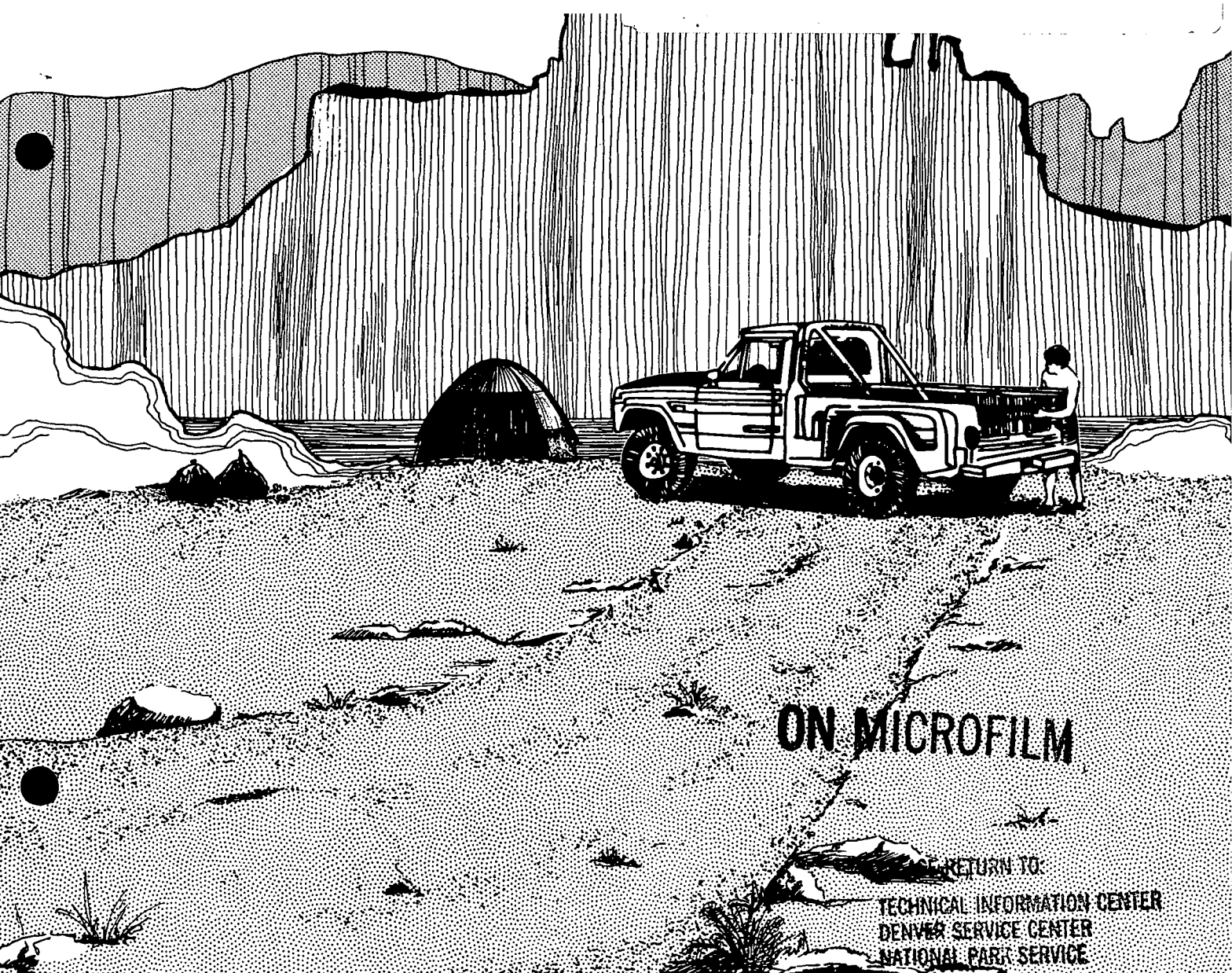
D-107
IN
STORAGE

ENVIRONMENTAL ASSESSMENT and MANAGEMENT/DEVELOPMENT CONCEPT PLANS for LAKE POWELL'S ACCESSIBLE SHORELINES

April 1988

Glen Canyon National Recreation Area

National Park Service - Rocky Mountain Region



ON MICROFILM

RETURN TO:
TECHNICAL INFORMATION CENTER
DENVER SERVICE CENTER
NATIONAL PARK SERVICE

ENVIRONMENTAL ASSESSMENT/MANAGEMENT/DEVELOPMENT CONCEPT PLAN FOR LAKE POWELL'S ACCESSIBLE SHORELINES

Glen Canyon National Recreation Area, Arizona-Utah
National Park Service
United States Department of the Interior

Responsible Official: L. Lorraine Mintzmyer
Regional Director
Rocky Mountain Region
12795 W. Alameda Parkway
P.O. Box 25287
Denver, Colorado 80225

For Further Information Contact: John O. Lancaster
Superintendent
Glen Canyon National
Recreation Area
P.O. Box 1507
Page, Arizona 86040
(602) 645-2471

SUMMARY OF PROPOSED PLAN

The proposed plan is intended to provide a balanced response to resource protection, visitor use, and park management needs, while considering anticipated National Park Service funding and staffing capabilities necessary to implement proposed actions. Included are management strategies which are applicable to all shoreline areas as well as site-specific strategies designed to address specific problems. The proposed plan also includes monitoring actions to determine success of proposed management strategies and evaluation of other management actions which may be necessary to administer Lake Powell's shorelines.

Under the proposal, Dirty Devil, Farley Canyon, Bullfrog Creek, Clay Hills, Cottonwood Canyon, Crosby Canyon, Stanton Creek, Warm Creek, Red Canyon, Blue Notch Canyon, and White Canyon would be open for day use and overnight camping. The National Park Service would work with the Navajo Nation to manage Neskahi, Copper Canyon, and Piute Canyon. Areas for day use would be provided at Halls Crossing Cove #4, The Chains, and Hole-in-the-Rock.

Interpretation, resource and visitor protection, lakewide shoreline clean up, and other management actions will be used to reduce resource impacts and visitor conflicts.

Improvements proposed at various shoreline sites include signing, physical traffic control barriers, designated camping areas, designated travel corridors, toilets, trash receptacles, lake buoy lines, parking, shade shelters, picnic facilities, and interpretive trails.

Implementation of the proposal will require slight increases in protection, interpretation and maintenance staffs. Total construction cost estimate is $4,672,000.

TABLE OF CONTENTS

CHAPTER I

Purpose and Need for the Plan. 1

A. Introduction 1
B. Legislative and Planning Framework 1
C. Issues 4

CHAPTER II

The Proposal and Alternatives Addressing the Issues. .7

A. Introduction 7
B. Proposed Plan. 7
    1. Purpose. 7
    2. Overall Management Actions 7
    3. Area Specific Actions. 11
    4. Staffing and Operational Needs 38
    5. Construction Cost Estimates. 44
    6. Monitoring/Additional Plans and Studies Needed. 47
C. Alternatives Considered. 48
    1. Alternative A - No Action. 48
    2. Alternative B - Minimum Management 53
    3. Alternative C - Concentrate Visitor Use. . . 59

CHAPTER III

The Affected Environment 67

A. Introduction 67
B. Existing Conditions. 67
C. Natural Resources. 71
    1. Water Resources. 71
    2. Soils. 73
    3. Vegetation 73
    4. Threatened and Endangered Species. 74
    5. Air. 75
D. Cultural Resources 75
E. Visitor Use/Recreation 76
F. Lake Powell's Carrying Capacity. 80
G. Facility Analysis and Staffing 82

CHAPTER IV

Environmental Consequences of the Proposal and Alternatives. 85

A. Introduction 85
B. Natural Resource Environmental Consequences. . . 85
   1. Water Resources. 85
   2. Soils. 87
   3. Vegetation 89
   4. Threatened and Endangered Species. 91
   5. Air. 91
C. Cultural Resource Environmental Consequences . . 92
D. Effects on Visitor Use/Recreation. 94
E. Effects on Lake Powell's Carrying Capacity . . . 98
F. Any Irreversible and Irretrievable Commitment of Resources 99
G. The Relationship Between Short-Term Uses of Man's Environment and the Maintenance and Enhancement of the Long-Term Productivity 100

CHAPTER V

List of Preparers and Consultants. 101

APPENDICES

Appendix A - Interpretive Program for the Proposed Plan. 105
Appendix B - Water Resources 115
Appendix C - Soils 119
Appendix D - Vegetation. 125
Appendix E - Cultural Resources. 131
Appendix F - Visitor Use/Recreation. 141

LIST OF MAPS

Project Map. 2
Proposed Plan. 8
Blue Notch and Red Canyons 12
Bullfrog Creek 15
Clay Hills 17
Crosby Canyon. 19
Dirty Devil. 21
Farley Canyon. 24
Stanton/Hansen Creeks. 26
Warm Canyon. 27
White Canyon 29
Halls Crossing Cove #4 31

LIST OF MAPS, CONTINUED

Hole-in-the-Rock 33
The Chains 34
Copper Canyon/Neskahi/Piute. 36
Cottonwood Canyon. 37
Lake Canyon. 39
Last Chance Creek. 41
Alternative A. 49
Alternative B. 54
Alternative C. 60

LIST OF FIGURES

Construction Cost Estimates - Proposed Plan. 44
Construction Cost Estimates - Alternative B. 57
Construction Cost Estimates - Alternative C. 64
Water Quality at Accessible Shoreline Sites. 72
Existing Acres of Disturbed Vegetation 73
Existing Facilities/Conditions 83

CHAPTER I

PURPOSE AND NEED FOR THE PLAN

INTRODUCTION

The primary purpose of this planning effort is to develop alternatives for management of Lake Powell's shoreline to reduce resource degradation, visitor-use conflicts, and safety hazards at twenty shoreline sites that presently have road access (see Project/Vicinity Map). A majority of Lake Powell's 1,960 miles of shoreline are sandstone cliffs on rockslide areas that are not accessible by road. The twenty shoreline sites that are accessible were identified in the park's General Management Plan (GMP). However, the GMP did not recommend developments or actions necessary to manage these shoreline sites.

Glen Canyon has experienced an average annual visitation increase of 6.4 percent for the past decade. It appears that use of accessible shorelines has experienced a similar increase. This has led to growing off-road-vehicle (ORV) use and a spread of trailing damage resulting in vegetation trampling and soil erosion. Also, the diversity of recreation activities has led to visitor conflicts and at times, safety hazards.

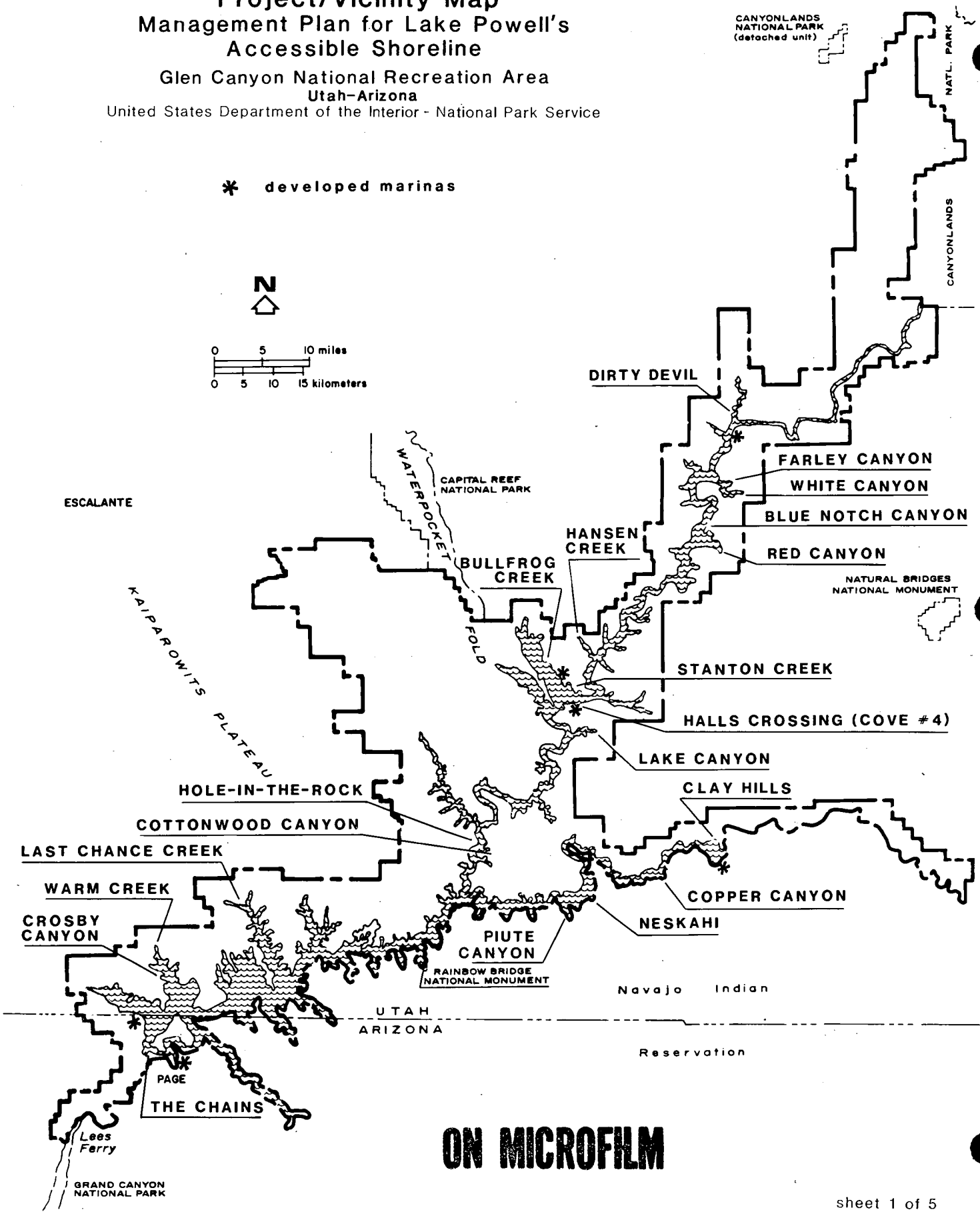
LEGISLATIVE AND PLANNING FRAMEWORK

Provisions for establishment of the national recreation area are authorized under Public Law 92-593, October 27, 1972. A General Management Plan for Glen Canyon was approved in July 1979. The GMP identified shoreline areas along Lake Powell where road access would be permitted. However, the GMP did not prescribe actions or improvements necessary to manage these areas. This planning effort will supplement the GMP by prescribing necessary management actions and improvements for each road accessible shoreline area.

Management of Lake Powell's accessible shoreline sites is also influenced by various resource management and development concept plans. These plans prescribe resource management actions applicable to shoreline sites or include marina development scenarios that will affect use of dispersed shoreline sites. Other

Project/Vicinity Map
Management Plan for Lake Powell's Accessible Shoreline

Glen Canyon National Recreation Area
Utah–Arizona
United States Department of the Interior - National Park Service



ON MICROFILM

sheet 1 of 5

608	80,100
Jan 87	RMRO

plans and approval dates applicable and compatible with this planning effort are as follows:

Natural Resource Management Plan	June 1986
Cultural Resource Management Plan	June 1987
Water Resources Management Plan	June 1987
Lake Powell Carrying Capacity Study	November 1987
Halls Crossing DCP	September 1985
Bullfrog Basin DCP	September 1985
Lone Rock DCP	May 1979
Wahweap DCP	July 1983
Hite DCP	August 1983
Antelope Point DCP	March 1986
Piute Farms DCP	May 1986
Statement for Management	September 1985

Glen Canyon's establishing legislation contains the following major legislative constraints applicable to management of Lake Powell's shorelines.

-"The Secretary shall administer, protect, and develop the recreation area...for the conservation and management of natural resources..."--This is being done consistent with the authorities granted in the NPS's 1916 enabling legislation.

-"...Nothing in this Act shall affect or interfere with the authority of the Secretary...to operate Glen Canyon dam and reservoir..."--Interactions between the Bureau of Reclamation and the NPS are formalized in a cooperative agreement.

-"...The Secretary may designate zones where, and establish periods when, no hunting, fishing, or trapping shall be permitted for reasons of public safety, administration, or public use and enjoyment."--Closed areas have been established in the past and additional closed areas can be established in the future under the guidelines in 36 CFR governing closures.

-"The Secretary, together with the Highway Department of the State of Utah, shall conduct a study of proposed road alignments within and adjacent to the recreation area. Such study...shall designate what additional roads are appropriate and necessary for full utilization of the area for the purpose of this act..."--A road study was completed in 1974 by the Utah Department of Transportation and NPS.

Management objectives contained in the park's Statement for Management applicable to this project are as follows:

-To manage the recreation area so that it provides maximum recreation enjoyment to the American public and their guests.

-To maximize the recreational experiences and the number of opportunities for enjoying the recreation area.

-To provide the richest possible interpretive experience to visitors of the recreation area.

-To encourage the maintenance of high water quality in all bodies and sources of water and to perpetuate the natural flow of free water.

-To manage the park's ecosystem in ways that interfere with the natural processes as little as possible, consistent with permitted recreational and commercial uses.

-To cooperate with the Navajo Tribe in managing and developing the southern shoreline of Lake Powell for recreation use.

-To determine the significance of the park's cultural resources and to maintain the integrity of these resources.

ISSUES

The following issues were identified by the public, the National Park Service, and other government agencies during a scoping and public involvement program begun in August 1986.

ISSUE A: THE LAKE AND ITS SHORELINES WITH ROAD ACCESS ARE USED FOR A VARIETY OF RECREATION ACTIVITIES. THIS VARIETY OF ACTIVITIES HAS CREATED CONFLICTS RELATED TO USER SAFETY AND DESIRED RECREATION EXPERIENCE.

Shoreline areas that are currently accessible by road have been receiving many forms of recreation activities ranging from jet skiing and off-road vehicle use, to fishing and camping. As a result, some user-safety

concerns have been identified. In some areas, boat launching, jet skiing, and swimming occur concurrently. Near-collisions between swimmers and watercraft have been observed and their frequency appears to be rising. Many shoreline areas are characterized by rolling sand and slickrock, which limit sight distance of vehicle users. Indiscriminate use by off-road vehicles has created safety conflicts with campers. Also, these dispersed shoreline areas are currently available for firearm use and hunting. This use requires analysis to determine if firearm control is necessary for visitor safety in heavily used areas.

Dispersed shoreline areas are used by a variety of groups, including families and large parties of young adults. Alcohol consumption, loud parties, and large group sizes have created conflicts with users desiring a more serene experience.

ISSUE B: MANY SHORELINE RESOURCES ARE BEING DAMAGED BY SOME TYPES OF RECREATION ACTIVITIES.

Previous use of shoreline resources has established use zones where resources are being impacted. These use areas have steadily grown in size with the increase of visitation. Vehicle use off established roads is illegal, yet it is a growing problem that results in damage to large areas in the vicinity of popular shoreline camping areas. Off-road vehicles and other recreation activities have encroached on previously undisturbed areas. This has resulted in vegetation trampling, soil erosion, lake contamination, and possible disturbance of surface archeological resources.

Shoreline areas also lack facilities for human waste and litter disposal. This has resulted in the build-up of human waste, the burying of garbage, the general littering of use areas, and degradation of water quality.

ISSUE C: SOME SHORELINE AREAS OF LAKE POWELL ARE ACCESSIBLE BY ROAD BUT HAVE NOT YET EXPERIENCED SIGNIFICANT LEVELS OF RECREATION USE. HOW SHOULD THESE AREAS BE MANAGED TO PREVENT PROBLEMS FROM DEVELOPING?

In some shorelines with road access, visitor use has not been established. There is a need to identify

management strategies that could be employed to prevent potential user and resource impacts before visitor use is established. Analysis is needed to determine if an area should be available for visitor use and if available, under what conditions should activities and resources be managed.

ISSUE D: THE TYPES AND LEVEL OF VISITOR USE AND ACTIVITIES NEED TO BE IDENTIFIED FOR SHORELINE AREAS WITH ROAD ACCESS.

A majority of facilities provided at the national recreation area are oriented towards the overnight user; little is available for the day-use visitor. Accessible shoreline areas have the capability of providing opportunities for the day-use public. Analysis is needed to determine if and how areas could be managed and designated for the day user. Also, to help minimize user conflicts, provide for visitor safety, and provide for a broad spectrum of recreation activities, there is a need to evaluate each shoreline area in relation to allowable uses and activities.

The need also exists to determine how much recreational use is occurring on accessible shoreline areas and how this use is related to Lake Powell's carrying capacity as described in the November 1987 report, "The Carrying Capacity of Lake Powell--A Management Analysis of Capacity for Boater Recreation."

ISSUE E: THE CLAY HILLS AREA AND ITS RELATION TO RIVER-RUNNING OF THE SAN JUAN REQUIRES ANALYSIS.

Clay Hills has been used for debarking of raft trips on the San Juan River. Fluctuating lake levels and natural siltation have created silt or mud flats that create difficulties during debarking activities. Also, there are no facilities available for human sanitation and litter disposal.

Analysis is required to determine if improvements should be placed at Clay Hills (such as a river-running boat recovery area, restrooms, and trash receptacles) to meet visitor needs, or if debarking activities should be relocated to a new shoreline area.

CHAPTER II

THE PROPOSAL AND ALTERNATIVES ADDRESSING THE ISSUES

INTRODUCTION

The proposal presented in this chapter constitutes the National Park Service's preferred course of action for management of shorelines which are accessible by road along Lake Powell. Other alternatives were developed to address the issues in various ways, and they are also displayed in this chapter. The alternatives have different emphases. Consequently, each provides a different response to the issues. In addition to the National Park Service proposal, three alternatives were developed. They are: no action, minimum management, and concentrate visitor use.

The proposal was selected over other alternatives analyzed because it is intended to provide a balanced response to resource protection, visitor use, and park management needs, while considering anticipated National Park Service funding and staffing capabilities necessary to implement proposed actions. Included are management strategies which are applicable to all shoreline areas as well as site-specific strategies designed to address specific problems. The proposal also includes monitoring actions to determine success of proposed management strategies and evaluation of other management actions which may be necessary to administer Lake Powell's shorelines.

THE PROPOSED PLAN

PURPOSE

This proposal provides intensive management actions and site improvements at high-use areas, while maintaining other selected areas with road access for low-to-moderate levels of visitor use. The proposal is consistent with the park's General Management Plan (GMP).

OVERALL MANAGEMENT ACTIONS

Shoreline sites where road access is permitted or can be considered, have been identified in the park's GMP and the 1974 road study completed by the National Park

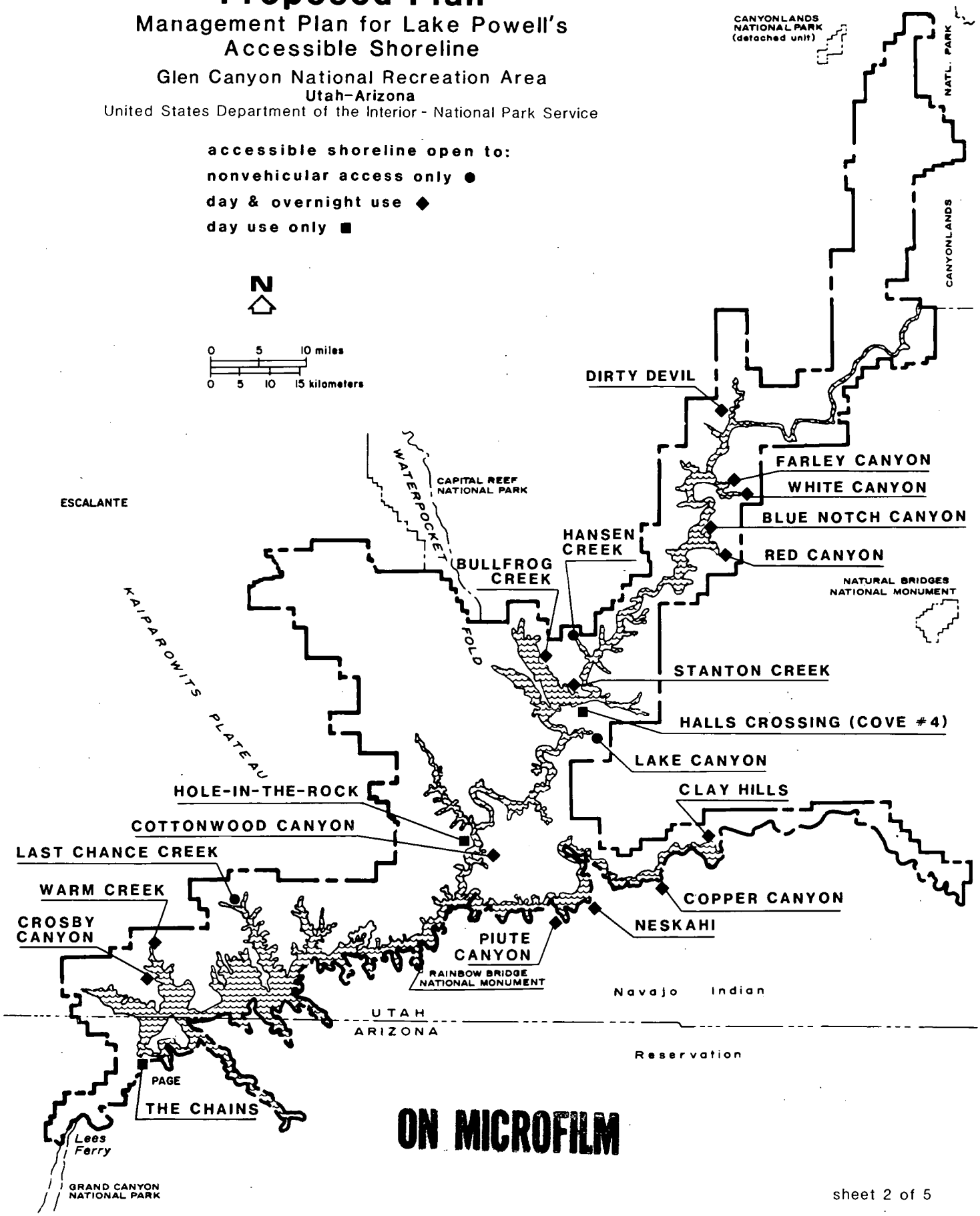
Proposed Plan

Management Plan for Lake Powell's Accessible Shoreline

Glen Canyon National Recreation Area

Utah–Arizona

United States Department of the Interior - National Park Service



ON MICROFILM

sheet 2 of 5

608 | 80,100
Jan 87 | RMRO

Service and Utah Department of Transportation. Under this plan, new roads will not be constructed to provide additional access to Lake Powell's shorelines.

Each of the twenty shoreline sites were examined to determine historic use patterns, visitor activities, segments of the public primarily served, developed areas in close proximity, existing resource damage, potential to experience additional resource damage, and proximity to other shoreline-use sites. Based on this examination and the goal of this plan, the sites were placed in one of three categories--(1) nonvehicular access only, (2) day use only, and (3) day and overnight use.

Sites open for day and overnight use generally receive higher amounts of visitation, are popular camping areas, and have conditions which lend themselves to prevention of resource damage through management actions or site improvements. Sites in this category include Blue Notch Canyon, Bullfrog Creek, Clay Hills, Cottonwood Canyon, Crosby Canyon, Dirty Devil, Farley Canyon, Red Canyon, Stanton Creek, Warm Creek, and White Canyon. Copper Canyon, Neskahi, and Piute Canyon would also be open to day and overnight use, however, management of these sites would require cooperation and coordination with the Navajo Nation.

Generally, day-use-only sites are located in close proximity to a marina or do not have easily accessible lake shorelines. Under this plan The Chains, Halls Crossing Cove #4, and Hole-in-the-Rock would be managed for day-use activities.

Shoreline sites managed for nonvehicular access include Hansen Creek, Lake Canyon, and Last Chance Canyon. These sites will be closed to vehicular access because of flash flood hazards associated with their access roads, because of resource conditions which cannot be efficiently managed to prevent resource degradation, or because the access road is not authorized in the GMP.

Areas managed for nonvehicular access only will be signed, gated, or otherwise marked at road access points to illustrate their closure to vehicles. The public will also be made aware of these vehicular closures through various information distribution techniques. Scheduled ranger patrols will be used to

enforce closures.

A firearm discharge prohibition will be implemented within one-half mile of all shorelines open to vehicular access to enhance visitor safety.

The interpretive program will be used as an educational tool to convey resource impacts created by visitor use and how these impacts can be prevented. The goal of this program is to obtain visitor self-regulation of restrictions and controls developed by the National Park Service. Appendix A contains additional information regarding the interpretive program associated with management of accessible shoreline areas.

To help distribute visitor use to sites with lower visitation and to inform the visitor of various opportunities available at each shoreline area, a recreation opportunity guide program will be implemented. This program will consist of an inventory of activities and probable experience opportunities available at each shoreline. Information would be available for visitor review and distribution at each visitor center and ranger station. The information will also be mailed to visitors as requests are received.

A shoreline clean-up crew which will clean up litter and fire rings will be established to help prevent resource damage. All areas more than 200 yards from the nearest toilet will include a self-contained waste disposal restriction. In areas receiving low use, the NPS will explore the use of self-composting toilets in an effort to reduce maintenance costs.

Through use of the Volunteers In Parks (VIP) program, the park will explore the possibility of using a Campground Host at Dirty Devil, Farley Canyon, Bullfrog Creek, and Stanton Creek. Presence of a Host in these areas should assist in the prevention of resource damage.

Many of the actions proposed by this plan are dependent on some visitor self-regulation. The visitor will be made aware of this condition and cautioned that failure to adhere to rules could lead to closure of the area.

It will be necessary to monitor shoreline sites to ensure that resource impacts are being controlled. A park "Monitoring Management Plan" will be developed to monitor impacts, determine effectiveness of management actions, identify research needs, and recommend additional management actions when it is necessary to control resource degradation. The plan should be developed upon approval of this plan. The plan will address resources and human impacts as well as signing needs and interpretive activities.

AREA-SPECIFIC ACTIONS

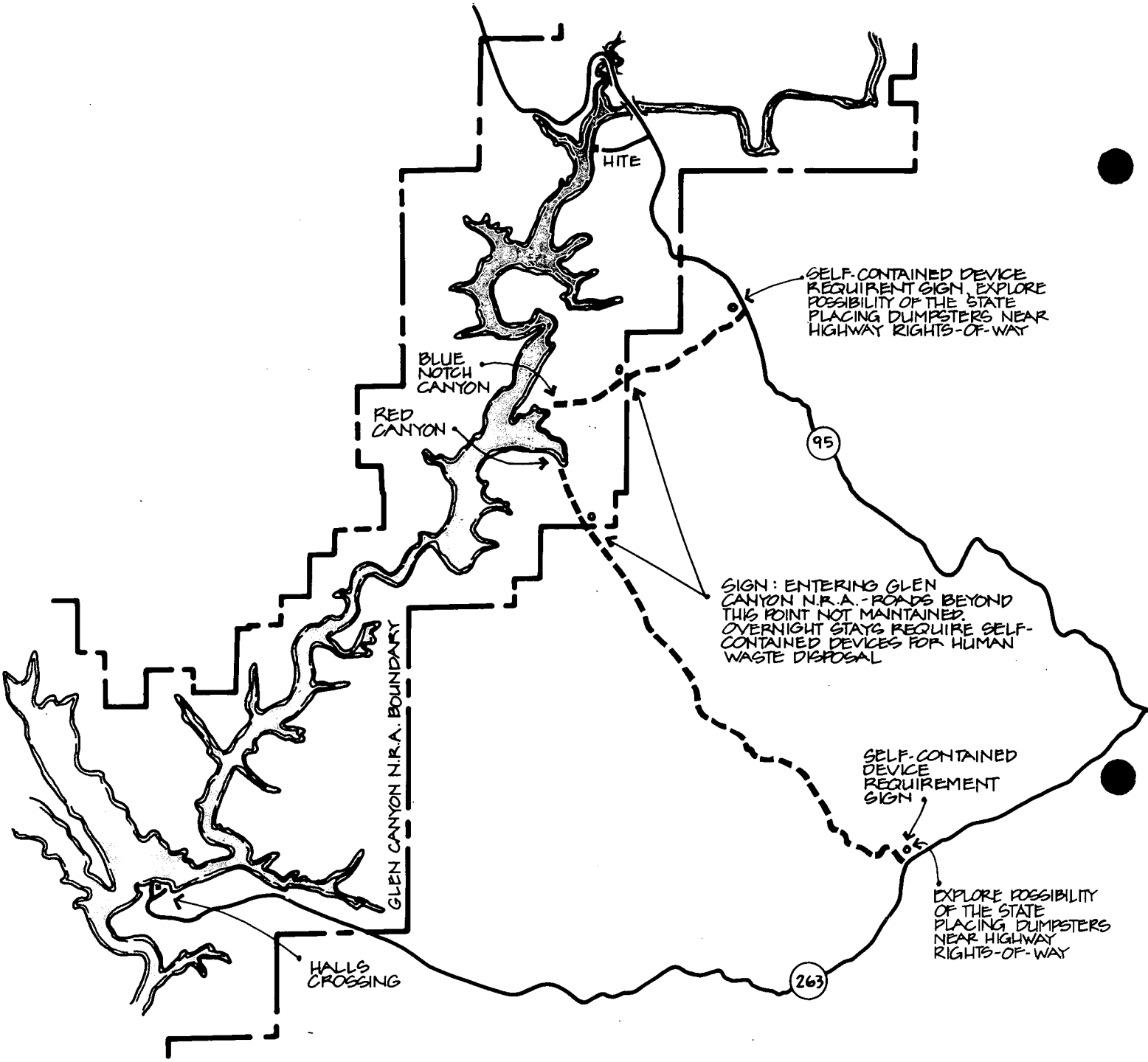
The following descriptions illustrate specific actions that will be employed at each shoreline area.

