in FY93, although it still may have occurred. Litter from picnickers is present on the nearby stream terrace, and visiting tour boats often float over the steamboat; their wakes cause continued movement of sediment. For FY94, continuing deterioration of the bow from wet-dry cycling was noted. Since the last monitoring episode in FY93 the amount of algae and sediment increased, particularly on the stern of the boat. A trail is nearby on shore and is used by picnickers and people fishing.

## Current Evaluation

Again, there is an increase in the amount of algae and sediment deposition since the last monitoring episode, particularly on the stern of the boat. The boiler has been used by people fishing.

## Recommendations

The steamboat is monitored by a stationary camera located on the opposite side of the river. Recommendations for best preserving the steamboat include extending the no-wake zone around the Lees Ferry boat launch area to incorporate the Spencer, and keeping the vessel underwater at all times. An "ideal" flow of 12,000 cfs or higher would accomplish the latter recommendation. The steamboat should be monitored annually from the shore, and monitored underwater prior to and following any extremely high or low flows. In addition, to prevent people from fishing from on top of the boiler, we have directed the placement of a sign on shore just above the steamboat to

inform visitors of the significance of the steamboat and asking their cooperation not to climb onto the boiler.

#### AZ C:2:11, Feature 14

This feature is located on the left and right banks of the Colorado River just upstream from Lee's Ferry on old alluvial terraces. It consists of the abutments of the USGS Cableway, and is included in the Lee's Ferry Historic District. The remnants on the right bank consist of concrete cable anchors, and the remnants on the left bank are on the Navajo Nation and consist of concrete cable anchors, a still-standing A-frame tower, and a cable car.

#### Previous Evaluations

The feature was monitored in FYs 91, 92, 93, and 94. The right bank concrete cable anchors are in stable condition. They do not appear to be threatened by either river fluctuations or dam operations.

The remnants of Feature 14 on the left bank are on the Navajo Nation and consist of concrete cable anchors, a still-standing A-frame tower, and a cable car. There is no change in the condition of the concrete cable anchors and the tower from previous monitoring episodes. However, the cable car has been humanly impacted since the FY92 monitoring episode. The wooden board frame on the front, back, and right sides of the cable car have been peeled away and rearranged on the ground nearby. More importantly, the terrace on which the remains set is being dissected by side canyon erosion caused by river fluctuations.

The FY94 monitoring effort indicated that the Feature 14 remnants on the right bank of the river were in stable condition. On the left bank of the Colorado River, the towers, artifacts, and ground surface around them were being distributed by surface erosion, gullying, arroyo cutting, bank slumpage, and side canyon erosion. These impacts were in turn being caused by the fluctuating river levels. An example human impact is the movement of loose boards of the cable car.

#### Current Evaluation

Due to the stable condition of the concrete cable anchors on the right bank, monitoring was discontinued. On the left bank, the FY95 monitoring effort has indicated an increase in surface erosion near the cable car. The loose boards continue to move.

#### Recommendations

The elements of Feature 14 on the left bank of the river are monitored by a stationary camera, and they should be monitored by an archaeologist annually, since they are being disturbed by impacts related to river fluctuations. In addition, instrument mapping of the left bank elements of

Feature 14 is recommended. Possible remedial actions include installing check dams and revegetation.

#### AZ C:2:13

This prehistoric site consists of a rock shelter with a low dry-laid wall enclosing the front. A sherd and lithic artifact scatter is present along with a small petroglyph panel. The site is located on the Navajo Nation on an alluvial terrace and talus slope where it contacts with a low Kayenta sandstone cliff face.

#### Previous Evaluations

The site was monitored in FYs 91, 93, and 94. It is actively eroding with impacts from sheet washing, gullying, arroyo cutting, and bank slumpage. A small rivulet crosses the site and drains into a Type I stream west of the site. Extensive trampling and trailing are also present. Evidence of camping on the site was noted in FY91, however, no trace of that activity was noted during the FY93 monitoring session. In FY94, surface erosion was noted for Features 1 and 3, the structures. Animals have rubbed against the rock art panel, eroding the lower portions of the petroglyphs. The artifact scatter in front of rock art panel 1 and Feature 1, the rock shelter, is continuing to erode through gully washing down the rivulet. Feature 2, on a high cutbank of the Type I stream, was eroding.

#### Current Evaluation

Surface erosion is present on the structures and the rock art, but there does not appear to have been an increase in erosion.

#### Recommendations

Annual monitoring is recommended, since the features are continuing to erode into a Type I stream. Mapping and testing of the cultural resources present are also recommended, since materials are being displaced.

#### AZ C:2:32

This site is a series of charcoal lenses eroding from a high cutbank of an alluvial terrace on the left bank of the river.

#### Previous Evaluations

The site is actively eroding with natural impacts including surface erosion, gullying, arroyo cutting, and bank slumpage. The cutbank was undermined by 1983 high CFS releases, causing bank slumpage and steepening and widening of gullies and the arroyo east of the site. These impacts are related to river fluctuations and dam operations, specifically, direct inundation, bank slumpage and steepening adjacent to the current high water zone and headward migration of arroyos due to lowering base levels. A Type I

arroyo is present 20 m east of the site. An increase in gully and arroyo cutting east of the site datum was not noted between FYs 92 and 93. There were no human-related impacts. In FY94, the continued loss of the lens and the terrace deposits was noted. Impacts included surface erosion, gullying, arroyo cutting, and bank slumpage.

