Columbia River System Operation Review

Final Environmental Impact Statement

Appendix D

Cultural Resources

US Army Corps of Engineers
North Pacific Division

DOE/EIS-0170

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PUBLIC INVOLVEMENT IN THE SOR PROCESS

The Bureau of Reclamation, Corps of Engineers, and Bonneville Power Administration wish to thank those who reviewed the Columbia River System Operation Review (SOR) Draft EIS and appendices for their comments. Your comments have provided valuable public, agency, and tribal input to the SOR NEPA process. Throughout the SOR, we have made a continuing effort to keep the public informed and involved.

Fourteen public scoping meetings were held in 1990. A series of public roundtables was conducted in November 1991 to provide an update on the status of SOR studies. The lead agencies went back to most of the 14 communities in 1992 with 10 initial system operating strategies developed from the screening process. From those meetings and other consultations, seven SOS alternatives (with options) were developed and subjected to full-scale analysis. The analysis results were presented in the Draft EIS released in July 1994. The lead agencies also developed alternatives for the other proposed SOR actions, including a Columbia River Regional Forum for assisting in the determination of future SOSs, Pacific Northwest Coordination Agreement alternatives for power coordination, and Canadian Entitlement Allocation Agreements alternatives. A series of nine public meetings was held in September and October 1994 to present the Draft EIS and appendices and solicit public input on the SOR. The lead agencies received 282 formal written comments. Your comments have been used to revise and shape the alternatives presented in the Final EIS.

Regular newsletters on the progress of the SOR have been issued. Since 1990, 20 issues of *Streamline* have been sent to individuals, agencies, organizations, and tribes in the region on a mailing list of over 5,000. Several special publications explaining various aspects of the study have also been prepared and mailed to those on the mailing list. Those include:

The Columbia River: A System Under Stress
The Columbia River System: The Inside Story
Screening Analysis: A Summary
Screening Analysis: Volumes 1 and 2
Power System Coordination: A Guide to the Pacific Northwest Coordination Agreement
Modeling the System: How Computers are Used in Columbia River Planning
Daily/Hourly Hydrosystem Operation: How the Columbia River System Responds to Short-Term Needs

Copies of these documents, the Final EIS, and other appendices can be obtained from any of the lead agencies, or from libraries in your area.

Your questions and comments on these documents should be addressed to:

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PREFACE: SETTING THE STAGE FOR THE SYSTEM OPERATION REVIEW

WHAT IS THE SOR AND WHY IS IT BEING CONDUCTED?

The Columbia River System is a vast and complex combination of Federal and non–Federal facilities used for many purposes including power production, irrigation, navigation, flood control, recreation, fish and wildlife habitat and municipal and industrial water supply. Each river use competes for the limited water resources in the Columbia River Basin.

To date, responsibility for managing these river uses has been shared by a number of Federal, state, and local agencies. Operation of the Federal Columbia River system is the responsibility of the Bureau of Reclamation (Reclamation), Corps of Engineers (Corps) and Bonneville Power Administration (BPA).

The System Operation Review (SOR) is a study and environmental compliance process being used by the three Federal agencies to analyze future operations of the system and river use issues. The goal of the SOR is to achieve a coordinated system operation strategy for the river that better meets the needs of all river users. The SOR began in early 1990, prior to the filing of petitions for endangered status for several salmon species under the Endangered Species Act.

The comprehensive review of Columbia River operations encompassed by the SOR was prompted by the need for Federal decisions to (1) develop a coordinated system operating strategy (SOS) for managing the multiple uses of the system into the 21st century; (2) provide interested parties with a continuing and increased long–term role in system planning (Columbia River Regional Forum); (3) renegotiate and renew the Pacific Northwest Coordination Agreement (PNCA), a contractual arrangement among the region's major hydroelectric–generating utilities and affected Federal agencies to provide for coordinated power generation on the Columbia River system; and (4) renew or develop new Canadian Entitlement Allocation Agreements (contracts that divide Canada's share of Columbia River Treaty downstream power benefits and obligations among three participating public utility districts and BPA). The review provides the environmental analysis required by the National Environmental Policy Act (NEPA).

This technical appendix addresses only the effects of alternative system operating strategies for managing the Columbia River system. The environmental impact statement (EIS) itself and some of the other appendices present analyses of the alternative approaches to the other three decisions considered as part of the SOR.

WHO IS CONDUCTING THE SOR?

The SOR is a joint project of Reclamation, the Corps, and BPA—the three agencies that share responsibility and legal authority for managing the Federal Columbia River System. The National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), and National Park Service (NPS), as agencies with both jurisdiction and expertise with regard to some aspects of the SOR, are cooperating agencies. They contribute information, analysis, and recommendations where appropriate. The U.S. Forest Service (USFS) was also a cooperating agency, but asked to be removed from that role in 1994 after assessing its role and the press of other activities.

HOW IS THE SOR BEING CONDUCTED?

The system operating strategies analyzed in the SOR could have significant environmental impacts. The study team developed a three–stage process—scoping, screening, and full–scale analysis of the strategies—to address the many issues relevant to the SOR.

At the core of the analysis are 10 work groups. The work groups include members of the lead and cooperating agencies, state and local government agencies, representatives of Indian tribes, and members of the public. Each of these work groups has a single river use (resource) to consider.

Early in the process during the screening phase, the 10 work groups were asked to develop an alternative for project and system operations that would provide the greatest benefit to their river use, and one or more alternatives that, while not ideal, would provide an acceptable environment for their river use. Some groups responded with alternatives that were evaluated in this early phase and, to some extent, influenced the alternatives evaluated in the Draft and Final EIS. Additional alternatives came from scoping for the SOR and from other institutional sources within the region. The screening analysis studied 90 system operation alternatives.

Other work groups were subsequently formed to provide projectwide analysis, such as economics, river operation simulation, and public involvement.

The three-phase analysis process is described briefly below.

- **Scoping/Pilot Study**—After holding public meetings in 14 cities around the region, and coordinating with local, state, and Federal agencies and Indian tribes, the lead agencies established the geographic and jurisdictional scope of the study and defined the issues that would drive the EIS. The geographic area for the study is the Columbia River Basin (Figure P-1). The jurisdictional scope of the SOR encompasses the 14 Federal projects on the Columbia and lower Snake Rivers that are operated by the Corps and Reclamation and coordinated for hydropower under the PNCA. BPA markets the power produced at these facilities. A pilot study examining three alternatives in four river resource areas was completed to test the decision analysis method proposed for use in the SOR.

- **Screening**—Work groups, involving regional experts and Federal agency staff, were created for 10 resource areas and several support functions. The work groups developed computer screening models and applied them to the 90 alternatives identified during screening. They compared the impacts to a baseline operating year—1992—and ranked each alternative according to its impact on their resource or river use. The lead agencies reviewed the results with the public in a series of regional meetings in September 1992.

- **Full-Scale Analysis**—Based on public comment received on the screening results, the study team sorted, categorized, and blended the alternatives into seven basic types of operating strategies. These alternative strategies, which have multiple options, were then subjected to detailed impact analysis. Twenty-one possible options were evaluated. Results and tradeoffs for each resource or river use were discussed in separate technical appendices and summarized in the Draft EIS. Public review and comment on the Draft EIS was conducted during the summer and fall of 1994. The lead agencies adjusted the alternatives based on the comments, eliminating a few options and substituting new options, and reevaluated them during the past 8 months. Results are summarized in the Final EIS.

Alternatives for the Pacific Northwest Coordination Agreement (PNCA), the Columbia River Regional Forum (Forum), and the Canadian Entitlement Allocation Agreements (CEAA) did not use the three-stage process described above. The environmental impacts from the PNCA and CEAA were not significant and there were no anticipated impacts from the Regional Forum. The procedures used to analyze alternatives for these actions are described in their respective technical appendices.

For detailed information on alternatives presented in the Draft EIS, refer to that document and its appendices.

WHAT SOS ALTERNATIVES ARE CONSIDERED IN THE FINAL EIS?

Seven alternative System Operating Strategies (SOS) were considered in the Draft EIS. Each of the seven SOSs contained several options bringing the total number of alternatives considered to 21. Based on review of the Draft EIS and corresponding adjustments, the agencies have identified 7 operating strategies that are evaluated in this Final EIS. Accounting for options, a total of 13 alternatives is now under consideration. Six of the alternatives remain unchanged from the specific options considered in the Draft EIS. One is a revision to a previously considered alternative, and the rest represent replacement or new alternatives. The basic categories of SOSs and the numbering convention remains the same as was used in the Draft EIS. However, because some of the alternatives have been dropped, the numbering of the final SOSs are not consecutive. There is one new SOS category, Settlement Discussion Alternatives, which is labeled SOS 9 and replaces the SOS 7 category. This category of alternatives arose as a consequence of litigation on the 1993 Biological Opinion and ESA Consultation for 1995.

The 13 system operating strategies for the Federal Columbia River system that are analyzed for the Final EIS are:

SOS 1a Pre Salmon Summit Operation represents operations as they existed from around 1983 through the 1990–91 operating year, prior to the ESA listing of three species of salmon as endangered or threatened.

SOS 1b Optimum Load–Following Operation represents operations as they existed prior to changes resulting from the Regional Act. It attempts to optimize the load–following capability of the system within certain constraints of reservoir operation.

SOS 2c Current Operation/No–Action Alternative represents an operation consistent with that specified in the Corps of Engineers' 1993 Supplemental EIS. It is similar to system operation that occurred in 1992 after three species of salmon were listed under ESA.

SOS 2d [New] 1994–98 Biological Opinion represents the 1994–98 Biological Opinion operation that includes up to 4 MAF flow augmentation on the Columbia, flow targets at McNary and Lower Granite, specific volume releases from Dworshak, Brownlee, and the Upper Snake, meeting sturgeon flows 3 out of 10 years, and operating lower Snake projects at MOP and John Day at MIP.

SOS 4c [Rev.] Stable Storage Operation with Modified Grand Coulee Flood Control attempts to achieve specific monthly elevation targets year round that improve the environmental conditions at storage projects for recreation, resident fish, and wildlife. Integrated Rules Curves (IRCs) at Libby and Hungry Horse are applied.

SOS 5b Natural River Operation draws down the four lower Snake River projects to near river bed levels for four and one–half months during the spring and summer salmon migration period, by assuming new low level outlets are constructed at each project.

SOS 5c [New] Permanent Natural River Operation operates the four lower Snake River projects to near river bed levels year round.

SOS 6b Fixed Drawdown Operation draws down the four lower Snake River projects to near spillway crest levels for four and one–half months during the spring and summer salmon migration period.

SOS 6d Lower Granite Drawdown Operation draws down Lower Granite project only to near spillway crest level for four and one–half months.

SOS 9a [New] Detailed Fishery Operating Plan includes flow targets at The Dalles based on the previous year's end–of–year storage content, specific volumes of releases for the Snake River, the drawdown of Lower Snake River projects to near spillway crest level for four and one–half months, specified spill percentages, and no fish transportation.

SOS 9b [New] Adaptive Management establishes flow targets at McNary and Lower Granite based on runoff forecasts, with specific volumes of releases to meet Lower Granite flow targets and specific spill percentages at run–of–river projects.