Blue Notch and Red Canyons

Vehicular access requires use of primitive 4x4 roads that are not maintained. Blue Notch is located nearly 10 miles from the State highway. Red Canyon is 20 miles from the State highway. This distance of travel on primitive 4x4 roads has resulted in very low levels of visitation. Because of these conditions and the lack of measurable resource degradation, facilities will not be provided at these shorelines. To help regulate use and inform the visitor of conditions, signs will be placed near the recreation area boundary to inform visitors that roads beyond this point are not maintained and that all campers must have self-contained devices for human waste disposal. Also, the park will explore the possibility of the State placing dumpsters within the State highway rights-of-way to help encourage litter disposal. Roads open to vehicular use will continue to be designated and a "pack-it-in--pack-it-out" program will be implemented for litter disposal. A sign with a map of the canyons will be displayed illustrating access and areas with specific regulations.

Bullfrog Creek

This shoreline site is located adjacent to the Burr Trail and in close proximity to the Bullfrog Basin marina. As a result, Bullfrog Creek is one of the most popular dispersed shoreline-use sites on Lake Powell. If the Burr Trail is upgraded, use will increase.



ON MICROFILM

Blue Notch & Red Canyons

Management/Development Concept Plan for Lake Powell's Accessible Shorelines

Glen Canyon National Recreation Area – Utah/Arizona

U.S. Dept. of the Interior – National Park Service

608|80,112
9-87 | RMRO

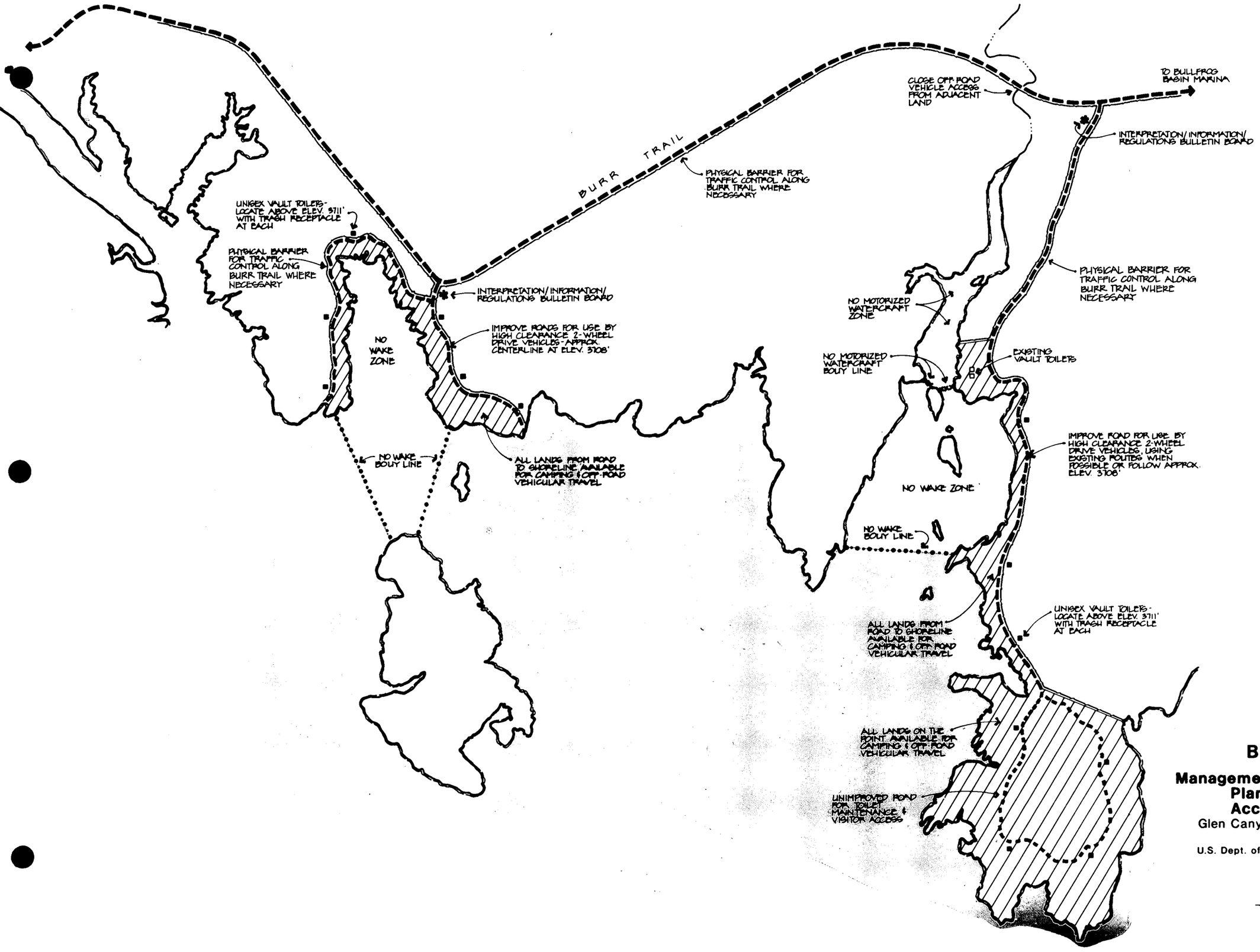
Management will be oriented towards providing for large volumes of both day and overnight use. To help minimize litter problems and hazards created by uncontrolled human waste disposal, twelve toilets and necessary trash containers will be placed throughout the area and above the lake's high water level. Minor road improvements will be made to allow use by high clearance, 2-wheel drive vehicles. These roads will be designated and physical control devices will be installed to restrict travel to designated areas. All land below the 3,700-foot elevation will be open to vehicular travel and camping. Estimated lakeshore camping capacity is 200 parties, measured linearly along the shoreline. A stacking of camping parties, or a depth factor from the shoreline, may occur during popular holiday periods.

To minimize potential conflicts between swimmers and boaters, portions of the cove will be marked as a "no-wake zone" and a small portion marked as a "no motorized watercraft zone." Signing will be used to convey user restrictions and to distribute site-specific information.

Clay Hills

A majority of this area's visitor use is from river-running activities on the San Juan. Primary use is for boat take-out and some overnight stays.

Existing conditions will be retained until the San Juan Marina at Piute Farms is no longer usable for boat take-out activities because of silt build-up. At that time, the park will explore the possibility of providing improvements at Clay Hills to accommodate overnight, day use and river-running activities. Potential improvements include designating roads open for vehicular travel and construction of a new road to a downstream area where the river channel maintains a silt-free access to the water. The improved area may also include parking. Signing may be used to convey use restrictions and to distribute site-specific information. A "pack-it-in--pack-it-out" program will be implemented immediately for litter disposal. All overnight stays will require use of self-contained devices for human waste disposal.



ON MICROFILM

N

0 840 feet

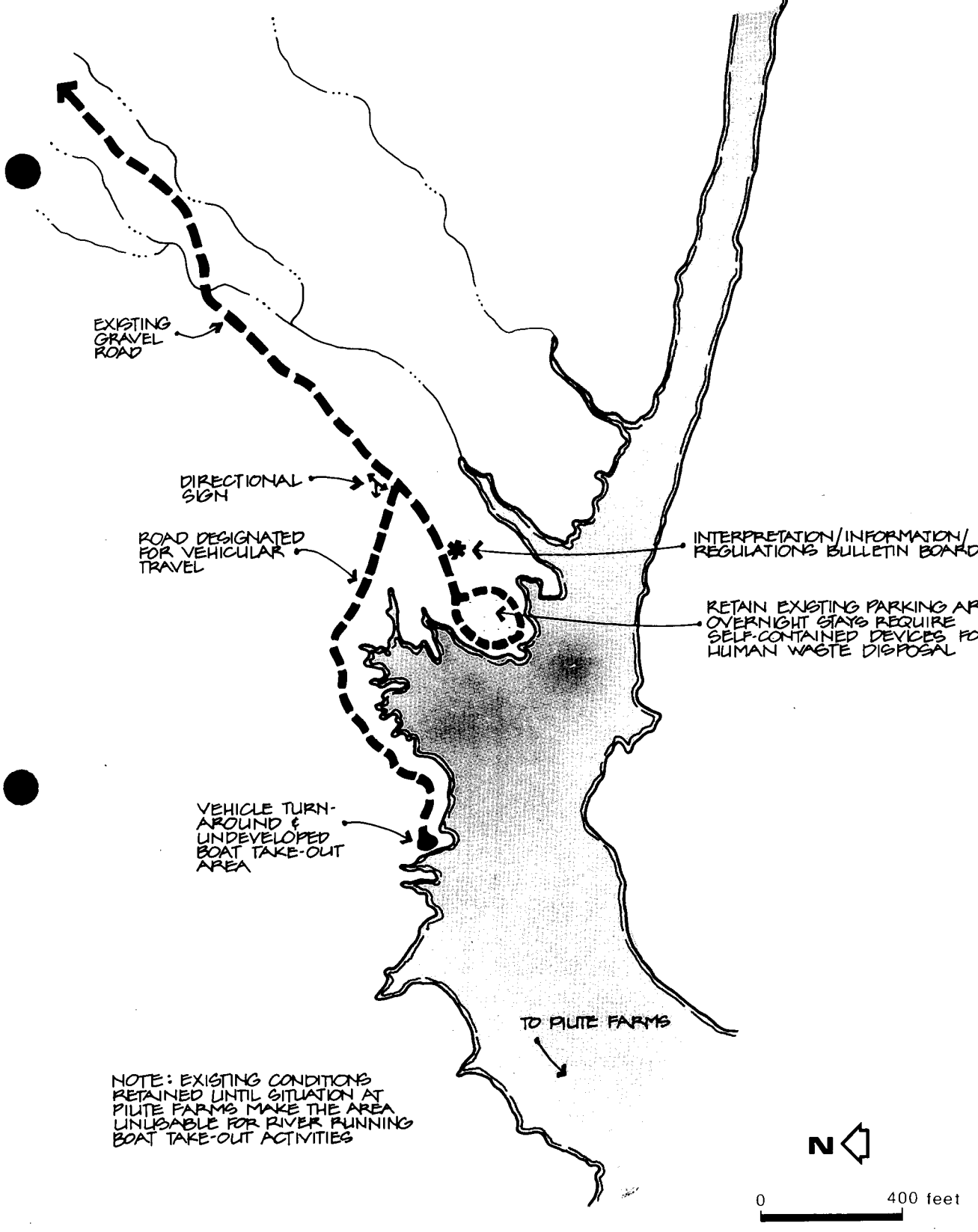
Bullfrog Creek

Management/Development Concept Plan for Lake Powell's Accessible Shorelines

Glen Canyon National Recreation Area
Utah/Arizona

U.S. Dept. of the Interior - National Park Service

608 | 80,119
9-87 | RMRO



Clay Hills

Management/Development Concept Plan for Lake Powell's Accessible Shorelines

Glen Canyon National Recreation Area - Utah/Arizona

U.S. Dept. of the Interior - National Park Service

608 | 80,107
9-87 | RMRO

Crosby Canyon

Located in the southern third of Lake Powell, Crosby Canyon can be accessed by a primitive 4x4 road which is not maintained. The road is located in a drainage bottom subject to flash flooding.

There are no proposed site improvements unless monitoring indicates problems with human waste disposal, in which case toilet(s) will be installed. Because this area is isolated, maintenance costs would be reduced by use of a self-composting toilet. Until toilet(s) are installed, use of self-contained devices for human waste disposal will be required. Day and overnight use will be allowed. Roads open to vehicular travel and lands available for camping will be designated. Estimated camping capacity is 50 parties at any given time.

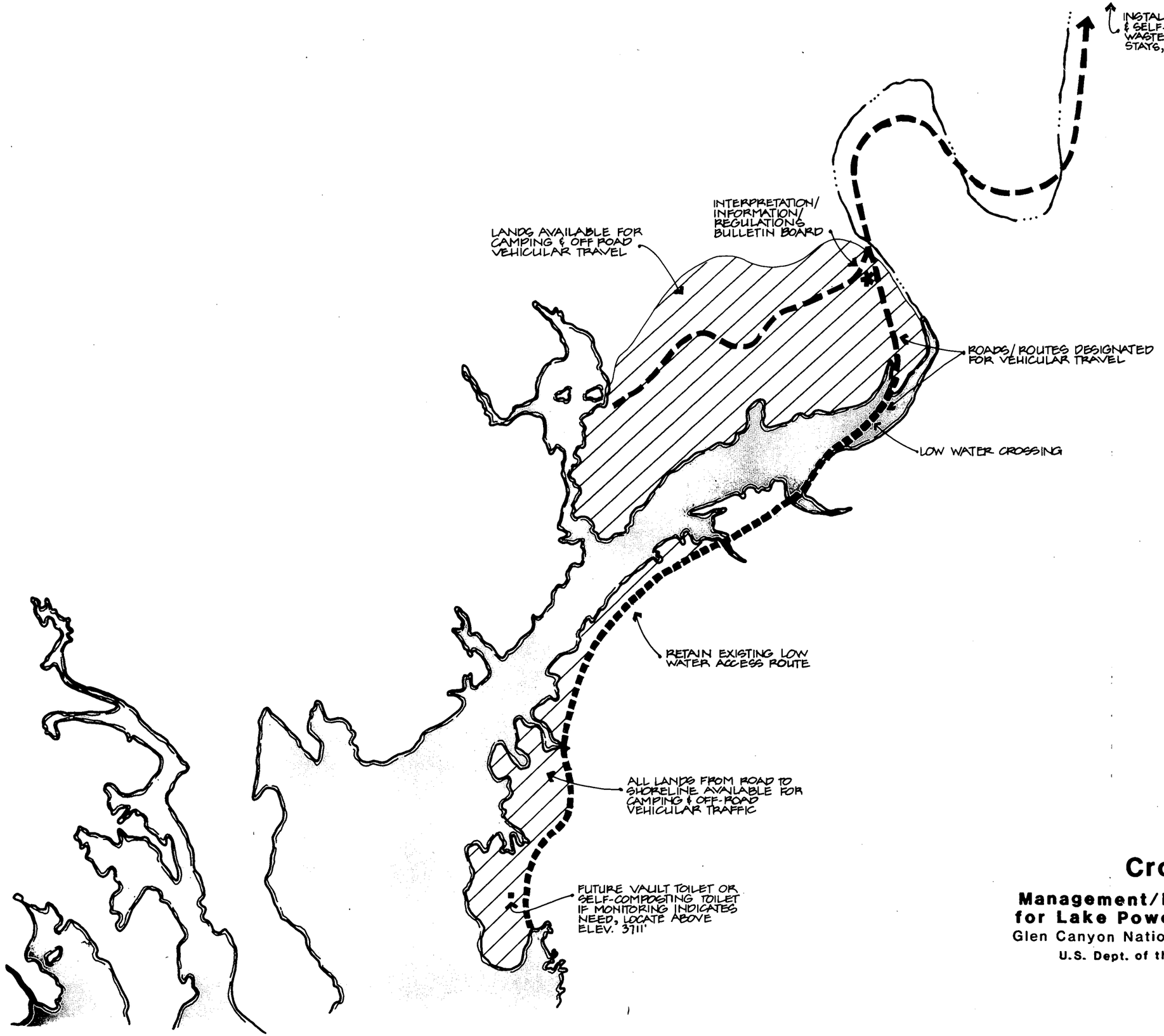
A "pack-it-in--pack-it-out" program will be implemented for litter disposal. Signing will be used to convey user restrictions and distribute site-specific information. Flood hazard warning and self-contained requirement signs will be installed along the Warm Creek Road.

Dirty Devil

This shoreline site is located adjacent to State Highway 95. Easy access and close proximity to the Hite marina has made this area a popular dispersed camping site.

Management will continue to provide for both day and overnight use. The purpose of proposed site improvements which include four toilets, trash containers, and designated dispersed camping areas, is to minimize resource impacts. Minor road improvements will be used to delineate roads and to correct soil erosion problems created by past use. Vehicular travel will be confined to designated roads and areas. Camping in the northernmost portion of this shoreline site will require the use of self-contained devices for human waste disposal. Estimated camping capacity is 60 parties at any given time.

Signing will be used to convey use restrictions and



N

0 400 feet

ON MICROFILM

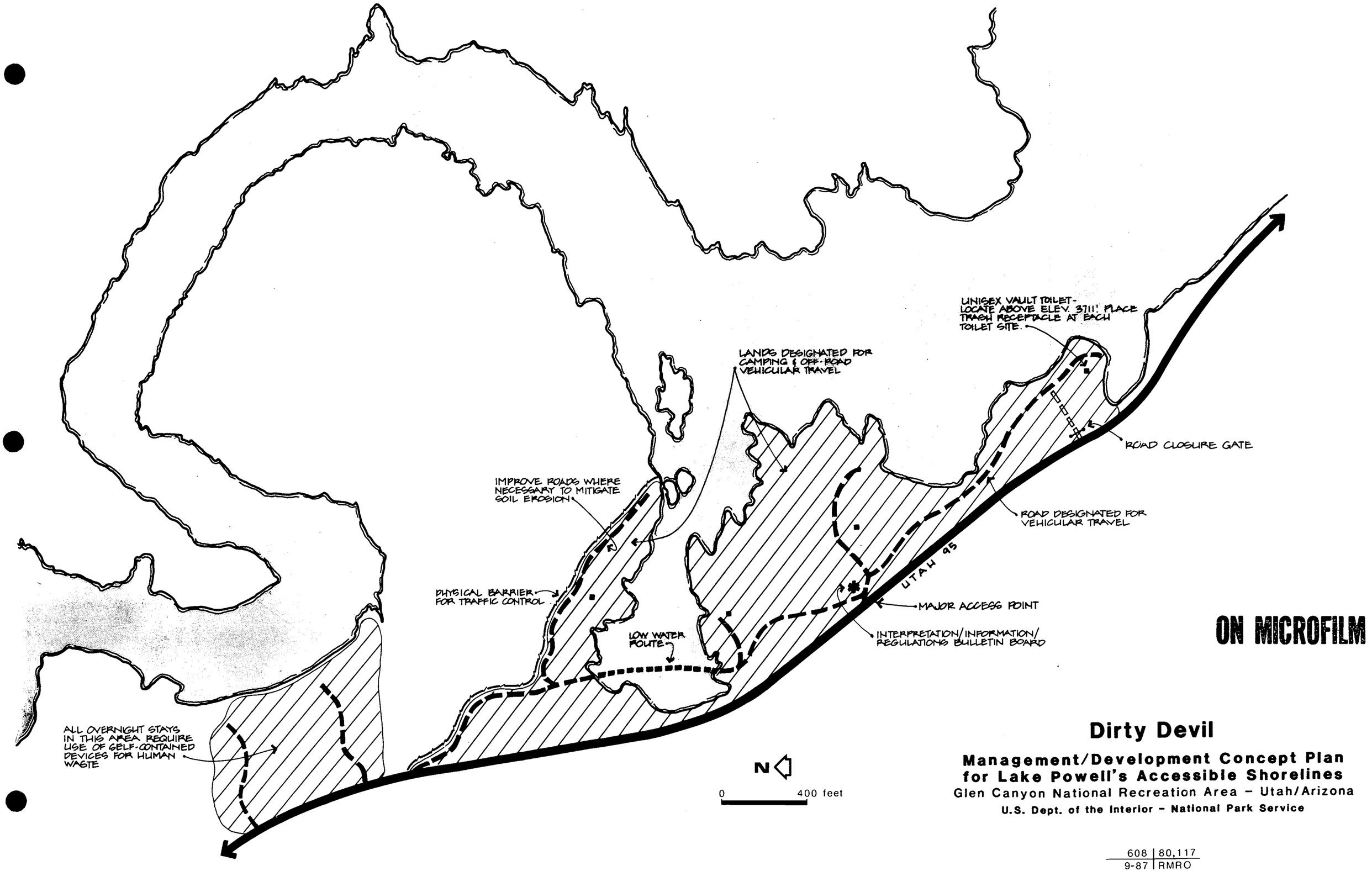
Crosby Canyon

Management/Development Concept Plan for Lake Powell's Accessible Shorelines

Glen Canyon National Recreation Area – Utah/Arizona

U.S. Dept. of the Interior – National Park Service

608 | 80,115
9-87 | RMRO



ON MICROFILM

Dirty Devil

Management/Development Concept Plan for Lake Powell's Accessible Shorelines

Glen Canyon National Recreation Area – Utah/Arizona

U.S. Dept. of the Interior – National Park Service

608 | 80,117
9-87 | RMRO

distribute other site-specific information to the public.

Farley Canyon

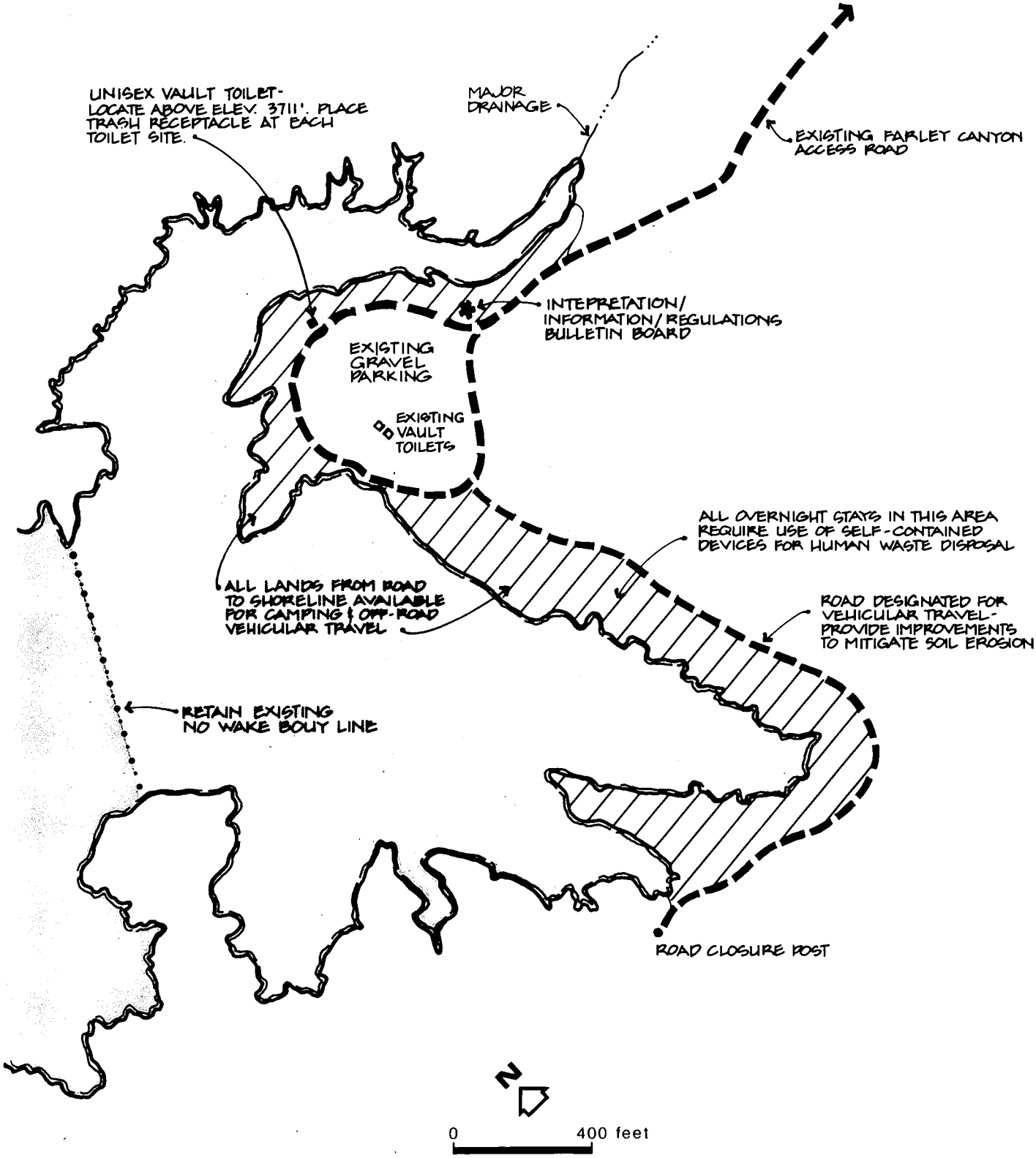
Access is provided by a well-maintained gravel road. A large gravel-surfaced parking lot and two toilets presently exist. This area is a popular dispersed camping site.

Management will be oriented towards providing opportunities for day and overnight use. To help minimize water quality impacts created by human waste, existing toilets will be maintained and an additional toilet will be constructed in close proximity to the lake's shoreline above elevation 3,711 feet. Trash containers will also be provided. Overnight use occurring outside the existing parking lot will require use of self-contained devices for human waste disposal. Minor road improvements along the northern shoreline will be used to delineate roads and to minimize soil erosion problems created by past use. A road presently provides access to this area's southern shoreline. Because of its relatively flat terrain, this area is experiencing considerable ORV damage. Under this proposal, this road and the southern shoreline will be closed to vehicular access.

Signing will be used to convey use restrictions such as prohibitions of sewage discharge from vehicles or watercraft and to distribute site-specific information to the visitor. The existing lake no-wake zone will be maintained to minimize conflicts between boaters and shoreline users. A fire ring or ground fire prohibition may be used in the future if monitoring reveals unacceptable resource impacts. Estimated capacity is 50 parties at one time. This may be increased during popular holiday periods as "stacking" from the shoreline occurs.

Stanton Creek

Because of its close proximity to Bullfrog Basin marina and relatively easy access, Stanton Creek has been a popular dispersed shoreline-use site. An old gravel pit and two toilets exist in this area. Past visitor use has resulted in considerable ORV damage, a



ON MICROFILM

Farley Canyon

Management/Development Concept Plan for Lake Powell's Accessible Shorelines

Glen Canyon National Recreation Area – Utah/Arizona

U.S. Dept. of the Interior – National Park Service

608 | 80,104
9-87 | RMRO

spreading of human waste and litter, and multiple fire rings.

Management will provide for both day and overnight use that preserves its current recreation opportunities of semi-isolation where shoreline campsite have been used as a boat anchorage. Camping-use zones will be available in the western portions of this area. Existing toilets will be maintained and trash receptacles placed in close proximity for litter disposal. All overnight stays will require use of self-contained devices for human waste disposal. Travel will be restricted to designated routes and to designated camping areas.

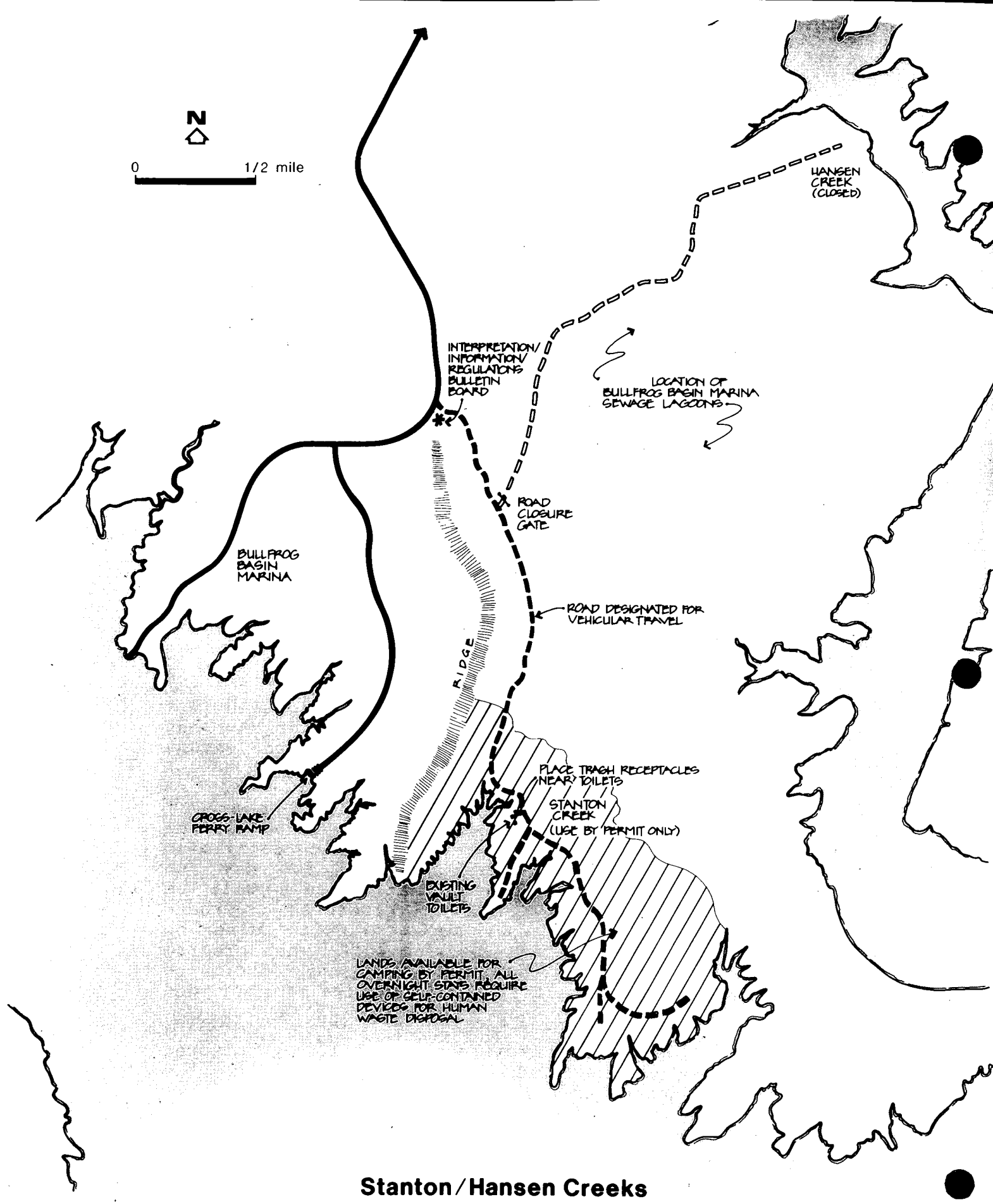
Physical capacity of this shoreline area is estimated to be 50 camping parties at one time. A permit system will be initiated upon establishment of an entrance station at Bullfrog to maintain use within the designated capacity and activities will be monitored to reduce resource degradation. The park will also monitor resource damage in order to adjust camping capacities to minimize such damage.