#### Current Evaluation

Since the last monitoring episode in FY94, an increase in bank slumpage has occurred. There are no human impacts.

#### Recommendations

The site is being monitored by a stationary camera located on the opposite side of the river. Additionally, on-site monitoring should take place annually.

AZ C:2:35

This is a PII Anasazi site containing an extremely sparse lithic and ceramic artifact scatter with a low wall. A charcoal stain indicating a hearth is also present. The site is located in old Colorado River alluvium and covered with shallow colluvium.

#### Previous Evaluations

The site was monitored in FYs 91, 93 and 94. The site sets back away from a high cutbank of the Colorado River. It is moderately stable in that fragile features are present but are not actively eroding. Away from the features, the site exhibits incipient erosion with surface erosion, gullying, and arroyo cutting present. Human impacts consist of a single trail to the site, which was not noted in FY91. These impacts do not appear to be related to river fluctuations or dam operations; however, there is a high potential for slope erosion due to gullying and arroyo cutting. Sherds are being washed down the gully north of the main site area. Gullying occurs on either side of the boulder outcrop/wall area and below the wall. The few artifacts and a midden area below the wall are threatened by continuing gully action. More serious undercutting of the river bank directly to the south may add to the site deterioration in the future. The wall appears unchanged from the FY91 to the FY93 monitoring episodes. The successive monitoring episodes evidenced continuing erosion of the midden area.

The FY94 monitoring effort showed that the structure, hearth, and artifacts were being impacted by surface erosion, and gullying and arroyo cutting were impacting the artifact scatter. As noted in the last monitoring episode in FY93, there was a high potential for slope erosion due to gullying and arroyo cutting. Sherds and lithic artifacts were washing down the gully north of the main site area. The cutbank south of the site was slumping as a result of river level fluctuations.

## Current Evaluation

As in previous evaluations, there is a high potential for slope erosion due to gullying and arroyo cutting. The slumping cutbank on the south side of the site has not caused any damage as of yet, however. The surface sample unit was checked, and there was no change in the position of the artifacts. The collector's pile shows evidence of human visitation. A flake was moved and replaced in a different position. A light trail is still discernable along the terrace.

## Recommendations

Annual monitoring is recommended due to the proximity of the site to the river cutbank.

AZ C:2:38

This site is a petroglyph panel situated at the base of a vertical Navajo sandstone cliff face where it joins a fluvial terrace. There are two possible prehistoric components at this site, late Archaic and PI-PIII Anasazi. The terrace in front of the panel probably contains buried cultural materials.

## Previous Evaluations

The site was monitored in FYs 91, 93, and 94. This rock art site is visited by over 40,000 people per year on guided tours. This causes surface erosion to the terrace in front of the panel. Extensive trailing can be seen meandering through the tamarisk and across the terrace to the panel. The rock-lined trail that now leads to the panel has been kicked out and displaced. However, the trampled viewing area in front of the panel has not grown appreciably in size since FY93.

The panel has undergone continuing impacts from graffiti, and the panel surface itself is impacted by wind, rain, and exfoliation. The modern dry-laid rock wall in front of the panel has been impacted by human visitation. Several of the large rocks from the top of the wall have been knocked to the ground. These impacts are not directly related to the river fluctuations or to dam operations.

## Current Evaluation

This site was visited twice during the FY95 monitoring effort. The first visit in March indicated that the dry-laid wall in front of the panel had been impacted by visitors displacing masonry elements. The second visit in June indicated no further change. The graffiti problem is under control for the present. A more concerted effort has been made to train tour guides about the importance of controlling this impact, and an NPS interpretive ranger is on site during much of the week.

## Recommended Remedial Actions

The site is monitored by stationary camera on a daily basis. On-site semiannual monitoring will continue due to the extreme visitation this petroglyph panel receives, and since there are probably buried cultural components in the terrace in front of the panel. The FY96 monitoring effort will begin following the tourist season in September, and a second visit will take place in the spring before the guided tours begin. The site is also visited by an archaeologist on an irregular schedule throughout the tourist season.

As a component of the ongoing trail maintenance program at Glen Canyon NRA, the trail to the petroglyph panel will be upgraded by adding geoweb fabric to stabilize the base of the trail. This will reduce the amount of downcutting and erosion to the terrace. The rocks aligning the trail will be reestablished, and other trails that meander across the terrace to the site will be eliminated. Stabilization, involving repointing and restacking of masonry elements, will be conducted on the modern rock wall in front of the petroglyph panel. This project will be completed in fall FY95.

When cultural resources are exposed on the terrace in front of the petroglyph panel, testing to determine the nature and extent of the subsurface cultural deposits will be recommended.

AZ C:2:50

This is a multicomponent camp consisting of two loci situated on the narrow remnant of an alluvial terrace on the right bank of the Colorado River. Locus A contains a fire-cracked rock scatter with charcoal, a cobble concentration and nearby hearth, and artifacts. Locus B contains a cist, fire-cracked rock, charcoal stains, the remains of an eroded structure, and artifacts.

## Previous Evaluations

This site was monitored in FYs 91 and 94. Bank cutting directly impacts the site and accelerated arroyo cutting and bank slumpage are occurring. Type I arroyos are present. Surface erosion and gullying are noted as well. A trail across the site is frequented by day hikers who access the area from the nearby Paria Riffle overlook parking area. The FY94 monitoring effort recorded a small pothole in Feature 7, a roaster.