SOS 9c [New] Balanced Impacts Operation draws down the four lower Snake River projects near spillway crest levels for two and one–half months during the spring salmon migration period. Refill begins after July 15. This alternative also provides 1994–98 Biological Opinion flow augmentation, integrated rule curve operation at Libby and Hungry Horse, a reduced flow target at Lower Granite due to drawdown, winter drawup at Albeni Falls, and spill to achieve no higher than 120 percent daily average for total dissolved gas.

SOS PA Preferred Alternative represents the operation proposed by NMFS and USFWS in their Biological Opinions for 1995 and future years; this SOS operates the storage projects to meet flood control rule curves in the fall and winter in order to meet spring and summer flow targets for Lower Granite and McNary, and includes summer draft limits for the storage projects.

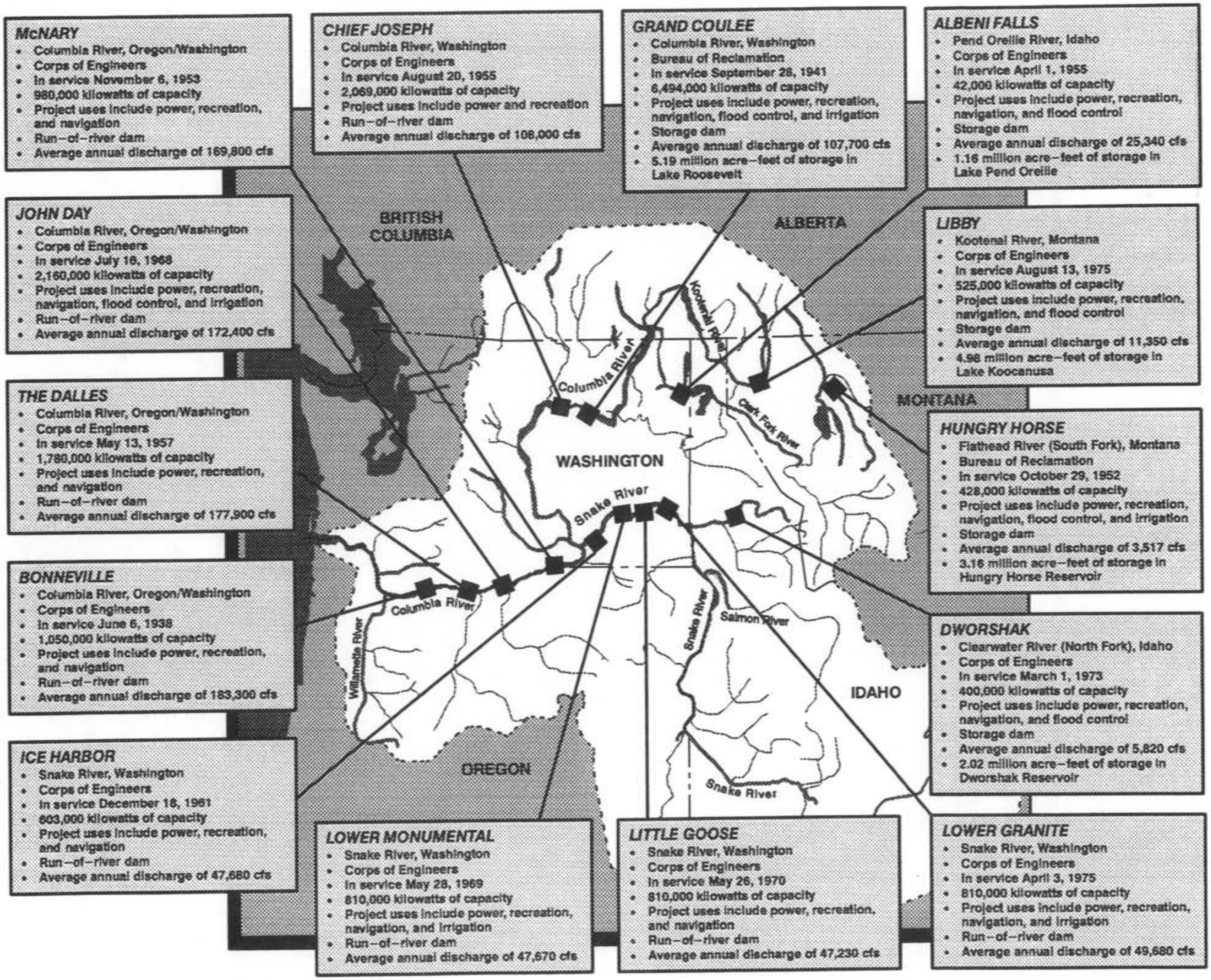
WHAT DO THE TECHNICAL APPENDICES COVER?

This technical appendix is 1 of 20 prepared for the SOR. They are:

A. River Operation Simulation
B. Air Quality
C. Anadromous Fish & Juvenile Fish Transportation
D. Cultural Resources
E. Flood Control
F. Irrigation/Municipal and Industrial Water Supply
G. Land Use and Development
H. Navigation
I. Power
J. Recreation
K. Resident Fish
L. Soils, Geology, and Groundwater
M. Water Quality
N. Wildlife
O. Economic and Social Impacts
P. Canadian Entitlement Allocation Agreements
Q. Columbia River Regional Forum
R. Pacific Northwest Coordination Agreement
S. U. S. Fish and Wildlife Service Coordination Act Report
T. Comments and Responses

Each appendix presents a detailed description of the work group's analysis of alternatives, from the scoping process through full–scale analysis. Several appendices address specific SOR functions (e.g., River Operation Simulation), rather than individual resources, or the institutional alternatives (e.g., PNCA) being considered within the SOR. The technical appendices provide the basis for developing and analyzing alternative system operating strategies in the EIS. The EIS presents an integrated review of the vast wealth of information contained in the appendices, with a focus on key issues and impacts. In addition, the three agencies have prepared a brief summary of the EIS to highlight issues critical to decision makers and the public.

There are many interrelationships among the different resources and river uses, and some of the appendices provide supporting data for analyses presented in other appendices. This Cultural Resources appendix relies on supporting data contained in other SOR Appendices. For complete coverage of all aspects of land use, readers may wish to review all three appendices in concert.



1 million acre feet = 1.234 billion cubic meters
1 cubic foot per second = 0.028 cubic meters per second

Figure P–1. Projects in the System Operation Review.

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CHAPTER 1

INTRODUCTION: SCOPE AND PROCESS

This study attempts to identify and analyze the impacts of the System Operating Strategy (SOS) alternatives on cultural resources. The impacts include effects on Native American traditional cultural values, properties and practices. They also include effects on archeological or historic properties meeting the criteria of the National Register of Historic Places.

In addition to responding to the requirements of the National Environmental Policy Act (NEPA), this analysis addresses the requirements of the National Historic Preservation Act (NHPA), the Archeological Resources Protection Act (ARPA), the Native American Graves Protection and Repatriation Act (NAGPRA), the Native American Religious Freedom Act (NARFA), and other relevant legislation. To meet their legally mandated cultural resources requirements, the SOR agencies will develop agreements and Implementation Plans with the appropriate State Historic Preservation Officers (SHPOs), Tribes, and the Advisory Council on Historic Preservation (ACHP) detailing the measures necessary to best manage the resource. The planning and implementation activities will be staged over a number of years in consultation with affected Tribes (see Chapter 6).

1.1 TRIBAL ISSUES AND CONCERNS

1.1.1 Introduction

The following list of issues and concerns originated from correspondence received from Tribes, reports prepared by certain Tribes under contract with the SOR, and testimonials during meetings of the Cultural Resources Work Group (CRWG). Some issues and concerns identified below extend beyond the scope of the SOR. They are presented here to fulfill a commitment made to the Tribes by the SOR managers to convey tribal issues and concerns in the EIS whether or not they specifically fell within the scope of the SOR.

The issues described below reflect the agencies' understanding of what they have heard from the Tribes. The intention is to present the statements in the Tribe's or individual's own words. Therefore, the issues may contain perspectives or proposals which are not those of the SOR agencies. This should not be construed as an attempt by the agencies to speak on behalf of Tribes.

The issues and concerns are organized into three broad categories of procedural, substantive, and behavioral topics. There is some redundancy in the list because of a conscious decision to err on the side of completeness rather than strive for perfect internal consistency.

1.1.1.1 Procedural Issues and Concerns

One of the main themes throughout all the meetings held with the Tribes of the region was their demand for co-management of the cultural resources, with adequate funding levels to give the Tribes assurances that cultural sites would be protected. This is not addressed in a forthright manner anywhere in the entire SOR EIS. We acknowledge that eventually programmatic agreements will be in place which will address site-specific needs. However, the Coeur d'Alene Tribe has serious doubts that this issue will ever be properly addressed without a firm commitment by the Federal agencies for co-management and funding. As an example, the Coeur d'Alene Tribe has provided a draft programmatic agreement which could be utilized by the Federal agencies as a base document to which the individual Tribal programmatic agreements could be tiered. This document was completed early in 1995. To date there has been no response from the three agencies regarding their thoughts about the Tribal issues (from the Coeur d'Alene Tribe).

a. Consultation with Tribes has been inadequate or nonexistent.

b. A true government–to–government process needs to be defined and implemented. It would include involvement of the affected Tribes in making SOR policy decisions.

c. There should be a clear distinction between the policy level decision making process used by each Tribe and communication at the technical or administrative level. Contacts with Tribal council is on a different level than contacts with Tribal staff.

d. Agencies need to understand and respect internal Tribal governmental processes.

e. The Federal trust responsibility to Tribes has not been fulfilled.

f. There should be a consistent process for defining what the trust responsibility is. This process must not be unilateral but should be a product of interaction with affected Tribal governments.

1.1.1.2 Substantive Issues and Concerns – General

a. Agreement on definitions of important concepts and terms has not been established. Examples of key concepts and terms are: cultural resources traditional cultural properties, National Register properties, Indian identities, etc.

b. The parameters of various treaties and ceded lands need to be clearly identified. Which ones apply where and under what circumstances need to be understood and agreed upon by all affected parties.

c. The locations of usual and accustomed fishing locations need to be identified.

d. The agencies have not demonstrated a clear intent to follow through on actual implementation of programs to protect cultural resources such as site monitoring, stabilization, and ARPA enforcement. The participation of Tribes in Section 106/NHPA processes does not constitute protection.

e. The agencies need to provide and identify responsibility for proper management of cultural, archeological, and traditional resources affected by their operations.

f. The agencies do not treat Tribes as sovereign nations. This applies equally to Tribes recognized by treaty, Executive Order, and the Indian Reorganization Act (IRA).

1.1.1.3 Substantive Issues and Concerns –Anadromous Fish

As an example of anadromous fish concerns reported by several of the Tribes, the paragraphs below were submitted by the Nez Perce Tribe.

The return of the salmon has an important meaning in the practice of our native religion. Special ceremonies and feasts are performed, acknowledging the return of the salmon, and a time of thanksgiving to the Hanyawat (The Creator).

The continued loss of the migratory fish has become a major concern among the Native American people, especially where the return extended to the upper Columbia River, the Snake River, and its tributaries.

The same considerations should be given to Idaho rivers and streams for the returning salmon coming through Zone 6, since the numbers of returning salmon are not exclusively destined for Zone 6 area spawning. A better operational system need to be implemented to allow smolt passage through dams.