Warm Creek

Access is provided by a primitive 4x4 road located in a drainage with flash flood hazards. Visitor use has remained relatively low and only minor resource damage has been observed.

Flood hazard warnings and signs requiring the use of self-contained devices for human waste disposal will be placed at the access road junction. No site facilities are proposed. The area will be open for day and overnight use. Roads open to visitor use will be designated and vehicular travel restricted to these routes. A designated parking area will also be provided and a "pack-it-in--pack-it-out" trash program will be implemented for litter disposal. Estimated physical camping capacity is 10 parties at any one time.

The access road and shoreline site will be monitored for flooding safety hazards and may be closed in the future for visitor safety.



Stanton/Hansen Creeks

Management/Development Concept Plan for Lake Powell's Accessible Shorelines

Glen Canyon National Recreation Area - Utah/Arizona

U.S. Dept. of the Interior - National Park Service

ON MICROFILM

608 | 80,105
9-87 | RMRO

Warm Creek

Management/Development Concept Plan for Lake Powell's Accessible Shorelines

Glen Canyon National Recreation Area – Utah/Arizona

U.S. Dept. of the Interior – National Park Service

608 | 80,109
9-87 | RMRO

White Canyon

The site has experienced resource damage from past ORV activities and a majority of past use has been for camping. Overnight use will continue to be allowed. To help minimize damage from ORV's, roads open to vehicular travel will be designated and travel restricted to these routes. Because of relatively level terrain and the ease of ORV travel, roads in the eastern portions of this site will be closed. However, vehicular travel will continue to be provided on lands below the 3,700-foot elevation. This portion of the shoreline will only be accessible during periods of low water. Dispersed camping areas with a capacity of about 40 parties at any one time will be designated.

Onsite signing will be used to convey user restrictions and distribute site-specific information. A "pack-it-in--pack-it-out" trash program will be implemented for litter disposal and overnight stays will require the use of self-contained devices for human waste disposal.

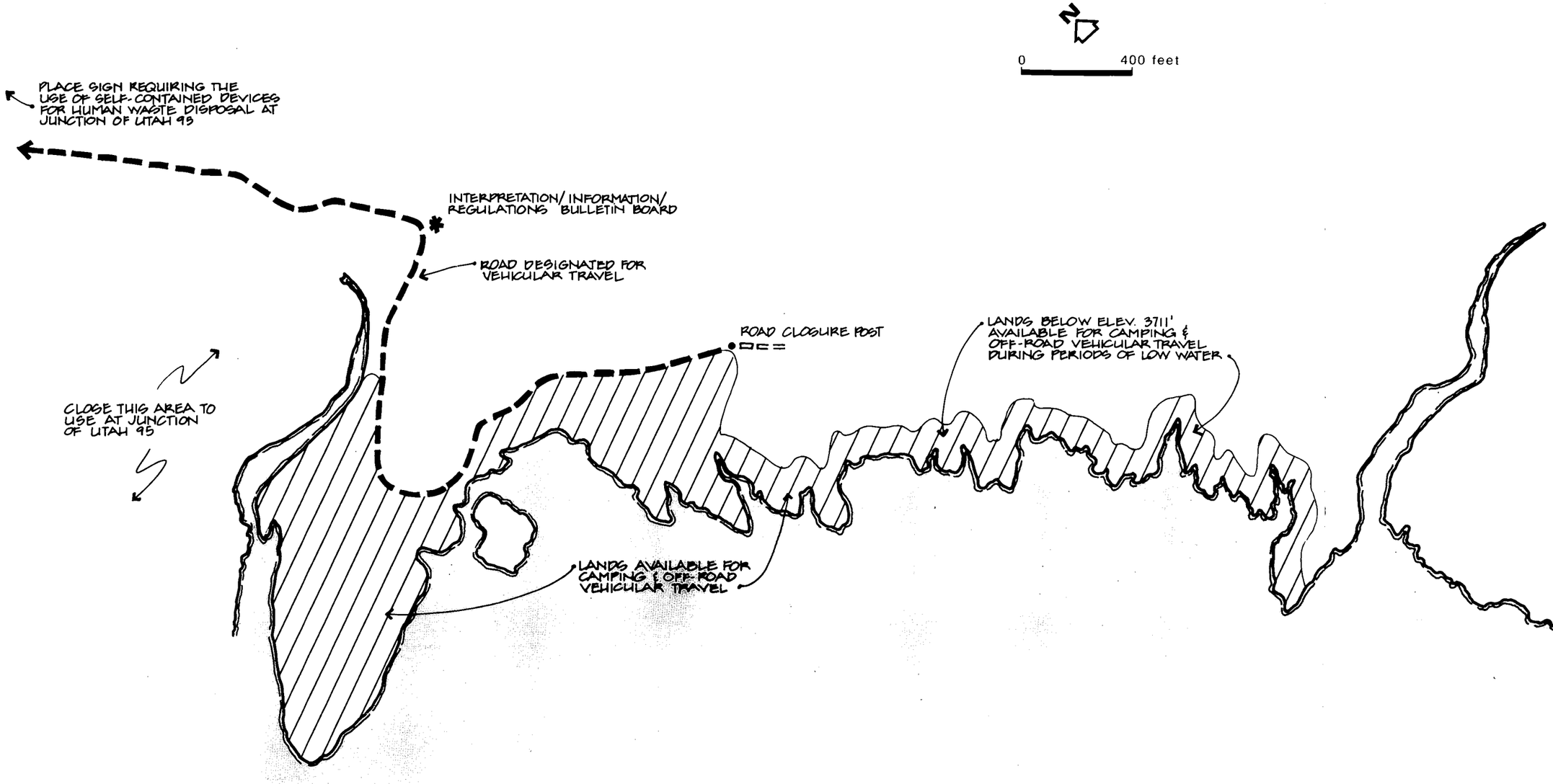
Halls Crossing Cove #4

This site is located adjacent to the Halls Crossing marina. It will be managed to supplement marina operations by providing opportunities for day-use activities.

A parking lot will be constructed near the ferry launch access road with some picnic facilities. A trail will provide pedestrian access from the parking lot to Cove #4. The cove will be closed to all motorized watercraft to provide safe swimming opportunities. However, a swim-beach area will not be designated. Signing will be used to convey user restrictions, safety precautions, and other site-specific information.

Hole-in-the-Rock

Road access to this area is terminated by a cliff high above the lake's surface and lake access is by a difficult foot trail. Use of this area will be restricted to day activities. The area's existing access road and a small parking lot will be designated for vehicular use. Vehicular travel off these



White Canyon

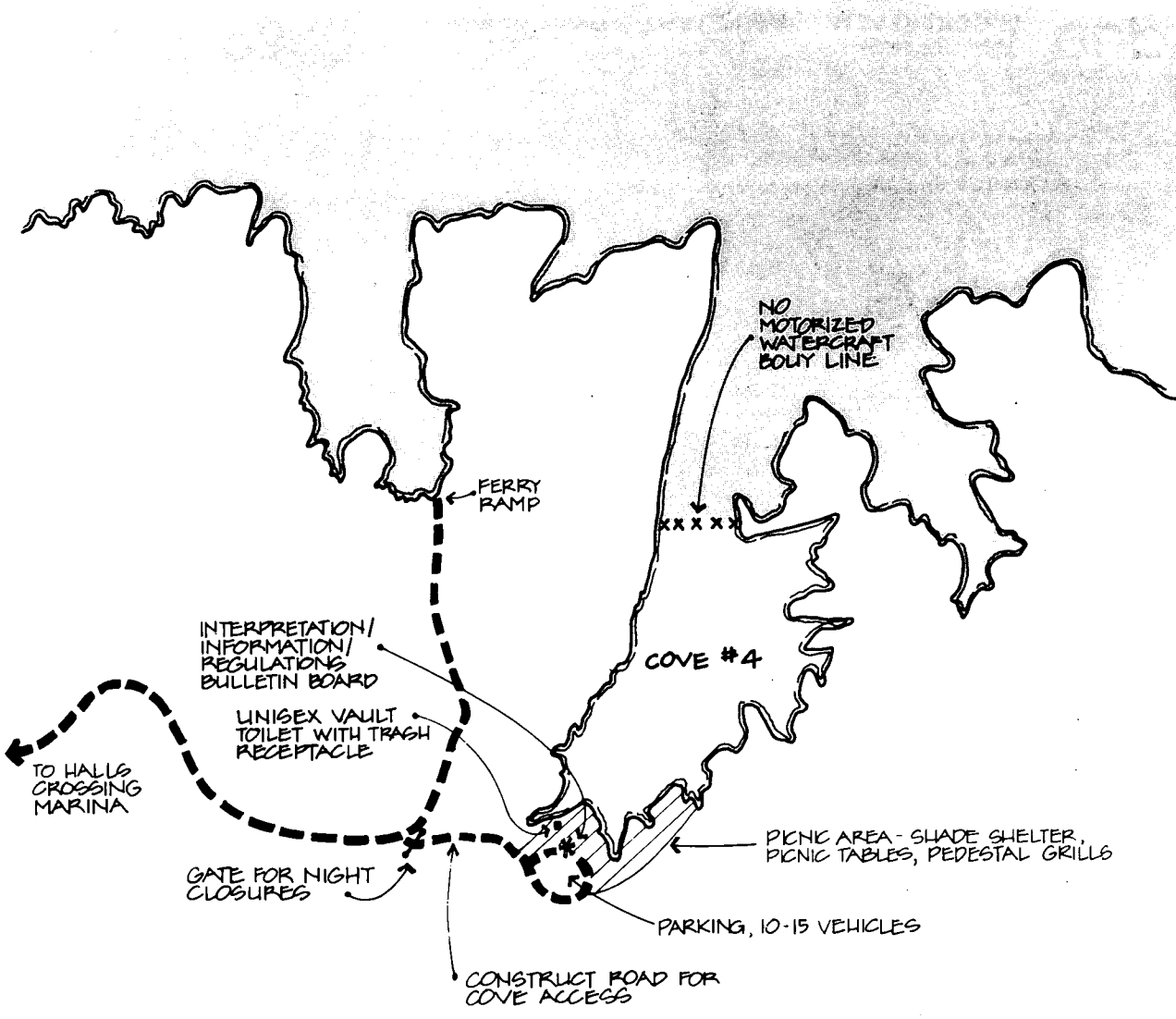
Management/Development Concept Plan for Lake Powell's Accessible Shorelines

Glen Canyon National Recreation Area – Utah/Arizona

U.S. Dept. of the Interior – National Park Service

608 | 80,116
9-87 | RMRO

ON MICROFILM



Halls Crossing Cove #4

Management/Development Concept Plan for Lake Powell's Accessible Shorelines

Glen Canyon National Recreation Area - Utah/Arizona

U.S. Dept. of the Interior - National Park Service

608 | 80,110
9-87 | RMRO

ON MICROFILM

designated areas will be prohibited. Site improvements will be limited to signs which interpret the historic significance of this area. A "pack-it-in--pack-it-out" trash program will be implemented for litter disposal.

The Chains

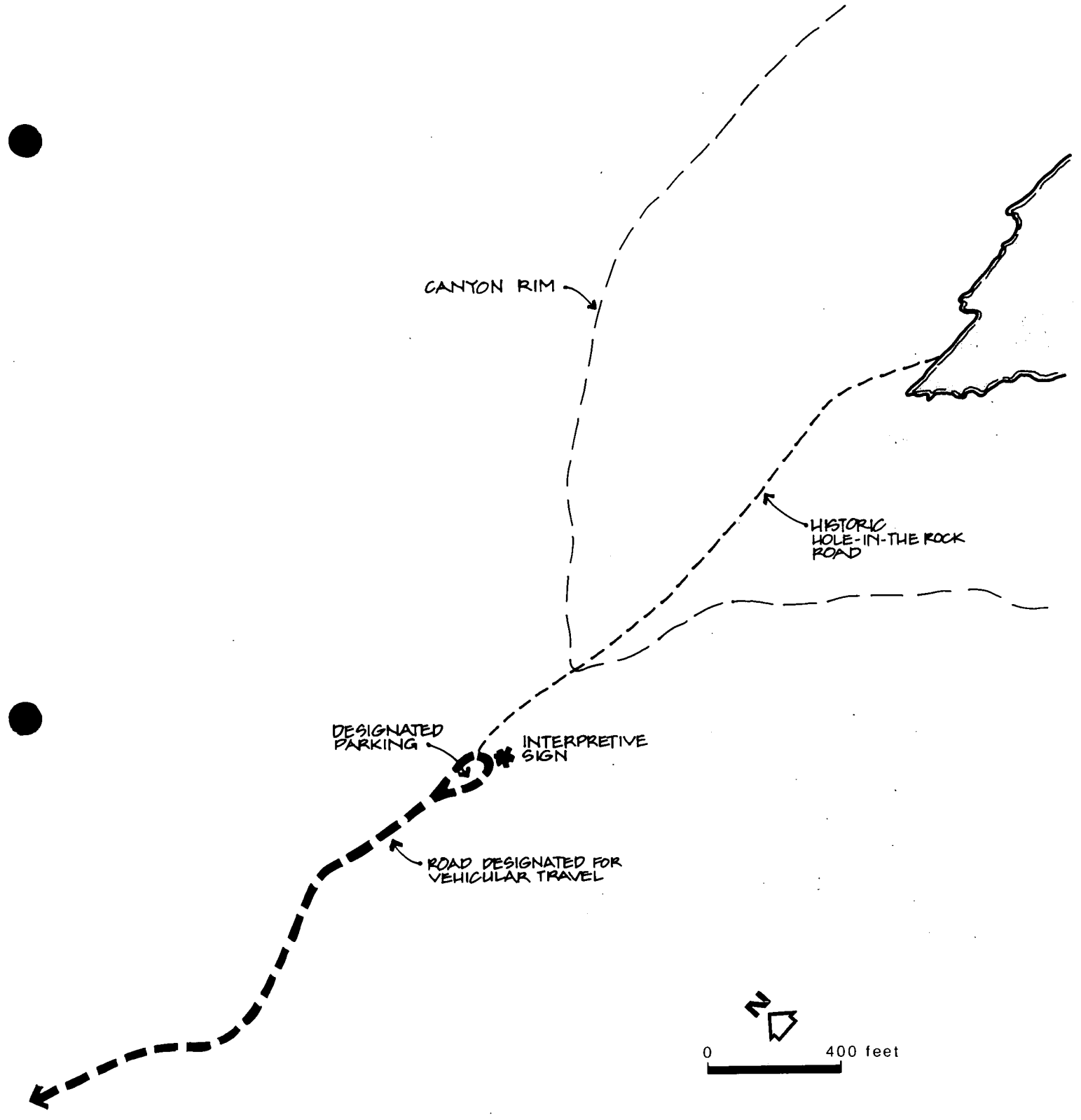
Located adjacent to the Glen Canyon Dam with easy access from U.S. Highway 89, this area has been a popular site with local residents and many visitors to the Carl Hayden Visitor Center.

The Chains will be intensively managed for day-use activities with flexibility in design to accommodate special-use activities. It will be able to accommodate about 100 parties at any given time. Roads will be paved to provide access to and within The Chains. All roads open to visitor use will be designated and physical barriers with ranger patrols used to restrict vehicular travel to these roads. Proposed site improvements include paved roads, vault toilets, trash containers, parking areas, pedestal grills, picnic tables, shade shelters, interpretive trails, and an environmental education area. Signing will be used to convey use restrictions, safety precautions, and other site-specific information. Also, signing will be placed along the shoreline to warn visitors of unsafe and hazardous swimming conditions due to sudden drop-offs and extreme water depths. Landscape scars created by previous construction activities will be rehabilitated. As visitor use grows in this area, it may be necessary to provide utilities and full service comfort stations.

Copper Canyon

This area has been identified by the Navajo Nation as the site for the future San Juan marina development. The NPS is presently working with the Navajo Nation to prepare a DCP to guide future marina development. The recently completed Lake Powell Carrying Capacity study identifies capacity that will be apportioned to the San Juan marina to guide preparation of its DCP.

Until permanent marina development occurs, management will be coordinated with the Navajo Nation to retain existing conditions. Construction of a marina at this location will not affect management strategies identified for the other dispersed shoreline sites.



Hole-In-The-Rock

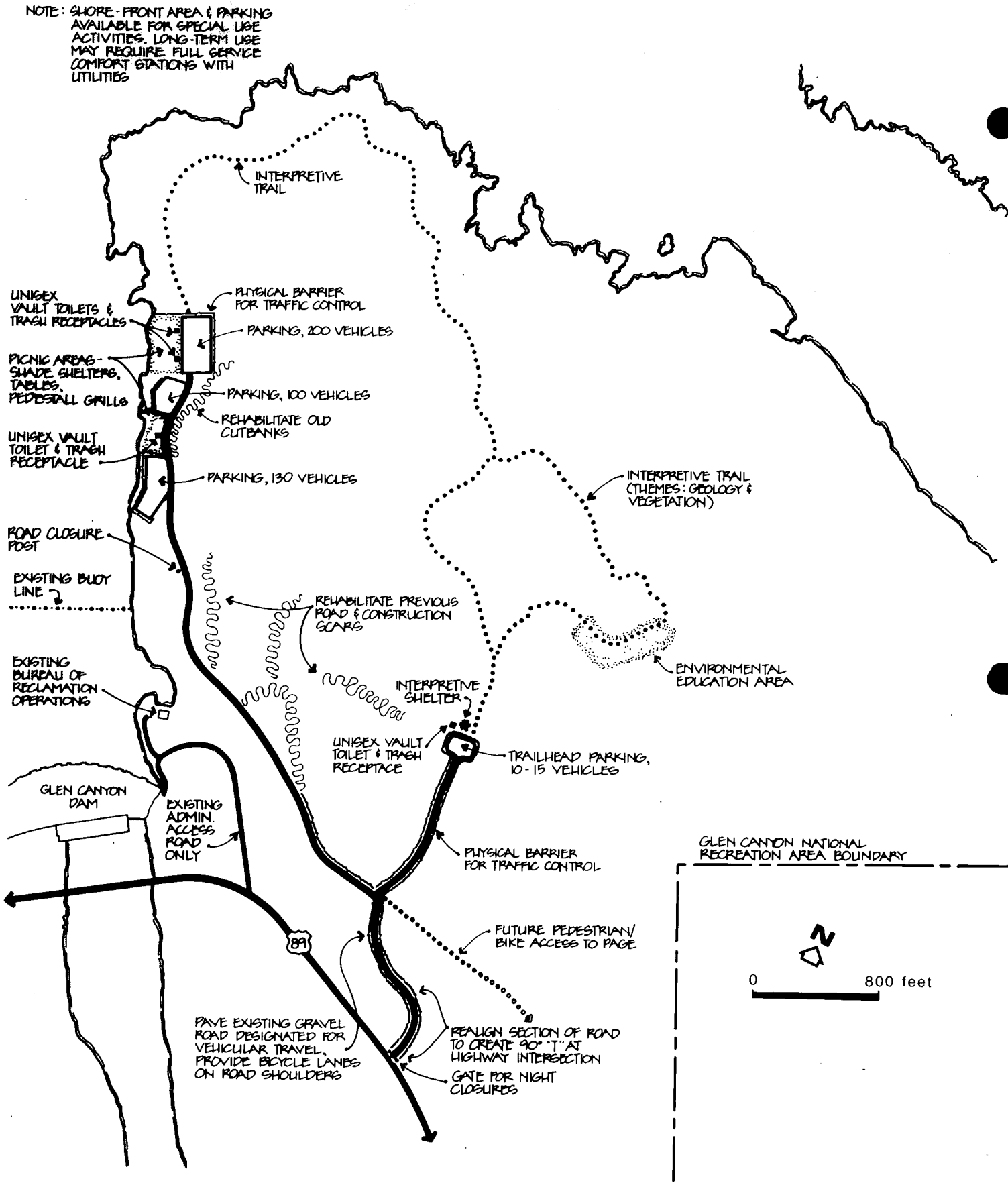
Management/Development Concept Plan for Lake Powell's Accessible Shorelines

Glen Canyon National Recreation Area – Utah/Arizona

U.S. Dept. of the Interior – National Park Service

ON MICROFILM

608 | 80,108
9-87 | RMRO



The Chains

Management/Development Concept Plan for Lake Powell's Accessible Shorelines

Glen Canyon National Recreation Area - Utah/Arizona

U.S. Dept. of the Interior - National Park Service

608 | 80,106
9-87 | RMRO

When the San Juan Marina is relocated from its present location at Piute Farms to this area, Piute Farms will be managed as a road access shoreline site. Management will be based on actions prescribed for other shoreline sites in this proposal.

Neskahi and Piute Canyon

Access to and management of these shoreline sites will be coordinated with the Navajo Nation. The NPS will strive to retain existing conditions and will monitor resources to determine if additional management actions may be necessary to minimize or prevent damage.

Cottonwood Canyon

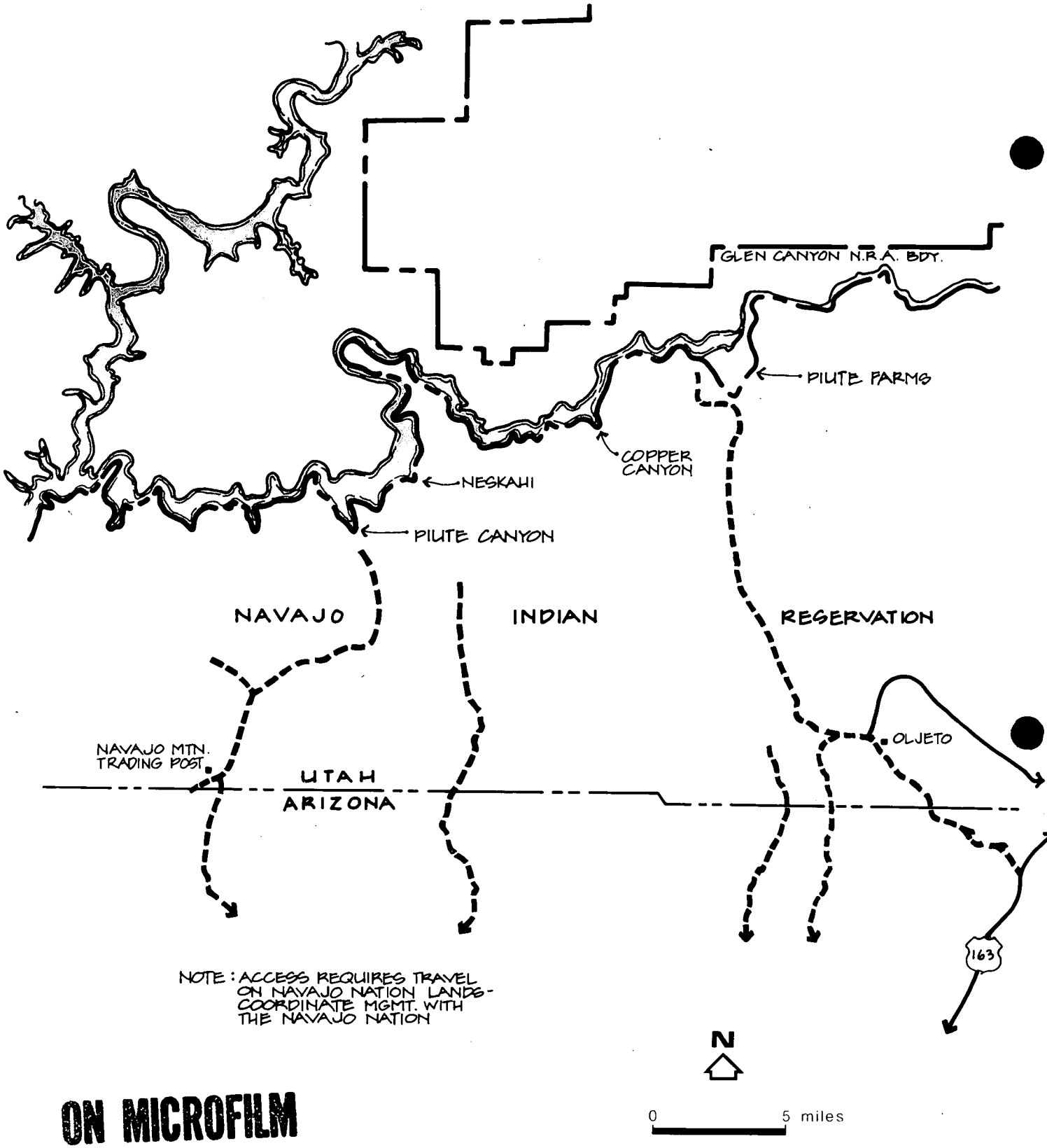
Access to this site requires nearly 30 miles of travel over primitive 4x4 roads which has kept vehicular use levels low. Road access will be maintained to the edge of Wilson Mesa near the head of Cottonwood Canyon. Interpretive information, and regulatory signs will be placed at this point. The park will maintain its closure of the Hole-in-the-Rock road at this point to protect this road's historic cribbing. Interpretation will focus on the Hole-in-th-Rock road and the fragility of historic cribbing associated with the road fabric. Foot trail access will be provided to traces of the historic road located in the canyon.

Hansen Creek

This site is located near Stanton Creek and receives very little visitor use. There is no measurable resource damage created by past use. However, relatively flat terrain, the lack of natural barriers to vehicular travel, and desert conditions make this area extremely vulnerable to resource damage from ORV activities. The same factors make restriction of vehicular travel to designated roads very difficult to enforce. This shoreline area was closed to vehicular access by installation of a gate at the Stanton Creek road junction near the location of Bullfrog Basin's sewage lagoons.

Lake Canyon

A majority of past use was generated by concessioner and NPS employees at Halls Crossing. The area's access road is not authorized in the GMP. Cove #4 at Halls



ON MICROFILM

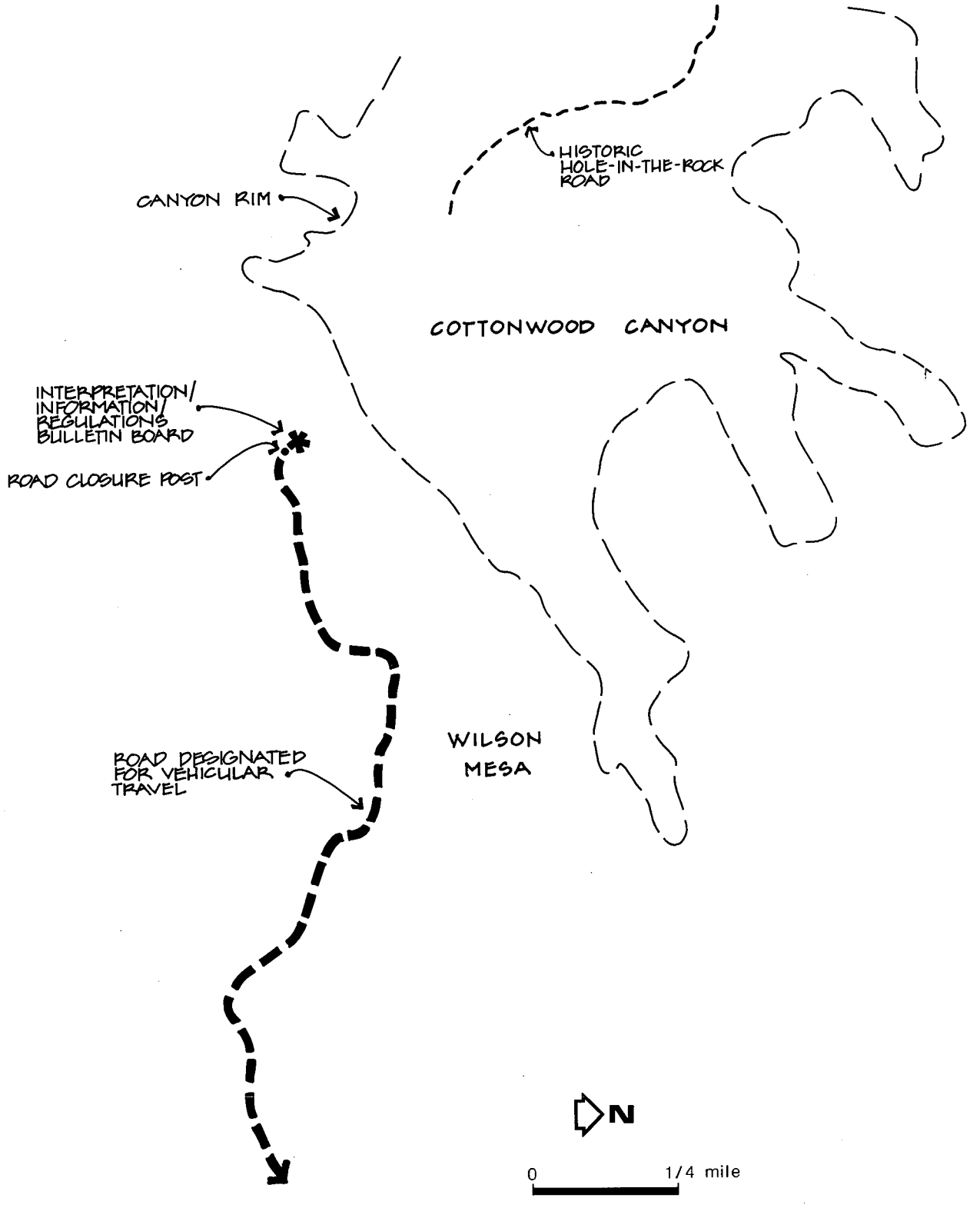
Copper Canyon, Neskahi, & Piute Canyon

Management/Development Concept Plan for Lake Powell's Accessible Shorelines

Glen Canyon National Recreation Area – Utah/Arizona

U.S. Dept. of the Interior – National Park Service

608 | 80,114
9-87 | RMRO



ON MICROFILM

Cottonwood Canyon

Management/Development Concept Plan for Lake Powell's Accessible Shorelines

Glen Canyon National Recreation Area – Utah/Arizona

U.S. Dept. of the Interior – National Park Service

608 | 80,111
9-87 | RMRO

Crossing which is presently closed, will be opened to provide a needed day-use area created by closure of Lake Canyon. Lake Canyon will be closed to vehicular access with a gate at the Utah Highway 276 road junction.

Last Chance Creek

Areas at this shoreline site which are used for overnight stays are subject to flash flood hazards. Therefore, this area will be closed to vehicular access via installation of signs along the county access road.