## Current Evaluation

Surface erosion, gullying, and arroyo cutting are impacting both loci. Trailing through the site has caused movement of three stone elements in Feature 6.

## Recommendations and Remedial Actions

Since the site is being impacted by fluctuating levels of the Colorado River, annual monitoring is recommended. The trail through the site should be better defined, possibly lined with rocks, to redirect foot traffic away from the features. Instrument mapping and testing of subsurface cultural deposits are recommended.

### AZ C:2:60, Feature 2

Feature 2 is a remnant masonry structure on the edge of a narrow alluvial terrace along the Stanton Road. The feature is on the left bank of the river on the Navajo Nation.

#### Previous Evaluations

The site was monitored in FYs 91, 93 and 94. Active erosion is occurring. Pre-dam floods have cut the river bank precariously close to the structure, and fluctuating water levels may cause further bank slumpage. Surface erosion, wind deflation, and trailing also occur. There were fewer human impacts observed in FY93 than there were in FY91.

#### Current Evaluation

There are no changes noted.

#### Recommendations and Remedial Actions

The structure is near an eroding cutbank of the Colorado River. Therefore, it should be monitored annually. Additionally, the structure should be stabilized.

### AZ C:2:60, Feature 8

Feature 8 is an historic petroglyph located on a steep Pleistocene terrace on the left bank of the river on the Navajo Nation.

#### Previous Evaluations

This feature was monitored in FYs 91, 93 and 94. The rock art element is in stable condition with no natural or human impacts evident, except for some slight surface erosion of the stone. The glyph can be seen from a nearby trail.

#### Current Evaluation

Other than some surface erosion to the panel, it is not impacted by natural or human agents.

## Recommendations

The panel is not being impacted by river fluctuations or dam operations. A biennial monitoring schedule is recommended due to its visibility from and proximity to the trail.

AZ C:2:72

This site is a prehistoric artifact scatter with associated buried hearth features. It is located on the left bank on the Navajo Nation on a Pleistocene alluvial terrace.

## Previous Evaluations

The site was monitored in FYs 91, 92, 93 and 94. Surface erosion, gullying, arroyo cutting, bank slumpage, and side canyon erosion have all increased. The headward migration of arroyos is extremely active on and around the site. The main arroyo at the east-northeast site boundary drains to the Colorado River. The site is being impacted by fluctuating river flows. A buried hearth has collapsed into the arroyo, and these same agents are displacing the artifact scatter. A visitor trail has also impacted one of the hearths.

## Current Evaluation

Since the FY94 monitoring episode, there has been no change.

## Recommendations and Remedial Actions

Due to the active erosion, it is recommended that monitoring continue annually. Monitoring efforts should concentrate on the migration of side arroyos that drain into the main arroyo noted above. Recommended remedial actions to reduce site impacts include planting vegetation and the installation of check dams. Mapping as a form of data recovery is suggested for the near future.

AZ C:2:75

This is a prehistoric camp and artifact scatter located on an alluvial terrace at the base of the Navajo sandstone cliff on the left bank of the river.

## Previous Evaluations

The site was monitored in FYs 91, 92, 93 and 94, and it is actively eroding. Surface erosion, bank slumpage, dune migration, gullying, and arroyo cutting are noted impacts. A trail from the Ferry Swale camp site climbs through Locus A. Since the FY91 monitoring episode, the artifacts in Locus B are being displaced by surface erosion, gullying, arroyo cutting, bank

slumpage, and side canyon erosion. Most recently, new evidence of bank slumpage is present in Locus B, increasing the size of the arroyo.

These impacts are directly related to river fluctuations and dam operations. A deep arroyo continues to cause heavy impact with major undercutting of the terrace bank, which has caused the loss of most of the site. Slickrock runoff from the side canyons is impacting the site as well.

#### Current Evaluation

The bank slumpage in Locus B has increased. There has also been an increase in arroyo cutting and side canyon erosion. There have been no changes in a surface sample unit placed to measure the movement of artifacts.

#### Recommendations

The site should be monitored annually. Recommended data collection measures include surface collection of the entire site and testing for subsurface deposits. The site was instrument mapped on April 13, 1995.

AZ C:2:77

This prehistoric artifact scatter on the left bank of the river is spread over the first alluvial terrace and is eroding from the cutbank of the second alluvial terrace.

#### Previous Evaluations

The site was monitored in FYs 91, 93 and 94. In FY91, gullying was noted along the terrace edge, and one arroyo was present 50 m south of the site. The terrace slope was eroding from sheetwashing and human foot traffic. No trails were present, just random foot prints. Gullying from heavy runoff could cause the terrace margin to retreat.

The FY93 monitoring results showed similar minor impacts caused by surface erosion, gullying, wind deflation, and bank slumpage. There was also recent camper trash. The impacts are not related to river fluctuations and dam operations. The FY94 monitoring effort documented the displacement of artifacts by surface erosion, gullying and bank slumpage.

#### Current Evaluation

The FY95 monitoring effort documented no further impacts. In FY94, a surface sample unit was placed to record the movement of artifacts by surface erosion. The monitoring effort recorded that no movement of artifacts occurred.

## Recommendations

The site should be monitored biennially to record non-river-related impacts. Testing for subsurface cultural deposits is recommended. The site was instrument mapped on April 13, 1995.

AZ C:2:78

This site, on the right bank of the Colorado River, is beneath a small Navajo sandstone rockshelter at the head of a major arroyo that cuts through the uppermost river terrace. Lithic artifacts are eroding out of the floor and down a loose soil slope below the shelter.