The question of Treaty access sites are being resolved with the intent to restore fishing facilities that were inundated by the backwaters of the dams between the Corp of Engineers and the treaty Tribes.

Cultural identity and survival remains to be an important part to the affected Tribes. The Native American people are closely associated with nature.

Allowing the salmon to be destroyed also destroys a part of our traditional culture and the native religion. In effect it becomes another act of genocide, destroying a part of our cultural values.

There are many causes that may be attributed to the loss of the great runs of salmon. Much of this can be focused upon the problems with fish passage facilities through the four dams located on the Lower Columbia and the four on the Lower Snake River.

There is a definite need for more effective law enforcement coordination, that would offer the safeguard the fishery, wildlife, and the native cultural resources. Such coordination should be implemented between all Federal and State law enforcement agencies and where applicable with Tribal law enforcement agencies, in providing better management.

Provisions for fish protection is integral and an important part to the SOR operations since it is designed to address the overall operation of the Columbia River system. If no attention is made by the SOR, then to whose benefit will the overall SOR operational functions be? Certainly, not to protecting the Native American cultural resources, or other issues that may be addressed to the SOR.

In considering the habitat loss due to "drawdowns," the lack of any statistics makes it difficult to determine what kind of comments should be presented in relating to drawdown effects. Based on such information comments would be made to include any adverse effects on archeological sites.

The Tribes still maintain the harvest of subsistence foods and plants, including medicinal herbs and plant usage. Some of these areas are now under water, because of the dams.

Future protection of such foods and plants, along with the fish and wildlife should be incorporated into the SOR "programmatic agreement" to be made with the affected Tribes.

In addition, here is a list of anadromous fish issues:

a. The need for access to in lieu treaty fishing sites has not been addressed. In addition, the agencies need to ensure that access is ongoing and for the intended purposes.

b. The issue of harvestabililty of salmon as well as survivability has not been addressed.

c. The interest of downriver Tribes, represented by CRITFC, (Columbia River Inter–Tribal Fish Commission), are not necessarily shared by upriver Tribes.

d. The issue of conflicting release requirements for treaty fish species has not been covered.

e. The holistic ecosystem approach advocated by Tribes has not been incorporated into the SOR or other studies managed by the agencies.

f. There is a lack of coordination by multi–agency fish managers, such as National Marine Fisheries Service and the U.S. Fish and Wildlife Service.

g. The scope of the SOR study is not adequate due to the exclusion of the Upper Snake and the Columbia River Estuary (below Bonneville Dam).

h. The impact of diminished salmon runs on tribal cultural identity and survival as well as for subsistence and ceremonial use has not been addressed. The importance of salmon to traditional Tribal religions has not been considered.

i. The question has not been addressed of whether or not different anadromous–fish have different drawdown needs.

j. The question has not been addressed concerning the possible effects of drawdowns on Tribal fish hatcheries

k. There are not enough fish ladders to provide for appropriate fish bypass.

l. The option of whether or not to remove the dams from the Federal hydrosystem has not been seriously considered by the SOR.

m. The agencies have not provided for law enforcement coordination among the agencies and Tribes for fish, wildlife, and cultural resource protection.

n. The need for habitat restoration as well as restoration of the salmon runs, based on treaty agreements, has not been addressed. This includes deep sea habitat as well as habitat associated with the river

o. The Tribes are not being considered as co–managers of fish resources on an equal basis with the agencies.

p. The preferred SOR alternative should integrally consider the need for restoration of fish runs.

q. Provisions for fish protection should be a part of any agreement concerning power, water, cultural resources, etc.

1.1.1.4 Substantive Issues and Concerns – Resident Fish

Resident fish are important to several Tribes who have lost all access to anadromous fish due to dam construction. This is more than an issue of sports fishery or businesses which serve sportsmen. Resident fish, to these Tribes, are a substitution for the lost anadromous fish stocks. The Coeur d'Alene Tribe, for example, stated that resident fish and anadromous fish programs should be balanced. Both resources are equally important to Tribes and one should not be sacrificed over another.

The following issues have not been adequately addressed by the SOR:

a. White Sturgeon stream flows on the Kootenai River.

b. Reservoir plantings for fish habitat restoration.

c. The conflict between SOR alternatives for anadromous and resident fish.

1.1.1.5 Substantive Issues and Concerns – Wildlife (including vegetation)

Mitigation for loss of riparian wildlife habitat has taken less priority than other issues. In many cases the mitigation requires acquisition of offsite lands which can be used in lieu of the original lands. This is expensive, and will become increasingly more expensive with the future increase in land values. Habitat restoration around the reservoirs will continue to be difficult to reclaim with fluctuating pool levels.

The following issues have not been adequately addressed by the SOR:

a. Habitat loss due to reservoir drawdown or sustained pool elevation.

b. Impact of system operation on subsistence and medicinal plants.

c. Impact of system operation on treaty reserved rights for hunting, fishing, gathering, and grazing.

d. The need to establish a comprehensive trust fund for wildlife and habitat mitigation.

e. Reservoir drawdown effects on ability to support wildlife. The SOR alternatives do not adequately consider the impacts of system operation on wildlife carrying capacity.

1.1.1.6 Substantive Issues and Concerns – Power

a. Consideration needs to be given to proportional sharing of revenues from power sales for resource co–management.

b. Support for fish restoration should be considered in power sales agreements.

c. The agencies have not fulfilled promises made to Native Americans to provide electrical power in exchange for Tribal lands lost due to dam construction.

d. The Tribes, as sovereign nations, should be involved in negotiations regarding Canadian Entitlement Allocation Agreements.

e. The role of power generation has "driven" the operation of the Federal hydrosystem; it is not considered equal with other resources.

f. The industrial rate BPA charges to industry does not reflect the environmental cost of fish restoration. BPA should charge more for power used by industry and use the additional revenue for fish restoration.

g. The use of thermal generating plants to make up for power generation losses while meeting fish flows has not been adequately addressed.

1.1.1.7 Substantive Issues and Concerns – Flood Control

Limited efforts have been made by the Corp of Engineers calling for the protection of Indian lands and facilities, as compared to non–Indian lands. Consequently, a lot of land (soil) has been washed away due to erosion, depleting the landbase of the respective Tribes involved with the SOR (from Nez Perce Tribe).

In the early 1960's the Nez Perce Tribe requested the Army Corp of Engineers to help address such erosion problems along the streams located on the reservation, involving trust lands. At that time the Tribe was confronted with technical and legal problems and no action was ever taken.

a. Flood control protection for Indian lands and facilities should be at the same level as for non–Indian lands.

b. Treaty reserved rights are not valued in cost/benefit formulas for flood control.

c. Tribes should be compensated where flood control measures result in the loss of fish and wildlife habitat.

1.1.1.8 Substantive Issues and Concerns – Navigation

a. Barge wake erosion and interference with treaty fishing activity has not been addressed.

b. Notification should be given to Tribes of transportation of any hazardous cargoes. The Tribes need to know the extent of any hazardous shipments being made on the river. This would give Tribes the opportunity to express their concerns, suggest safeguards, or opposition to the responsible Federal agencies. For example, such shipments should be scheduled so they do not occur during critical fish migration periods.

c. Large shipments of toxic materials could result in catastrophic spills.

d. The effects of lock operations on fish passage and mortality has not been adequately addressed

e. Dredging activities should be limited to absolute minimum, or necessity. The scheduling of maintenance dredging in the Columbia River channel should be coordinated with Tribes. The placement of dredged material on cultural sites must be avoided.

f. Barge size should be balanced against flow requirements for fish enhancement.

1.1.1.9 Substantive Issues and Concerns – Irrigation

a. The problem of the return of agri–chemical fertilizers and pesticides to the Columbia River caused by irrigation has not been adequately addressed.

b. The use of water diverted for irrigation versus fish during periods of fish runs has not been adequately addressed.

c. Insufficient attention has been given to protecting fish smolts from irrigation intakes. This includes the placement of movable irrigation intakes during reservoir drawdown.

d. The fishery effects of irrigation and water reserves for the Upper Snake River have not been adequately addressed.

e. Tribes are concerned about pumping costs.

1.1.1.10 Substantive Issues and Concerns – Recreation

Recreation is a good past–time. However, there are curious people and amateur “archeologist” who see good opportunities during the recreation season, looting and/or grave robbing from nearby cultural sites. Vandalism and destruction of such sites have increased (from Nez Perce Tribe).

a. The impacts of system operation on Tribal recreational enterprises has not been adequately addressed.

b. Bass fishing and windsurfing interfere with Indian treaty fishing and access.

c. Stream bank erosion from recreational boating cause slumping/wasting and undercut boat ramps.

d. The agencies need to do a better job managing use of off–road of recreational vehicles to minimize impacts to cultural sites and wildlife habitat during reservoir draw-down.

1.1.1.11 Substantive Issues and Concerns – Air Quality

There is no evidence the agencies will take any action to resolve the dust abatement problems at Tobacco Plains, Libby Dam, Kettle Falls, and Coulee Dam.

The Coeur d'Alene Tribe reported several concerns which should be addressed by the SOR:

- We have concern for the “downwinders” of the reservoirs; for example, consider the amount of powdered slag which has been deposited into the Columbia River by Canadian sources. When drawdown occur this material becomes dry powder on the exposed shore. What happens then to those recreation users of Lake Roosevelt when the slag becomes windborn? The PM–10 fugitive dust particles from this material may contain hazardous chemicals from this material may contain hazardous chemicals from the milling process, and should be evaluated by the SOR managers.
- What type of on site air quality monitoring has been done to establish the base levels of fugitive materials from the reservoirs, especially during pool drawdowns in the dry months?
- While it is true that there are low resident populations in the vicinity of the reservoirs, the fact that Lake Roosevelt, Lower Granite and John Day have recreational use exceeding 1,000,000 individuals indicates a potential problem with fugitive dust particles.
- How are the Tribes adjacent to the reservoirs affected by fugitive dust and PM–10 materi-als?
- Has any testing been done to determine chemical pollution of the lands adjacent to the reservoirs, especially those which may have heavy metals associated with the materials deposited into the Columbia River.
- The Tribe is concerned with the effects of high winds funnelling through the Columbia River Valley and the ability of these winds to transport PM–10 material. We use the deposition of high amounts of Mt. St. Helens ash onto the Coeur d'Alene Reservation in 1980 as an example of these wind deposits.

1.1.1.12 Substantive Issues and Concerns – Water Quality

The water quality has deteriorated due to a number of causes, such as pesticides and herbicides transferred by irrigation systems into the river drainage. Industrial chemical spills have caused extensive contamination to the Columbia River system. Strict enforcement, or penalities should be imposed for such neglect and danger to life (from Nez Perce Tribe).

Nuclear radiation has had a significant part in contam-inating the river system, as we are learning from the river pathways studies that have been conducted under the Technical Steering Panel for the Hanford Environmental Dosage Reconstruction Project (HEDRP). Final report of these studies are pending (from Nez Perce Tribe).

Water quality should be examined for what is occurring in the Columbia River system and how it affects human health. For example, the dumping of 400 tons per day of slag into the Columbia River by the Cominco mill at Trail, British Columbia, should be addressed in this section. What effects has this had on human health and natural resources of the area? (From the Coeur d'Alene Tribe.)