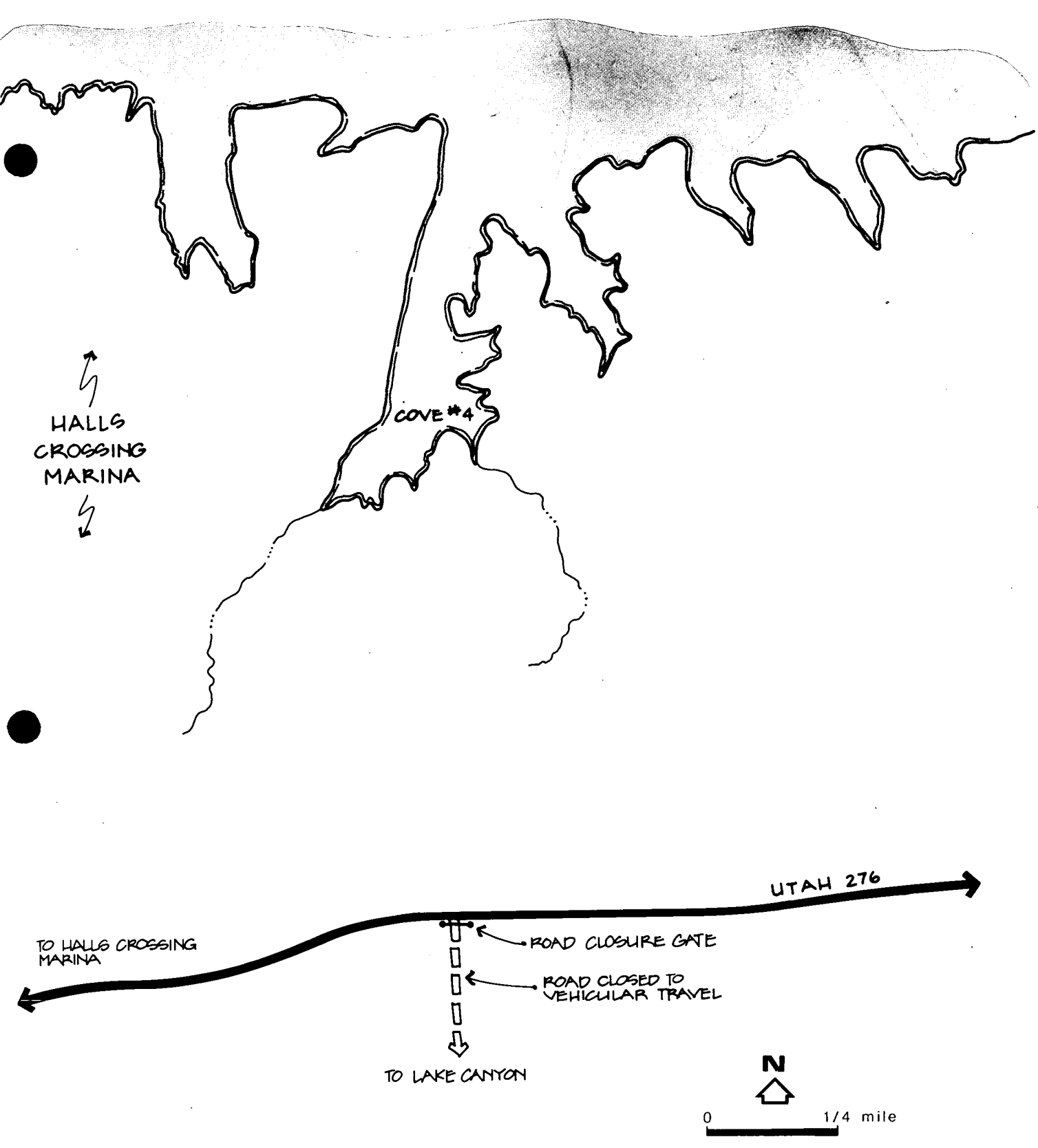
STAFFING AND OPERATIONAL NEEDS

Full implementation of the proposed plan would require slight increases in staff and equipment. The following illustrates estimated personnel and equipment increases.

	Staffing Person Years
Uplake District	
Personnel	
Permanent	
1-GS-5 Park Ranger (Protection)	1.0
1-WG-7 Motor Vehicle Operator	1.0
Seasonal	
4-GS-5 Park Ranger (Protection)	2.1
2-GS-5 Park Ranger (Interpretation)	.8
3-WG-3 Laborers	1.2
2-WG-5 Motor Vehicle Operators	1.2

Equipment

- 2 patrol boats (protection)
- 2 4x4 vehicles
- 9 portable radios
- 1 garbage truck
- 1 trailer-mounted sewage pumper
- 1 pickup with water tank
- 1 maintenance boat
- 1 patrol boat (Interpretation)
- emergency equipment



ON MICROFILM

Lake Canyon

Management/Development Concept Plan for Lake Powell's Accessible Shorelines

Glen Canyon National Recreation Area - Utah/Arizona

U.S. Dept. of the Interior - National Park Service

608 | 80,113
9-87 | RMRO

EXISTING COUNTY ROAD

PLACE SIGNS AT APPROPRIATE JUNCTIONS OF PRIMITIVE ROADS, CLOSING AREA TO VEHICULAR ACCESS

N

0 400 feet

Last Chance Creek

Management/Development Concept Plan for Lake Powell's Accessible Shorelines

Glen Canyon National Recreation Area – Utah/Arizona

U.S. Dept. of the Interior – National Park Service

608 | 80,118
9-87 | RMRO

ON MICROFILM

	Staffing Person Years
Downlake District	
Personnel	
Seasonal	
2-GS-5 Park Ranger (protection)	1.2
3-WG-3 Laborers	1.3
2-WG-5 Motor Vehicle Operators	1.2
2-GS-5 Park Ranger (Interpretation)	1.3
Equipment	
1 patrol boat (Protection)	
1 4x4 vehicle	
4 portable radios	
emergency equipment	
1 maintenance boat	
1 pickup with water tank	
1 patrol boat (Interpretation)	
Parkwide	
Personnel	
Permanent	
1-GS-7 Resource Management Technician	1.0
1-GS-7 Park Ranger (Interpretation)	1.0
Total Person Years	14.3

CONSTRUCTION COST ESTIMATES-PROPOSED PLAN

The following are development cost estimates for improvements proposed at each accessible shoreline site:

Shoreline Site	Proposed Improvement	Gross Construction Cost	Advance and Project Planning Costs	Total Project Costs
Blue Notch Canyon	Information Bulletin Board Road Signing	$ 1,000	$ 200	$ 1,200
Bullfrog Creek	13 Vault Toilets 14 Trash Receptacles 2.3 Miles Road Improvements 0.9 Miles Maintenance Road 4.6 Miles Guardrail 2 Information Bulletin Boards Road Signing	$1,154,000	$ 220,000	$1,374,000
Clay Hills	.75 Miles Road Construction Information Bulletin Board Road Signing	$ 246,000	$ 47,000	$ 293,000
Cottonwood Canyon	Information Bulletin Board Road Signing	$ 1,300	$ 200	$ 1,500
Crosby Canyon	Vault Toilet Information Bulletin Board Road Signing	$ 24,000	$ 4,500	$ 28,500
Dirty Devil	4 Vault Toilets 4 Trash Receptacles .25 Miles Road Improvements 0.4 Miles Guardrails Information Bulletin Board Road Closure Gate Road Signing	$ 166,000	$ 32,000	$ 198,000

Farley Canyon	Information Bulletin Board Vault Toilet 2 Trash Receptacles 0.4 Miles Road Improvements Road Closure Gate Road Signing	$ 54,000	$ 10,000	$ 64,000
Halls Crossing Cove #4	Vault Toilets (2) 3 Trash Receptacles 0.3 Miles Road Construction Information Bulletin Board Road Closure Gate Road Signing 15-Car Parking Lot 10 Picnic Tables 10 Pedestal Grills Picnic Shelter (25'x25')	$ 194,000	$ 37,000	$ 231,000
Hole-in-the-Rock	Information Bulletin Board Road Signing	$ 1,300	$ 200	$ 1,500
Lake Canyon	Road Closure Gate Road Signing	$ 2,000	$ 500	$ 2,500
Last Chance	Road Signing	$ 4,000	$ 700	$ 4,700
Red Canyon	Information Bulletin Board Road Signs	$ 1,000	$ 200	$ 1,200
The Chains	4 Vault Toilets 4 Trash Receptacles 1.2 Miles Road Paving 1.1 Miles Guardrail			

	2 Information Bulletin Boards Road Closure Gate Road Signing Interpretive Shelter 440-Car Paved Parking 1.9 Miles Trail Construction 8.7 Acres Landscape Rehab. 100 Picnic Tables 100 Pedestal Grills 20 Shade Shelters (25'x25')	$2,066,000	$ 394,000	$2,460,000
Stanton Creek	Information Bulletin Board Road Signing 2 Trash Receptacles	$ 1,800	$ 300	$ 2,100
Warm Creek	Information Bulletin Board Road Signing	$ 1,300	$ 200	$ 1,500
White Canyon	Information Bulletin Board 2 Road Closure Gates Road Signing	$ 4,500	$ 800	$ 5,300

GRAND TOTAL $4,670,000

NOTE: No improvements currently proposed for Copper Canyon, Neskahi, and Piute Canyon--if improvements are required at a later date, the park will explore joint funding with the Navajo Nation.

MONITORING/ADDITIONAL PLANS AND STUDIES NEEDED

The "Monitoring Management Plan" will be used to establish monitoring procedures and to identify research needs. The following activities will be addressed:

1. Water quality monitoring of heavily used shoreline sites.
2. Monitoring of vegetative disturbance to check success of management actions and improvements designed to curb increased ORV use. (Also includes monitoring the invasion and spread of exotic species.)
3. Site-specific cultural resource surveys, in compliance with 36 CFR Part 800, prior to surface-disturbing management actions.
4. Monitoring of indirect impacts associated with cultural resources.
5. Visitor-use surveys or other means to determine levels and types of recreation use.
6. Monitoring to measure amount of human waste contaminating soils to determine need for future toilets or other management actions.
7. Monitoring to determine effects of ground fires to establish whether a ground fire prohibition will be necessary.
8. Ethnographic overview and assessment as related to use of shoreline sites by members of the Navajo Nation.

ALTERNATIVES CONSIDERED

ALTERNATIVE A - NO ACTION

This alternative is analyzed as required by the Council of Environmental Quality's implementing regulations for the National Environmental Protection Act. Current management practices and existing shoreline improvements will be retained.

Under this alternative, all shoreline sites except Halls Crossing Cove #4 and Lake Canyon would be open for day and overnight use with road access. Improvements would be limited to rehabilitation or replacement of existing facilities or actions necessary for visitor safety.

A prohibition of firearm discharge does not exist at any of Lake Powell's accessible shorelines. Ranger patrols occur on an unscheduled basis as time allows. Most ranger presence occurs as a result of emergency response actions. Interpretation occurs informally through ranger contacts - there are no formal programs.

Shoreline clean-up follows popular holiday periods (e.g. Memorial Day) and is limited to the more popular, easily accessible shoreline sites (e.g. Farley Canyon, Bullfrog Creek, The Chains).

There are no existing provisions to warn visitors of flash flood hazards. If this alternative were implemented, flood hazard warning signs would be installed in strategic locations to inform visitors of this condition.

Vehicular travel in Glen Canyon National Recreation Area is restricted to designated roads unless otherwise posted (e.g. Lone Rock), however, enforcement of this restriction has been nearly impossible.

The following descriptions illustrate management actions and policies existing at each shoreline area.

Blue Notch Canyon

Vehicular travel is restricted to existing roads. There are no facilities or other shoreline improvements.

Alternative A

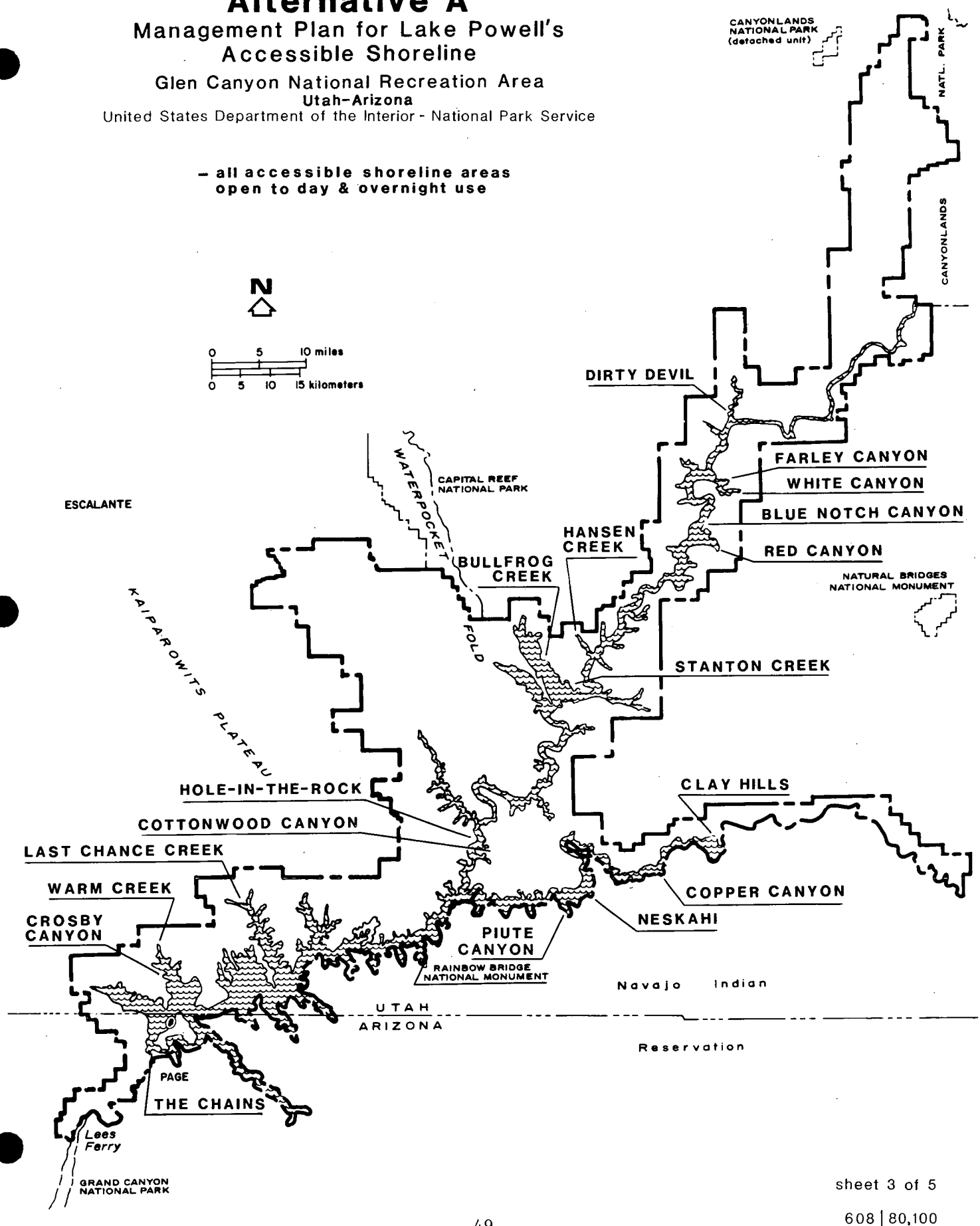
Management Plan for Lake Powell's Accessible Shoreline

Glen Canyon National Recreation Area

Utah-Arizona

United States Department of the Interior - National Park Service

– all accessible shoreline areas open to day & overnight use



sheet 3 of 5

608 | 80,100
Jan 87 | RMRO

ON MICROFILM

Bullfrog Creek

Two toilets have been constructed in the lower end of this area. Vehicular travel is restricted to existing roads.

Copper Canyon and Neskahi

Above the elevation 3,720 feet, all land is managed by the Navajo Nation. On NPS lands, vehicular travel is restricted to existing roads. There are no facilities or shoreline improvements existing.

Cottonwood Canyon

Vehicular travel within the canyon has been prohibited to protect historic cribbing of the Hole-in-the-Rock road. There are no facilities or improvements existing.

Crosby Canyon

Access to this site requires travel through a drainage bottom with flash flood hazards. This access will be signed to warn visitors of potential flood hazards. Facilities and shoreline improvements do not exist, and vehicular travel is currently restricted to existing roads.

Dirty Devil

There are no site improvements existing at this area. Vehicular travel occurs throughout on exposed slickrock surfaces.

Farley Canyon

Existing improvements include two toilets and a large aggregate-surfaced parking lot. A no-wake zone is presently enforced in this vicinity of the lake. Some roads have been closed with closure posts and vehicular travel restricted to existing roads. During popular holiday periods, the park has used a Campground Host at this site.

Hansen Creek

Vehicular travel has been restricted to the existing access road. No facilities or other site improvements exist.

Hole-in-the-Rock

Interpretation is limited to a marker for the historic Hole-in-the-Rock road. With the exception of the access road and small parking area, there are no site improvements.

Lake Canyon

Glen Canyon's GMP closed road access to this shoreline site. This closure to vehicular access will be enforced in this alternative.

Last Chance Canyon

Access to and use of this site is through or within drainages with flash flood hazards. Flood hazard warning signs will be installed to inform visitors of potential hazards.

Piute Canyon

Above the elevation 3,720 feet, all land is managed by the Navajo Nation. On NPS lands, vehicular travel is restricted to existing roads. There are no facilities or shoreline improvements existing.

Red Canyon

The area's access road is located in portions of a drainage bottom with flash flood hazards. Flood hazard warning signs will be installed to caution visitors about this potential hazard. There are no facilities or improvements existing.

Stanton Creek

An old gravel pit and two toilets exist in this area. While vehicular travel regulations require travel on existing roads only, the proliferation of 4 x 4 tracks indicates that enforcement of this regulation is difficult.

The Chains

Trash containers and an aggregate-surfaced parking lot are currently provided. At times, special use permits have been issued for the use of this area. Vehicular travel has been restricted to designated roads and parking areas.

Warm Creek

Access requires travel through drainages with flash flood hazards. Flood hazard warning signs will be installed to caution visitors about this condition. Vehicular travel has been restricted to designated roads.

White Canyon

There are no developments existing at this area. Vehicular travel has been restricted to existing roads although enforcement is difficult.

Alternative B-Minimum Management

This alternative outlines the minimum actions required for the safe and effective management of shoreline areas considering visitor use and resource protection. All actions prescribed are limited to current funding and staffing capabilities.

Under this alternative, Dirty Devil, Farley Canyon, Bullfrog Creek, Clay Hills and Crosby Canyon would be open for day and overnight use. The Chains would be restricted to day-use activities. Remaining shoreline areas would be closed to vehicular access. Areas closed to vehicular access will be signed, gated, or otherwise marked at road access points to illustrate their closure. The public will also be made aware of closures through various information distribution techniques. Scheduled ranger patrols will be used to enforce closures. The interpretive effort will include the placing of handouts near the entrance of areas open to use. All areas open to overnight use will require self-contained devices for human waste disposal. Fire rings and ground fires will also be prohibited. The following descriptions illustrate specific actions associated with shoreline areas open to visitor use.

Bullfrog Creek

Lands currently experiencing heavy visitor use and resource impacts will be identified and boundaries marked. Land outside this boundary will remain closed. Closure will be enforced with scheduled ranger patrols from the Bullfrog developed area. All roads within the posted boundary will be open to vehicular travel and a designated ORV-use area will be provided. Roads, trails, and camping areas will not be designated. Toilets will be provided for human sanitation and a "pack-it-in--pack-it-out" trash program will be implemented for litter disposal. A no-wake zone on the lake will be established to help minimize user conflicts and provide a safer water-user environment. Signs will be placed onsite to convey site restrictions and distribute information.

Clay Hills

A "pack-it-in--pack-it-out" trash program will be implemented for litter disposal and minimal signing placed onsite for information distribution.

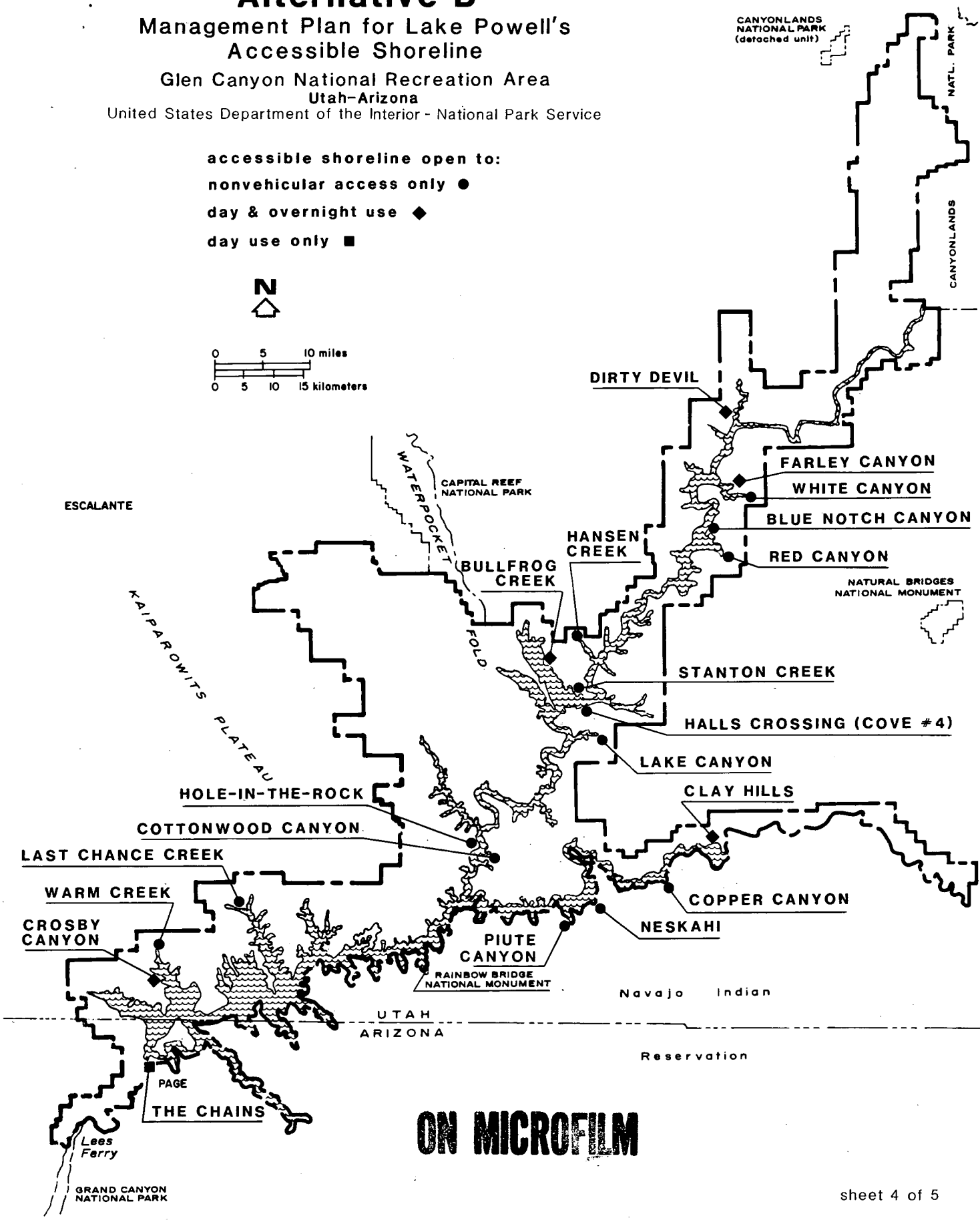
Alternative B

Management Plan for Lake Powell's Accessible Shoreline

Glen Canyon National Recreation Area

Utah–Arizona

United States Department of the Interior - National Park Service



ON MICROFILM

sheet 4 of 5

608	80,100
Jan 87	RMRO

Crosby Canyon

Roads to and within this area will be designated, and signing placed to warn visitors of flood hazards along the access road. A "pack-it-in--pack-it-out" program will be implemented for litter disposal. Minimal signing will be placed onsite for information distribution.

Dirty Devil

Areas currently experiencing resource impacts will be identified and boundaries marked. Land outside this boundary will be closed to visitor use. Closures will be enforced with scheduled ranger patrols from the Hite subdistrict. Within the posted boundary, there will be no roads, trails, or camping sites designated - the entire area will be open for vehicular travel. Toilets will be provided for human sanitation and trash containers for litter disposal. Minimal signing will be placed onsite to convey various restrictions and information necessary to manage this area. An identified cultural resource site will be closed to vehicular use.

Farley Canyon

To help mitigate water quality impacts at this site, additional toilets will be constructed near the shoreline-use area. Roads open to vehicular use will be designated and vehicular use off these designated routes will be prohibited. Farley Canyon's southern shoreline will be closed to vehicular access. A "pack-it-in--pack-it-out" trash program will be implemented for litter disposal. The existing no-wake zone on the lake will be maintained. Minimal signing will be placed onsite to convey restrictions and information necessary to manage this area.

The Chains

Roads and parking areas will be designated and vehicular travel off these designated routes will continue to be prohibited. Additional trash containers will be placed and signing used to convey use restrictions and information. Toilets will also be provided in close proximity to the existing parking lot. The Chains will be managed for day-use activities

only, with total closure of the site after daylight hours.

Staffing and Operational Needs

This alternative was developed to manage accessible shoreline areas with existing staffing levels. While additional staffing will not be required, there will be a need for the following equipment additions.

Uplake District

1 Patrol Boat (protection)
1 Patrol Boat (interpretation)
3 Portable Radios
Emergency Equipment

Downlake District

1 Patrol Boat (interpretation)
2 Portable Radios

CONSTRUCTION COST ESTIMATES - ALTERNATIVE B

Shoreline Site	Proposed Improvement	Gross Construction Cost	Advance and Prjct Plng Costs	Total Project Costs
Bullfrog Creek	13 Vault Toilets 2 Information Bulletin Boards Road Signing 3.1 Miles Fencing	$400,000	$ 76,000	$ 476,000
Clay Hills	Information Signing	$ 1,300	$ 200	$ 1,500
Crosby Canyon	Information Bulletin Board Road Signing	$ 1,300	$ 200	$ 1,500
Dirty Devil	4 Vault Toilets 4 Trash Receptacles Information Bulletin Board Road Signing	$ 93,000	$ 18,000	$ 111,000
Farley Canyon	Vault Toilet Information Bulletin Board Road Closure Gate Road Signing	$ 25,000	$ 5,000	$ 30,000
The Chains	4 Vault Toilets 4 Trash Receptacles 2 Information Bulletin Boards Road Closure Gate Road Signing 1.2 Miles Road Paving 1.1 Miles Guardrail 400-Vehicle Paved Parking Lot	$665,000	$127,000	$ 792,000
			GRAND TOTAL	$1,412,000

ALTERNATIVE C - CONCENTRATE VISITOR USE

The purpose of this alternative is to minimize lakewide shoreline impacts by concentrating shoreline use in limited areas and providing improvements at these areas to accommodate visitor and resource needs.

Under this alternative, the following shoreline sites would be open to day and overnight use: Dirty Devil, Farley Canyon, Bullfrog Creek, Clay Hills, and Crosby Canyon. Halls Crossing's Cove #4, and The Chains would be restricted to day-use activities. Lake Powell's remaining shoreline areas would be closed to vehicular access.

Areas closed to road access will be signed, gated, or otherwise marked at road access points to illustrate their closure. The public will also be made aware of these closures through various information distribution techniques. Scheduled ranger patrols will be used to enforce closures. The interpretive program will be used as an educational tool to convey resource impacts created by visitor use and how these impacts can be mitigated. The goal of this program is to obtain visitor self-regulation of restrictions and controls. The following descriptions illustrate specific actions that would be employed at each shoreline area open to visitor use.

Bullfrog Creek

Because of the close proximity of Bullfrog and Stanton Creeks to the Bullfrog developed area, Stanton Creek will be closed and Bullfrog Creek will be managed for both overnight and day use. Site improvements will include toilets, trash containers, and trails. Minor access road improvements will be made and all roads open to vehicle use will be designated and control devices installed to restrict vehicles to the road surface. All ORV use will be prohibited. Opportunities for ORV use are available in the local area on lands designated for ORV use by the Bureau of

Land Management. To minimize potential conflicts between boaters and swimmers, portions of the cove area will be designated a "no-wake zone." Signing will be used to convey various restrictions and information.

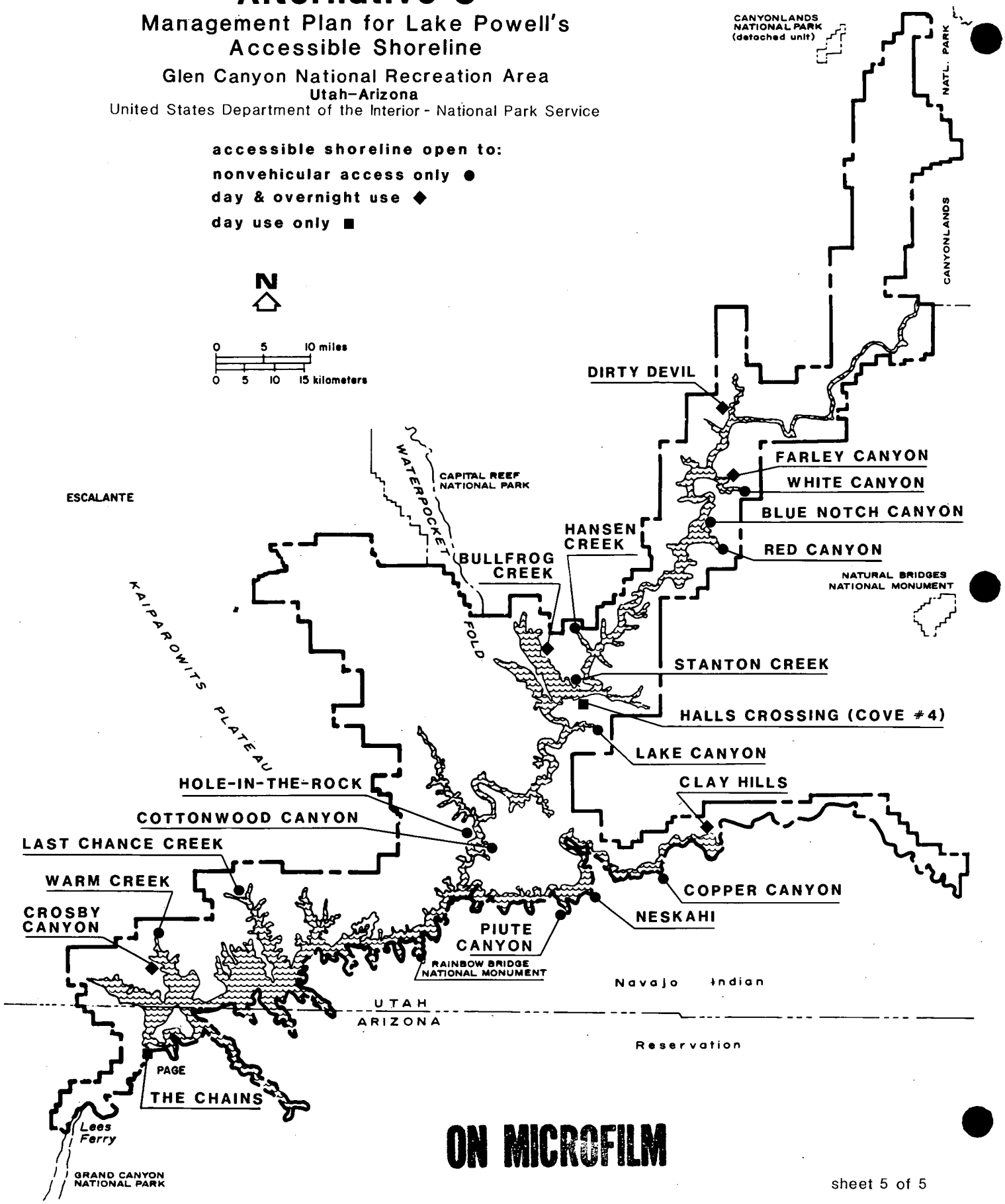
Alternative C

Management Plan for Lake Powell's Accessible Shoreline

Glen Canyon National Recreation Area

Utah–Arizona

United States Department of the Interior - National Park Service



ON MICROFILM

sheet 5 of 5

608 | 80,100
Jan 87 | RMRO

Clay Hills

This shoreline area will be managed to support river-running activities. All roads open to use will be designated and traffic control devices employed to restrict traffic to the road surface. Toilets will be provided in close proximity to a proposed river-runners' boat take-out area. This area will also include parking and a boardwalk to cross the San Juan's mud flats. Signing will be used to convey various restrictions and information necessary to manage this area.

Crosby Canyon

Management will be oriented towards providing both overnight and day-use activities. Proposed site improvements include toilets and trash containers. All roads open to use will be designated and traffic control devices will be installed to restrict vehicular travel to the road surface. Signing will be used to convey site restrictions and distribute information necessary to manage this site.

Dirty Devil

This shoreline area will be managed to accommodate overnight and day use with site improvements and other management techniques. Site improvements include toilets, trash containers, and designated parking and camping areas. Minor road improvements will be used to mitigate resource damage created by soil erosion. All roads open to vehicle use will be designated. Signing will be used to convey various restrictions and information. Because this area would be managed as a "semiprimitive" campground, the National Park Service will explore the possibility of charging fees to use this shoreline camping site.