## Previous Evaluations

The site was monitored in FYs 91 and 94. The site is not currently being impacted by the Colorado River, but the arroyo through the terrace is cutting headward 4 m west of the site. Surface erosion, arroyo cutting, and side canyon erosion are displacing the artifacts.

## Current Evaluation

Surface erosion has increased since the last monitoring episode in FY94, but all artifacts plotted on the original site map were relocated.

## Recommendations

The site should be monitored annually. Instrument mapping and testing for subsurface deposits is also recommended.

AZ C:2:79

This site is located on the left bank of the Colorado River in and around a rockshelter on a talus ridge at the contact with a Navajo sandstone cliff face. Ceramic and lithic artifacts and a masonry wall segment are present and suggest an early-mid PII Anasazi affiliation.

## Previous Evaluations

The site was monitored in FYs 91 and 94. The wall is being impacted by surface erosion, gullyng, and vegetation. The artifacts are being displaced by surface erosion, gullyng, and arroyo cutting. The arroyo is a Type I stream, draining to the Colorado River. Impacts are related to river fluctuations and dam operations.

## Current Evaluation

As noted during the FY94 monitoring episode, vegetation is still impacting the structure wall, but there are no increase in impacts.

## Recommendations

The site should be monitored annually. It was mapped by total station equipment on April 13, 1995.

AZ C:2:81

This is a prehistoric artifact scatter buried in the uppermost alluvial terrace on the left bank of the river. Artifacts are exposed along the visitor trail to AZ C:2:38.

## Previous Evaluations

The site was monitored in FYs 91, 93 and 94. Visitor impacts have cut the trail deeply, further exposing the site. The trail leads to AZ C:2:38, a large petroglyph panel just downstream. In FY 91, the trail ranged from 10-50 cm deep. In FY 93, the trail was 70 cm deep in some places. Since the monitoring episode in FY91, maintenance crews lined the trail with a rock boundary to help direct visitors to the petroglyph site.

The trail has increased in width and depth since the site was monitored in FY93. In addition, other trails funneling into the main trail have been established. Natural impacts include surface erosion and wind deflation, and a recent rain storm has aggravated the erosion problem along the trail, downcutting it as much as 50 more cm.

Maximum depth of the trail cut is now over 1 m in some places. Continuing use of the trail is exposing more of the site. More artifacts are noted on the surface, but so far, there are no buried cultural materials noted in the trail cuts. None of the impacts appear to be related to river fluctuations or dam operations, instead, the site is impacted by foot traffic from 40,000 visitors per year. Continued exposure of artifacts and buried components is likely.

## Current Evaluation

The site was monitored twice in FY95. The trail through the site is now a Type II stream. The trail has not increased in width or depth since the tremendous downcutting episode that occurred last year.

## Recommendations and Remedial Actions

As part of the trail maintenance program at Glen Canyon NRA, the trail through AZ C:2:81 to the petroglyph panel will be repaired and upgraded by adding geoweb fabric to stabilize the base of the trail. This will reduce the amount of downcutting and erosion to the terrace and through the site. The rocks aligning the trail will be reestablished, and other trails that meander across the terrace to the site will be eliminated. This project will be completed in Fall FY96.

As an element of Section 106 Compliance for the trail maintenance program, Site AZ C:2:81 was tested to determine the nature and extent of any buried deposits (Burchett 1995). No subsurface artifacts were recovered. As a part of the testing program, surface artifacts were mapped and collected, however. Another element of Compliance will include monitoring of the trail rehabilitation activities by an archaeologist. Due to the amount of visitation, the site should be monitored semi-annually.

#### AZ C:2:83

This is a prehistoric artifact scatter with associated hearth located on the left bank of the river on the Navajo Nation. The remains are on a talus slope at the base of the Shinarump Conglomerate above the fluvial terrace.

#### Previous Evaluations

The site was monitored in FYs 91, 93 and 94. This area has seen much activity in the last century, including construction associated with Lee's Ferry, the dugway road, and a gauging station. Hikers trail through the site as well. Surface erosion is extensive, and a cutbank is on the eastern side of the site. The exposed surface hearth will continue to erode. A Type I arroyo is below and northwest of the artifact scatter. Headward migration of the arroyo will eventually cut into the scatter. The presence of the arroyo is related to river fluctuations, but surface erosion will displace the surface expression of the site prior to that. Continued use of the trail to the USGS gauging station is noted. The hearth has been extensively impacted by trampling. It is a light charcoal stained lens of sand. Three small flecks, but no chunks, of charcoal were noted.

The FY94 monitoring effort recorded an increase in the surface erosion to the hearth and artifacts. The thin veneer of fine well-sorted sands that was capping the hearth stain has eroded away to expose a deposit of coarse gravelly sands, and gullying has begun eroding downslope through the cultural deposit. The charcoal staining is still present but is eroding downslope. These most recent impacts are due to late summer rains in the area. Evidence of the trail passing through the site to the U.S.G.S. Gauging Station has eroded away.

#### Current Evaluation

There are no changes to the condition of the feature or of impacts since the last monitoring episode in FY94.

#### Recommendations

Annual monitoring is recommended to record impacts from surface erosion.

AZ C:2:88

This site is located on the right bank of the Colorado River within an overhang shelter at the contact between a Navajo sandstone cliff face and a talus slope. The shelter contains a grinding slab enclosed by two expedient parallel walls extending from the back of the overhang. A single sherd below the shelter suggests a possible PII Anasazi affiliation.