There are many river uses but we must prioritize the uses that affect the quality of the other uses. All interested parties within the Columbia system must address water quality and overuse, we cannot establish healthy ecosystem without water quality. The velocity of the river and the river systems natural filtering ability must be restored. The Columbia River must be able to clean itself out. The water in the river is warm, slow, and dirty with agricultural, industrial, and radioactive pollutants. This happened in the last 150 years with most destruction happening in the last 50 years. This is not effective long–term management of the river system (from the Umatilla Tribes).

Regarding data gaps in SOR Water Quality Appendix, the Coeur d'Alene Tribe commented: With over 1500 NPDES permits in Idaho, Oregon, and Washington there should be more additional information and modeling available on fecal coliform, Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), Dioxin, metals, Total Phosphorus, and other nutrients. Metals and nutrients from the Coeur d'Alene Basin and Canada should be analyzed.

There is no mention of Total Maximum Daily Load Requirements under Section 303(d) of the Clean Water Act (page 2–11 and 2–12). There are 62 basins in Washington under a 5–year program and 6 designated basins in Idaho. Tribal water quality standards (such as the Colville Tribal Water Quality Standards) and future proposed Tribal clean water act programs may be affected by this system regulation. Stormwater discharges are another water quality impact to be considered.

The following issues and concerns have not been adequately addressed:

a. The return of pesticides and herbicides in irrigation and small tributary water to the mainstream Columbia.

b. Human health risks due to consumption of contaminants in fish.

c. Effect on water temperature of SOR alternatives during low water years.

d. Effects on fish migration of erosion, siltation, and increased sediment load.

e. Flushing of contaminants into the river system from superfund sites.

f. Re–suspension of toxic sediments due to erosion and dredging activity.

g. Effects of water level and temperature on anadromous and resident fish and treaty fishing rights.

h. Effects of nuclear radiation on Columbia River, particularly Hanford Reach, e.g., fish consumed by Tribes.

i. Canadian mining effects (tailings from cyanide leaching process) on water quality at Lake Roosevelt.

j. The agencies are not making use of USGS and other studies regarding sediment.

1.1.1.13 Substantive Issues and Concerns – Social Economic

As stated earlier, the reduction of salmon resources has had a serious impact on the traditional ceremonial activities and especially as it relates to the native religious practices. The Tribes are consulted by the SOR managers with limited involvement and the staff people have given Tribes partial consideration in recognizing the term "sovereignty" status. Cultural sensitivity is an important part of any negotiation process between the SOR and the Tribes. This is what it is all about, as far as the Tribes are concerned (from Nez Perce Tribe).

Adequate funding should be provided to assist the Tribes to become more extensively involved. The Tribes are faced with budgetary restraints, due to the limited resources on the reservation, that would, otherwise, enable them to adequately meet their annual administrative and program expenses. The various Federal programs have given assistance to help relief the Tribe's financial obligations. The SOR should assist the Tribes in the preparation of a cultural resource management plan and to include appropriate Tribal employment opportunities in the SOR cultural resource related programs, that would represent more direct involvement. The Tribal cultural resource programs should be recognized as qualified to acquire Federal agency contracts, since their personnel carry out similar work responsibilities as SHPO and carry the credentials, or expertise in working in such field (from Nez Perce Tribe).

The following issues and concerns have not been adequately addressed:

Impact of SOR alternatives on Tribal enterprises.

Effects of reduced salmon resources on traditional ceremonies and practices.

Conflict between changing recreational use patterns (windsurfing) and traditional uses.

Disruption of familial social interaction, linguistic, and cultural traditions due to dam and reservoir operation.

Arbitrary separation of Indian peoples by international boundary (i.e., Kootenai).

The social–cultural context of contemporary Native American communities affected by SOR.

Displacement of Tribes from former riverine environment and isolation from employment/contracting opportunities.

Promises not kept for free electrical power to compensate for loss of rail services due to realignment or termination of service.

Discriminatory consequences of SOR issues affecting Tribes which are viewed negatively by the general public (i.e., treaty fishing rights).

The lack of adequate funding and staffing for Tribes prevented proper participation and involvement.

Lack of Tribal participation in social–economic analysis.

Impacts on Indian communities which are not Federally recognized.

Impacts to traditional subsistence/medicinal resources and cultural sites.

Communication breakdown due to failure to consult with Tribal elders leading to agencies overlooking traditional cultural concerns. The inconsistent use of oral versus written comments by Tribal leaders resulting in faulty agency interpretations of Tribal views.

1.1.1.14 Substantive Issues and Concerns – Cultural Resources

a. Need to complete baseline cultural resource inventories and evaluations.

b. Need to complete Cultural Resource Management Plans (CRMPs) for operating projects.

c. The cultural survey data sets for the various Federal projects is inconsistent.

d. Appropriate Tribal employment opportunities through SOR cultural resources programs is necessary (monitoring, oral history compilation, inventory surveys) to complete protection process. Tribal cultural resources programs are qualified as Federal agency contractors.

e. Federal agency use of Tribal curation repositories, which meet 36 CFR 79 standards is not addressed

f. The Columbia River itself is a cultural resource as well as a traditional cultural property with spiritual value to Tribes. Tribes are concerned that SOR does not fully take into account the cultural context of natural resources such as fish, wildlife, plants and streams.

g. SOR cultural resource findings and conclusions have not been validated by Tribal elders. This should be a part of the consultation process.

h. The need for effective public education and enforcement of ARPA is not adequately addressed.

i. Cultural sites included in Hanford Reach, Hells Canyon, and the lower Columbia River Estuary need to be addressed.

j. Any SOR alternative is an undertaking that will result in discovery of previously unrecognized or unrecorded sites which must be protected.

k. Need to be aware of increased potential for site erosion and slumpage caused by certain river operations.

l. Need to carry out site stabilization or data recovery at threatened significant sites.

m. Need to conduct site monitoring and ARPA enforcement to prevent vandalism and looting of sites.

n. Need to assume full responsibility for burial protection and NAGPRA provisions for exposed human remains and grave goods.

o. Need to provide identification and protection of traditional cultural properties and appropriate level of Tribal coordination.

p. Need to carry out curation of archeological collections in accordance with applicable laws, regulations, and agreements in consultation with Tribes.

q. Need for public interpretation and education concerning cultural resources.

r. Need to better define and implement Tribal involvement in the entire SOR process.

s. Tribal concern that the Federal agency definition of cultural resources is too narrow.

t. Tribal concern that SOR does not consider the full range of effects on natural resources essential to maintaining traditional cultural practices.

u. Concern that the findings of the Cultural Resources Work Group will not influence the selection of a preferred alternative.

v. Concern that the requirements of the Endangered Species Act and the National Marine Fisheries Service's biological opinion are the real determining factors behind the selection of a preferred alternative.

w. Concern about developing a mechanism for effective communication, coordination, and consultation between agencies and Tribes.

x. Need to provide funding to carry out the terms of an interagency programmatic agreement or of individual programmatic agreements with Tribes. Failure to do so would place the agencies in a position of being in noncompliance with sections 106 and 110 of the NHPA.

Many of those issues will be generally addressed in an interagency programmatic agreement and more specifically in the individual programmatic agreements or memoranda of understanding which will be developed between the Tribes and the agencies. Implementation of commitments and obligations identified in the various agreements may depend on available funding.

Issue (v) continues to be a point of disagreement between the agencies and Tribes. The agencies have stated that the legal requirement to comply with ESA is a major factor in the selection of the preferred alternative. Practically speaking, there is little chance that any findings or recommendations of the CRWG will result in the selection of a different alternative or a modification of the one selected.

Broad concerns have been expressed about the potential effects of system operations on cultural resources. These concerns focused on the methodology used in assessing and comparing these resources at the

14 Federal projects. A major issue in developing a methodology acceptable to the majority of CRWG members was the need to incorporate the broader traditional views of cultural resources held by Native Americans into the framework off the NEPA process. In an attempt to address this issue, section 2.5 was added in Chapter 2 in an effort to include the historic and cultural context of the study, as perceived by Native Americans, as well as specific geographic and archeological data.

1.1.2 Contrast of Native American and Euroamerican Perspectives

Several factors combined to make this study especially challenging. One is the need to understand and incorporate the natural, holistic view of cultural resources held by Native Americans and the highly specific scientifically oriented Euroamerican approach. The way in which cultural resources is defined is itself a product of values and perceptions; there is no universally accepted definition of cultural resources.

Not all members of the CRWG are comfortable with the term "Euroamerican." Some feel it ignores the historic role of other ethnic groups in the region such as Chinese–Americans. Others feel the term is out–dated and that a more relevant term would be "western technology." While the term Euroamerican is not inclusive of all historic sites, it is used here to denote a characteristic set of values which are in sharp contrast to traditional values and beliefs held by many Native Americans. Western technology is a product of the Euroamerican system of values. Many people view technology as an independent element in western culture. But a driving force behind technology is the core Euroamerican value which views nature and the material world, in general, as something to be manipulated, used, consumed, or even subjugated. Western technology, then, demonstrates this core Euroamerican value in action. At the same time, it is important to acknowledge that it is a value which many non–Indians do not personally accept.

The Euroamerican culture places high value on the importance of scientific and/or objective observation. A good observer is generally expected to remain detached and not become personally involved in the subject. Information developed from physical observations, according to Euroamerican values, is usually considered more trustworthy than subjective material. In fact, the word "subjective" is sometimes used pejoratively to imply that information or opinions of a subjective nature may not be trustworthy. This contrasts with the traditional Native American value which understands that "the people" are another component of nature with responsibilities in the material world. The Native American value places importance on complete physical and spiritual interaction in the natural world. Nature's law supersedes all human created laws. To some Native Americans, the Euroamerican attitude of the "disinterested observer suggests a lack of respect. In fact, some Native Americans point out that the difference between the role of observer and that of a participant is a critical distinction. In the words of one Native American, a member of the CRWG:

> *You don't understand that this ain't a game. It's a way of life that you have to learn. We're all put here for a purpose and a reason.*[1]

1.1.3 Adequacy of Information

Another factor is the lack of complete information on the cultural resources for each affected Federal project. This factor has two components. One is the need for a deeper and more complete understanding of the cultural context of the known cultural resources as viewed by Native Americans who have occupied the Columbia Plateau for thousands of years. This is embodied in oral traditions and knowledge which is preserved and handed down to present and future generations by Tribal elders. It is not, for the most part recorded in books or documents. This knowledge is held sacred by Native Americans, and is something which they may feel is inappropriate to share on a purely academic basis. Doing so may, in fact, be a violation of their cultural norms.

[1]Mr. Jeffrey Van Pelt, Confederated Tribes of the Umatilla, at a CRWG meeting on January 31, 1995.

The second component stems from the fact that not all project lands have been surveyed for cultural resources nor have all identified cultural resources been evaluated in cooperation with affected Native American Tribes and/or by National Register criteria.

As the Umatilla Tribes state in their reports (see exhibits), "The agencies have not been able to fully identify actual cultural resource properties that this undertaking will have an effect on. This cannot be accomplished without conducting cultural resource inventory work along the reservoirs. The cultural resource modeling is an academic exercise and is useful but these models need to be adequately tested before such broad statements can be made. Further there is no indication that the agencies have began to identify the resources necessary to conduct adequate cultural resource inventories."