Farley Canyon

The cove's southern shoreline will be partially closed. Remaining shorelines will be managed for overnight and day use. Existing toilets will be maintained and additional toilets will be provided in closer proximity to the lake's shoreline. Trash containers and designated parking and camping areas will also be provided. Road improvements along the northern

shoreline will be used to mitigate soil erosion. A gate or other closure device would be used to terminate this road and close the southern shoreline to ORV use. All roads open to vehicle use will be designated. Signing will be used to convey various restrictions and information. Farley Canyon will be managed as a "semiprimitive" campground similar to Dirty Devil. The National Park Service will explore the possibility of charging fees to use this camping site. The existing no-wake zone in the cove would be maintained.

Halls Crossing (Cove #4)

This area will be managed for day-use activities and closed to overnight use. A parking lot will be constructed near the ferry launch ramp access road with access to Cove #4 along a constructed trail. Vehicular use of the trail will be prohibited. Cove #4 will be closed to all motorized watercraft to provide safe swimming opportunities. However, a swimming beach or area will not be designated. Signing will be used to convey use restrictions, safety precautions, and other information necessary to manage this area.

The Chains

A majority of use at this area is from local residents and will therefore be intensively managed for day-use activities in a "city park" atmosphere. Roads will be improved to provide access to and within The Chains. All roads open to vehicular use will be designated and ranger patrols used to restrict vehicular use to designated roads. Site improvements include toilets, trash containers, parking areas, pedestal grills, picnic tables, shade shelters, trails, and some children's play equipment. A no-wake zone will be established in close proximity to the lake's shoreline. Signing will be used to convey use restrictions, safety precautions, and other information necessary to manage this area.

STAFFING AND OPERATIONAL NEEDS

This alternative will require slight increases in staff and equipment. The following illustrates estimated personnel and equipment increases.

	Staffing Person Years
Uplake District	
Personnel	
Permanent	
1-GS-5 Park Ranger (Protection)	1.0
Seasonal	
2-GS-5 Park Ranger (Protection)	1.0
1-GS-5 Park Ranger (Interpretation)	.4
2-WG-3 Laborers	.8
1-WG-5 Motor Vehicle Operator	.4
Equipment	
1 Patrol Boat (Protection)	
1 4x4 Vehicle	
6 Portable Radios	
1 Garbage Truck	
1 Pickup with Water Tank	
1 Maintenance Boat	
Emergency Equipment	
1 Patrol Boat (Interpretation)	
Downlake District	
Personnel	
Seasonal	
1-GS-5 Park Ranger (Protection)	.6
2-WG-3 Laborers	.8
1-WG-5 Motor Vehicle Operator	.4
1-GS-5 Park Ranger (Interpretation)	.6
Equipment	
1 Patrol Boat (Protection)	
1 4x4 Vehicle	
3 Portable Radios	
Emergency Equipment	
1 Maintenance Boat	
Parkwide	
Personnel	
Permanent	
1-GS-7 Resource Management Technician	1.0
Total Person Years	7.0

CONSTRUCTION COST ESTIMATES - ALTERNATIVE C

Shoreline Site	Proposed Improvement	Gross Construction Cost	Advance and Project Planning Costs	Total Project Costs
Bullfrog Creek	13 Vault Toilets 14 Trash Receptacles 2.3 Miles Road Improvements 0.9 Miles Maintenance Road 4.6 Miles Guardrail 2 Information Bulletin Boards Road Signing	$1,154,000	$ 220,000	$1,374,000
Clay Hills	Boardwalk Information Bulletin Board Road Signing	$ 197,000	$ 38,000	$ 235,000
Crosby Canyon	Vault Toilet Information Bulletin Board Road Signing	$ 24,000	$ 4,500	$ 28,500
Dirty Devil	4 Vault Toilets 4 Trash Receptacles .25 Miles Road Improvements 0.4 Miles Guardrails Information Bulletin Board Road Closure Gate Road Signing	$ 166,000	$ 32,000	$ 198,000
Farley Canyon	Information Bulletin Board 2 Trash Receptacles 0.4 Miles Road Improvements Road Closure Gate Road Signing	$ 54,000	$ 10,000	$ 64,000

Halls Crossing Cove #4	Vault Toilet 3 Trash Receptacles 0.3 Miles Road Construction Information Bulletin Board Road Closure Gate Road Signing 15-Car Parking Lot 10 Picnic Tables 10 Pedestal Grills Picnic Shelter (25'x25')	$ 194,000	$ 37,000	$ 231,000
The Chains	4 Vault Toilets 4 Trash Receptacles 1.2 Miles Road Paving 1.1 Miles Guardrail 2 Information Bulletin Boards Road Closure Gate Road Signing Interpretive Shelter 440-Car Paved Parking 1.9 Miles Trail Construction 8.7 Acres Landscape Rehab. 100 Picnic Tables 100 Pedestal Grills 20 Shade Shelters (25'x25')	$2,066,000	$ 394,000	$2,460,000
			GRAND TOTAL	$4,590,500

CHAPTER III

THE AFFECTED ENVIRONMENT

INTRODUCTION

This chapter summarizes significant physical and biological characteristics of Lake Powell's accessible shorelines. Also, it summarizes visitor-use trends and the relationship to Lake Powell's boating carrying capacity. Descriptions of those aspects of the environment likely to be affected by either the proposed plan or the alternatives, including major areas of concern identified by the public are included.

EXISTING CONDITIONS

The following descriptions illustrate existing conditions at each shoreline site.

Blue Notch Canyon

Vehicular access to this shoreline is by an unmaintained primitive 4x4 road. There are no developments or measurable resource impacts.

Bullfrog Creek

Two toilets have been constructed in the lower end of this area. The effects of high levels of unregulated visitor use are most apparent along the shoreline of Bullfrog Creek. Human waste is evident throughout the area, which at times provides strong odors. Litter, fire rings, and off-road vehicle use are all contributing to a degrading shoreline environment. High levels of use are contributing to excessive noise, conflicts among recreationists, and decreasing water quality. A spider web of roads exists from unregulated off-road vehicle activities. Many activity conflicts have been observed among recreationists, particularly during heavy use periods.

Clay Hills

Much of this shoreline's visitor use is a result of river-running activities on the San Juan. Developments are limited to a small parking lot and informal boat take-out area. Primary resource impacts are from human waste along shorelines.

Copper Canyon and Neskahi

Above the elevation of 3,720 feet, all land is within the Navajo Indian Reservation. Because access to this area is poor, visitor-use levels have been low and only minor resource damage has occurred. Feral burrows have created trampling damage at Neskahi. A system of old mining road cuts near the lake are evident in both areas. Copper Canyon has been selected by the Navajo Nation as the future permanent San Juan marina.

Cottonwood Canyon

A majority of past resource degradation has been from cattle grazing trailing damage. Degradation created by visitor use has originated from the boating public. Road access is poor and has kept vehicular-use levels low. Anasazi ruins and evidences of historic cribbing associated with the Hole-in-the-Rock road are within the canyon.

Crosby Canyon

For the most part, access to this area requires a four-by-four vehicle. The present access road is located in a canyon bottom which is subject to flash floods. There are no site improvements existing at this area. Most use occurs during periods of lower lake levels. Shorelines have been subjected to an increase of tamerisk invasion.

Dirty Devil

There are no site improvements existing. Historic visitor use has adversely impacted shoreline environments and created litter and human waste problems. Multiple fire rings are apparent throughout the area. Off-road vehicle use is created by the need to access dispersed camping sites near the lake.

Farley Canyon

Existing improvements include two toilets and a large aggregate-surfaced parking area created by a State Highway Department borrow pit. A no-wake zone is presently enforced in this vicinity of the lake. During popular holiday periods there is excessive noise and other activities which have led to visitor

conflicts and complaints. The shoreline environment has been adversely affected by human waste, litter, and multiple fire rings. Indiscriminate off-road vehicle use has created primitive roads in portions of this area.

Hansen Creek

Day-use activities are predominant and resource degradation is not apparent. Low amounts of visitation can be attributed to poor lake access created by topographic barriers.

Hole-in-the-Rock

Road access terminates at a cliff high above the lake's surface; access to the lake is by a difficult foot route. A marker for the historic Hole-in-the-Rock road presently exists.

Lake Canyon

This area is undeveloped and primarily serves day-use activities. Most resource impacts are the result of human waste, litter, and off-road vehicle use. Historic visitation levels appear to be low. Glen Canyon's General Management Plan closed road access to this site. Also, no direct vehicle access exists to the water because of steep, sandstone sideslopes.

Last Chance Canyon

Roads which access this canyon pass through drainages with flash flood hazards. For the most part, a four-wheel-drive vehicle is required. Visitor use is low and there is no evidence of resource damage. Also, the invasion of tamerisk is increasing.

Piute Canyon

Above the elevation of 3,720 feet, all land is within the Navajo Indian Reservation. There are presently no developments. Current road access is poor and travel time required for access precludes day trips.

Red Canyon

Road access requires travel on an unmaintained

primitive road. The road is located along a canyon bottom that is subject to flash flooding. Currently, visitor use is low and there are no measurable resource impacts.

Stanton Creek

An old gravel pit and two toilets exist. Because this area is located adjacent to the Bullfrog Basin marina, high levels of visitor use are common. This has resulted in adverse impacts to the shoreline environment, a spreading of human waste and litter, multiple fire rings, conflicts among recreationists, and excessive noise. The most evident damage is from ORV use where large areas have lost native vegetation cover, giving the appearance of a spider web network of roads that criss-cross the area.

The Chains

A majority of users are local residents of Page, Tuba City, Shento, and Kaibito. It is a popular spot for fishing and day-use activities. Trash containers are currently provided, but their use by the visitor seems to be minimal. The Chains is located close to the Carl Hayden Visitor Center, where more than 500,000 visits are recorded each year. It has the potential of providing an access to the lake for many of these visitors, however, some safety hazards do exist from steep drop-offs and the close proximity to the Glen Canyon Dam spillway.

Warm Creek

Access is along a primitive road and requires travel through drainages with flash flood hazards. Visitor use has remained relatively low and only minor resource damage has been observed. There are no developments at this site. The invasion of tamerisk is increasing throughout this area.

White Canyon

This area is experiencing considerable damage from ORV activities. In addition, increasing levels of visitor use are creating minor impacts to the shoreline environment and human waste and litter is becoming a problem. There are no developments existing. Existing

road access requires a high-clearance vehicle during dry periods.

NATURAL RESOURCES

Water Resources

Recreational sites long the shores of Lake Powell are subject to the effects of annual changes in lake elevation. Elevations commonly fluctuate 20 to 25 feet in a year, with low water at the end of March, and high lake elevations in July and August.

In drainages, where the topographic gradient is low compared with the rest of the shoreline, the zone of lake influence extends for a relatively long horizontal distance. At low water, expanses of exposed silt and sediment in the lower drainages render them undesirable as recreation-use points and at high water, the lake usually extends up into a zone of thick riparian vegetation. For these reasons, most of the shoreline-use sites are found outside the immediate floodplain of the larger drainages.

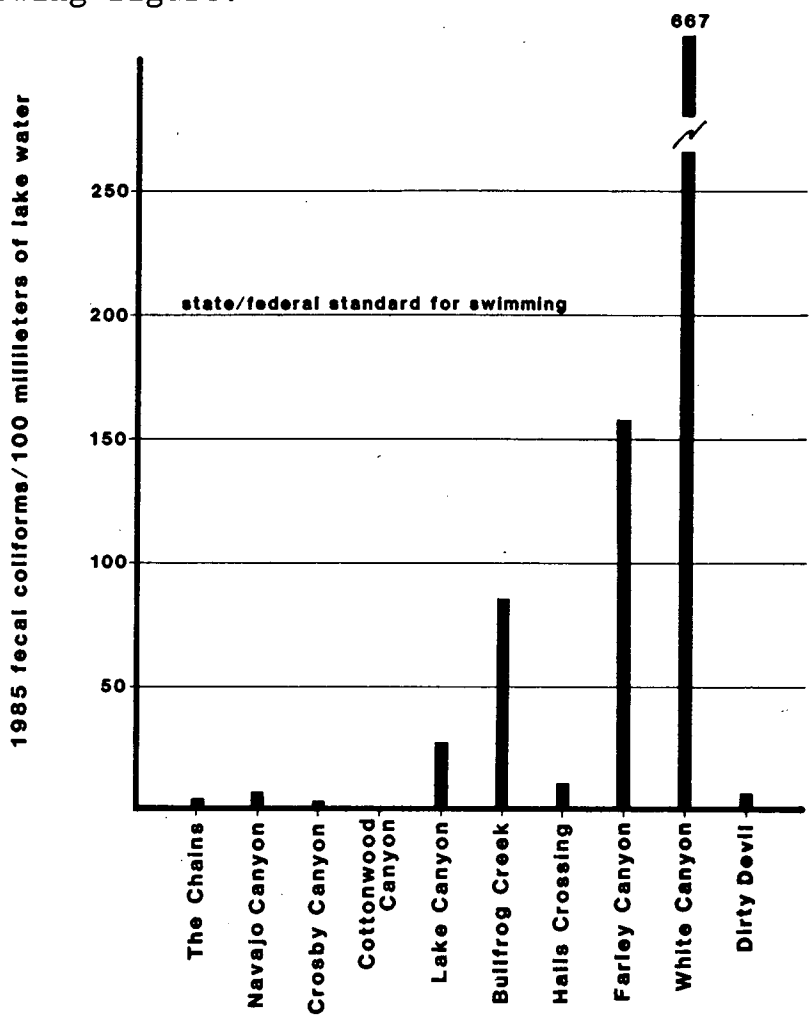
Floodplain data was obtained by consultation with the Bureau of Reclamation, U.S. Geological Survey, and field inspections by park resource management specialists. Appendix B includes discussions on flood hazards at each shoreline area.

There are no existing facilities located in flood-prone areas at any shoreline site. However, access to Blue Notch Canyon, Red Canyon, Crosby Canyon, Piute Canyon, and Warm Creek requires travel on roads located in drainage bottoms with flash flood hazards.

The principal water quality issue for shoreline recreation at Lake Powell is the effect on human health of waste contributed by the recreationists themselves. Other sources of potentially detrimental pollutants are from non-recreation uses in the area and their effects are insignificant.

The existing water quality at Lake Powell is excellent nearly everywhere except at the most heavily used sites, where human waste evidently causes low-to-moderate levels of pollution. No sites are consistently above the health standard for swimming in

content of fecal coliform bacteria. Nevertheless, the tendency for shoreline use to increase bacteria in water is evident. The coliforms measurements for some accessible shoreline sites are illustrated in the following figure.



Water Quality at Monitored Shoreline Sites

These data are based on a limited number of samples (N = 2 to 10) and should be interpreted as general indications of water quality and not statistically reliable parameters. The high value at White Canyon, for example, is based on a single high reading out of 8 samples.

Soils

Appendix C contains a detailed description of soils at each shoreline area.

The Moenkopi and Old Cutler geologic formations are typical in the Hite marina area. This area includes the Dirty Devil, Farley Canyon, and White Canyon shoreline sites. Chinle soils predominate in the Blue Notch and Red Canyon sites. These soils are vulnerable to impact and slow to recover from disturbance. At Bullfrog Creek, sandy shorelines predominate, which are generally suitable for intensive recreation activities.

Stanton Creek, Hansen Creek, Lake Canyon and Halls Crossing Cove #4 include large areas of the sensitive Carmel derived soils. Once disturbed, these soils are subject to severe erosion while re-establishment of vegetation is difficult. At Crosby Canyon, Warm Creek, The Chains and Last Chance Canyon, the Entrada and Morrison sandstone/siltstone predominate. Navajo sandstone and sandy soils can be found throughout the Cottonwood Canyon and Hole-in-the-Rock shoreline areas.

Along the San Juan arm, Moenkopi and Chinle formations are found throughout the Copper Canyon, Neskahi, and Piute Canyon sites. Again, these sites are subject to extreme erosion and are difficult to revegetate.

Vegetation

Lake Powell's accessible shorelines have and continue to experience vegetation disturbance from recreation use (primarily off-road vehicle travel). Areas of major disturbance were mapped and nearly 600 acres were found to have experienced major vegetation degradation. Nearly all shoreline areas have experienced some degree of vegetation disturbance. Acres of existing vegetation disturbed are illustrated on the following table.

Existing Acres of Disturbed Vegetation

Shoreline Site	Existing Disturbed Acres
Farley Canyon	23 acres
Clay Hills	70 acres
Halls Crossing Cove #4	18 acres

Hansen Creek	4 acres
Stanton Creek	125 acres
Hole-in-the-Rock	6 acres
Lake Canyon	40 acres
Bullfrog Creek	186 acres
The Chains	67 acres
Blue Notch Canyon	22 acres
Red Canyon	36 acres

Appendix D contains a discussion of vegetation types and communities found at each shoreline site.

Threatened and Endangered Species

Within the recreation area, two endangered wildlife species (peregrine falcon and bald eagle) are reported and two plants are listed [Brady pincushion cactus (Pediocactus bradyi) and Jones Cycladenia (Cycladenia humilis var jonesii)]. The National Park Service monitors the status of these species and is working with authorities and other agencies and organizations toward population maintenance and enhancement.

There are approximately 50 rare plant species which occur in the recreation area, 20 of which are considered to be candidate species for listing as threatened or endangered under the Endangered Species Act. One of these plants, Hole-in-the-Rock prairie clover (Dalea flavescens var. epica), is reported in sandy soils at the Halls Crossing/Bullfrog areas.

The Hole-in-the-Rock prairie clover is a herbaceous perennial with a total distribution reported from the base of the Henry Mountains south to Halls Crossing, a range of approximately 10 miles. Within this range, it occurs in sandy loam soils within sparse desert shrub communities. Approximately half of the total range occurs within the recreation area.

The Hole-in-the-Rock prairie clover is closely related to the common prairie clover (Dalea flavescens var flavescens) and additional taxonomic and ecological investigations are recommended by the U.S. Fish and Wildlife Service. These studies are currently being initiated and will be ongoing as this plan is developed, and additional information will be incorporated as it is obtained.

Air Quality

Glen Canyon lies within the Four Corners Air Quality Control Region. The area has little industry and a relatively low population, with a small amount of vehicular use. Analysis of air quality data concludes that the air quality of the national recreation area is excellent. Air quality excellence decreases near local pollution sources such as automobiles, motor boats, and the coal-fired Navajo Generating Station. Glen Canyon is within a Class II airshed. Regional decreases in air quality occasionally occur during periods when concentrated air masses move in from the west.

CULTURAL RESOURCES

Cultural resource inventories and data were obtained by file searches and reconnaissance surveys by the park archeologist. Appendix E contains results of that effort for each shoreline site.

In the Blue Notch Canyon, Red Canyon, Crosby Canyon, Hansen Creek, Warm Creek, and White Canyon study areas, there are no known cultural resources, although cultural resources are located in the vicinity of these areas.

Copper Canyon, Neskahi, and Piute Canyon are in the vicinity of Pueblo period sites related to Anasazi occupation. Lithic scatters were found in Farley Canyon, Stanton Creek, and The Chains. Highly dispersed chert flakes were found in Halls Crossing Cove #4. Several lithic scatters including an extensive campsite were found at Dirty Devil.

Two of three previously recorded sites at Clay Hills are probably inundated; a third was not relocated. At Lake Canyon, an extensive lithic scatter, large prehistoric campsite, and isolated flakes were discovered. Only remains of the historic Hole-in-the-Rock road have been recorded at the Hole-in-the-Rock shoreline site. Bullfrog Creek contained a single prehistoric campsite and a small lithic scatter.

Cottonwood Canyon contains some of the most significant cultural resources in the park, including cribbing from the historic Hole-in-the-Rock road as well as prehistoric rock shelters, and open sherd, and lithic sites.

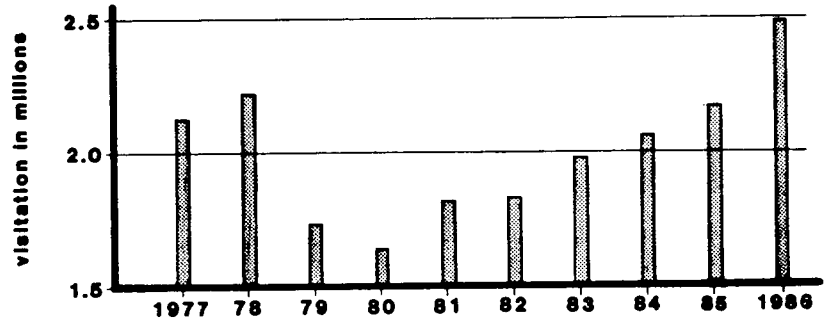
In November and December 1987, interviews were conducted with Navajo people residing in the Piute Mesa and Nokai areas of the Navajo Indian Reservation. Piute Mesa includes the Piute Wash and Neskahi shoreline sites, while Nokai includes the Copper Canyon and Clay Hills shoreline sites. The purpose of the interviews was to determine use of natural and cultural ethnographic resource for religious and other purposes by Navajo people.

Each of the four shoreline sites have been and are currently used for livestock grazing, mostly sheep. Most grazing is conducted during the winter months under permit from the Navajo Nation. These canyon areas contain "salt" plants not available on the mesa and easily accessible water for livestock. The canyon bottoms also contain willows that are still collected for basket making and other plants used for medicine. Navajo medicine men collect plants along the shorelines of Piute Wash, Neskahi, and Copper Canyon. In the upper portions of Piute Wash, small areas are cultivated for agricultural purposes, including cornfields and fruit trees.

It appears that Copper Canyon has religious significance because of echoes (talking walls) from sandstone walls near the mouth of the canyon. Although its specific location is unknown, Copper Canyon also includes a sacred ceremonial site. Most of the people interviewed indicated that Piute Wash contained a major sacred religious ceremonial site near the lake's edge on the west side of the canyon. While all of the shorelines were used to practice some religious activities, Piute Wash is the most important and was referred to as, "very sacred".

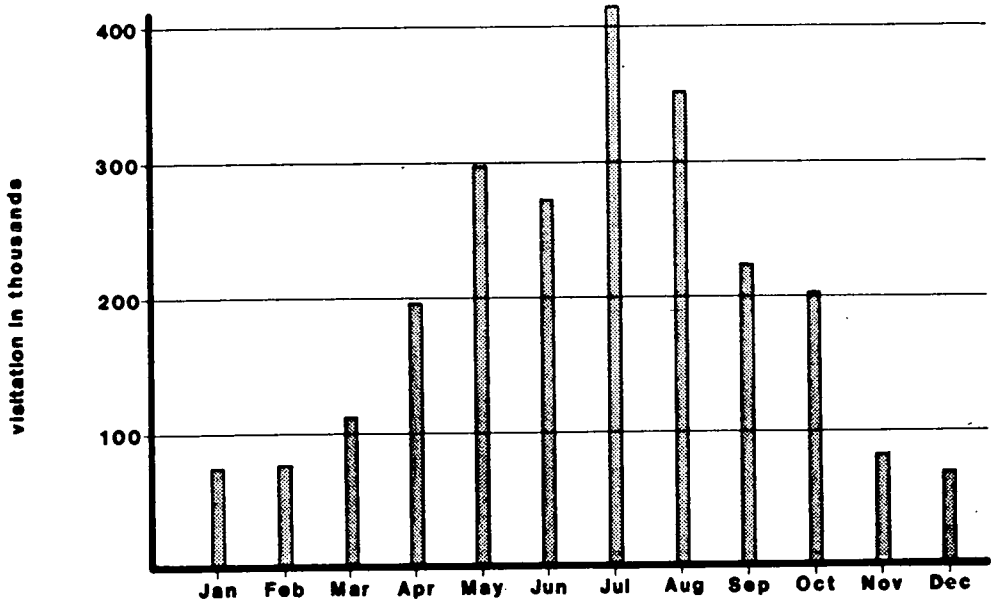
VISITOR USE/RECREATION

From 1977 through 1986, use at Glen Canyon averaged more than two million visits annually. This represented an average annual increase in visitation of 6.4 percent. It is anticipated this pattern of use will continue as facilities are upgraded and expanded at Lake Powell's developed marinas.



Annual Visitation

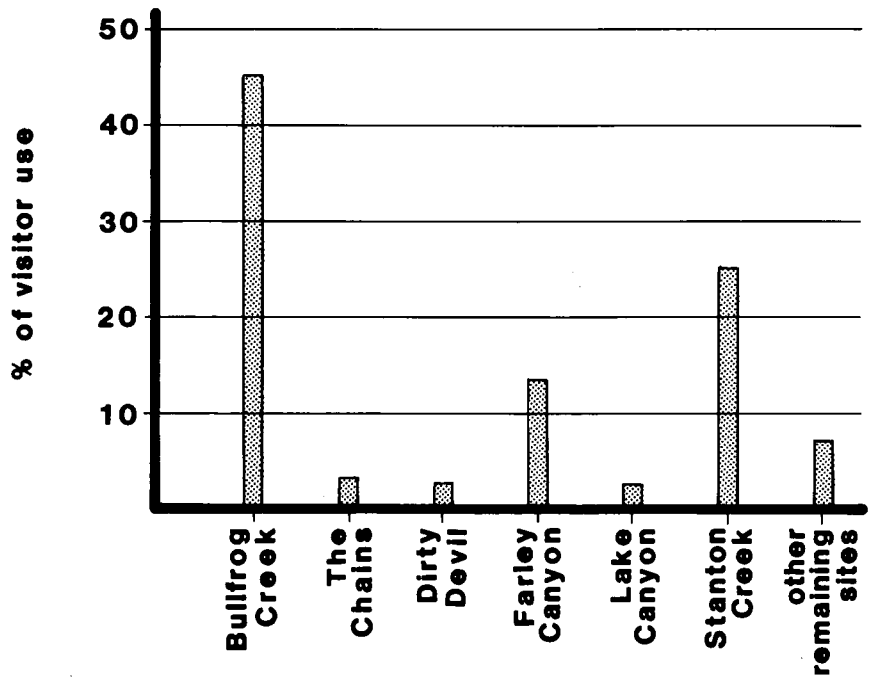
Fluctuations in visitation occur throughout the years. In 1986, 56 percent of visits occurred during the major visitor-use season of May through August. Shoulder season visitation, April-May and September-October, comprised 31 percent of total visits. Off-season visitation, January-February and November-December, accounted for the remaining 13 percent of 1986 totals. An analysis of monthly visitation trends for the past ten years indicates a growing amount of use during the shoulder seasons. This may be attributed to Lake Powell users seeking to recreate in a less crowded setting.



Monthly Visitation - 1986

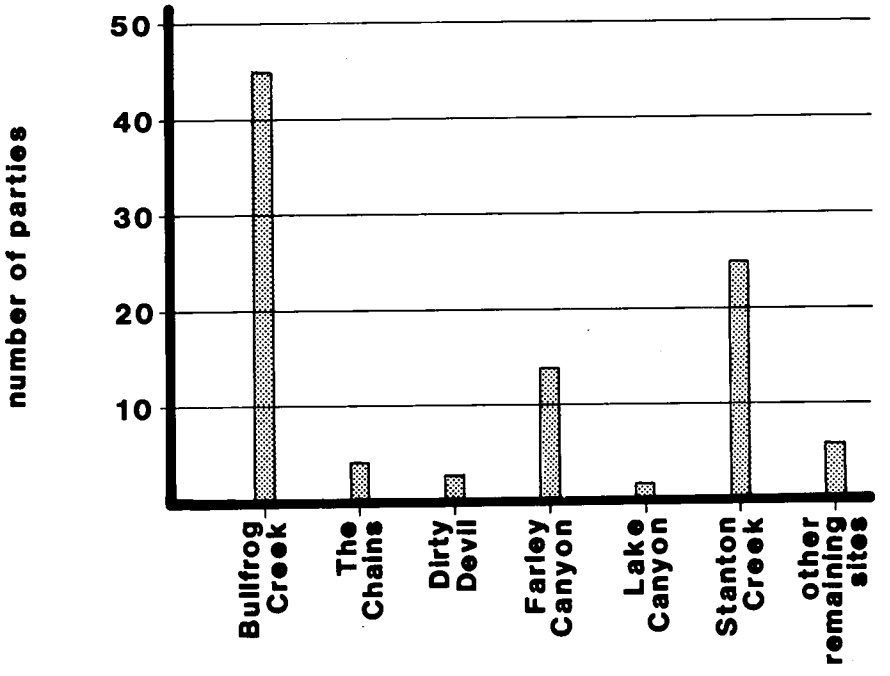
Over the years, the collection of visitor use data has been oriented towards Lake Powell's developed marinas. For this reason, quantified use of the twenty accessible shorelines has not been available. To help estimate and quantify shoreline use for this plan, an aerial observation and visitor survey program was initiated at the outset of this effort. On August 6, 12, 20, 21, and 31, 1986, one or two daily aerial overflights were made of each shoreline site. The number of parties, cars, recreation vehicles, campers, tents, powerboats, sailboats, houseboats, and boat trailers was recorded. Based on the number of parties present and the average party size of 6.2 derived from the 1985 Boater Survey, it was calculated that an average of 476 daily visits was made to accessible shorelines (excluding boat-in use) during the survey period. Using monthly visitor-use distribution patterns occurring lakewide for 1986, it can be inferred that accessible shorelines received about 100,000 visits during that calendar year.

The following table illustrates the distribution of use (100,000 visits to accessible shoreline sites in 1986) to each shoreline area. As illustrated, Bullfrog Creek and Stanton Creek are the most popular shoreline areas receiving about 70 percent of total shoreline use.



Distribution of Use By Site

During the major visitor use season, Bullfrog Creek has an average of 45 parties present at any given time while at the more isolated shoreline areas, there are many days when no visitors are present.



Average Number of Parties at Each Site

Some general trends of visitor use and characteristics were obtained from the aerial observation and visitor survey program. They are as follows:

-Use at the north end of the lake tended to be consistent: the users were mostly from Utah; the preferred activity was fishing; the peak season was mid-April to mid-May, encompassing Easter Sunday; and length of stay was 5 to 8 days.

-Use at the south end of the lake was distinctly different than at any other shorelines documented. The Chains was used predominantly as a day area for fishing. Small parties overwhelmingly from Arizona, used this area.

-The middle region of the lake had varied usage and only minor trends are clear. These trends are: the majority of users came from Colorado. Large parties were more likely to use Bullfrog Creek and Stanton Creek.

-Lakewide, the numbers of cars and powerboats were roughly equal.

-Recreational vehicles (RV's) and campers were about equally represented, and were preferred over tents and trailers by 3:1. Tents and trailers were about equally represented.

-Off-road-vehicle (ORV) use occurred lakewide. Two percent of the parties used ORV's and half of that use occurred at Bullfrog Bay.

-Powerboats were preferred over houseboats and sailboats by roughly 10:1.

-Sailboat and houseboat use were roughly equal.

-Powerboat users preferred Bullfrog Bay (31% of lake use); then Farley (19%); and Stanton Creek (16%).

-Sailboat users preferred Bullfrog Bay (26% of lake use).

-Houseboat users preferred Bullfrog Bay (40% of lake use).

Appendix F contains a discussion of other visitor use/recreation influences at each shoreline site.

LAKE POWELL'S CARRYING CAPACITY

In November 1987, a study was completed that quantified the limits to boater use based on important resource, physical, safety, and recreational quality factors. The results included the "boats-at-one-time" limit computed for each lake study zone and a table of boat distribution by marina of origin. The study identified the most limiting factor in each zone and apportioned that limit among the several marinas. The study indicated that launches from approved marinas including launches from public ramps would consume all of the lake's carrying capacity under existing conditions of

management and use. Should additional management actions be undertaken to reduce the effects of shoreline use on water quality and trash accumulation, then additional capacity would be available.

The study established a relationship between zones of use and launch point, by evaluating trip itineraries, and concluded that most boaters occupy shoreline sites within a day of the point of launch. The study also revealed that the average length of stay for Lake Powell boaters using runabouts, ski boats, or cruisers is four days.