#### Previous Evaluations

The site was monitored in FYs 91 and 94. Natural impacts include surface erosion and gulying caused by runoff from a dripline at the top of the overhang. A 3 m deep Type I arroyo is located 3 m west of the shelter, and surface erosion is causing minor displacement of artifacts and is beginning to undermine the wall. One stone wall element has been moved from below the wall to the back of the wall. Recent trash is present, and a trail ascends the talus slope to the site. Recent graffiti was scratched into the wall above the site. This graffiti includes a "P" and wavy lines. Visitor trampling of vegetation has occurred in the rock shelter, although no foot prints were present.

#### Current Evaluation

The monsoon thunderstorms noted last fall hit this site as well. A storm cleaned out the Type I arroyo and formed a new debris flow below the site on the shore of the river. Trailing and trampling are reduced.

#### Recommendations

The site should be monitored annually to record enlargement of the encroaching arroyo. The site is a candidate for instrument mapping.

AZ C:2:91

This prehistoric site consists of two loci with charcoal lenses and an associated artifact scatter on top of an alluvial terrace on the left bank of the river on the Navajo Nation.

#### Previous Evaluations

The site was monitored in FYs 91, 93 and 94. Natural impacts are extensive and include arroyo cutting, gulying, surface erosion, wind deflation, and bank slumpage. These impacts increased in severity from FY 93 to FY94. A 6 m deep Type I arroyo bisects the site and is eroding through the charcoal lenses. Recent seasonal rains have caused a debris flow that has scoured the Type I arroyo, removing all vegetation and causing collapse of the arroyo walls. An ephemeral game-foot trail was present, though little use is noted.

## Current Evaluation

Arroyo cutting, bank slumpage and side canyon erosion have increased, causing more material in the charcoal lenses to collapse into the arroyo. The trail across the terrace is almost unnoticeable.

## Recommendations

The site should be monitored annually.

AZ C:2:100

This is a prehistoric site consisting of buried charcoal features and artifact scatters located on an alluvial terrace. The remains are on the left side of the river on the Navajo Nation.

## Previous Evaluations

This site was monitored in FYs 91, 92, 93 and 94. The site is actively eroding from side draining Type I arroyos. Natural impacts include arroyo cutting, gullying, surface erosion, wind deflation, and bank slumpage. These impacts are related to river fluctuations and dam operations, based on headward migration of arroyos due to the lowering of the base level. A gear and a bicycle frame have been plotted on a revised site map. Artifacts are expected to move downslope. Trampling and trailing through the site also occurs.

The FY94 monitoring noted no changes to Feature 1, the charcoal lens in the cutbank. The bicycle frame collapsed. Feature 2, a set of sandstone slabs, was more dispersed since the monitoring episode in FY93. The cutbank near the gear receded 12 cm since FY93. Bank slumpage had therefore increased.

## Current Evaluation

The FY95 monitoring results note no changes to Feature 1, the lens in the cutbank or to the bicycle frame. Feature 2, the set of sandstone slabs, has a new gully eroding into it. The bicycle gear has collapsed into the arroyo, indicating an increase in bank slumpage and arroyo cutting.

## Recommendations and Remedial Actions

The site is being monitored by stationary camera, and on-site monitoring is recommended annually. The installation of check dams and planting vegetation could help to reduce the erosion. Mapping as a form of data recovery is recommended.

This prehistoric site includes a hearth with charcoal staining and an associated artifact scatter. It is located on top of a dune remnant that caps an alluvial terrace on the left side of the river.

#### Previous Evaluations

The site was monitored in FYs 91, 92, 93 and 94. Surface erosion, gullying, and arroyo cutting are impacting the entire site, and runoff is impacting the hearth. Artifacts southwest of the site are eroding down the terrace slope. These impacts are related to river fluctuations, i.e., direct inundation of the site has occurred, but the site is also threatened by surface erosion and eolian deflation. The charcoal lens exposed in the cutbank is eroding and getting smaller. A system of trails is nearby, and foot prints were noted on site.

#### Current Evaluation

Since the last monitoring episode in FY94, bank slumpage around the hearth has increased. One new trail is present in the arroyo and on the north side of the hearth. A previously noted trail is also present on the south side of the hearth.

#### Recommendations

The site should be monitored annually. The site should be surface collected, mapped and tested. Excavation of the site is also recommended.

## V. MANAGEMENT SUMMARY

This management summary includes site-specific measures to reduce impacts, measures to protect site integrity, a work plan for FY96, and an assessment of the monitoring program.

### Measures to Reduce Site Impact

Table 8 lists specific recommendations designed to reduce site impacts for all monitoring locations within Glen Canyon NRA. The FY96 work plan outlined below prioritizes these actions based on what sites need immediate attention. Eighteen monitoring locations are recommended for some form, or combination of, remedial action. One site is recommended for three impact reduction measures, four sites are recommended for two impact reduction measures, and 13 sites are recommended for one impact reduction measure. These methods include retrailing, obliterating trails, planting vegetation, installation of check dams, and stabilization. Closing the site to visitors is also an option within the remedial action plan, but this recommendation was not applied to a site within Glen Canyon NRA.

Stabilization of the cultural features is the most commonly recommended method for reducing site impacts. In several cases masonry walls are under the threat of collapse. Remortaring of top course elements is recommended in one case, while reconstructing a door frame is suggested for another.