1.1.4 Method of Evaluation

The lead agencies, in an attempt to apply modeling techniques to measure the effects of proposed operating strategies, have assessed all known cultural resources sites equally, regardless of National Register status. The objective of the modeling work is to provide a tool for decisionmakers who, ultimately, must budget for and manage programs designed to protect and preserve cultural resources affected by the operation of the dams. According to Section 301 of the 1992 amendments to the NHPA, an Historic Property or Historic Resource means any prehistoric or historic district, site, building, structure, or object included in or eligible for inclusion on the National Register, including artifacts, records, and material remains related to such a property or resource. Such resources must be significant in American history, architecture, archeology, engineering, or culture and, normally, must be at least 50 years old. According to guidelines published in National Register Bulletin 38, a traditional cultural property may be eligible for inclusion in the National Register because of "...its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community." Native Americans point out that there are many traditional cultural properties known to them at the various Federal projects which are not included in the lead agencies list of cultural resources sites. They disagree with the statistical methods employed by the modeling approach which treats all cultural resources sites equally and they further disagree with the assumptions made in using this approach. In fact, some Native Americans prefer not to have traditional cultural properties listed.

From the Euroamerican perspective social scientists define cultural resources as finite, unique and nonrenewable examples of past human behavior and thought. They provide people today with a sense of place -- a connection with what has come before and that which is yet to occur. In a time of rapid social, political and economic change, cultural resources represent historical continuity and identity. The study of cultural resources provides people with a better understanding of themselves and their environment. Contemporary society can learn from previous social and environmental strategies as it continues to struggle with the problems of subsistence and human interaction. Because cultural resources are nonrenewable and endangered from a broad array of natural and human activities, their preservation takes on increased urgency and importance.

The importance of traditional cultural resources to Native Americans is, in many ways, experienced more directly and personally than by the social scientist. This fact is acknowledged in Bulletin 38 which states:

> *Traditional cultural values are often central to the way a community or group defines itself, and maintaining such values is often vital to self respect Properties to which traditional cultural value is ascribed often take on this kind of vital significance, so that any damage to or infringement upon them is perceived to be deeply offensive to, and even destructive of, the group that values them.*[2]

[2] Bulletin 38, page 2

In the words of an elder of the Coeur d'Alene Tribe speaking about the effects on their reservation and aboriginal lands from pollution created by mining and other industrial causes:

> *It has eliminated our tribe's ability to enjoy recreation in the Coeur d'Alene River outside of our reservation, but within our aboriginal lands. The processes of anomie took place, and that is the uprooting of people, by the pollution of other means, and forcing them to move elsewhere for their food and their livelihood. It destroyed their culture, so that we have a cause of concern.*[3]

Federal agencies, working from academic and legal definitions, tend to focus on tangible evidence such as sites and artifacts. There is a risk that they may overlook traditional cultural properties which, Bulletin 38 points out, can often be identified only through knowledgeable users of the areas under study or through other forms of ethnographic research. Many Native Americans find the agencies' legal and academic definitions too narrow. More than this, they assert that the protection and preservation of traditional cultural resources is of critical importance to the survival of their culture and way of life.

1.2 GEOGRAPHIC SCOPE

The geographic area for the study is the Columbia River Basin, including the portion that lies in Canada.

The Columbia River originates at Columbia Lake on the west slope of the Rocky Mountain Range in British Columbia. The river flows from Canada into the United States, travels through Washington State, and eventually forms part of the border between Oregon and Washington. Extending a total of 1,214 miles (1953 km), the Columbia River finally flows into the Pacific Ocean near Astoria, Oregon.

The Columbia River Basin is bounded by the Rocky Mountains to the east and north, the Cascade Range on the west, and the Great Basin to the south.

Within the drainage, there are numerous subbasins formed by tributaries of the mainstem river. The three major tributaries in the United States are the Kootenai, the Clark Fork–Pend Oreille, and the Snake. In this context, the Columbia Basin is synonymous with the Columbia Plateau.

The scope of the SOR encompasses 14 Federal dams on the Columbia and lower Snake rivers (Figure P–1) that have a major influence on multiple purpose system operation, and for which power operation is regulated and coordinated under the Coordination Agreement. These include five storage reservoirs: Hungry Horse, Libby, Albeni Falls, Grand Coulee, and Dworshak, and nine downstream run–of–river reservoirs: Chief Joseph, Lower Granite, Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, The Dalles, and Bonneville. The review does not evaluate impacts at other Federal reservoirs, such as the Willamette Valley projects, because the operational impacts of these reservoirs on the mainstem Columbia River–portion of the system is small. In some cases, these reservoirs are already being studied under separate authorities.

The SOR also mentions but has not analyzed the possibility of potential effects of operations at the five non–Federal mid–Columbia River dams (Wells, Rocky Reach, Rock Island, Wanapum, and Priest Rapids) owned by three public utility districts (Chelan, Douglas, and Grant), and Brownlee Dam owned by Idaho Power Company. SOR alternatives that involve drawdown, increased storage, or increased streamflow beyond existing operations have potential for cultural resources effects at these reservoirs. Likewise the SOR has not conducted detailed impact analyses for federally administered reaches of the river that are not regulated by dams, such as the Hanford Reach and the middle Snake River reach in the Hells Canyon National Recreation Area. These reaches are also sensitive to SOR alternatives that would increase streamflow beyond current limits. Some members of the CRWG believe the Hanford Reach should be included in this study.

[3] Mr. Henry Sijohn, Coeur d'Alene Tribe, at a CRWG meeting on January 31, 1995.

1.3 HISTORIC AND CULTURAL CONTEXT

The historic and cultural context of the SOR constitutes an important component of the affected environment of the SOR, especially for Native Americans. The impacts of the SOSs and the operation of the Federal dams in general on the lifeways of those who occupied the Columbia Plateau for thousands of years before the arrival of non–Native populations is an important consideration. The word "context" is key. The arrival of these nonindigenous cultures in the Columbia Plateau began a process which had a profound effect on much of the Native American culture. The effects of disease, large scale harvesting of natural resources such as salmon and timber, and actions taken by the Federal government to force Tribal people onto reservations are clearly not the result of the operation of the Federal dams. However, in the historic and cultural context of the Plateau, the building and operation of the dams is perceived by many Native Americans as a significant example of a process which threatens the existence of their culture. In this context the SOR is perhaps the first Federal study to attempt a broad look at the impacts of the operation of the Federal dams on cultural resources and, specifically, on Native American culture.

1.4 LEGAL REQUIREMENTS

1.4.1 Treaty Rights

Central to the requirement to preserve, protect, stabilize, and enhance/restore cultural resources is the status of Indian Tribes in our constitutional system of government. This status is reflected in the trust relationship the Government has with federally recognized Tribes.

Indian treaties are contractual agreements between sovereign Tribal nations and the U.S. Government. The important element in most treaties is a cession of lands by the Indians – recognized as belonging to them through aboriginal title – to the U.S. Government, in return for a delineation of reservations lands and the guarantee of explicit and reserved rights. As contracts entered into by the Federal government, treaties represent the supreme law of the land. Their provisions supersede any conflicting laws. Treaties can only be changed by the U.S. Congress.

In addition to respecting aboriginal rights and treaty–reserved rights, the Federal government must honor its Trust Responsibility to Indian Tribes. This doctrine can be traced to Cherokee Nation v. Georgia (30 US [5 Pet.] 1 [1831]), in which the U.S. Supreme Court stated that Indian Tribes were not foreign nations, but constituted "distinct political" communities "that more correctly, perhaps, be denominated domestic... nations" whose "relation to the United States resembles that of a ward to his guardian."

Regional treaty Indian Tribes actively work to maintain rights preserved by treaties with the U.S. Government initiated by Washington Territorial Governor Isaac Stevens at the Hells Gate and Walla Walla Treaty Councils in 1855, and at The Dalles Treaty Council conducted by Joel Palmer in 1855. Since the time of the original treaty councils, there have been adjustments to Indian lands (land cessions) and the creation of Executive Order reservations. The treaties and Executive Orders are the basis for recognition of Indian lands (reservation and individual allotments), ceded lands (those lands relinquished to the U.S. Government on which certain privileges to hunt, fish, gather wild subsistence foods, and pasture livestock were retained by the Tribes), and usual and accustomed fishing sites (traditional Indian fishing stations at major fisheries along the river). The Indian consultation requirements under NHPA and ARPA are derived from these treaty provisions.

The Federal government discontinued formal treaty making in 1871 because of the insistence of the House of Representatives that it should have a direct influence in the control of Indian affairs. Prior to that time all treaties with Indian nations required ratification only by the U.S. Senate. There are two main differences between formal agreements made with Tribes by treaty and Executive Order. First, the formal and legal recognition of a Tribe by Executive Order must be approved by both houses of the Congress. Second, as a general rule, off–reservation reserved rights belong only to the Tribes who signed a treaty. Executive Order Tribes cannot share in off–reservation reserved rights unless their specific agreement speaks to those resources. However, the legal validity and status of Executive Order Tribes and treaty Tribes is the same.

The Indian Reorganization Act of 1934, also known as the Wheeler–Howard Act, sought to protect the land base of the Tribes and authorized them to adopt constitutions and by–laws which were subject to ratification by a majority vote of Tribal members. These were then subject to the approval of the Secretary of the Interior. Tribes were free to decide whether they would adopt a form of government based on the Federal system of checks and balances or to continue with their more traditional forms of self–governance. At present there is a mix of IRA and non–IRA Tribes in the Columbia Basin and neither form of Tribal government bestows additional powers or privileges beyond the scope of their charter.

1.4.2 National Historic Preservation Act

An important legal authority that requires consideration of impacts to cultural resources on Federal projects is the NHPA of 1966, as amended in 1980 and 1992. This Act established the Advisory Council on Historic Preservation, State Historic Preservation Offices, Federal Historic Preservation Officers, and the National Register of Historic Places. For the purposes of this study, the most relevant sections of the Act are Sections 106 and 110. Section 106 provides a consultative process for Federal agencies to comply with the requirements to address the effects of undertakings, whereas Section 110 requires active management protection for federally–owned historic properties. The act pertains specifically to archeological sites, historical sites, and historic buildings, structures and objects, including traditional cultural properties that meet the criteria for inclusion on the National Register of Historic Places. The procedures required of Federal agencies are codified in the Code of Federal Regulations at 36 CFR Part 800.