Access points evaluated in this plan which could reasonably serve as undeveloped boat launch points include Crosby Canyon, Clay Hills Crossing, Stanton Creek, Bullfrog Creek, Red Canyon, Blue Notch Canyon, White Canyon, Farley Canyon, and the Dirty Devil site. To estimate launch rates from these points, boat trailer counts were included in the aerial observations of visitor use. The mean daily total of empty trailers was 225. If the mean trailer count is corrected for length of stay, by dividing by four, then the daily launch rate from miscellaneous access points could be estimated to be 56, an insignificant fraction when compared to the total launches from developed areas.

The following table illustrates that within additional management actions, Lake Powell can accommodate 2,572 boat launches per day. Currently approved marina development plans would generate about 1,850 launches a day upon their full implementation. While there appears to be excess capacity, much would be consumed by the future San Juan marina and any extra capacity must be based on additional management actions regarding shoreline clean-up and reduction of water quality impacts. It appears that Lake Powell has the capacity to accommodate boat launches generated by accessible shoreline sites.

Red, Blue Notch, and White Canyons receive insignificant use for boat launching. The Crosby, Stanton, and Bullfrog launch points are located in zones of the lake shown by the carrying capacity study to be zones of heavy boating shoreline use.

Table 15

Comparison of Marina Launch Capacity with Carrying Capacity Launch Rate (launches/day)

marina	marina launch capacity		carrying capacity launch rate	
	existing	approved*	existing	additional mgmt.**
Wahweap/ Lone Rock	644	870	↑ 685 ↓	↑ 1,358 ↓
Antelope Point	0	240		
Bullfrog Basin	220	420	↑ 440 ↓	↑ 800 ↓
Halls Crossing	145	206		
Hite	114	* (114)	50	414
total	1,123	1,850	1,175	2,572

* Launch rates from proposed facilities in current plans.

** Additional management - applying management actions to a particular limiting factor to increase BAOT capacity.

FACILITY ANALYSIS AND STAFFING

Staffing specifically related to management of Lake Powell's shorelines is not currently available. Maintenance activities are restricted to pumping of existing vault toilets at Bullfrog Creek, Farley Canyon, and Stanton Creek. Following major weekends (e.g., Memorial Day, Fourth of July, and Labor Day) of visitor use, maintenance crews are used for waste and trash cleanup at the most popular shoreline areas.

Currently there is no interpretive involvement at the shoreline areas. Due to a lack of staffing and funding; interpreters, informational signing, brochures, and other handouts are not available.

With the exception of major use weekends, visitor and resource protection efforts are limited to response to reported emergencies and unscheduled/occasional ranger patrols as time permits. During major use weekends, daily patrols of Dirty Devil, Farley Canyon, and Bullfrog Creek are made. The Chains area receives

daily patrols throughout the major visitor use season--June through September.

Facilities existing at accessible shoreline areas are limited. Most efforts are concentrated on the more popular shorelines. The following figure illustrates existing facilities and their conditions:

EXISTING FACILITIES/CONDITIONS

	Vault Toilets	Dumpsters	Roads*	Information Signs	Aids to Navigation
Blue Notch			F		
Red Canyon			F		
Bullfrog Creek	2	1	U		
Clay Hills			U	1	
Crosby Canyon			U	1	
Dirty Devil			U		
Farley Canyon	2		M	1	Wakeless
Warm Creek			F		
White Canyon			U	1	
Halls Crossing					
Cove #4			N		
Hole-in-the-Rock			M	1	
The Chains		2	M	3	
Cottonwood Canyon			F		
Hansen Creek			U		
Stanton Creek	2	1	M		
Lake Canyon			N		
Last Chance Creek			N		

* U - unmaintained 2WD
F - unmaintained 4WD
M - maintained dirt 2wd
N - no approved road, but illegal vehicle use apparent

CHAPTER IV

ENVIRONMENTAL CONSEQUENCES OF THE PROPOSAL AND ALTERNATIVES

INTRODUCTION

This chapter discusses the estimated effects of each alternative and the proposed plan. This disclosure provides the information necessary to compare the relative merits of the alternatives and proposal. Included are discussions on any adverse environmental effects which cannot be avoided, the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources necessitated by implementation of the proposal.

NATURAL RESOURCE ENVIRONMENTAL CONSEQUENCES

Water Resources

Proposed Plan

No facilities exist or are proposed for any flood-prone areas or wetlands. As required by the NPS Floodplain/Wetland Protection Guidelines, undeveloped areas subject to flash flooding and frequented by people will be posted with signs warning of flash flood danger. Warning signs will be installed along all roads which are in or access these kinds of areas. The interpretive program would also reduce visitor exposure to these hazards by increasing their level of knowledge and caution. Sites where visitors would benefit from these actions would be those where access is through a confined floodplain - Warm Creek, and Crosby Canyon in particular. Last Chance Canyon, a third area of hazardous access, would be closed, effectively eliminating the potential flood hazard to visitors there.

The proposal includes provisions which would increase visitor awareness of appropriate shoreline-use sites and increase NPS presence in the backcountry. These actions would further reduce visitor exposure to floods.

The proposal also includes measures to improve, or prevent deterioration of, shoreline water quality. These measures include visitor education, promulgation of a self-contained waste disposal rule, and the installation of permanent toilets at key sites. Farley Canyon and Bullfrog Creek, which have been observed to have poor water quality in the past, may have improved water quality as a result of the proposal. Stanton Creek, an area experiencing intermittent water quality impact from current use, would be managed under a permit system with a self-contained waste disposal restriction, which may eliminate a source of water quality contaminants.

All of the other accessible sites, which maintain good water quality under current conditions, would have a reduced chance of future deterioration because of the visitor education aspects of the proposal, ranger patrols, and requirements for self-contained waste disposal.

Provisions of the proposal designed to reduce the incidence of unauthorized off-road travel by motor vehicles (certain road closures, increased patrols and public education) would reduce the spread of erosion and consequent silting of shoreline areas.

Alternative A - No Action

No facilities exist or are proposed to be constructed in the "No Action" alternative. To gain compliance with the NPS Floodplain/Wetland Protection Guidelines, all undeveloped areas subject to flash floods will be posted with warning signs.

Potential water quality improvement which might result from measures contained in the proposal would not occur. The existing condition of lowered shoreline water quality at Bullfrog Creek, Farley Canyon, and Stanton Creek may continue.

Existing water quality impact resulting from erosion on the spreading network of off-road vehicle trails would also continue.

Alternatives B and C

The water resource benefits of these alternatives would approximate those of the proposed plan.

These alternatives would, however, close additional areas to overland access, thus reducing further the potential for water quality damage from ORV-related erosion.

Soils

Proposed Plan

Under the proposal, lands would be disturbed to support day use and overnight camping. Disturbance would be in the form of road improvements, fencing, placement of toilets and trash containers, and designation of camping and other use areas. The majority of these projects would be accomplished in areas previously disturbed by recreation use.

Impacts to soils will be confined to designated zones of use at each shoreline area. This will enhance resource preservation efforts on lands adjacent to these designated zones. The construction of guardrails, fences, or other physical barriers will confine vehicular traffic to designated corridors and prevent the spread of impacts associated with off-road vehicle use along Lake Powell's shorelines. Signing will also be used to confine use and prevent spread of impacts. These improvements and management actions will help maintain the resource integrity for the majority of shoreline resources.

At Dirty Devil, Farley Canyon, and White Canyon, the proposal will provide the opportunity for a spectrum of recreation use, while limiting impacts to the Moenkopi and Old Cutler formations typical in the general Hite area.

Chinle soils in the Blue Notch and Red Canyon vicinity are vulnerable to impact and are slow to recover from disturbance. Impacts would be limited by signing of designated road and shoreline-use zones. Sandy shorelines of the Bullfrog Creek area would be intensively used for various recreation activities below the 3,700 foot elevation. Because of fluctuating lake levels, impacts on these shorelines would be minimal. No erosion, slope raveling, or other soil impacts are anticipated.

The soils of Hansen Creek and Lake Canyon would be

protected by closure of these areas to vehicle access. The sensitive Carmel soils at Stanton Creek would also be partially protected by managing this area under a permit system. However, repair of damage previously incurred will require long-term management efforts because of the desert environment. Carmel soils also occur at Halls Crossing Cove #4. A small, confined, previously disturbed area will be used for construction of a small parking lot, and an existing 4x4 track will be designated as an access road and pedestrian trail. Management actions will confine impacts to this small area.

At Crosby Canyon and Warm Creek, impacts to the Entrada and Morrison sandstone/siltstone would be limited to designated road corridors and use zones. Similar soils at Last Chance Canyon would not experience additional impacts because of closure to vehicle access.

Integrity of Navajo sandstone-produced sandy soils will be retained at Cottonwood Canyon through closure to vehicular access. Impacts to these soils at Hole-in-the-Rock would be limited to the access road and small existing parking lot.

Alternative A - No Action

Under this alternative, shoreline areas will continue to experience rapidly expanding impacts to soils by an expansion of recreation use to a larger land area. Examples include expansion of unauthorized road networks from increased demand for shoreline camping. Visitor unawareness of park regulations due to a lack of signing and information distribution which has resulted in increased off-road vehicle use and the corresponding impact to soils.

During the past five years, Bullfrog Creek and Dirty Devil have experienced an increase from an occasional vehicle to hundreds of vehicles pursuing shoreline recreation opportunities. The resultant impact to soils has expanded beyond the immediate shoreline area and under "no action", the rapid expansion would continue. If left unmanaged, hundreds of miles of new roads may be blazed on the land and thousands of acres of soil could be severely impacted, including sensitive desert soils.

Shoreline soil contamination would continue from human waste. These contaminated soils would become inundated

by fluctuating lake levels and create high bacterial loading in the recreational waters.

Alternative B - Minimum Management

Under this alternative, impacts at Dirty Devil, Farley Canyon, Bullfrog Creek, Clay Hills, Crosby Canyon, and The Chains would be similar to those described for the proposed plan. However, the intensity of impacts would be greater from increased use created by closure of many accessible shoreline areas. It will be difficult to limit impacts to the designated use zones because of visitor-use pressures, lack of physical barriers along roadways, and lack of rangers for frequently scheduled patrols. This could result in the continued uncontrolled impact to desert soils of the area.

Closure of a majority of the shoreline areas will reduce soil impacts. However, due to the previously described conditions, occasional vehicle use may still occur and continue to damage desert resources.

Alternative C - Concentrate Visitor Use

Impacts associated with this alternative are similar to those described for alternative B. The primary difference is that physical barriers would be constructed to confine use to designated corridors and zones. This action should substantially reduce the impacts from spreading off-road vehicle use.

Vegetation

Proposed Plan

The majority of lands involved with the proposal have been previously disturbed by recreation use. The designation of travel corridors and use zones will provide for enhanced protection of vegetation on adjacent lands. Most impacts from this proposal would be on the mixed shrub community prevalent at Bullfrog Creek, Halls Crossing Cove #4, Dirty Devil, Farley Canyon, White Canyon, and Clay Hills.

The blackbrush community will experience additional impacts at The Chains, while this community will not be affected at Hole-in-the-Rock. Closure of Lake Canyon

to vehicular access will aid in the recovery of blackbrush in this area.

The Chinle soils and mat saltbrush are sensitive to disturbance and difficult to reclaim. At Last Chance Canyon, disturbance of this species will be mitigated by closure to vehicle access. Through designation of travel corridors and use areas, impacts to this species will be limited to small areas at Warm Creek and Crosby Canyon. Cooperative management of the San Juan Arm sites with the Navajo Nation is necessary to curb further disturbance of mat saltbrush at these sites.

While vegetation can recover from disturbance throughout the shoreline sites, reclamation in these area vegetation types is extremely slow. All management actions must strive to minimize disturbance associated with implementation of the proposed plan.

Alternative A - No Action

Under "no action", disturbed shoreline acres would continue to grow, resulting in a loss of additional shoreline desert plant communities. Existing disturbed acres are illustrated in Chapter III. The amount of increased vegetation disturbance from unregulated visitor use is unknown. With the loss of native perennial vegetation, habitats vacated will be invaded by exotic species such as cheatgrass or puntene vine.

Alternative B - Minimum Management

Impacts associated with shoreline areas open under this alternative are similar to those described for the proposed plan. However, the intensity of impacts would be greater because of limited shorelines that would be available for use. At Bullfrog Creek, impact to native plant communities on rolling dunes will continue.

Alternative C - Concentrate Visitor Use

Only a limited number of shoreline areas would be open under this alternative. While use of open shoreline sites will be high, adjacent plant communities should be protected via installation of physical barriers and scheduled enforcement duties. Shoreline areas closed to vehicle access should recover under natural processes. Exotic species will initially be present

until native species are able to recover to pre-disturbance composition and density.

Threatened and Endangered Species

The proposal would have no impact on the peregrine falcon and bald eagle. In the proposal, visitor use levels will be managed in the vicinity of access areas and would not affect adjacent raptor habitats. It has also been determined that listed species of plants will not be affected by the proposal.

The Hole-in-the-Rock prairie clover, a candidate threatened/endangered species, has been identified in the vicinity of the Bullfrog Creek study area. The habitat has been isolated in the proposal for protection from the impact of off-road vehicle use with the installation of guardrails and fencing. These steps are being proposed to provide protection to the surrounding vegetation, including the habitat of the Hole-in-the-Rock prairie clover. The integrity of this habitat will be monitored by the Shoreline Evaluation Team included in the proposed plan.

Air

In the "no action" alternative, potential exists for an increase in the amount of land where vegetation would be removed or disturbed by ORV and other recreation activities. Removal of vegetative cover will increase the fine particles of soil (fugitive dust) carried by the wind and may decrease visibility. In the proposed plan and action alternatives, areas will be closed, or use areas designated, to help reduce acres of vegetation disturbance. This should result in a decrease of acres subject to wind erosion.

In all alternatives, visibility could be reduced by emissions from combustible engines. The principal pollutants are carbon monoxide, oxides of nitrogen, and organic compounds. The amount of emission is dependent on the number of people and vehicles using the shoreline areas. With the exception of alternative B, Minimum Management, the amount of recreation use should be similar for the proposed plan and remaining alternatives. In alternative B, use levels can be expected to decrease because of shoreline closures. In alternative C, Concentrate Visitor Use, emissions would be limited to small designated areas where the amount of air available for dilution would be decreased.

Although no specific air quality modeling was completed for this analysis, based on the regional meteorology and potential emissions, it is determined that local air quality for gaseous pollutants are within the national ambient air quality standards (40 CFR, Part 50).

CULTURAL RESOURCE ENVIRONMENTAL CONSEQUENCES

Prior to specific surface-disturbing actions, an intensive inventory will be conducted for the purpose of identifying cultural resource properties which may be impacted by the proposed action. If such properties are located, appropriate mitigation measures will be undertaken by the National Park Service, in compliance with the provisions of 36 CFR Part 800, pertaining to consultation with the Advisory Council on Historic Preservation. The NPS will consult with the Utah/Arizona State Historic Preservation officer and the Advisory Council on Historic Preservation in development of a programmatic agreement that will address impacts on cultural resources resulting from the proposed action. The programmatic agreement will be negotiated following approval of this plan.

As a result of the implementation of either the proposed plan or its alternatives, both direct and indirect impacts may be anticipated. Direct impacts are those which may result from authorized surface-disturbing actions undertaken by either the National Park Service or the visitor. Indirect impacts are those which may occur during use of the identified project area or the surrounding vicinity, as a result of such activities as pot hunting, ORV use, and casual visitation.

The Copper Canyon, Neskahi, and Piute Wash sites, located on the Navajo Indian Reservation, contain cultural and natural ethnographic resources. The proposed plan and alternatives do not include any actions that would change or preclude use of these shorelines or their resources by the Navajo people. Any actions that may be employed would require coordination and consultation with the Navajo Nation and would further insure continuance of current uses.

At Clay Hills, the proposed plan and alternatives A and B would have no effect on the area's limited

ethnographic resources. In alternative C, construction of boardwalks on the San Juan mud flats may effect some shoreline access and disturb plants collected for medicine and other purposes.

In the following discussions, possible direct and indirect impacts of proposed actions on known and projected sites is considered.

Proposed Plan

Potentially significant cultural resource properties have been identified in the Bullfrog Creek, Dirty Devil, Farley Canyon, Cottonwood, Lake, Stanton Creek, and The Chains study areas. These properties will be protected by closure of the Lake area, and vehicular traffic restrictions imposed for the remaining areas. Residual indirect impacts may be anticipated due to casual collections by visitors, and monitoring of identified sites should take place. Direct impacts to an identified site (a large lithic scatter) in The Chains may be anticipated as a result of construction of an interpretive trail, however, this impact will be mitigated prior to surface disturbance. The historic Hole-in-the-Rock road will not likely be impacted by the proposed levels of day use in this proposal.

The White Canyon study area does not contain identified properties, however it is located in a highly sensitive region of the park which may be open to increased indirect impacts due to vandalism and visitor use if a substantial increase in visitation is experienced. Monitoring of selected sites in the vicinity of this study area is recommended.

No cultural resource properties have been identified in the Blue Notch, Red Canyon, Crosby Canyon, Halls Crossing, Hansen Creek, Last Chance, Warm Creek and Clay Hills Crossing study areas. No impacts to sites in these areas are anticipated as a result of actions identified in this alternative.

The Copper Canyon, Neskahi and Piute Farms study areas are all located in an area which is known to be sensitive for cultural resources. Prior to initiating management actions, the evaluation of potential impacts to cultural resources should be undertaken in conjunction with the Navajo Tribe.

Alternative A - No Action

Ongoing deterioration of identified properties caused by heavy visitor use and ORV activity can be expected to continue at the Bullfrog Creek, Dirty Devil, Lake, Stanton Creek, Cottonwood, and The Chains study areas, resulting in substantial site deterioration. Uncontrolled future growth of visitation may result in new impacts to properties at Farley Canyon. Deterioration of constructed segments along the Hole-in-the-Rock road should be anticipated if visitation is unregulated. Highly significant sites adjacent to White Canyon, located on both National Park Service and Bureau of Land Management lands, will experience an increase in vandalism if visitor use is not controlled. Similarly, sensitive resources will likely be degraded if protective action is not taken, in conjunction with the Navajo Tribe, at Copper Canyon, Neskahi, and Piute Farms.

Damage to cultural resources is not anticipated under this alternative for the Blue Notch, Red Canyon, Crosby Canyon, Halls Crossing, Hansen Creek, Last Chance, Warm Creek and Clay Hills Crossing study areas.

Alternative B - Minimum Management

Impacts under this alternative would be slightly less than under the proposed action, due to the protective nature of closures at all but the Dirty Devil, Farley Canyon, Bullfrog Creek, Clay Hills, and Crosby Canyon study areas. Anticipated impacts for the proposed plan would be generally the same for these areas, although an increase in indirect impacts may be anticipated as a result of increased visitor demand on fewer areas.

Alternative C - Concentrate Visitor Use

Impacts under this alternative would be very close to those anticipated under alternative B, although there might be an increase in indirect impacts to an identified site in The Chains as a result of authorized day-use activities.

EFFECTS ON VISITOR USE/RECREATION

Proposed Plan

The proposed plan will reduce visitor conflicts while

providing a variety of recreation opportunities. Degradation of the recreationist's physical setting from trash, human waste, fire rings, and off-road vehicle use will be reduced by implementing the proposed management actions and site improvements. The interpretive program and signing along access roads will help inform the visitor of each area's opportunities and the regulations governing use. This should increase visitor satisfaction and reduce visitors traveling to an area for a specific activity (e.g. ORV use), only to find that the opportunity is not available.

Cottonwood, Lake, and Last Chance Canyons - Cottonwood, Lake, and Last Chance Canyons will be closed to vehicular travel. This will allow exclusive use for boat-in campers and eliminate conflicts with the vehicular user. Cottonwood Canyon is a popular boat-in area and vehicular access will be limited, resulting in no user conflicts. Vehicular access to Lake Canyon is limited to canyon overlooks; there is no vehicular access to the lakeshore. The proposal will close this area to vehicular access and provide an alternate day-use area at Halls Crossing Cove #4. This will reduce conflicts with the boating public and provide the nonboater with a secluded day-use area close to the Halls Crossing Marina. Because of poor road conditions, very little recreation use occurs at Last Chance Canyon. Closure of this area will have few recreation impacts, however, because of flash flood hazards associated with the access road, visitor safety will be enhanced.

Halls Crossing Cove #4 - Halls Crossing Cove #4 will provide a day-use area available for swimming and picnicking not presently available in the Halls Crossing vicinity. The closure to motorized watercraft will provide safe swimming opportunities with no user conflicts. The walk-in nature of the area will provide a relaxed, more secluded atmosphere to an area located near the core of a marina development.

Hansen Creek - Closure of Hansen Creek will have minimal effect on recreation opportunities because the area receives very little recreation use.

Stanton Creek - Stanton Creek will be managed to retain its current qualities of semi-isolation with

opportunities to camp near the lakeshore by a suitable boat anchorage.

Hole-in-the-Rock - Recreation use of Hole-in-the-Rock will not be affected by the proposal. The area is presently day-use with camping available within five miles along the Hole-in-the-Rock access road.

The Chains - Improvements to The Chains will enhance recreational opportunities by providing several day-use activities not presently available at the site or nearby. Visitors with only a short time available will have an opportunity to take a short hike on the interpretive trails or picnic along the lakeshore. The community of Page will benefit by having an environmental education area available for use by their school children, as well as others, and by having a shorefront area and parking near town for picnicking and special-use events. Aesthetically, the area will be improved by the removal of landscape scars created by previous construction. Trash, human waste and fire impacts will be reduced by the installation of site improvements.

Red and Blue Notch Canyons - Recreational opportunities will be unchanged at Red and Blue Notch Canyons. Human impacts will be reduced by the requirement that visitors carry self-contained devices, such as porta-potties, for their human waste and pack out their trash.

Bullfrog Creek and Farley Canyon - At Bullfrog Creek and Farley Canyon, recreational opportunities will be maintained and recreational-use conflicts will be reduced. The water-use restrictions or zones will provide discrete areas for swimmers and boaters and a combination of no-wake area so that all types of water recreation may occur safely and with minimum conflicts. Human impacts will be reduced by providing facilities. Off-road vehicle impacts will be reduced by closing fragile areas to their use, while still providing the opportunity below the 3,700-foot elevation.

Dirty Devil and White Canyons - At Dirty Devil and White Canyons, recreational opportunities will not change with the exception of off-road vehicle use. Human impacts will be reduced by the installation of site improvements.

Crosby Canyon and Warm Creek - At Crosby Canyon and Warm Creek, recreational opportunities will remain as they are and the potential for conflict with boat-in campers will be reduced by the designation of camping areas. Off-road vehicle and human impacts will be reduced by the designation of vehicular travel routes and site improvements.

Clay Hills - Visitor safety and convenience will be enhanced at Clay Hills by the future construction of a new access road to the river.

Human impacts will be reduced by the trash pack-out and containerized human waste regulations. Use of Piute Farms Marina as a river-runner takeout will have the same effects as the proposal until the marina is moved due to siltation.

Copper, Neskahi, and Piute Canyons - Recreational opportunities at Copper, Neskahi, and Piute Canyons will not be changed. Human impacts will be reduced by the trash and human waste carry-out system.

Alternative A - No Action

Recreation use conflicts and impacts to natural and cultural resources from recreation activities will continue to increase as visitation to Glen Canyon National Recreation area increases. Visitors will experience greater inconvenience coupled with declining recreational experience. Human impacts will increase to the level where they may cause localized public health problems. The effects of "no action" are further discussed in the "Issues" of Chapter I.

Alternative B - Minimum Management

Recreation consequences of the minimum management alternative will be similar to those in the proposed plan with several exceptions. Opportunities for a variety of recreational experiences will be significantly restricted due to the closure of all but six of the areas. The areas left open will receive more crowding and human impacts from the greater number of visitors which are expected to use them because of the lack of available alternative locations. Enforcement activities of the park staff may have to be increased to address violations of the area closures

and to meet the increased law enforcement incidents at the areas left open. Maintenance of closure signs and gates may also increase due to anticipated vandalism. Human impacts to the closed areas will be significantly reduced. The visual impacts to The Chains area, from past construction, will continue.

Alternative C - Concentrate Visitor Use

The concentrated use alternative will have recreational impacts similar to those of the proposed plan and alternative B.

EFFECTS ON LAKE POWELL'S CARRYING CAPACITY

Proposed Plan

The proposal would result in additional interpretive programs to provide information on boating use of the lake with minimal impact; it would result in the adoption of a self-contained waste disposal rule for all shoreline users; and it would result in the installation of new toilet facilities at impacted sites. All of these actions would help minimize existing carrying capacity constraints of shoreline and water quality degradation by reducing shoreline use and water quality impacts. This effect would be especially significant at Bullfrog Creek and Farley Canyon, where impacts from vehicular users are believed heaviest among the accessible shoreline sites.

The proposal contains no provisions which would tend to increase the rate of boat launches from road accessible shoreline sites, since access roads would remain in their existing condition. Stanton Creek would be managed under a permit system which may slightly reduce the rate of boat launches from accessible shoreline areas near Bullfrog Basin marina.

The net effect of these provisions would be to maintain boat launching rates at near their existing levels (from accessible shoreline areas) while reducing shoreline impacts. The daily launch rate of 56, described in Chapter III, from accessible shoreline sites should remain consistent. Therefore, use of accessible shoreline sites should not affect overall carrying capacity of Lake Powell.

Alternative A - No Action

Current level of boat launching from accessible shoreline areas would continue and the resulting shoreline impact would remain. The current rate of launches from accessible shoreline sites (56 boats per day) is well below the estimated capacity increment available lakewide; thus, in comparison with the other alternatives, the effect of no action would be to forego actions that would raise the available carrying capacity increment by minimizing shoreline and water quality impacts.

Alternative B - Minimum Management

Impacts on carrying capacity would be similar to those of the proposal except that less mitigation of existing impacts would be realized. Alternative B does not include a shoreline cleanup program, and includes fewer permanent toilet facilities at heavily used sites. Of the areas closed to road access under this alternative, only Stanton Creek receives significant launching activity.

Alternative C - Concentrate Visitor Use

The effect of alternative C on carrying capacity would be intrinsically the same as for the proposed plan, because the principal accessible shoreline boat launch sites would be given similar treatment in each case. Under alternative C, however, Red Canyon, Blue Notch Canyon, White Canyon, and Warm Creek are potential launch points - currently with little use - which would be closed. This alternative would therefore have less effect on Lake Powell's carrying capacity than the proposed plan in future years.

ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The phrase "irreversible commitment of resources" describes a loss of future options. It applies primarily to the effects of the use of non-renewable resources, such as cultural resources, or to those factors such as soil productivity that are renewable only over long periods of time. Measures to protect resources that could be irreversibly affected by recreation use of shorelines were built into the proposed plan.

Actions such as physical barriers for vehicle control would protect soils from unauthorized use and thus protect soil productivity. Under alternative A and to a lesser extent, alternative B, soil productivity may be impaired by off-road vehicle travel. While extraction of gravel and rock for construction purposes can be considered an irreversible commitment of the resource, the amount of this use in relation to the total supply would be minor in all alternatives.

Irretrievable commitment of resources is, in part, opportunities forgone for the period of time that a resource cannot be used. Road and facility construction at some shoreline areas are irretrievable commitments, in the sense that opportunities for primitive recreation and native plant communities are forgone.

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

One management objective of the national recreation area recognizes outdoor recreational pursuits as a dominant or primary recreation use. However, natural and historical values must be conserved. The proposed plan recognizes this potential conflict of values and attempts to provide a balanced response. Thus, the proposed management actions and developments can be viewed as the long-term preservation of the environment rather than short-term consumptive use.

CHAPTER V

LIST OF PREPARERS AND CONSULTANTS

Preparers

Larry Belli, Resource Management Specialist, Glen Canyon
John Benjamin, Park Ranger-Downlake District Ranger, Glen Canyon
Linda Carlson, Editorial Assistant, Rocky Mountain Regional Office, Division of Planning and Compliance
Denis Davis, Facility Manager, Glen Canyon
Ronald Everhart, Chief, Concessions Management, Glen Canyon
Jim Holland, Resource Management Specialist, Glen Canyon
Chris Kincaid, Archeologist, Glen Canyon
Lori Kinser, Visual Information Specialist, Rocky Mountain Regional Office, Division of Planning and Compliance
David Pape, Park Ranger - Interpretation, Glen Canyon
Ross Rice, Park Ranger-Uplake District Ranger, Glen Canyon
John Ritenour, Chief, Protection and Resource Management, Glen Canyon
Michael Snyder, Team Captain/Landscape Architect, Rocky Mountain Regional Office, Division of Planning and Compliance
Victor Vieira, Resource Management Specialist, Glen Canyon
Pauline Wilson, Concessions Management and Navajo Nation Liaison, Glen Canyon
Charles Wood, Biologist, Glen Canyon
National Park Service, Water Resources Branch, Fort Collins

Consultation and Coordination

The following individuals and organizations were consulted during preparation of this environmental document:

United States Fish and Wildlife Service
Advisory Council on Historic Preservation
Arizona State Historic Preservation Officer
Utah State Historic Preservation Officer

The following Navajo people were contacted when determining Navajo ethnographic resources of the shoreline sites located within the Navajo Indian Reservation:

Mr. Kee Holiday, Sr.
Mr. Jim Fatt
Mr. George Tom
Mr. Shonnie Holiday
Mr. Lee Miles
Mrs. Nelda White
Mrs. Ella Nimrod
Mrs. Julia Fatt
Mrs. Meta Bitsinnie
Mr. Sterling Clarke, Sr.

APPENDICES

APPENDIX A

INTERPRETIVE PROGRAM FOR THE PROPOSED PLAN

This appendix illustrates options for interpretive operations that could be employed at each shoreline area open to vehicular access as described in the proposed plan.

In developing interpretive operations, several factors have been taken into consideration, which will determine the scope of interpretive operations at a particular access site. These factors include: the distance of the access site from a developed area where interpreters are stationed, the need to provide exhibits and facilities which will be resistant to vandalism, and consideration of the primary goals of interpretation being the safety of the visitor, protection of the resource, and the provision of information and interpretive services.

An effort has been made within Glen Canyon National Recreation Area to standardize interpretive facilities including bulletin boards. This standardization of interpretive facilities will be applicable to shoreline areas.

Because of the remote locations of some shoreline access areas, four-wheel-drive vehicles or watercraft would be needed to transport interpretive personnel.

At some shoreline areas, several options for interpretive services are described. The option implemented at each shoreline area will be dependent on the level of available funding. For each area, OPTION I is the easiest to develop and least expensive, and the higher-numbered options represent an upgrading towards a more optimum interpretive program. The highest-numbered option is always the most expensive.

Blue Notch Canyon:

Because visitation is low and this area has no measurable resource impacts, no interpretive services are planned. If, in the future, additional use with resulting impacts does occur, interpretive services will be required.

Bullfrog Creek:

OPTION I. Develop a site bulletin addressing shoreline access camping and other recreational uses for the Bullfrog Creek shoreline access area. Standardized information could include NPS regulations on shoreline camping, sanitation, safety, etc. Specific information would include: where and how to contact the nearest Park Ranger; location of nearby facilities; fishing regulations and techniques; boating; nearby attractions; safety concerns specific to Bullfrog Creek; specific user-conflict concerns; location of nearest visitor center; interpretive programs and schedule, etc. This site bulletin would be placed in brochure boxes located on the shoreline access roads.

OPTION II. Use standardized bulletin board complex at road access points. The bulletin board would contain information on shoreline camping regulations, sanitation, water quality concerns, the Adopt-A-Canyon clean-up program, fires and fire rings, vehicle use, user conflicts, fishing regulations, and other topics of interest to the shoreline user. A site bulletin on specific safety concerns, attractions, fishing techniques, facilities nearby, etc., would be developed and placed in a brochure box attached to the bulletin board complex.

OPTION III. Because of the close proximity of Bullfrog to the Bullfrog Creek shoreline access areas, a Traveler Information System utilizing a short-range AM radio transmitter might be used to inform visitors of shoreline access camping availability and regulations, and to provide interpretive information. Signs would be located along Highway 276 informing visitors of the radio information availability and which frequency to tune their radios to for the information.