Trail obliteration is recommended in six cases. Where sites are difficult to detect, trails are the result of inadvertent visitor use. Many sites are traversed by multiple trails, and they are formed by private and guided boaters hiking and fishing within the canyon. Until these trails are obliterated, people will continue walking on them, thus impacting site features. If these trails are not eliminated, they tend to become entrenched, making shallow to deep gullies that connect, in some circumstances, with river-based or terrace-based drainages as in the case of the trail through C:2:81. Trails exacerbate the effects of all classes of erosion, from surface erosion to arroyo cutting and bank slumpage.

The installation of check dams is recommended in five cases where, using traditional methods, dams made from sticks or branches can reduce the downcutting on alluvial terraces cut by shallow gullies. The planting of vegetation is suggested in three cases where increased vegetation on terrace surfaces would reduce the amount of surface erosion and gullying.

Retrailing is recommended in three cases where established trails exist. Some of the desired trails need maintenance, such as replaced stone borders to redirect traffic from ancillary paths toward the desired trail.

Table 8. Site-specific recommended measures to reduce site impacts.

AZ Site Number, Feature	Retrail	Obliterate Trail	Plant Vegetation	Install Check Dam	Stabilize
C:2:11, Feature 1	0	0	0	0	1
C:2:11, Feature 14 *	0	0	1	1	0
C:2:33	0	0	0	0	1
C:2:38 *	1	1	0	0	1
C:2:50 *	1	0	0	0	0
C:2:57	0	0	0	0	1
C:2:60, Feature 2 *	0	0	0	0	1
Feature 4	0	0	0	0	1
C:2:72 *	0	0	1	1	0
C:2:76	0	1	0	1	0
C:2:81 *	1	0	0	0	0
C:2:86	0	1	0	0	0
C:2:90	0	1	0	0	0
C:2:91	0	1	0	0	0
C:2:99	0	0	0	1	0
C:2:100 *	0	0	1	1	0
C:2:106	0	1	0	0	0
C:3:3	0	0	0	0	1
Totals	3	6	3	5	7

\*: Indicates monitoring locations inspected during FY95.

## Measures to Protect Site Integrity

After all measures of reducing site impacts are exhausted and deterioration continues, methods to protect a site's integrity are activated. Generally, these are methods used to collect archaeological data before they are irretrievable. The four measures suggested to protect site integrity are: mapping, surface collection of the entire site, subsurface testing, and excavation.

Table 9 lists site-specific recommendations for protecting site integrity. Some form, or combination of, data collection is recommended at 32 monitoring locations. Twenty-four locations have been recommended for total station mapping. This process of data recovery is essential prior to several methods of reducing site impact, or data collection. Ten sites have thus far been mapped. The fiscal years during which they were mapped are indicated on Table 9. Five other sites have also been mapped. In FY94, C:2:32 and C:2:105; and in FY95, C:2:35, C:2:71, and C:2:73 were mapped.

Testing a site for subsurface cultural deposits, including the collection of radiocarbon and ethnobotanical samples, could be the most affective and efficient option for collecting archaeological data. Fourteen monitoring locations are recommended for testing.

Surface collecting the entire site is recommended at four monitoring locations. Site C:2:81 was surface collected in FY94 (see Table 9) as part of the Section 106 compliance for the rehabilitation of the Petroglyph Trail. It is recommended that prior to implementing the total collection of artifacts, methods of reducing site impacts have been attempted. Excavation is warranted at one site, C:3:10. The FY96 Work Plan below prioritizes these recommendations depending on whether the sites are in immediate, moderate or minor danger of deterioration.

Table 9. Site-specific recommended measures to protect integrity.

AZ Site Number, Feature	Map	Surface Collect	Test	Excavate	Other
C:2:11, Feature 3 *	1	0	0	0	0
Feature 4	1	0	0	0	0
Feature 5	1	0	0	0	0
Feature 11	1	0	0	0	0
Feature 12	0	0	0	0	1
Feature 14 *	1	0	0	0	0
Feature 21	1	0	0	0	0
C:2:13 *	1	0	1	0	0
C:2:33	0	0	1	0	0
C:2:38 *	FY94	0	1	0	0
C:2:39	1	0	0	0	0
C:2:40	1	0	0	0	0
C:2:50 *	1	0	1	0	0
C:2:53	0	0	1	0	0
C:2:57	1	0	0	0	0
C:2:60, Feature 7	1	0	0	0	0
C:2:72 *	1	0	0	0	0
C:2:75 *	FY95	1	1	0	0
C:2:77 *	FY95	0	1	0	0
C:2:78 *	1	1	1	0	0
C:2:79 *	FY95	0	0	0	0
C:2:80	1	0	0	0	0
C:2:81 *	FY94	FY94	1	0	0
C:2:82	0	0	1	0	0
C:2:84	1	0	0	0	0
C:2:86	0	0	1	0	0
C:2:87	1	0	0	0	0
C:2:88 *	1	0	0	0	0
C:2:99	1	0	1	0	0
C:2:100 *	1	0	0	0	0
C:2:106	0	0	1	0	0
C:3:10 *	1	1	1	1	0
Totals	24	4	14	1	1

\*: Indicates monitoring location inspected in FY95.

## FY96 Monitoring Work Plan

The FY96 scope of work includes monitoring activities, site mapping, continuing terrestrial photogrammetry, and remedial actions.