1.4.3 Other Federal Laws

The ARPA provides civil and criminal penalties for unauthorized disturbance or removal of prehistoric cultural resources from and federally–owned land. Unauthorized disturbance or removal of any cultural property on Federal lands is illegal and subject to Federal prosecution. ARPA procedures for Federal agencies are codified in 43 CFR Part 7 (USDI), 36 CFR Part 296 (USDA/FS), AND 32 CFR Part 229 (DOD). Other legislation of importance to federally recognized Tribes include the following: NAGPRA, which requires the individual agencies that manage the projects to identify and inventory ancestral Indian skeletal remains and associated archeological collections, to provide these inventories to affected Tribes, to arrange repatriation of remains and associated artifacts, items of cultural patrimony or sacred objects where appropriate and establishes procedures for the disposition of inadvertently discovered human remains located on Federal or Tribal lands; the Columbia River Gorge National Scenic Area Act, which establishes management procedures for addressing cultural resources issues and impacts within the Columbia River Gorge National Scenic Area; the In Lieu Sites legislation (Public Law 100–581, Title IV) which designates certain Federal sites on Bonneville, The Dalles, and John Day projects to be used for Tribal treaty fishing access on the Columbia River and authorizes the acquisition of additional sites on the Bonneville pool and specifies site improvements; and the Religious Freedom Restoration Act of 1993 (RFRA), which reinstates the strict "compelling interest test" in cases where an individual's free exercise of religion may be "burdened" by Government action. The Government has to have a very strong reason to infringe on the free exercise of religion. This constraint on Federal agency actions affecting Native American religious beliefs was first established in the American Indian Religious Freedom Act of 1978 (AIRFA), which set forth a policy that the United States will protect and preserve American Indians' rights of freedom of belief, expression and exercise of traditional religions.

Finally, as previously mentioned, the Tribes are concerned that the SOR process recognizes and takes into account the fact that Native Americans have a broader definition of cultural resources than that contained in Federal cultural resources laws. For them, all of the natural and human–made resources necessary to their traditional way of life as expressed in their beliefs, customs, legends, and ceremonies are essential to their well–being. To the Tribes, a real test of the meaning of Federal agency "trust responsibilities" comes in the specific ways the agencies respond to perceived threats to Tribal rights and resources in the operation of the Columbia River system.

1.5 CULTURAL RESOURCES WORK GROUP STUDY PROCESS

The complexity of the Columbia River system presented a challenge to the SOR lead agencies in devising a study process. Not only did the study encompass the many uses of the system, but it had to address those uses from the perspective of three management agencies, the affected Tribes, four cooperating agencies, and the general public.

1.5.1 Work Group Formation

The CRWG was established as one of 10 technical work groups assigned to conduct data gathering, coordination, and technical analysis for the SOR Environmental Impact Statement (EIS). For the initial screening phase of the study, the CRWG was organized around lead agency (Tier 1) cultural resource specialists and coordinators who would identify and describe the undertaking and formulate a model for determining its effects. The work group was then expanded to include counterparts (Tier 2) from cooperating agencies who would provide technical review and comment on the proposed undertaking and its impacts on lands or resources that they manage. Finally, contributing organizations and Tribes contracted to provide additional supporting technical information to the CRWG study effort. (For a full list of participating members, see Chapter 7, List of Preparers.)

CRWG responsibilities also included full–scale analysis of study options selected from the screening process for inclusion in the Final EIS. This second phase analysis required coordination with SHPOs for Idaho, Montana, Oregon, and Washington; the affected Indian Tribes; cooperating agencies; and the ACHP. This coordination was intended to collect information of record and technical feedback to determine the adverse effects to significant cultural properties and to begin to develop Programmatic Agreements containing the management actions necessary comply with Sections 106 and 110 of the NHPA.

1.5.2 Public Involvement

The initial public scoping notices and meetings did not draw many public comments. Written public comments expressed the concern that many cultural resource sites associated with the Columbia River and tributaries needed protection and preservation. Therefore, the principal public issue with cultural resources first focused on identification and protection.

During the screening stage of analysis, the CRWG invited representatives from the Idaho, Montana (did not attend), Oregon, and Washington SHPOs to review the approach being taken and the impact model. However, no other public coordination was undertaken because it was not possible to describe the Federal action comprehensively or define its effects regarding cultural resources until the study options for full–scale analysis were identified and selected. Since neither the system alternatives nor the reservoir impacts had yet been determined, the CRWG leadership determined that it was not possible to coordinate effectively with Indian Tribes, cooperating agencies, and the ACHP during the, screening phase. Most of the planned public involvement for the CRWG was intended for the full–scale analysis phase when the alternatives and their projected effects could finally be identified, including adverse impacts.

1.5.3 Participation of the Tribes

Affected Tribes have repeatedly stated that they believe they were wrongly excluded from participation in the initial 2 to 3 years of work of the CRWG. They have pointed out that notifying Tribes by letter that the work group was being formed was not consultation. While acknowledging that the SOR in general and the CRWG in particular has done a better job of working with them over the past 2 years, they assert that the overall consultation process has been inadequate for two reasons. First they indicate that SOR agencies did not consult with them on a government–to–government basis as they should have and failed to provide funding necessary for the participation of the Tribes until late in the process. Second, they assert that they were excluded from the initial deliberations and decision making of the work group with the result that their unique concerns and perspectives were not represented. As an example of this they point to the screening process described in the next section; a process which, they assert, was carried out without their consultation or participation. They have expressed concern that important decisions, in which they should have played a part, were made without them. As a result, they continue to express distrust with the process and the viability of their role in it.

As a direct consequence of the concerns expressed by the Tribes regarding what they perceive as the inadequacy of consultation with them, they have repeatedly requested that the SOR process be halted and the study begun over or, at the least, that it be put on hold for a year to allow them time to catch up with the process. The SOR agencies have responded to the Tribes' concerns by offering contracting opportunities to enable them to perform studies on issues of concern and reviews of SOR materials so that they could contribute their knowledge and views. In addition, at the request of the Tribes the agencies extended the period for comment on the Draft EIS to gain maximum benefit of their technical and/or policy views and concerns. The SOR agencies decided, however, to proceed with the completion of the project as scheduled.

1.5.4 Screening Phase

While other SOR work groups were tasked to develop operating alternatives that would provide the greatest benefit to given resources, the CRWG determined that it had a different responsibility. The CRWG evaluated the proposed alternatives' impacts on cultural resources to determine which would have the least negative effects. Although the CRWG did not identify a specific alternative for analysis, it made certain assumptions about the nature of impacts to cultural resources in the Columbia River system for the purposes of developing a screening model. These assumptions included the following:

a. Adverse impacts to cultural resources increase in direct proportion to the percentage of sites exposed by low water;

b. Lowering pool elevations, especially in spring and summer, exposes more cultural sites to potential erosion and vandalism;

c. Raising and maintaining pool elevations decreases the percentage of sites exposed and tends to minimize additional adverse effects to cultural sites.

The "value measure" employed to quantify changes in river use and impacts to cultural sites, therefore, was cultural site exposure within a "zone of vulnerability," defined by water fluctuations associated with various river operating scenarios represented by the alternatives (see Glossary for definitions). The CRWG agreed that other factors affecting specific cultural sites would be taken into account in determining appropriate management or treatment measures once the operating strategy was chosen.

The screening task reduced the 90 alternative operating strategies to a smaller number for full–scale analysis. To accomplish its part of the screening process, the CRWG examined potential adverse impacts to cultural sites at both storage and run–of–river dams Dworshak Dam (storage reservoir) and John Day Dam (run–of–river reservoir) were selected to test the method for impact analysis and to contrast the problems for cultural resources management experienced at each type of reservoir. The data base for this analysis was the cultural resources site inventories available for these two reservoirs. Using the 1990–91 annual operation plan for the river system as a baseline, and comparing the impacts of a particular alternative at Dworshak and John Day Reservoirs to this baseline operation, the results of the screening process indicated the cultural resource protection objectives were best met by a full pool. Therefore, full pool alternatives were regarded as optimum for cultural resources protection.

The impact model itself is discussed more thoroughly in Chapter 3.

1.5.5 Full-scale Analysis

The CRWG employed two different approaches to modeling the effects of changed reservoir operations at the 14 Federal projects in the Columbia River system. Both approaches used the latest inventory listing of cultural sites for each Federal project and modeled effects based upon pool elevation of the various operating strategies. One approach was a computer simulation model of the potential effects of the alternative operating strategies on known archeological sites within the reservoir pools. This approach focused on shoreline erosion, exposure of sites within the drawdown zone, and inundation. It simulated the movement of reservoir shorelines over 50 years of record to exemplify natural variation in riverflow patterns. It counted the number of days that known sites would be exposed in a drawdown zone, experience shoreline erosion, or be inundated for each alternative, and then compared the potential effects of alternatives based on this simulation. For modeling purposes, all cultural sites were treated equally, without regard to their importance in traditional Native American practice or their National Register eligibility. For practical purposes, this was a consistent way of treating the otherwise large number of unevaluated cultural sites in the existing inventory of most Federal dam projects.

The CRWG used a second approach to complement the erosion and exposure analysis. This approach was an analysis of the potential for site loss due to geomorphic processes of erosion. As part of this analysis, the Corps of Engineers' Waterways Experiment Station conducted a study of erodable soils and landform types at Dworshak and John Day to determine factors in cultural resource site erosion and potential methods of preservation and stabilization. These two reservoirs are generally representative of the physical and operational conditions present at storage and run–of–river dams, respectively, in the Columbia and Snake River system. This information also will be used in developing site protection/preservation and monitoring programs in response to the effects of the operating strategy ultimately chosen for implementation by the SOR process.

The CRWG recognized that additional information and evaluation based on personal observation, professional experience, and inherited knowledge of the areas are of great importance to any assessment of cultural resource impacts. In the case of the SOR, incomplete or missing cultural resources data increased the need for other types of evaluation. Professional experience helped to fill in data gaps, such as the relative severity of ongoing impacts at some of the reservoirs; it also aided in comparing the alternatives. Some of these types of observations were included in Chapters 2, 3, and 4 by agency archeologists and historians.

A major repository of information is found in the traditions and practices of the various Columbia Basin Tribes. It is not reasonable, however, to expect that the Tribes will submit this information in writing or any other form to the agencies for inclusion in this EIS. The reasons for this are varied and complex but were summarized by the Chairman of the Coeur d'Alene Tribe, Mr. Ernest Stensgar, in a November 2, 1994, letter to the Interagency Team:

> *The Federal agencies must recognize that those sites which are not identified by the Federal agencies will not be released by the Tribes. We do not believe the agencies will keep the locations confidential due to the number of Federal employees with the agencies, the possible release through Freedom of Information Act disclosure requests, and the overall distrust Native Americans have as a result of past Federal actions.*

This does not mean, however, that the large body of cultural resources known to the Tribes must go unprotected. Some Tribes are in the process of or contemplating becoming certified as Historic Preservation Officers. Others have implemented, are developing, or planning to develop programs of their own to manage and protect cultural resources. In the words of Mr. Stensgar in his November 2, 1994, letter:

> *The Coeur d'Alene Tribe feels the ultimate protection of these sites should rest with the Tribe. This means funding must be provided directly to the Tribes by the Federal agencies to allow for protection*

activities. This will prevent strangers invading our relatives' resting place with the handling of the remains and artifacts, which would be a sacrilege to us as Indian people.

Although Mr. Stensgar speaks only for the Coeur d'Alene Tribe, it is safe to assume that other affected Tribes would agree with his statement. For Federal agencies cultural resource protection implies, ultimately, listings on the National Register, and compliance with various laws and regulations. For Tribes, the importance of cultural resources extends well beyond these legal and procedural issues and encompasses a traditional way of life. For them, protection of cultural resources equates to the preservation of their existence and identity as autonomous cultures.