OPTION IV. In addition to those items included in OPTIONS II and III, develop a series of wayside exhibits to be located near the high water level of the shoreline where heaviest use occurs. These wayside exhibits would cover the human and natural history of Bullfrog Creek, and orientation information concerning nearby attractions and marina facilities. Wayside exhibits could also address the nearby Waterpocket Fold, Henry Mountains, and Burr Trail. A wayside exhibit with a map showing the extent of the Bullfrog

Creek access area would be helpful, along with orientation information concerning nearby facilities and marinas.

OPTION V. An interpreter stationed at Bullfrog would do roving interpretive contact work in the Bullfrog Creek shoreline-access areas. An on-site interpreter would hand out "boating packets" with specific information on Bullfrog Creek and Bullfrog area, and distribute the "Boat-It-In--Bag-It-Out" trash bags. Because of the close proximity of the Bullfrog Creek shoreline access areas to Bullfrog, visitors could be invited to interpretive programs presented at Bullfrog or a centralized interpretive facility might be developed near the shoreline-access points for the presentation of interpretive programs. These on-site roving interpretive services would be in addition to having all other options in place on shoreline-access roads.

Clay Hills:

OPTION I. Because of the remote location of this site and the limited visitation to this area, no interpretive services are planned unless a permanent San Juan marina development occurs.

OPTION II. Develop a series of wayside exhibits at the river-running take-out point. These exhibits would welcome visitors to the Glen Canyon NRA and provide visitors with information on the human and natural history of the area. An exhibit would also be developed with an area map and orientation information.

Copper Canyon and Neskahi:

No interpretive services are planned for these locations. Visitation is very low and little resource damage has occurred. If a marina site is developed in this area, a site bulletin and wayside exhibit program will be developed for these locations. It might be noted that Copper and Neskahi Canyons are located adjacent to the Navajo Reservation. Consideration should be given to providing Navajo translations of any interpretive materials.

Cottonwood Canyon:

A wayside sign will be placed at the road closure point

which would focus on the Hole-in-the-Rock road and the fragility of historic road cribbing beyond that point.

Crosby Canyon:

OPTION I. Develop a site bulletin addressing shoreline access camping and other recreational uses. Standardized information could include NPS regulations on shoreline camping, sanitation, safety, etc. Specific information might include: where and how to contact the nearest Park Ranger; location of nearby facilities, ORV restrictions; fishing regulations and techniques, nearby attractions; safety concerns specific to the shoreline access site; specific user-conflict concerns; location of nearest visitor center; interpretive programs and schedule; etc. This site bulletin would be placed in a brochure box located on the shoreline access road.

OPTION II. Use standardized bulletin board complex at road access point. The bulletin board would contain information on shoreline camping regulations, sanitation, water quality concerns, litter disposal, fires and fire rings, vehicle use, user conflicts, fishing regulations, and other topics of interest to the shoreline user. A site bulletin on specific safety concerns, attractions, fishing techniques, facilities nearby, etc., would be developed and placed in a brochure box attached to the bulletin board complex.

OPTION III. In addition to those items included in OPTION II, develop a series of wayside exhibits to be located near the high water level of the shoreline where heaviest use occurs. These wayside exhibits would cover the human and natural history of Crosby Canyon, and orientation information concerning nearby attractions and marina facilities. The human history aspect of Crosby Canyon is significant, as coal from this canyon powered the Spencer gold mining operations at Lees Ferry.

Dirty Devil:

OPTION I. Develop a site bulletin addressing shoreline access camping and other recreational uses. Generalized information could include NPS regulations on shoreline camping, sanitation, safety, etc. Specific information might include: where and how to

contact the nearest Park Ranger; location of nearby facilities; fishing regulations and techniques; nearby attractions; safety concerns specific to the Dirty Devil shoreline access site; dealing with driftwood during the spring run-off; specific user-conflict concerns; location of nearest visitor center; interpretive programs and schedule; etc. This site bulletin would be placed in a brochure box located on the shoreline access roads.

OPTION II. Use standardized bulletin board complex at road access points. The bulletin board would contain information on shoreline camping regulations, sanitation, hazards, water quality concerns, the Adopt-A-Canyon clean-up program, fires and fire rings, vehicle use, user conflicts, fishing regulations, and other topics of interest to the shoreline user. The site bulletin listed in OPTION I would be developed and placed in a brochure box attached to the bulletin board complex.

OPTION III. Because of the close proximity of Hite to the Dirty Devil shoreline access areas, a Traveler Information System (TIS) utilizing a short-range AM radio transmitter might be used to inform visitors of shoreline access camping availability and regulations, and to provide interpretive information. Signs would be located along Highway 95 informing visitors of the radio information availability and which frequency to tune their radios to for the information.

OPTION IV. As the interpretive program develops in the Uplake District, an interpreter stationed at Hite would do roving interpretive contact work in the Dirty Devil shoreline access areas. An on-site interpreter would hand out "boating packets" with specific information on the Dirty Devil and Hite areas, and distribute the "Boat-It-In--Bag-It-Out" trash bags. Because of the close proximity of the Dirty Devil shoreline access areas to Hite, visitors could be invited to interpretive programs presented at Hite, or an interpretive facility might be developed near the shoreline access points for the presentation of interpretive programs. These on-site roving interpretive services and programs would be in addition to other options being in place.

Farley Canyon:

OPTION I. Develop a site bulletin addressing shoreline access camping and other recreational activities for Farley Canyon. Standardized information could include NPS regulations on shoreline camping, sanitation, safety, etc. Specific information would include: where and how to contact the nearest Park Ranger; a map showing the extent of the shoreline access area at Farley Canyon; location of nearby facilities; fishing regulations and techniques; boating information; nearby attractions; safety concerns specific to Farley Canyon; specific user-conflict concerns; location of nearest visitor center; interpretive programs and schedule; etc. This site bulletin would be placed in a brochure box located on the shoreline access road.

OPTION II. Use standardized bulletin board complex at the road access point. The bulletin board would contain information on shoreline camping regulations, sanitation, water quality concerns, litter disposal, fires and fire rings, vehicle use, user conflicts, fishing regulations, and other topics of interest to the shoreline user. A site bulletin on specific safety concerns, attractions, fishing techniques, facilities nearby, etc., would be developed and placed in a brochure box attached to the bulletin board complex.

OPTION III. In addition to those items included in OPTION II, develop a series of wayside exhibits to be located near the high water level of the shoreline, where heaviest use occurs. These wayside exhibits would cover the human and natural history of Farley Canyon, and orientation information concerning nearby attractions and marina facilities.

OPTION IV. As the interpretive program develops in the Uplake District, an interpreter stationed at Hite could do roving interpretive contact work in the Farley Canyon shoreline-access area. An on-site interpreter would hand out "boating packets" with specific information on Farley Canyon and the Hite area, and distribute the "Boat-It-In--Bag-It-Out" trash bags. Because of the close proximity of Farley Canyon shoreline access area to Hite, visitors could be invited to interpretive programs presented at Hite, or an interpretive facility might be developed near the Farley Canyon shoreline for the presentation of

interpretive programs. These on-site interpretive services would be in addition to all items in OPTIONS II and III being in place.

Halls Crossing Cove #4:

Because this area is within the Halls Crossing development zone, interpretation will be coupled with efforts ongoing at the developed area.

Hole-in-the-Rock:

Wayside exhibits are already in place at the access road termination point, and in the form of a floating exhibit on Lake Powell below the historic site. No other interpretive services are planned at this location, which is extremely remote by road access. If, in the future, additional use with resulting impacts does occur, additional interpretive services will be required.

Piute Wash:

No interpretive services are planned for this location. Visitation is low and no measurable resource impacts can be noted. If marina developments take place on the San Juan arm of Lake Powell and visitation to this area increases, a site bulletin or bulletin board complex would be developed. It might be noted that Piute Wash is located adjacent to the Navajo Reservation. Consideration should be given to Navajo translations of any interpretive materials.

Red Canyon:

Because visitation is low and this area has no measurable resource impacts, no interpretive services are planned. If, in the future, additional use with resulting impacts does occur, interpretive services will be required.

The Chains:

OPTION I. Use standardized bulletin board complex at road access point. The bulletin board would contain information on shoreline day-use regulations, sanitation, water quality concerns, litter disposal, fires and fire rings, vehicle use, user conflicts,

fishing regulations, and other topics of interest to the shoreline user. A site bulletin on specific safety concerns, attractions, fishing techniques, facilities nearby, etc., would be developed and placed in a brochure box attached to the bulletin board complex.

OPTION II. Because of the close proximity of the Carl Hayden Visitor Center to The Chains shoreline access area, a Traveler Information System utilizing a short-range AM radio transmitter would be used to inform visitors of shoreline access day-use availability and regulations, and to provide safety information. Signs would be located along Highway 89 informing visitors of the radio information availability and which frequency to tune their radios to for the information.

OPTION III. In addition to those items included in OPTIONS I and II, develop a series of wayside exhibits to be located near the high water level of the shoreline where heaviest use occurs. These wayside exhibits would cover safety issues related to water recreation. Several accidents including drownings have occurred at The Chains location and topics should include cliff diving, swimming with clothing on, alcohol-related accidents, swimming near boats and fishermen, use of glass containers, dangers associated with walking on the slickrock shoreline, and drop-offs.

OPTION IV. An interpreter stationed in the Wahweap Sub-District or from the Carl Hayden Visitor Center would do roving interpretive contact work in The Chains shoreline-access area. An on-site interpreter would hand out "boating packets" with specific information on The Chains and Wahweap area, and distribute the "Boat-It-In--Bag-It-Out" trash bags. Because of the close proximity of The Chains to Wahweap and the Carl Hayden Visitor Center, visitors would be invited to interpretive programs presented at Carl Hayden and/or Wahweap. These on-site roving interpretive services would be in addition to having a bulletin board complex and wayside exhibits in place. Because a high percentage of the use at The Chains area is Native American, consideration should be given to providing Navajo translations of interpretive materials.

Warm Creek:

Because visitation is low and this area has only minor

resource damage, no interpretive services are planned. If, in the future, additional use with resulting impacts does occur, interpretive services might be required.

White Canyon:

OPTION I. Develop a site bulletin addressing shoreline access camping and other recreational uses. Standardized information could include NPS regulations on shoreline camping, sanitation, safety, etc. Specific information might include: where and how to contact the nearest Park Ranger; location of nearby facilities; fishing regulations and techniques; nearby attractions; safety concerns specific to the White Canyon shoreline access site; and specific user-conflict concerns. These site bulletins would be placed in a brochure box located on the shoreline access road.

OPTION II. Use standardized bulletin board complex at road access point. The bulletin board would contain information on shoreline camping regulations, sanitation, water quality concerns, litter disposal, fires and fire rings, ORV use, user conflicts, fishing regulations, and other topics of interest to the shoreline user. A site bulletin on specific safety concerns, attractions, fishing techniques, facilities nearby, etc., would be developed and placed in a brochure box attached to the bulletin board complex.

OPTION III. In addition to those items included in OPTION II, develop a series of wayside exhibits to be located near the high water level of the shoreline where heaviest use occurs. These wayside exhibits would cover the human and natural history of White Canyon, and orientation information concerning nearby attractions and marina facilities.

OPTION IV. As the interpretive program develops in the Uplake District, an interpreter stationed at Hite would do roving interpretive contact work in the White Canyon shoreline access area. The on-site interpreter would hand out "boating packets" with specific information on White Canyon and the Hite Area. The interpreter would

also distribute the "Boat-It-In--Bag-It-Out" trash bags. Because of the close proximity of the White Canyon shoreline-access area to Hite, visitors would be invited to interpretive programs presented at Hite, or an interpretive facility might be developed near the shoreline-access point for the presentation of interpretive programs as justified by visitation. These on-site roving interpretive services and programs would be in addition to having a bulletin board complex and wayside exhibit program in place.

APPENDIX B

WATER RESOURCES

The following is a specific discussion on water resource characteristics occurring at each shoreline area analyzed in this planning effort.

Blue Notch and Red Canyons - Both of these canyons are long drainages which could experience flash floods in the main channels. The study areas are bisected by the channel in each case. The topography rises steeply from the washes to adjoining benches and terraces, from which the lakeshore is reached. As a result, the shoreline-use areas are of low flood risk.

Bullfrog Creek - This area is primarily located on lakeshore Eolian sands with minor areas of drainage. A small drainage in the southeast portion of the study area would be subject to minor flooding during the heaviest storms. A tributary of Bullfrog Creek enters the lake at the northwest edge of the study area, above the visitor-use sites. Floods would be of significant magnitude in this drainage, but would not directly affect access routes or shoreline-use zones.

Clay Hills - The Clay Hills study area is outside of any significant drainage and would be subject only to local sheet flow and shallow flooding in small washes draining Mike's Mesa.

The access road to this site is well maintained and located several miles northwest of the main wash draining into the Clay Hills area. The road is subject to minor flooding where it crosses small tributary washes.

Copper Canyon - The shoreline-use area is subject only to local sheet flow and shallow flooding in washes. Copper Canyon is subject to flash flooding, but its channel within the study area is deeply incised and flood waters would be contained in the canyon.

Cottonwood Canyon - Cottonwood is an incised drainage which would flood during periods of heavy rain, receiving runoff from the southwest quarter of Wilson Mesa. The depth of the canyon is an indication that floods of the past have been large enough to cause

significant downcutting. Numerous terraces, colluvial slopes and Eolian sand deposits above the floodplain provide accessible terrain of low flood hazard.

Crosby Canyon - This canyon potentially has campsites in the floodplain at low water and on the benches at higher lake elevations. The access route traverses hazardous flood zones in Crosby Canyon.

Dirty Devil - The Dirty Devil shoreline area occupies benches and gently-sloping colluvial deposits from the base of mesas to the west. Drainage areas above the shore are very small, posing but slight hazard of flooding.

The Dirty Devil is a major river for this arid region, draining 4,159 square miles. Although its average discharge is only 101 cubic feet-per-second (cfs), flood discharges to 35,000 cfs have been recorded. The river empties into an arm of Lake Powell approximately 5 miles above the shoreline-use study area. Floods on the river would not pose a direct threat to the use area, but could result in wave turbulence that would affect the shore downlake. Suitable campsites, however, are located well above the shore.

Farley Canyon - This area is limited on the north by Farley Canyon and bisected by a smaller drainage. Farley Canyon poses little or no threat of flooding for the principle shoreline-use sites, and visitors may find the floodplain accessible at low water. The access road does not traverse the floodplain, although it does cross a number of small washes.

The wash bisecting the area poses a minor flood hazard to campers in or near its delta. The drainage area for this wash is small, however.

Halls Crossing Cove #4 - This area is on a cove of Lake Powell formed in a small drainage. The flood hazard is very slight, and only exists in the immediate channel of the drainage.

Hansen Creek - The Hansen Creek study area is on terrain not subject to flood hazards. The overlook is on high ground, while the shoreline-access point is on steep, lakeshore terrain with a very limited drainage reach.

Hole-in-the-Rock - This study area has no flood hazard. The Hole-in-the-Rock feature is a wash cutting down from the mesa to the lakeshore, but this wash has a very small drainage reach.

Lake Canyon - This canyon site is located on an arm of Lake Powell distant from any drainages. It would be unaffected by floods except for sheet flow and localized washes draining from the mesa above.

Last Chance Canyon - Last Chance Creek is a perennial stream with a high flash flood hazard. Camping occurs along the wash bottom near the lakeshore. Shoreline access is confined to the floodplain.

Neskahi - This study area contains one major incised wash, or small canyon, and numerous small peripheral drainages. Flood hazards are limited to the channel of Neskahi wash.

Piute Canyon - The study area is at the mouth of a deep drainage highly prone to flash flooding. The commonly used shoreline sites, however, are on the lakeshore 1 to 1.5 miles down drainage of where flood waters would reach the lake. In this location, visitors would be protected from the major dangers of flash flooding in the main Piute Creek channel. The access road crosses the drainage channel several times, and is exposed to high flood hazard at the crossings.

Stanton Creek - Stanton Creek contains the mouths of two small creek drainages which would flood during extreme precipitation events. The magnitude of any flood would be relatively small, however, because the drainages are very limited in size, and have a relatively shallow, broad configuration that would not confine runoff. The southern portion of the study area is exposed rock outcrop along the lakeshore, that would not be subject to flooding.

The Chains - The Chains site is located on sandstone terraces, adjacent to the deepest part of Lake Powell. There are no major washes, so flood hazard is slight.

Warm Creek - The Warm Creek shoreline-use zone is primarily located on benches and rolling topography adjoining Warm Creek Bay. At high lake levels, campsites are above the immediate drainage. At low

lake levels, camping activities may occur in the floodplain where tamarisk thickets are forming.

Access to this area is through the wash bottom, where the road is subject to inundation during floods. Part of the route is confined between the walls of a narrow canyon, posing a safety hazard at flood stage.

White Canyon - White Canyon is a major wash, immediately north of the study area. It would be subject to floods, although the study area and access road are located well out of the floodplain. A secondary drainage adjoins the southern edge of the study area. Locations suitable for shoreline use are not in the floodplain of either drainage. Minor flooding could be experienced in the numerous small washes dissecting the shoreline in this area, but these would pose minimal safety hazard.

The southern one-half of this shoreline reach is unusable at high lake elevations, when the rising waters reach an incised wash and cut off access.

APPENDIX C

SOILS

Blue Notch and Red Canyons - The two areas are similar in geology, in that both have highly colored, clay Chinle soils exposed near the shoreline. The Chinle shoreline is covered with a sparse alluvium and is relatively open with rolling hill topography. Wingate sandstone cliffs are present in the area but set back from the shoreline a few miles.

Bullfrog Creek - Geology of the Bullfrog Creek area is varied, with two formations exposed; Summerville-Entrada, and Quaternary alluvial and Eolian deposits. The differential weathering of these formations provides a distinct topography interspersed with Entrada outcrops. These are wide bands of Summerville Formation, which in this area, appear as multicolored, fine-grained silt and clay, weathered into "badlands" topography. The colluvial material from the Henry Mountains caps the Summerville in portions of the study area and forms flat mesas. On these higher uplands of the study area, there are large Eolian sand dune deposits. These are isolated throughout the area and vary in depth depending on location.

Clay Hills - Clay Hills and the eleven mile access road are located along the base of the Red House Cliffs, which form a regional geological landmark. These 1,000-feet-high cliffs are formed by the steep Wingate Formation.

The study area is located in the lower member of the Old Cutler Formation, which is composed of evenly bedded siltstone and fine-grained sandstone. This area is vulnerable to erosion and impact due to its silty composition. The ruggedness of the terrain is due to the locally intense surface runoff from the surrounding lands.

Copper Canyon, Neskahi, Piute Canyon - These shoreline access sites involve primarily the Moenkopi and Chinle Formations. The areas can be described as canyon country with steep Wingate escarpments, forming physical barriers around the lake. Only limited area is available for camping in the Chinle slopes and the

Moenkopi Badlands. Both formations are composed of thin bed mudstone and siltstone varying in color from purple to gray for the Chinle, and red to pale brown for the Moenkopi.

The steep Wingate Sandstone Cliffs, which surround each of the three sites, limit vehicular access to four-wheel-drive vehicles. These same cliffs create geological hazards through mass sloughing, especially evident in Piute Canyon, where the canyon walls are in close proximity to the shoreline. The potential geological hazard at Piute Canyon is so great, warning notices to the public may be necessary.

Cottonwood Canyon - The study area can be described as a narrow canyon with weathered and rounded canyon walls of Navajo sandstone. The sandstone walls are light in color - for the most part creams and reds. The canyon is created by Wilson Mesa, which forms a rim along both the Colorado and San Juan Rivers.

Crosby Canyon - This area is characterized by its massive Morrison siltstone/sandstone mesa, which is dissected by ephemeral stream channels and canyons. Lower benches above the water's edge are narrow (approximately 1,000 feet in width), and composed of an intermingled and finely bedded deposit of Summerville shale and siltstone, and Entrada sandstone. Local Eolian sand deposits or small dunes are common in and around the lower benches. The sandstone step topography is typical of the general area between the community of Big Water and the Kaiparowits Plateau.

Access is provided along a narrow drainage, which in some areas, has developed a canyon which measures 200 to 300 feet in depth.

Dirty Devil - The general area is located at the base of steep cliffs, capped by the Wingate Formation and underlain by exposed strata of the Chinle, Moenkopi and White Rim formations. The shoreline area itself consists of broad exposures, ridges and low hills of exposed Cedar Mesa slickrock overlain in the northern portion by limited Eolian gravel-bearing caps. Much of the Cedar Mesa outcrop is inundated by Lake Powell as it backs up into the incised channel of the Dirty Devil.

The southern portion is characterized by the weathered colluvial covering from the steep cliffs above, where these deposits have filled the Cedar Mesa Canyons.

Farley Canyon - The Farley Canyon drainage cuts through the deep red Moenkopi and white rim formations, forming a narrow channel at the Lake Powell shoreline. Steep cliffs of these formations rise on each side of the drainage. Quaternary stream gravels are concentrated at the mouth of the canyon and provide a base for shoreline use. These cobbles form thick beds at the mouth of the canyon and cover the surrounding weathered hills. Extending into the area from the south, is a remnant of an old lake deposit or river meander, which was 300 feet above the river prior to the filling of Lake Powell. These silts and sands are more evident to the south in the canyon just south of Farley Canyon. This is the only known or reported location of this deposit within the recreation area.

Halls Crossing Cove #4 - This location is a sheltered site at the base of a steep Entrada sandstone outcrop. The Carmel siltstone and mudstone is exposed near the shoreline with a light covering of alluvial gravels. Near the existing road is an isolated Entrada boulder. The Carmel formation behind this boulder is basically level for 1,000 feet, then gently slopes to the shoreline.

Hansen Creek - The small Hansen Creek location is composed primarily of alluvial and Eolian deposits over the base of Entrada sandstone. Steep outcrops of Entrada sandstone prevent vehicular access to the shoreline. The large Eolian sand deposit provides access to the canyon rim and potential campsites.

Hole-in-the-Rock - The Hole-in-the-Rock area can be described as a sandstone bench which is located below the Kaiparowits Plateau, but above the Colorado River Valley. The bench is composed of Navajo sandstone with small water pockets and small areas of sand accumulation which support perennial vegetation.

Lake Canyon - The Lake Canyon area generally consists of an extensive Navajo sandstone outcrop with a cap of pediment gravels and Eolian deposits. The area extends along the north side of Lake Canyon from the mouth of the canyon to the first arm extending north. Within

this area, the Navajo sandstone is weathered to a slope that prevents vehicular access to the lakeshore. The slickrock exposed near the water is capped with sand and gravels near the top of the canyon. The Eolian sand is deep and invites off-road vehicles. At the extreme point, where Lake Canyon enters the Colorado River, the Navajo sandstone is exposed and weathered into knobs and spires.

Last Chance - Last Chance Canyon is a long, narrow canyon carved in the light colored Entrada Sandstone, and has steep walls greater than 1,000 feet in height. At the head of the canyon, the drainage is moderate and provides vehicular access to the shoreline. The bench above the canyon is composed of Entrada sandstone, Morrison sandstone and mudstone.

Stanton Creek - Stanton Creek is characterized by three geologic formations (Carmel badlands, Entrada sandstone outcrops, Quaternary Eolian sand deposits) and isolated scatters of alluvial gravel. The Carmel formation is characterized by clay/silt beds which vary in color from red-to-white-to-yellow. They weather at varying rates, resulting in some areas having sharp ridges while others have rounded hills.

The Entrada sandstone outcrops in several areas within the study area. Along the northern boundary the Entrada forms a steep escarpment, which supports weathered alcoves along the base. The shallow alcoves in this area are hazardous, due to the active sloughing of the roof and walls. This escarpment is approximately 400 feet high, limiting access. Along the eastern portion of the area, the Entrada forms spires which are 20 to 30 feet high and which add a varied topography to the area.

The alluvial cobble gravels form caps on top of the Entrada outcrops to the south of the study area and over the Entrada, The Carmel, and the Eolian sands in the northern portion. Along the base of the steep Entrada escarpment, there are rolling hills of Eolian sand capped by gravels. There, sandy gravels extend northeast across a broad flat at the extreme north end of the study area. The deposition areas are relatively small, and limited in distribution to protected sites. The shallow alcoves in this area are hazardous, due to the active sloughing of the roof and walls.

The Chains - The major Eolian component of the geology of the area is Navajo sandstone, which covers the majority of the study area. Small buttes of Page sandstone up to 100 feet in height, cap the Navajo along the northern and eastern portions of the study area. Within the area, there are colluvial gravel deposits, which appear to be thin caps on the terraced Navajo sandstone. Along the base of Manson Mesa, a large mesa upon which the City of Page, Arizona is located, are small deposits of deep sand.

During the construction of the dam, much of this area was leveled and used for a staging area. Approximately one-third of the study area was disturbed for this purpose during the 1950's.

Warm Creek - The Warm Creek Drainage is an active ephemeral desert wash channeling through the Dakota, Morrison, and Entrada formations. At the high-water shoreline, only limited area is available for camping. This area is a kind of weathered alluvium, which provides an opportunity to camp outside the wash channel. The small shoreline area is surrounded by steep cliffs of the three primary formations.

White Canyon - The White Canyon Drainage cuts through the deep red Moenkopi and banded Cutter formations. The project area lies at the base of steep Moenkopi Cliffs along the Lake Powell shoreline. Access is provided over approximately three miles of slickrock and small drainages. The study area can be described as weathered Moenkopi and Cutter hills, dissected by runoff channels. The hills are rounded from weathering and red in color. The soils are highly eroded silts and clays and vulnerable to disturbance.

White Canyon proper is a narrow drainage which is cut into the Cedar Mesa portion of the Cutter formation. The canyon walls are steep up to 300 feet within a few miles of the Lake Powell shoreline.

APPENDIX D

Vegetation

Blue Notch and Red Canyons - The Chinle substrate, with a light alluvial cover, only supports a sparse shad scale community. The predominate species are shad scale (Atriplex confertifolia), Mormon tea (Ephedra torreyana), and galeta (Hilaria jamesii). Plants are widely spaced, with less than five percent vegetative cover. The sparse nature of the vegetation is due to the high saline soils typical of the Chinle formation. The shoreline riparian community has not developed. At present only a few saltcedar (Tamarix ramosissima) plants are established.

Bullfrog Creek - The weathered Summerville badlands support a sparse perennial plant cover (less than 10%) of shrubs and grasses. In these areas, only four-wing saltbrush (Atriplex canescens) predominate, with sunflowers (Vandevea stylosa), and Indian ricegrass (Oryzopsis hymenoides).

Mesa tops support a more diverse stand of perennial species, characterized by shrubs and grasses. Predominant species include shad scale (Atriplex confertifolia), indigobush (Psorothamnus fremontii), matchweed (Gutierrezia microcephala), galleta (Hilaria jamesii), and Indian ricegrass (Oryzopsis hymenoides).

Stabilized dunes compose approximately 25% of the study area. These areas support dense vegetation of sunflower (Vanclevea stylosa), mint (Poliomentha incana), Mormom tea (Ephedra nevadensis), and Indian ricegrass (Oryzopsis hymenoides). Perennial plants in this area provide 15 to 20 percent cover and are usually large and openly spaced.

The shoreline supports a young stand of saltcedar (Tamarix ramosissima) with Russian thistle (Salsola kali) and horseweed (Conyza canadensis).

Clay Hills - The Clay Hills area supports a sparse and widely spaced, mixed shrub community. Mormon tea (Ephedra torreyana), rabbit brush (Chrysothamnus nauseosus), dogbane (Amsonia eastwoodii), and shad scale (Atriplex confertifolia) predominate. Perennial plants are spaced on the average of 10 to 15 feet

apart, with only limited annual plant occurrence in between. The shrubs are dwarfed by the poor plant substrate, which is typical in portions of the Colorado Plateau, where poor soil conditions predominate.

The shoreline riparian vegetation is developing, with saltcedar (Tamarix ramosissima), seepweed (Suaeda fruticosa), Russian thistle (Salsola kali), and horseweed (Conyza canadensis) established. Camelthorn (Agalhi camelorum) is an invader, which is a small, spreading shrub, that occupies sandy beaches along the river channel. It spreads rapidly and can render a beach unuseable due to its sharp, long thorns.

Copper Canyon, Neskahi, and Piute Canyon - The perennial vegetation along the San Juan Arm can be described as a sparse, mixed-desert shrub community. The primary components of this community are shad scale (Atriplex confertifolia), Mormon tea (Ephedra torreyana), matchweed (Gutierrezia microcephala), and rabbit brush (Chrysothamnus nauseosus). Along the shoreline, riparian species are becoming established. These include saltcedar (Tamarix ramosissima), horseweed (Conyza canadensis), iodinebush (Suadea torreyana), and jimsonweed (Datura metaloides). This community, as well as the mixed shrublands surrounding the shoreline, are heavily impacted due to the presence of a local burro population.

Cottonwood Canyon - The areas of sand deposition along the canyon walls supports a mixed shrub plant community. The predominant plants include four-wing saltbrush (Atriplex canescens), sunflower (Vanclevea stylosa) and yucca (Yucca angustissima). The perennial vegetation is intensively grazed by domestic livestock and trailing is evident throughout the canyon.

Crosby Canyon - The perennial vegetation of the Crosby Canyon area is typical of the sandstone benches of the southern portion of Lake Powell. Low-growing shrubs and grasses, which are widely spaced, characterized the local flora. Predominant species include shad scale (Atriplex confertifolia), golden head (Acamptopappus sphaerocephalus), prickly pear (Opuntia erinacea), and Indian ricegrass (Orysopsis hymenoides). Pockets of sandy soil support sandsage (Artemisia filifolia), Mormon tea (Ephedra torreyana), yucca (Yucca angustissima), and Indian ricegrass.

The shoreline riparian community is developing with pockets of dense vegetation. Saltcedar (Tamarix ramosissima) comprises the majority of this community, with Russian thistle (Salsola kali), horseweed (Conyza canadensis), iodine bush (Suadea torreyana), and haplopappus (Haplopappus acredenius). The shoreline community is sparse but developing.

Dirty Devil - There are two desert plant communities within the Dirty Devil study area. These are the riparian shoreline and mixed shrub communities. The developing riparian shoreline community is characterized by a sparse "bathtub ring" of vegetation in which the root structure actually penetrates a perennial water table. The only woody species occurring in this zone is saltcedar (Tamarix ramosissima) with an annual understory of Russian thistle (Salsola kali), horseweed (Conyza canadensis) and jimsonweed (Datura metaloides).

The alluvial soils scattered throughout the study area and rock crevices, support a variety of shrubs and grasses. No single species predominates and composition changes as soil conditions vary. Common plants include: blackbrush (Coleogyne ramosissima), Mormon tea (Ephedra torreyana), matchweed (Gutierrezia microcephala), prickly pear (Opuntia erinacea), Indian ricegrass (Oryzopsis hymenoides), and galleta (Hilaria jamesii). No sensitive plant species were identified.

Farley Canyon - The study area, for the most part, is devoid of vegetation, due to previous use as a borrow site and the heavy concentration of visitors. The southern portion, an area of rolling, alluvial hills, supports a mixed-shrub, perennial plant association. The conspicuous species are shad scale (Atriplex confertifolia), indigobush (Psorothamnus thompsonii), Mormon tea (Ephedra torreyana), blackbrush (Coleogyne ramosissima), and buckwheat (Eriogonum corymbosum). Vegetation in this area covers approximately 15% with the cobble pavement exposed in between.

The shoreline vegetation has developed in the cove on the southern part of the area. Here saltcedar (Tamarix ramosissima) is established and is approximately five feet tall. The stand is dense and provides limited cover, creating limited wildlife habitat along the shoreline.

Halls Crossing Cove #4 - This cove supports a mixed-shrub community, representative of the Great Basin Desert. In the shallow soils, a shad scale community, dominated by plants tolerant of saline soils has developed. The most common species is shad scale (Atriplex confertifolia), with Mormon tea (Ephedra torreyana), matchweed (Gutierrezia microcephala), and mesa dropseed (Sporobolus flexuosus). Plant cover is estimated at 15 to 20 percent.