### Monitoring Activities

**Site Selection Process.** As noted in Section II above, the intent of the Monitoring Plan is for sites to be visited to the minimal extent necessary in order to identify and prevent erosional process and human impacts. Five monitoring schedule categories are being used. They are based most importantly on whether erosional impacts are related to river fluctuations and/or dam operations. Lesser issues for site selection include erosion not related to the river or dam, visitor impacts such as graffiti on rock art panels, visibility of sites from the river or trails, and proximity of sites to heavy use areas.

The five monitoring schedule categories include semi-annual monitoring, annual monitoring, biennial monitoring, monitoring every 3-5 years, and discontinue monitoring. See Table 1 for the monitoring schedule for all 69 locations monitored within Glen Canyon NRA. For FY96, 54 locations to be monitored include those assigned to the annual (N=21), biennial (every two years; N=31), and semiannual (twice a year; N=2) schedules on Table 1.

**Level of Effort.** Monitoring activities are scheduled to begin in October 1995. The two locations to be monitored on a semi-annual basis will be inspected in the fall following the visitor season and then again in the spring prior to high visitor season. For FY96, it is estimated that an average of five locations can be monitored per two-person day. Conducting the 54 monitoring episodes should require about 22 person days.

As a part of the monitoring effort, comparison data will continue to be gathered at the sites with surface artifact recording units to document changes in artifact counts and erosion patterns. Drafting maps in the lab will require 4 person days. A total of 26 person days are required to perform the field portion of the monitoring activities.

Reporting procedures include updating computer files and submission of a trip report and the annual report synthesizing FY96's monitoring results. Entering computer data will require 5 days. One Trip Report immediately following completion of the FY96 field work will be provided to all signatories for review, and will require 4 person days. The annual report, due on August 1, 1996, will require 12 person days to complete.

### Detailed Site Mapping

As in the past, five sites are chosen for total station mapping for FY96: C:2:72, 91, 99, 100 and C:3:10. These sites were chosen for mapping based on their Priority Ranks indicated on Table 10. This field work will require 5 person days and the use of Bureau of Reclamation personnel. An April time table is being planned.

## Terrestrial Photogrammetry

Film retrieval and replacement every 34 days at the camera locations will continue. This process involves day trips down the river from the dam. These day trips are opportunities for any signatories wishing to travel between Lee's Ferry and Glen Canyon Dam. Glen Canyon NRA requests that arrangements be made with Tim W. Burchett, (520) 608-6275, at least one month in advance. The NPS river boat has a capacity of 7 people, 6 visitors and the driver. Film changes, processing requisitions, and mailing will require 22 person days.

## Remedial Actions

Following the stabilization workshop conducted in May FY95, the next step involves writing a remedial action plan. Due to varying degrees of site conditions, it is crucial to prioritize the needs of each site based on the degree of impact. Three priority ranks were subjectively established. Information used to prioritize the sites for remedial actions include the accumulated monitoring data, comparative photographic records, and the field archaeologist's opinions concerning relative need of the remedial actions.

Table 10 lists site type, impacts, priority rank, and recommendations for 37 monitoring locations. The other 32 sites monitored by Glen Canyon NRA have thus far not received remedial action/data recovery recommendations. Sites with extensive impacts are given a priority rank of 1 (N=11), and remedial actions should take place on these sites first, preferably beginning in FY96.

Moderate impacts are given a priority rank of 2. These sites (N=9) are not endangered by any immediate impact, therefore, remedial actions will be conducted following the completion of remedial actions at Priority 1 sites. A priority rank of 3 (N=17) is recommended when there are very minor impacts, and remedial action will occur following the completion of remedial actions at Priority 2 sites. All remedial actions will be preceded by a reassessment of the site to insure that previous recommendations are still necessary and/or appropriate.

Table 10. Summary of the Sites that have been assigned remedial action/data recovery recommendations and priority ranks.

AZ Site Number, Feature	Site Type	Impacts	Rank	Recommendations
C:2:11, Feature 3	Lee's Main Ferry Site	Bank slumpage, wall collapse	3	Map
Feature 4	Sandstone corral	Trailing	3	Map
Feature 5	Cable Crossing Inscriptions		3	Map
Feature 11	Lee's Ferry Mining Operation	Surface erosion, gully, trailing	3	Map
Feature 12	Spencer Steamboat	Wet-dry cycling	2	Extend no-wake zone around steamboat
Feature 14	USGS Cableway	Surface erosion, gully, arroyo cutting, bank slumpage	1	Plant vegetation, install check dam
Feature 21	Hogans	Surface erosion, gully, arroyo cutting, growing vegetation	3	Map
C:2:13	Rock shelter w/wall	Surface erosion, gully	2	Map, test
C:2:33	Rock shelter w/granary	Surface erosion, gully, trailing, wall collapse	3	Stabilize, test
C:2:38	Petroglyph panel	Panel surface erosion, trailing, graffiti	1	Retrail, obliterate trail, stabilize, test
C:2:39	Lithic scatter	Surface erosion, gully, trailing, animal burrowing	2	Map
C:2:40	Lithic scatter	Surface erosion, gully	2	Map
C:2:50	Camp	Surface erosion, gully, arroyo cutting, trailing	2	Retrail, map, test
C:2:53	Artifact scatter	Surface erosion	3	Test