1.6 CURRENT RELATED FEDERAL ACTIONS

In addition to the SOR, the Corps of Engineers is undertaking a Columbia River System Configuration Study at its lower Snake River and lower Columbia River projects to examine construction alternatives to the long–standing, problem of anadromous fish passage. The BPA's Intertie Project, which provides for the valuation and treatment of cultural resources at SOR storage projects, also has implications for the implementation and management phase of the SOR. The completion of the National Park Service's Hanford Reach Wild and Scenic Rivers EIS, and the implementation of the Forest Service's Columbia Gorge Management Plan are related Federal actions that potentially affect cultural resources within the SOR study area. The Bureau of Land Management and the Forest Service are jointly conducting an "Interior Columbia Basin Eastside Ecosystem Management Project" to develop and adopt a coordinated ecosystem management strategy for all of the public lands they manage in the Columbia Plateau east of the Cascade Mountains. Finally, the Bureau of Reclamation has initiated a study of the Snake River system above Brownlee Dam. The chosen strategy could also affect cultural resources within the SOR study area.

1.7 SUMMARY OF FINDINGS AND RECOMMENDATIONS

This final version of the draft Appendix D issued in July of 1994 has been substantially revised in an attempt to more directly reflect the concerns and views of the various Indian Tribes involved in the SOR process. However, the basic finding described in the draft remains the same: that all the system operating alternatives would have significant impacts on cultural resources. The CRWG, then, has initiated the lengthy process to comply with NHPA requirements for mitigating impacts to significant cultural resources.

The NHPA compliance procedures, discussed in Chapter 6, starts with consultation among affected and interested parties. The CRWG has begun this process which includes the affected state SHPOs, Indian Tribes, other affected Federal agencies, interested publics, and the ACHP. The Appendix takes into account legal requirements under NHPA, ARPA and NAGPRA, as well as NEPA.

CHAPTER 2

CULTURAL RESOURCES IN THE COLUMBIA BASIN

2.1 THE NATURAL ENVIRONMENT

The Columbia River is the fourth largest river in North America. It originates at Columbia Lake in the Rocky Mountains of British Columbia, Canada and flows 1,214 miles (1,953 km) to the Pacific Ocean. Three large tributaries of the Columbia River are of primary interest to the SOR: the Kootenai and Pend Oreille Rivers, which join the Columbia River near the Canadian border and the Snake River which joins the Columbia about 330 miles (531 km) from the mouth. The drainage area comprises most of Washington, Oregon, and Idaho; the western quarter of Montana; the southeastern corner of British Columbia; and small portions of Wyoming, Utah, and Nevada.

Landforms in this basin include mountains, highlands, valleys, plateaus, and plains. Numerous ranges which make up the Northern Rocky Mountains cover central, northern, and eastern Idaho, western Montana, western Wyoming, and southern British Columbia. The Okanagan Highlands are an area of relatively low, semiarid mountains located between the Northern Rockies and the Cascade Mountains. The crest of the Cascade Mountains defines most of the western edge of the basin The Columbia Plateau extends from north–central Washington to just below the border with Oregon. Except for a narrow gorge where the Columbia River has cut a path to the ocean, the Cascade Mountains separate the coast from the interior of the region and strongly influence the climate. The Snake River Plain extends from southeastern Oregon across southern Idaho and includes parts of northern Nevada and Utah. Many small rivers drain this area, which extends south from the Canadian border to the Blue Mountains, west to the foothills of the Cascades and east above the Snake River to the Rocky Mountains in eastern Idaho. The Blue Mountains lie to the southeast of the Columbia Plateau and extend from southeastern Washington to central Oregon.

The climate in the Columbia River Basin ranges from mild maritime conditions near the river's mouth to near desert in some inland valleys. The Cascade Mountains separate the coast from the interior of the basin and divide Washington and Oregon into two distinct climatic regions. The coastal climate is mild and wet, with only occasional extremes of temperature. East of the Cascades, the interior climate has far greater extremes. Here most of the precipitation is in the form of snow, and summers are hot and dry. The Columbia and Snake River Plateaus are generally semiarid with little or no rain during the summer growing season and only small amounts of snow during the winter. Relatively large amounts of precipitation occur in the mountains, and many of the higher Cascade and Rocky Mountain peaks retain glaciers.

2.2 FISH AND WILDLIFE

The aquatic life in the Columbia River Basin ranges from tiny organisms that live in the mud to sturgeon that weigh hundreds of pounds. It includes plants that function not only as food items but also as protective cover and resting spots for resident and anadromous fish during various stages in their lives. Before Euroamericans developed the region, annual runs of salmon and steelhead returning to the Columbia River were estimated to be between 8 to 16 million fish. Recent records indicate that the runs now total about 2.5 million salmon and steelhead (including fish harvested in the ocean), of which about 0.5 million are wild fish. The Northwest Power Planning Council estimates that before the arrival of Euroamericans the Snake River Basin produced about 1.4 million chinook salmon (NPPC, 1986). By the mid 1950s, this number was reduced by 95 percent and another tenfold decrease has occurred in the last 30 to 40 years (Matthews and Waples, 1991). The depletion of the salmon runs, and the listing of Snake River chinook and sockeye as endangered species, are issues of paramount importance to Columbia Basin Tribes who view the salmon as an essential cultural resource.

Resident fish existed in all parts of the Columbia River system before the dams were built. They mixed with anadromous fish in stream reaches accessible to the latter and were the only fish present in areas above natural anadromous fish barriers. At present, there are both native and non–native (introduced) resident fish in the Columbia River Basin. Introduced species can reduce the populations of native fish through predation and competition. For example, walleye and channel catfish use habitat such as backwaters that are important to native species during various life stages. Many native species have also declined because humans have eliminated or damaged their habitat through dam construction, water pollution, and disruptive land use practices. Because of population declines, several Columbia River Basin resident fish stocks are candidates for legal protection. The USFWS has formally proposed the Kootenai River white sturgeon for listing as an endangered species under the ESA. The bull trout has been petitioned for listing under the ESA. Other fish have been designated species of special concern, including west slope cutthroat trout in Montana.

Wildlife in the Columbia Basin includes many species of waterfowl, raptors, and game birds; aquatic fur bearers, such as muskrat and river otter; and big game such as black tailed and mule deer, Rocky Mountain elk, black bear, bobcat, and lynx. Among these the bald eagle, peregrine falcon, grizzly bear, and gray wolf are federally listed as endangered or threatened.

2.3 PREHISTORY

The prehistory of the lower Columbia River Basin, like that of most of North America, spans approximately 13,000 years.

Paleo Indian cultures lived more than 10,000 years before the present (B.P.), during the rapidly warming terminal Pleistocene period. Where conditions were favorable, they exploited large mammals such as mammoth, mastodon, camel, and horse which became extinct during or shortly after this period. Paleo Indians also hunted species such as bison, mountain sheep, and deer, which were larger than their modern descendants (Butler, 1986).

During the Early Period (6,000 to 10,000 years B.P.) small numbers of native bands may have inhabited large territories at low density, traveling within them to exploit seasonally or locally abundant resources, especially large hoofed mammals. Prehistoric people also exploited favorable fishing sites, such as The Dalles, Kettle Falls, Priest Rapids, John Day Narrows, Umatilla Rapids, and others only seasonally during this time period. Peak salmon runs made salmon harvest at these sites efficient at certain times. Because population density is believed to have been relatively low during this period, people relied on residential mobility rather than intensive food production and storage to overcome seasonal food scarcity.

The Middle Period (2,000 to 6,000 B.P.) was characterized by a continental warming and drying trend that peaked sometime between 8,000 and 4,000 years ago (Aikens, 1993). This influenced the distribution of vegetation zones. The modern climatic pattern was established by approximately 4,000 years ago. Sometime around the beginning of this period the spear thrower and dart replaced the thrusting spear as the dominant weapon technology.

The bow and arrow was introduced at the beginning of the Late Period about 2,000 years ago. Population densities continued to grow throughout this period, fostering an intensification of food production that included the historically observed pattern of food storage, particularly of dried salmon, roots, and berries for winter consumption.

2.4 THE HISTORIC PERIOD

European and American influence began in the early 1700s. A large number of Tribes belonging to several distinct linguistic and cultural groups occupied the

Columbia Basin. These included Chinookan peoples along the lower Columbia from the river mouth to the Dalles; Sahaptin speakers, such as the Yakama, Umatilla, Wanapum, Nez Perce, and Palus Tribes of the central Columbia and lower Snake basins; Interior Salish speakers, such as the Colville, Wenatchee, Spokane, Kalispel, and Coeur d'Alene of the upper Columbia and its tributaries; the Kootenai speakers of the Kootenai Basin; and Numic speakers, such as the Shoshone, Bannock, and Burns–Paiute of the Malheur, upper John Day and Deschutes Basins.

The different bands of Indian people observed a seasonal cycle of subsistence activity. The seasonal activities of the Sahaptin–speaking people is fairly representative of the subsistence practice throughout the nonmountainous parts of the Columbia Basin in early historic times (Hunn, 1990). Therefore, they are used only as an illustration of Native lifeways in this area. Sahaptins lived in winter villages near the Columbia River or on the lower reaches of its major tributaries, subsisting on food stores during the winter, supplemented by hunting and fishing. They lived in large, multifamily lodges covered with tule mats.

In the early spring, the Sahaptins harvested Indian celeries and fished spawning runs of suckers in the major rivers. Later, they roamed uplands further from the winter villages to collect bitterroot and celeries for long–term storage. In May, they went to favorite fishing sites on the main river, many owned and inherited, for the spring chinook runs. By late May flooding made fishing difficult, so they went into the Cascade Mountains to escape the summer heat, and to harvest and dry large quantities of huckleberries, and hunt deer and other game.

The Sahaptins returned to the Columbia to harvest Salmon between July and October. The most important of the species was the fall chinook which came up stream during September. The chinook runs produced large quantities of stores for winter food. It is estimated that as much as one third of the Sahaptin's annual diet may have come from salmon. Edible roots may have supplied an additional 50 percent of the annual Sahaptin food supply, with game and huckleberries making up much of the remaining amount (Hunn, 1990).

The seasonal cycle of other Indian peoples of the Columbia Basin varied depending on the distribution and quantity of local food resources. Tribes of the mountain regions depended less on anadromous fish and more on large game than the Plateau peoples. Indians of the lower Columbia in the Portland Basin practiced a nearly sedentary lifestyle with a strong emphasis on varied resources near lakes, rivers, and the estuary.

Horses came to the Plateau from New Mexico some time after 1730, and changed Indian mobility, warfare, and subsistence logistics. European diseases such as smallpox arrived with the crews of exploring vessels even before trading ships began to arrive on the Pacific coast in the 1790s. Prior to the arrival of settlers overland from America, relations between Indians and Euroamericans were mostly amicable and governed by mutual interest in trading of furs for manufactured goods. Indian populations declined dramatically after 1770 because of introduced diseases. By 1830, the Northwest had lost approximately 50 percent of its native population to disease (Boyd, 1990) and more than 80 percent by 1870.