Hansen Creek - The perennial vegetation of the area is representative of dune vegetation. Plants common at this area include yucca (Yucca angustissima), psorelea (Psorelea juncea), dogbone (Amsonia eastwoodii), and indigobush, (Psorothamnus fremontii). Plant cover is estimated at 20 percent. Except in the cracks and crevices, the Entrada sandstone is basically barren of perennial plants. In these areas, isolated plants of blackbrush (Coleogyne ramosissima), hopsage (Grayia spinosa), and globemallow (Sphaeralcea parvifolia) can be found.

Hole-in-the-Rock - The shallow pockets of soil located on the bench support a blackbrush community. The predominant species is blackbrush (Coleogyne ramosissima) with other common plants including Indian ricegrass (Oryzopsis hymenoides), globemallow (Sphaeralcea parvifolia), and aster (Machaeranthera canescens).

Lake Canyon - The mesa above Lake Canyon, with the deposits of deep sand, support a blackbrush community. Blackbrush is usually associated with shallow soils, indicating a hardpan or calechie layer near the surface. Plants common in the community are blackbrush (Coleogyne ramosissima), indigobush (Psorothamnus fremontii), Mormon tea (Ephedra torreyana), and Indian ricegrass (Oryzopsis hymenoides). Perennial plant cover is estimated at twenty percent.

Last Chance Canyon - The bench above Last Chance Canyon supports a sparse community of mat saltbrush (Atriplex corrugata). Perennial plant cover is estimated at less than ten percent and few associates occur within this area. Within the canyon, the riparian community is composed of primarily saltcedar (Tamarix ramosissima), and rabbit brush (Chrysothamnus nauseosus).

Stanton Creek - The weathered Carmel badlands support a sparse, mixed-shrub plant association of shad scale (Atriplex confertifolia), indigobush (Psorothamnus fremontii), matchweed (Gutierrezia microcephala), and Indian ricegrass (Oryzopsis hymenoides). Because of past disturbance, there is an understory of cheatgrass (Bromus tectorum) which provides a greenish hill in the spring, and a straw carpet during the remainder of the year.

The protected pockets of Eolian sand and alluvial gravel deposits support the dense vegetation of four-wing saltbrush (Atriplex canescens), pepperbrush (Lepidium montanum), encelia (Encelia virginensis), and mesa drop seed (Sporobolus flexuosus).

The shoreline (3,700 feet) is typical of Lake Powell's developing riparian vegetation. Saltcedar (Tamarix ramoisissima) predominates along the shoreline at heights of two to six feet, where vegetation can become established. A seasonal understory of Russian thistle occurs and persists within the narrow band of saltcedar. Rabbit brush (Chrysothamnus nauseosus) occurs sparsely along the shoreline, but becomes the dominant species in the shallow drainages or wash channels.

The Chains - The vegetation of The Chains study area is variable, supporting a sparse, mixed-shrub plant community of blackbrush (Coleogyne ramosissima), Mormon tea (Ephedra torreyana) and Indian ricegrass (Oryzopsis hymenoides). The shrubs are widely spaced with large exposure of bare rock. In some areas, plant occurrence is limited to the cracks or fissures in the sandstone, where roots can become established. Over much of the disturbed area, perennial vegetation has not been reestablished.

Warm Creek - The Warm Creek drainage is active and supports a variety of desert riparian plants. Rabbit brush (Chrysothamnus nauseousus) is the most common species with saltcedar (Tamarix ramosissima) becoming more prominent as one approaches the shoreline. At the water's edge, saltcedar has formed a dense thicket.

The alluvial knoll which serves as the campsite, supports a shad scale community. Common plants include shad scale (Atriplex confertifolia), wirelettuce

(Stephanomeria pauciflora), Mormon tea (Ephedra torreyana), and Indian ricegrass (Oryzopsis hymenoides). Perennial plant cover is estimated to be 10 percent of the campsite and slightly higher in the wash channel.

White Canyon - The Moenkopi soils support a sparse, mixed, desert-shrub plant community. In some instances shrubs are 20 to 30 feet apart with open soil in between. Vegetation is similar to that of Farley Canyon, consisting of shad scale (Atriplex confertifolia), indigobush (Psorothamnus thompsonii, Mormon tea (Ephedra torreyana), blackbrush (Coleogyne ramosissima), and buckwheat (Eriogonum corymbosum). Perennial plant cover is estimated to be less than 15%.

APPENDIX E

CULTURAL RESOURCES

The following is a discussion of cultural resources for each shoreline site. This information was derived from file searches and/or reconnaissance survey by the park archeologist.

Blue Notch and Red Canyons - No cultural resource properties have been recorded in either the Red Canyon or Blue Notch Canyon study areas, although extensive prehistoric remains were noted in nearby sections of the main Colorado River channel during the pre-inundation surveys of the 1950's and 1960's. The likelihood of finding significant sites within these study areas is considered low due to the unfavorable environment. While it is possible that lithic sites may be associated with chert deposits occurring in weathered Chinle formations, these sites are not likely to be extensive or highly significant.

Bullfrog Creek - The only documented archeological field work in the Bullfrog Creek study area took place as part of the pre-inundation studies conducted by the University of Utah (Fowler 1959). The Bullfrog drainage was partially inventoried at the reconnaissance level in 1958, and 12 sites were recorded, none in the DCP study area.

A brief archeological reconnaissance was conducted for this planning effort. Portions receiving reconnaissance included the upper (northwestern) sandy and rocky beach area, the central large dune-covered mesas, and the dune/sandstone contact along the southern beachline.

Field work revealed the presence of a single site near the center of the study area. The site measures approximately 300 feet x 75 feet, and contains several whole "biscuit" or one-hand manos, basin metate fragments, several chert cores, and at least 100 flakes. This site appears similar in most respects to the prehistoric "campsites" recorded by Fowler and others in 1958.

A highly dispersed scatter of 10 to 15 chert flakes was found on a sandy mesa top near the southern end of the

study area, on the bank of a slickrock drainage. It is quite possible that additional materials have been buried underneath shifting sands. An isolated white chert biface fragment was found in the vicinity.

No other cultural materials were located during the reconnaissance. The inner reaches of the canyon incised into the Entrada sandstone were not explored carefully, although a quick examination from the adjacent mesa tops revealed no alcoves or overhangs which appeared suitable for occupation. Alluvial materials in this canyon appeared fresh and unstratified.

The possibility for locating numerous additional sites in the study area must be considered low. If additional sites are found, they would likely be lithic scatters or campsites similar to those previously located. A possible exception to this might be a rock shelter, alcove or rock art site located in the incised slickrock canyon which was not visible from above. The likelihood of this is considered low, however.

Clay Hills - Previous work in the Clay Hills area was limited to reconnaissance level surveys completed by both the Museum of Northern Arizona and the University of Utah, as part of the pre-inundation studies in the late 1950's. Several sites were recorded by the University of Utah in the immediate vicinity of the crossing, consisting of non-structural lithic and ceramic sites, as well as small alcove habitation sites. Three sites were recorded within the boundary of the current study area itself: a small ceramic scatter (42SA285) and a small lithic scatter (42SA275) were recorded by the University of Utah, and a ceramic lithic scatter (NA6798) was recorded by the Museum of Northern Arizona. All but the ceramic scatter are thought to be currently inundated or covered by clay sediments and the ceramic scatter could not be relocated. Existing records do not indicate extensive use of the dissected sandstone flats away from the river in the immediate vicinity of the crossing.

A single transect was surveyed around the cove-shaped center of the study area to the extreme western boundary along the river. This narrow band of high ground, consisted of an eroded sandstone terrace or shelf, lying between the steep cliff face and the high water line.

No cultural resources of any kind were located during this survey. In several areas, nodules of chert, petrified wood and other siliceous materials were located in colluvial deposits, which, no doubt, were eroded from once overlying Chinle formations.

The probability of finding additional sites in this area is considered low.

Copper Canyon, Neskahi, Piute Canyon - The main channel of the San Juan Arm was surveyed for cultural resource values by the Museum of Northern Arizona during the pre-inundation studies of the 1950's and 1960's. Many sites were recorded below the current high water mark, and some were recorded above this level in, or in the immediate vicinity of, the three San Juan Arm DCP study areas. These sites include sherd and lithic scatters, petroglyph panels, sites with 6 to 10 structures, and extensive midden components. Most are probably representative of Pueblo period Anasazi occupations.

Cottonwood Canyon - Several significant historic and prehistoric cultural resources are known to exist in Cottonwood Canyon, including several rock shelters, open sherd and lithic sites, and portions of the historic Hole-in-the-Rock road. It is probable that several additional significant prehistoric sites lie within the canyon boundaries, as indications are that only a small portion of it was covered during the pre-inundation inventories of the late 1950's and 1960's. The Hole-in-the-Rock road is a historic wagon trail constructed by early pioneers of the region. Several sections of dugway and rock-faced embankments still exist along the road alignments.

Crosby Canyon - There is no record of previous archeological work in, or in the vicinity of, the Crosby Canyon study area. No sites have been recorded within several miles.

Reconnaissance of the survey area for the purpose of this project was limited to the southern shoreline. Zig-zag transects were concentrated on the broad, sandy flatlands near the shore. No cultural resource materials of any kind were located. No cobble deposits other than lag gravels were noted, and the likelihood of finding additional sites in this location is considered low.

Dirty Devil - Limited reconnaissance of the Dirty Devil Canyon was completed during the 1958 pre-inundation studies conducted by the University of Utah (Fowler 1959). Although nearly 10 miles of the lower inner gorge were examined, no sites were recorded, probably because of the regular scouring of the narrow channel by river waters. On the upper terraces, a single site was recorded (42 GA 434). This site is located in the northern portion of the current study area, and consists of a campsite. Materials collected at the site in 1958 included several Tusayan corrugated sherds, several points, blades, and other stone tools. Several small, open lithic sites were located in the upland areas near the Hite marina by Marvin Kay in 1974 (Kay 1974). No other nearby sites were located during background research.

Archeological reconnaissance conducted for the purpose of the current project was minimal. The entire area was more-or-less evenly covered. During this field work, the single, previously recorded site was relocated, and several additional but limited prehistoric remains were noted as described in the following paragraphs.

A small cluster of four-to-six large primary flakes of poor quality gray chert were found in the northern part of the study area. Nearby terrain was lightly covered by a mantle of Eolian sand mixed with small igneous gravels, large cobbles, and medium-to-small gravels of chert, jasper and other siliceous materials. No other evidence of testing of this material was noted. A small lithic scatter, located in a narrow cleft nearby, was heavily impacted by modern camping activities; it possibly represented a component of the previously recorded campsite.

A large lithic site (ca. 100 feet x 75 feet) was also located in the northern portion of the study area which is currently being impacted by camping, ORV and recreational use. The site consists of several hundred primary and secondary flakes, cores and debitage associated with the reduction of terrace cobbles, which occur in limited quantities throughout the vicinity. Several activity areas were definable. Materials present included gray chert, white chalcedony, fine-grained quartzite, and jasper.

A smaller (50 foot x 50 foot) but similar site was located near the edge of a cliff overlooking the Dirty Devil. Again, a small cobble deposit was utilized as a lithic source, and discrete activity areas were recognizable. Three additional lithic sites were located across the slickrock flats, mostly at the heads of shallow drainage basins.

In the central and southern portions of the study area, no cultural resource materials were noted. In the southern area, however, colluvial slides contained nodules of a coarse, cherty material, probably originating from Chinle deposits exposed on the cliff face above. No testing of these nodules was in evidence.

The site recorded by Fowler in 1958 was re-located and found to contain not only a concentration of materials at the base of a low cliff, but a surrounding lithic scatter of several hundred flakes covering an adjoining dune area. This site is in the northern portion of the study area. Although no diagnostic points or bifaces were found, a single basin metate fragment was found imbedded in sandy deposits. Fowler did not record groundstone in this location in 1958, and it is possible that deposits of some depth once existed at this location, despite his conjecture to the contrary.

A more intensive inventory of the area would probably not reveal many additional large sites. For the most part, unsurveyed areas were low probability, steep, heavily ORV-impacted, slickrock and colluvial hills. There is a good chance, however, that additional small lithic reduction sites similar to those previously found, will be located in the interior of the northern portion of the study area.

Farley Canyon - Previous reconnaissance-level inventory of the Farley Canyon study area was conducted by Marvin Kay in 1974 (Kay 1974). This survey resulted in the identification of two sites in the vicinity, one inside and one outside of the study area. Both were lithic sites containing only primary flakes, and thought by Kay to represent quarrying of Pleistocene terrace cobble gravels, located on low ridge crests along the main drainage.

A field examination of the study area was conducted for

this project. Coverage amounted to a single transect at mid-elevation, halfway between the shoreline and the farthest perimeter. The badland foothills of the White Rim formation below the high Moenkopi mesa, at the north of the study area, were quickly examined, as well as the terrace cobble deposts along the south shore. Little time was spent on the heavily impacted gravels covering the low hills in the northern portion, and the farthest hills along the southwest shore could not be reached at all within the allotted time.

Two sites were located in the study area, one was a lithic site previously recorded by Kay (42SA3958), and one was a modern trash dump. The lithic site was found to extend across all of the terrace gravels examined (a distance of slightly less than ¼-mile). Utilization appeared light, and was also quite dispersed. In addition to the primary flakes recorded by Kay, secondary and tertiary flakes were also found.

The historic trash dump was located in the gravel deposit area, and was probably associated with recent uranium mining activities. It primarily contained cans and bottles, as well as some crockery, several large metal frames, and pieces of machinery. No materials were found to suggest the dump was greater than 20 to 30 years old. No signs of recent use were noted.

Halls Crossing Cove #4 - Although no cultural resource properties have been previously recorded within the Cove #4 study area, several are known in the general vicinity and were recorded by Marvin Kay in 1974 during reconnaissance inventory of the Halls Crossing developed area. Data recovery work was completed at some of these sites, prior to disturbance associated with construction activities. For the most part, these sites are lithic scatters and limited temporary campsites, probably associated with utilization of Pleistocene terrace gravels and cobbles, which mantle the low hills in the vicinity.

A reconnaissance of a portion of the upland areas in Cove #4 resulted in the location of a mano and several chert flakes. These materials were highly dispersed, and in a location which had been previously disturbed by earthmoving and vehicular traffic. Most of the remainder of the study area is Carmel badlands and lies below the high water line, and although it was not

examined during field reconnaissance, it probably does not contain significant cultural properties.

Hansen Creek - No previously recorded sites lie within the Hansen Creek study area, although several lithic scatters and small structural sites were recorded near the headwaters of Hansen Creek during inventories of the late 1970's. The sandy Eolian uplands lying above the Hansen Creek drainage are considered to have high potential for the occurrence of lithic scatters and associated campsites, due to the abundance of Pleistocene gravels in the general vicinity.

Field reconnaissance undertaken for the purpose of this DCP did not result in the location of any cultural resource materials.

Hole-in-the-Rock - The historic Hole-in-the-Rock road crosses this location. No other previously recorded sites lie within the Hole-in-the-Rock study area.

Lake Canyon - Several sites were previously identified in the Lake Canyon study area during the pre-inundation inventories of the 1950's and 1960's. These sites were substantial, and included rock shelters with structures, rock art, and large ceramic and lithic scatters. It is probable, however, that most of these sites were inundated during the filling of the lake.

Reconnaissance for the purpose of the current DCP did not include an effort to identify these previously identified sites, as they were all distant from the primary impact area, and lay along the lower slickrock shoreline. Field examinations focused on the sandy upland areas, many of which are currently being impacted by ORV traffic.

Field reconnaissance revealed the presence of an extensive lithic scatter in the northern portion of the study area, as well as a large, prehistoric campsite along the southeastern shore uplands. Several isolated flakes were also found, and it is considered probable that additional cultural material exists in the remaining sandy upland areas, in association with dispersed deposits of Pleistocene terrace gravels.

Stanton Creek - No record of previous survey of the Stanton Creek area was found during background

research. The pre-inundation studies conducted by the University of Utah in 1958 (Fowler 1959) show no sites recorded near Stanton Creek, although much survey work was conducted in the nearby Bullfrog, Hansen Creek, and Halls Crossing areas.

Archeological reconnaissance conducted for the current project was minimal. The reconnaissance concentrated on the steep Entrada escarpment to the north and the broken Entrada-Carmel formations and hills to the center and the south.

Field work resulted in the location of a single site - a lithic scatter which probably represents a combination of core reduction and tool manufacturing activities. The site is large (ca. 150' in diameter), and contains probably 200 to 300 lithic artifacts. The majority of the debitage consists of primary and secondary flakes, however several concentrations of tertiary and thinning flakes were noted. At least one activity area could be identified, as well as several utilized flake tools. No cultural affiliation or age could be determined. The site was located in the northern portion of the study area.

The only other cultural remains found in the study area consisted of isolated flakes removed from gravel cores, which were found in extremely small and isolated gravel deposits. Utilization of these gravels in this area was extremely light. No utilization of the gravels capping the foothills in front of the steep Entrada scarp to the north was noted. The Entrada scarp face itself was intensively examined for alcove sites and rock art, with negative results.

It is possible that additional lithic sites may be found, especially near the Entrada outcrops, just outside of the study area to the northeast. The flat constricted drainages flanked by Entrada ridges in the south should also be more carefully checked.

The Chains - Existing records indicate that The Chains probably received at least reconnaissance-level inventory by crews from the Museum of Northern Arizona (MNA) during the pre-inundation studies of the late 1950's. A single lithic site was previously recorded in the study area (2CN16), probably by the MNA, although this site is no doubt currently inundated.

Several sites were recorded along the right bank near The Chains area, including small shelters, sherd and lithic scatters, and rock art. This area was also surveyed by the University of Utah.

A brief field reconnaissance was conducted in the study area for this project. This reconnaissance was concentrated in the terrace gravels and slickrock flats and knobs of the northwestern part of the study area.

A single, large lithic site was recorded which more-or-less coincided with a large scatter of Pleistocene terrace cobbles and Eolian deposits located on the lowest extent flatlands, overlooking the bend in the river at the extreme northwest portion of the study area. This site was found to contain primary flakes and cores almost exclusively, and probably represents quarrying of the cobble gravels. This cobble deposit, measuring several hundred feet in length and at least 200 to 300 feet in width, is the largest within The Chains area, although smaller deposits exist in other portions of the study area to the east. No other evidence of utilization of these gravels was found.

Warm Creek - No cultural resource properties were previously recorded within the Warm Creek study area. Portions of the lower Warm Creek drainage, however, were inventoried by the University of Utah during the pre-inundation studies in the 1950's and 1960's. Several shelters and open sites containing sherds and lithics were located downstream; none closer than a mile from the study area boundary. The likelihood of encountering significant sites is considered low.

White Canyon - Although no cultural resource properties have been previously recorded in the White Canyon study area, many are known in the immediate vicinity. Pre-inundation surveys identified sherd and lithic scatters and associated prehistoric structures along the main channel of the Colorado River (one or two miles distant), as well as in the Blue Notch area to the southeast. An extremely large lithic scatter was identified on the bench above the incised portion of White Canyon, approximately 1.5 miles northeast of the study area.

Reconnaissance of the White Canyon study area for the purpose of the current DCP revealed no cultural

resource materials. However, just outside the study area, a large petroglyph panel and rock shelter were located. The panel was in good shape, although it appeared as though vandals had removed a slab of rock containing part of a large pecked element. The rock shelter was highly deflated and shallow and appeared to be highly disturbed by erosion. A sparse lithic scatter was located in the shelter and vicinity.

Reconnaissance was extended for approximately 1.5 miles south, to an area where ORV-access to additional areas appeared to be cut off.

APPENDIX F

VISITOR USE/RECREATION

The following is a site-specific discussion of recreation factors at each accessible shoreline area.

Blue Notch and Red Canyons - The Red Canyon area is very remote with restricted access which requires a long drive over rough dirt roads. The opportunity for solitude is excellent. Recreational impacts to the area are very light.

Access to the Blue Notch area is by four-wheel-drive or high-clearance, two-wheel-drive vehicles. The area provides an excellent opportunity for solitude and a remote camping experience. Use of the area is light, with fishing being the most common activity. Recreational campsites are minimal and consist primarily of campfire rings.

Bullfrog Creek - The Bullfrog Creek study area is easily accessed from the Burr Trail. Primary use is shoreline water oriented recreation. Activities include camping, picnicking, ORV use, swimming, boating, water skiing, fishing and sunbathing. Obviously not all these activities are compatible, especially when considering that they may all be occurring at the same time. Crowding in the summer-use season aggravates the situation. The area supported 600 vehicles and approximately 2,000 visitors over the 1986 Memorial Day weekend.

Heavy visitor use and a lack of sanitation facilities results in a proliferation of "toilet paper blooms" and piles of fecal matter. Areas most heavily impacted are the draws and washes that provide some cover. Campers with holding tanks and large boats have been known to dump their sewage onto the beach.

The area away from the shoreline receives heavy off-road vehicle use. The Summerville badlands and Eolian dunes are used for this purpose.

Vehicles and visitors concentrate along the shoreline. The actual location varies with the fluctuating reservoir level. Since no local rock is available, only a few rock fire rings are left. However, there

are numerous campfire scars along the beach and the beach sand is becoming a dingy gray color, resulting from lake water washing over the rings and mixing the ash with the sand. In addition, trash along the lakeshore is very noticeable. Broken glass and cans present hazards to campers. There are no trash receptacles on site. The nearest dumpster is at the junction of the Notam Road and Utah Highway 276.

Clay Hills - The primary recreational use at this site is as a "take-out" for San Juan River-runners. In 1986, about 5,700 people used Clay Hills for this purpose. Approximately 20 to 30 river-runners used the area each day during the rafting season. Vehicles camped near water's edge, while people awaited the arrival of their river parties. Often entire river parties will set up camp, if it is late when they come in off the river. Fishermen also use the Clay Hills area, although in much smaller numbers than the river-runners.

No facilities presently exist to meet the needs of trash and human waste disposal. Campers are presently using the shallow canyons and washes as backcountry latrines. This, compounded by similar usage by river-runners and fishermen, has created a sanitation problem.

A recreational issue at this site is the sedimentation of the area and its impact on recreational use. During part of the year (June and July), the lake level is high enough to facilitate river trip take-out, but during the rest of the year, extensive mud flats are exposed. These are difficult to walk on, and require that river-running gear be hand-carried across its approximately 100-yard width.

Copper Canyon - This area presently has drive-in campers. Most are fishermen taking advantage of the excellent fishing in the area. Access is limited to four-wheel-drive or high-clearance, two-wheel-drive vehicles, since a drive down the wash for several miles is necessary to access the lakeshore.

Cottonwood Canyon - Vehicle access to the site is along Wilson Mesa from the Halls Crossing area. The road is very rugged and frequently impassible. There is no evidence to suggest that vehicles have recently been

down to the lakeshore in Cottonwood Canyon. The roadway from the head of the canyon is obliterated in some places. The historic cribbing at the head of the canyon only reveals evidence of livestock and foot traffic on the trail. Very few vehicles ever get to Wilson Mesa, and those that do appear to stop before getting to Cottonwood Canyon. The canyon is very heavily used by boat campers, with all the available sites being used most nights. This use results in the presence of trash, campfire rings, and human waste.

Crosby Canyon - Access to this shoreline area is down Crosby Wash from the Warm Creek Road. High reservoir levels have reduced the number of available drive-in campsites substantially. There are two camping areas along the road. The area on the south is always accessible, while the area on the north is inaccessible at full reservoir levels. Crosby Canyon receives a high amount of recreational use.

Off-road vehicle use is increasing. Evidence of this use is spreading beyond the immediate camping area. Campfire scars and trash are noticeable on the sites themselves. Human waste is concentrated in isolated locations.

Dirty Devil - The Dirty Devil study area consists of a small land base located between Utah Highway 95 and the lakeshore on the Dirty Devil arm. The planning area is divided into three isolated areas by canyons filled with the waters of Lake Powell. The northern area is the largest and lacks shoreline access. The primary use of this area is for four-wheel-drive vehicle camping. There are numerous trails which wind through the area and terminate at protected sandstone pockets, which provide a view of the lake and protection from sand and wind. At each of these sites there are fire rings as well as sanitation and litter problems. There are presently no sanitation facilities provided. The area has had as many as 100 campers at one time.

The center area is smaller but provides limited shoreline access where boats can be launched, and therefore is used for a swimming beach. This area is intensively used for six months of the year, with vehicles parked close to each other. At this site, there are serious sanitation concerns.

The southern portion of the study area is the smallest and provides one access point to the water. This site also serves as a boat ramp and receives heavy camping use. All three portions of the study area have many fire rings. This may be due to a combination of the unlimited available firewood, the sandstone boulders which are easily gathered, the isolation of camps and the temporary nature of visitors. The closer one gets to the shoreline, the more numerous are the fire rings and associated camping impacts. These areas are also subject to littering.

There is some partitioning of use within the area. The northern portion seems to be a convenient and scenic spot for passers-through to camp. It is close to the highway, yet provides the visitor with the feeling of isolation even though the next party may be only a few hundred yards away, separated only by the sandstone topography. The other two sites appear to serve campers who are staying for a longer period of time and who desire access to the boat ramp and shoreline firewood. Fishing is the most common activity, being the predominant use during the fall, winter and spring. In the summer, boating and water skiing predominate.

There is some evidence of off-road vehicle use, especially in the northern area where vehicle trails meander into the canyons of the weathered sandstone.

Farley Canyon - Farley Canyon, because of its limited space, is the most concentrated use site of all the sites inventoried. Highly concentrated use is accepted here. Two hundred and fifty vehicles have been observed in this 5-to-10-acre site over Memorial Day weekend. Two concrete vault toilets are maintained at this site, but are some distance from the outer edges of the use area. A wakeless buoy has been positioned in the primary-use cove, which reduces conflicts between swimming and motorized activities.

The weathered, badland topography of the area is being impacted by off-road vehicle use. While not of the magnitude of Bullfrog Creek or other access areas, the potential for impact in this area is of concern.

Farley Canyon is posted with a sign which requests that litter be transported from the area and this seems to be effective.

Halls Crossing Cove #4 - Use of the area is very light owing to access restrictions resulting from the Halls Crossing-Bullfrog Ferry launch ramp. Its location, adjacent to the Halls Crossing developed area, and the calm water of the cove provide an excellent opportunity for swimming, picnicking and sunbathing, which is not readily available in the Halls Crossing area. There is limited boat access to the area from the lake. As a result, few boaters use the area. Camping impacts to the area are now existent while trash, though present, is a minor problem.

Hansen Creek - There is one visitor-use site at the end of a four-mile dirt road ending at Hansen Creek. It is the only site in the Bullfrog area which provides an opportunity for solitude for those without a boat. Use of the area is presently minimal because relatively few people know about the site. Primary use of the area appears to be day use by local residents. Camping impacts to the area are light, consisting of very few campfire rings and relatively little trash. The open nature of the terrain makes the area very susceptible to off-road vehicle impacts. There is some evidence that those impacts are starting to spread, although compared to nearby Stanton Creek and Bullfrog Bay sites, they are very minor.

Hole-in-the-Rock - The area is primarily a vehicle turn-around, at the end of the historic Hole-in-the-Rock road. The only access to the water is several hundred feet down the rugged Hole-in-the-Rock Trail. Visitors to the area are attracted by the historic site. Primary use is by boaters who hike up the trail from the lake. Very little to no camping occurs on the site. A survey of the area indicated that those who drive in to the site, tend to camp at a site about 5 miles up the road, which is more protected and provides some shade. Camping use of that area appears to be very light. Trash and campfire rings are present but are minor impacts. Off-road vehicle use does not appear to be a problem.

Lake Canyon - The Lake Canyon area, near the Halls Crossing Marina, provides a day-use area for local residents to picnic and swim. Some camping does occur in the area, however, overall the use of the area can be termed "moderate." Trash and off-road vehicle impacts are the most common problems, with fire rings

and human waste also present. Trash is concentrated at the few sites where people can park and walk to the lake. Much of it is related to picnicking and after-hours parties. Off-road vehicle use results from people driving along the canyon in search of areas suitable for camping, yet near the water and away from other parties. Some recreational off-road vehicle use is also occurring in the area.

Last Chance Canyon - Little to no recreational use appears to occur in the area. Access is four-wheel-drive only, down Last Chance Wash from the Last Chance/Grand Bench Road. There is only the wash bottom to camp in at the lakeshore, and the muddy, flat nature of the area may make meaningful access to the water impractical, except at times of highest lake levels.

Neskahi - Vehicle access to the area is nearly impossible. Although boat-in campsites are plentiful in the Neskahi area, drive-in sites are limited in both number and quality by the terrain.

Piute Canyon - Road access to Piute Canyon is very difficult and access to the water may be impossible. There is only one vehicle campsite available at the end of the road. It does not appear to have been used by drive-in campers in the recent past. There is some evidence of boat camping at the site during higher water levels. The main boat-in campsite is 200 yards down canyon from the vehicle campsite, and accessible to it by foot. Trash, campfire rings and human waste are the recreational impacts in the area, and they appear to be more related to boat campers.

Stanton Creek - The Stanton Creek shoreline is variable with the majority of the area consisting of rock ledges with small, isolated sand beaches. This area is intensively used by recreational visitors, and evidence of this use is visible throughout the area. The shoreline area is clear of vegetation and large areas away from the shoreline are cleared by intensive camping use. Fire rings line the shoreline and pockets of litter are common. The Carmel badlands and alluvial and Eolian deposts are used by off-road vehicles and this use is increasing, thereby expanding the area of intensive impacts.

Off-road vehicle activity is strongly evident in the weathered alluvial hills and Carmel badlands. This area, with its ledges and weathered slopes, is 25% covered by ORV tracks. The concentration of recreational impacts (fire rings, litter, etc.) are greatest near the water's edge, where access roads approach the lakeshore. The presence of two vaulted toilets in the northern portion of the study area may minimize the sanitation issue locally, but in the southern portions, sanitation remains a serious issue.

The Chains - The Chains area was originally used for the construction of Glen Canyon Dam. There is a circuitous route to the lake from U.S. 89. The area is adjacent to Glen Canyon Dam and the City of Page, Arizona. Visitation is day-use only. Visitors use the area for fishing, swimming, picnicking and sunbathing. Local residents use the area for evening gatherings where alcohol is conspicuously used. For the last two years, the Page School System used a small portion of the area for a summer environmental education program called, "Sunship Earth", for grades five through seven. No facilities, other than two garbage dumpsters, are provided in the area.

Warm Creek - Access to the Warm Creek site is along the wash down Warm Creek and requires a four-wheel-drive most of the time. The site is frequently inaccessible when the wash is flowing. There is one campsite along the lakeshore on a small rise. At low water levels, there may be more sites available. However, the flat, gradual nature of the shoreline results in most of the area near the water being very wet and soggy.

The campsite on the knoll appears to be lightly used. It appears to have been used as a cowboy camp in the past, most likely by ranchers working the surrounding grazing allotment. The main recreational impact in the area, is the existence of old campfire scars. There is some litter in the area. Fecal matter and toilet paper do not appear to be a problem. The overall recreational use of the area is minimal. The limited available camping and poor access suggest that use of the area will remain light for the foreseeable future.

White Canyon - White Canyon provides an opportunity for a more isolated camping experience in the Hite Marina area, while still being relatively close to marina

facilities. Access to the site is three miles down a dirt road. The amount of lakeshore camping area available is a function of reservoir level. The terrain restricts most of the camping to the east side of the area, with the head of the canyon providing more sites. The area receives light to moderate use, with large concentrations of visitors during holiday weekends. Fishing appears to be the primary recreational activity here.

While recreation impacts, in the form of toilet paper, blown trash, and fire rings are present, the main impacts in the area are off-road vehicle scars, with an expanding network of roadways. This network has resulted primarily because people drive along the northeastern shore looking for suitable campsites. There are two locations with fire rings, and trash concentrations are above the full-pool line of the reservoir. All the rest of the camping areas are below the full-pool zone of Lake Powell.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1988—575-132/85,128 REGION NO. 8