AZ Site Number, Feature	Site Type	Impacts	Rank	Recommendations
C:2:57	Historic habitation	Surface erosion, gully, arroyo cutting, trailing	2	Stabilize, map
C:2:60, Feature 2	Masonry structure	Surface erosion, trailing	3	Stabilize
Feature 4	Stock gate	Surface erosion, trailing	3	Stabilize
Feature 7	Corrals, stock pens		3	Map
C:2:72	Camp	Surface erosion, gully, arroyo cutting, bank slumpage	1	Plant vegetation, install check dam, map
C:2:75	Camp	Surface erosion, gully, arroyo cutting, bank slumpage	1	Mapping completed in FY95; surface collect, test
C:2:76	Camp	Gully, trailing	1	Obliterate trail, install check dam
C:2:77	Artifact scatter	Surface erosion, gully, bank slumpage	1	Mapping completed in FY95; test
C:2:78	Rock shelter w/artifacts	Surface erosion, arroyo cutting	2	Map, test
C:2:80	Lithic scatter	Surface erosion, gully, arroyo cutting	3	Map
C:2:81	Artifact scatter	Surface erosion, gully, trailing	1	Retrail, surface collect, test
C:2:82	Rock shelter w/wall, artifacts	Surface erosion	3	Test
C:2:84	Overhang w/wall, midden	Surface erosion, gully, collecting	3	Map
C:2:86	Cist, wall, artifacts	Surface erosion, trailing	2	Obliterate trail, test
C:2:87	Historic artifacts, tower	Surface erosion, gully, arroyo cutting	3	Map

AZ Site Number, Feature	Site Type	Impacts	Rank	Recommendations
C:2:88	Shelter w/walls, artifacts	Surface erosion, wall collapse, trailing	2	Map
C:2:90	Structures, petroglyphs, ceramics	Surface erosion, gully, panel surface erosion, trailing	3	Obliterate trail
C:2:91	Camp	Surface erosion, gully, arroyo cutting, bank slumpage, trailing	1	Obliterate trail
C:2:99	Artifact scatters, rock alignment	Surface erosion, gully, trailing	1	Install check dam, map, test
C:2:100	Camp	Surface erosion, gully, arroyo cutting, wind deflation, bank slumpage	1	Plant vegetation, install check dam, map
C:2:106	Roaster	Surface erosion, trailing	3	Obliterate trail, test
C:3:3	Glen Canyon Dam Trail	Surface erosion, gully, arroyo cutting	3	Stabilize
C:3:10	Camp	Surface erosion, gully, arroyo cutting, bank slumpage, trailing	1	Surface collect, test, excavate
Totals	37		1 = 11 2 = 9 3 = 17	

Writing a remedial action plan identifying a limited number of sites most appropriate for immediate remedial action and including field methods will require 10 person days, and will be sent to the members of the Programmatic Agreement. Response is requested within 30 days. In the case of retrailing and trail obliteration, a memorandum will be substituted for the proposal. This will provide for immediate attention to those two impacts.

#### Monitor Program Assessment

The FY95 GCES monitoring program within Glen Canyon NRA is complete. By the end of the FY93 program, 126 monitoring episodes had been conducted at 69 locations from Glen Canyon Dam to the Paria Riffle -- one at 24 sites, two at 33 sites, and 3 episodes at 12 sites. This suggests fairly comprehensive monitoring coverage during the first three years of the ongoing monitoring program. The FY94 monitoring program has filled the holes in the data base at the 24 sites with only one monitoring record. One-hundred ninety-five monitoring episodes have been conducted thus far through FY95.

Since the monitoring program began in FY91, field logistics have been modified to optimize the time spent on the river, while recording methodologies have been adjusted to obtain the most important and interesting data on natural and human impacts present.

The long-term monitoring and remedial action program has successfully completed several tasks. The program has determined what impacts occur at what sites. It has determined what kinds of impacts are related to river fluctuations and dam operations, and what impacts are related to other factors. Rates of erosion are beginning to be understood. Remedial action recommendations have been assigned and prioritized. The next task involves operationalizing the methods for remedial actions and then implementing those actions at priority sites, with follow up monitoring at those sites to assess the success or failure of the remedial actions.

VI. REFERENCES CITED

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Fairley, Helen C., Peter W. Bungart, Christopher M. Coder, Jim Huffman, Terry L. Samples, and Janet R. Balsom

1991 The Grand Canyon River Corridor Survey Project: Archaeological Survey along the Colorado River between Glen Canyon Dam and Separation Canyon. Draft report submitted by Janet R. Balsom, Principal Investigator, Grand Canyon National Park. Prepared in cooperation with the Glen Canyon Environmental Studies.



# United States Department of the Interior

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IN REPLY REFER TO:

L7617 GLCA-C

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GLEN CANYON ENVIRONMENTAL  
STUDIES OFFICE

AUG 7 1995

RECEIVED  
FLAGSTAFF, AZ

Bureau of Reclamation  
Attention: David Wegner  
GCES Office  
P.O. Box 22459  
Flagstaff, Arizona 86002-2459

Dear Interested Parties:

Enclosed please find the GCES Fiscal Year 95 Trip Report and the Fiscal Year 95 Archaeological Monitoring Summary Report for sites within Glen Canyon National Recreation Area from Glen Canyon Dam to the Paria Riffle.

Included in the Summary Report are the FY95 scope of work, trends in erosional impacts, site-specific results and recommendations. The management summary includes measures to reduce site impacts, measures to protect site integrity, the FY96 Work Plan, and an assessment of the monitoring program.

If you have any questions, please direct them to Archeologist Tim W. Burchett at 520-608-6275.

Sincerely,

  
(FOR) Joseph F. Alston  
Superintendent

Enclosures 3

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**GLEN CANYON DAM EIS LIST**

(7/95)

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