2.5 CULTURAL RESOURCES – THE TRIBAL PERSPECTIVE

Following is an attempt to summarize the Tribal perspective of cultural resources. This perspective is characterized by a broad, holistic view which treats virtually all elements and features of nature as cultural resources that have spiritual significance for Native Americans. This view contrasts with that of the Federal agencies as defined by Federal law and pursued in Euroamerican academia which tends to emphasize identification and evaluation of physical sites and artifacts. While their importance is acknowledged by Native Americans, they assert that their definition of cultural resources is much broader.

This summary of the Tribal perspective is compiled from written reports provided by various Tribes under contract with the SOR agencies, statements made by tribal representatives at SOR meetings, and other sources. It reflects the SOR agencies' understanding of what they have heard from the Tribes regarding their view of cultural resources. Specific Tribal representatives and sources are quoted verbatim as being representative of general views that we believe the various tribes hold in common. At the same time, the agencies respect the uniqueness of each Tribe and do not intend to imply that the Tribes can be culturally grouped together. While some beliefs are held in common, other beliefs are quite different.

This summary should not be construed as an expression of agreement by the agencies with the traditional Native American perspective on cultural resources. However, it is intended to demonstrate a sincere effort to listen to and understand the Tribal positions in general. It should also be noted that each Tribe may have a specific view that may or may not agree with this summary.

2.5.1 The Sacredness of the Natural World

Native Americans have traditionally conducted their lives based on the belief that there is a close physical and spiritual interrelationship between humans and nature. This interrelationship extends from the distant past (time immemorial), to the present, and continues infinitely into the future throughout the physical world. It does not assume that humans are superior to the animals or other aspects of nature but, rather, views human existence as an integral part of the natural and spiritual world. All that exists is alive and sacred. The land, rock, water, air, the animals, and humans each occupies a unique role in the universe. They honor their relationships to all natural things. It is for this reason that religion, in the traditional Native American view, is an integral part of life from day–to–day and season to season. Life, for them, is a process of maintaining a balance with the rest of the world and it is this balance which constitutes their world order. Failure to respect the proper place of all things in the natural world would be to upset this balance and could destroy it.

The close bond of the Indian to the natural world is demonstrated in the seasonal cycle of subsistence discussed in section 2.4. For each Tribal culture, the annual cycle of subsistence formed an integral part of their cultural fabric. According to the Spokane Tribe of Indians, members of the Interior Salish group:

> *Before the construction of Coulee Dam the Spokane people were dependent upon and interwoven with an annual cycle The removal of any part of this cycle destroys all opportunity of continuing that cycle. Removal of the salmon and related cultural components by the construction of the dam destroyed traditional Spokane culture. They could no longer carry out a traditional way of life with a significant portion of their economy, diet, and spirituality missing.*[1]

2.5.2 Unwritten Knowledge

Native Americans deeply respect Tribal elders as the ones who traditionally preserve and transmit cultural information and their language down to the younger generation. Thus, the main body of cultural knowledge contained in Tribal traditions and practices is unwritten and the process of teaching it to future generations depends on a personal relationship between elders and the younger Tribal members. This knowledge is sacred and cannot be given to just anyone who asks for it. To be ready to receive such knowledge takes preparation and discipline. This contrasts with the view of most Euroamericans who place greater credence in the written word and tend to expect that if someone truly means what they say, they will "put it in writing." Native Americans do not accept this particularly in regard to their spirituality:

> *Now how can you sit across the table and listen to someone like myself or these elders and then put down what kind of impact those alternatives have on our way of life, our way of belief, and our way of teaching? It would be pretty prodigious if you guys can do that. I've been working for eight years trying to learn how to interpret what my elders have been telling me. Many times they won't give you the answer that you're looking for... You want answers to your questions. Many times elders will throw another question out there to make you think, to make you sit back and think about all of your future...*[2]

[1]Review of SOR Draft EIS Appendix D, Cultural Resources, page 4.
[2]Mr. Jeffery Van Pelt, Confederated Tribes of the Umatilla, CRWG meeting January 31, 1995.

From the traditional Tribal perspective, then, the primary and most authoritative source of cultural information are the elders. Tribes generally do not place the same value on the work and findings of professional archeologists. In the words of Mr. William Yallup, Yakama Nation,

> *The oral histories would disclose much more than archeologists can ever find. You have to know the subject matter before you can even talk about it.*[3]

2.5.3 Tangible and Intangible Impacts

Bulletin 38 encourages its users to address the intangible cultural values that may make a property historic.[4] From a Tribal perspective, the relationship of their intangible values to various tangible natural and cultural resources is of critical importance. Three examples of this concern salmon, burial sites, and changes due to inundation.

2.5.3.1 Salmon: A Natural and Cultural Resource

As outlined in section 2.4, salmon were a major food source for most Columbia Basin Tribes. The sacred aspect of the salmon is honored in Tribal cultures today just as much as in the past. The ceremonies and respect shown the salmon helped insure their return. The drastic reduction in salmon runs over the past 50 years reflects a major cultural loss to virtually all of the Columbia Basin Tribes.

2.5.3.2 Burial Sites

Native Americans traditionally believe that continuity in time connects their ancestors with those living today and those yet to be born. It is believed that each person who lived in the past, lives now, or is yet unborn has a name which is preordained. Death does not end kinships or relationships. Thus, the belief that each living or inanimate thing has its own unique place in the universe extends to the spirit world and across time. Therefore, the burial sites of Native Americans are sacred to them and to disturb the remains of an ancestor for any purpose is a sacrilege.

The Spokane Tribe of Indians, among others, have spoken directly to this concern.

> *The most sacred cultural resource to the Spokane people negatively impacted by the operation of Coulee Dam is not eligible for National Register status. These are the graves and cemeteries of Spokane Indian ancestors. As stated before, the respect, admiration, and dedication for the ancestors by the Spokane people cannot be written on paper, nor can it be underestimated.*[5]

2.5.3.3 Traditional Value of Landforms

Certain places in the landscape are traditionally considered to be of special significance to the Tribes. Vision quest sites, social and political gathering places, and sites associated with stories, Tribal history or community history, have been inundated or are affected by erosion due to reservoir action. In the Tribal perspective, this is a loss of a cultural resource and a loss of part of their culture.

2.5.3.4 Responsibility of Federal Agencies

The Federal agencies undertaking operation of the dams are responsible for effects to cultural resources caused by their operations. These agencies must provide for and include Tribes in any and all management plans or actions for cultural, traditional, and archeological resources, according to the Colville Tribes.

2.6 CULTURAL RESOURCES DEFINED

Known cultural resources in the Columbia Basin consist of traditional cultural properties as identified by affected Tribes as well as various archeological sites. Other cultural resources include the historic settlement and development activities of Euroamericans, Asians, and other non–Native cultures over the past 200 years. Archeological sites are typically represented by open campsites, housepit villages, rockshelters, rock art (petroglyphs/pictographs), lithic quarries and workshops, burials and cemeteries; and isolated rock cairns, pits, and alignments. Historical sites are denoted by structures, buildings, objects and districts that represent post–contact human activity.

[3]CRWG meeting, January 10, 1995.
[4]Bulletin 38, page 3.
[5]Letter with Review of SOR EIS from the Spokane Tribe of Indians, dated September 26, 1995.

These include the remains of farms, towns, trading posts, mining sites, military forts, burial sites, abandoned settlements, and transportation and industrial facilities. These features are identified and evaluated on the basis of tangible traces, materials, or scientific evidence for significant cultural activity.

Contemporary Native Americans recognize archeological sites, but also include a much broader range of features from the natural environment and the sacred world as cultural resources. These are called traditional cultural properties and encompass such things as distinctive shapes in the natural landscape, named features in local geography, natural habitats for important subsistence or medicinal plants, traditional usual and accustomed fisheries, sacred religious sites and places of spiritual renewal. Some Tribes believe that the Columbia River itself is a traditional cultural property. Traditional cultural properties pertain to those cultural sites and natural features and resources that are important in contemporary traditional social and religious practices that help preserve cultural identity.

The cultural resources of the affected area are a rich source of information about the human past and are directly threatened by the water resources developments of Federal agencies. The record of human activity in the Columbia River Basin, as revealed in archeological and historical studies, stretches back almost 13,000 years and yields valuable information about the environment and human adaptation to it over time. As the cultural resources of the region become more fully known through systematic investigation and analysis, so too does the knowledge of the lifeways of the people who left them behind, and the ability to learn from such data. The discussion below provides a brief overview of what is currently known from past archeological and historical studies.

2.7 CULTURAL RESOURCES SIGNIFICANCE

2.7.1 Criteria of Significance

Historic property significance is a legal concept derived from the evaluation process used in determining the eligibility of historic properties for listing on the National Register of Historic Places; it involves the identification, evaluation and management of cultural resources as defined by the ACHP in 36 CFR Part 60.4. It includes the following criteria of eligibility: A property must possess the quality of significance in American history, architecture, archeology, engineering, or culture; integrity of location, design, setting, materials, workmanship, feeling, and association; and

a. Be associated with events that have made a significant contribution to the broad patterns of our history; or

b. Be associated with the lives of persons significant in our past; or

c. Embody the distinctive characteristics of a type, period, or method of construction; or that represent the work of a master; or that possesses high artistic value or that represents a significant and distinguishable entity whose components may lack individual distinction; or

d. That have yielded, or may be likely to yield, information important in prehistory or history.

In addition, Bulletin No. 38 from the National Park Service advises Federal agencies that traditional cultural properties which have traditional cultural significance may be determined eligible for the National Register of Historic Places.

> *"Traditional" in this context refers to those beliefs, customs, and practices of a living community of people that have been passed down through the generations, usually orally or through practice.*[6]

Federal agencies are required to take into account the effects of their undertakings on significant historic properties. The first step in this determination process (the so-called Section "106 process") is the identification of any such potential properties through a records search and/or a survey. The next step requires the evaluation of identified properties to see if they are significant, using the criteria listed above from 36 CFR Part 60.4. If significant properties are found, the agency must then establish whether the undertaking will have an effect on that property. If an adverse effect would occur, then the agency must develop appropriate mitigation for the significant property.

[6]Ibid, page 1.

Currently, within the area affected by SOR, the inventory stage has not been completed at many Federal projects. Further, most of the cultural resource sites that have been inventoried through archeological surveys have not been evaluated for eligibility for listing on the National Register Completion of this process is the first major cultural resource management task for Federal agencies in addressing or taking into account SOR effects. The status of the cultural resources evaluation process at individual projects within the affected area is given below.

2.7.2 Historical Significance

Archeologic and historic sites are significant for a variety of different reasons based upon their National Register eligibility. The Criteria of Eligibility for the National Register (described above) make special reference to the quality of preservation of sites and their contents, their location, the integrity of setting and materials, and their association with particular ethnic groups or historically known individuals and events. The particular site setting and/or contents may be essential in evaluating and applying research questions about the past. The level of significance varies according to the question asked and the potential of the site for providing relevant information.

Common research themes in regional archeological investigations have been concerned with culture history (i.e., events in the history of a culture, particularly the sequence and age of those events); different aspects of culture process (i.e., how people in the past carried out certain kinds of activities); and human adaptations in response to environmental changes (i.e., association with natural events such as floods, volcanic eruptions, mud slides, buried soils and forest fires). Archeological sites are also important to the heritage of regional Native American groups, but their primary interest lies with protection rather than scientific investigation. Archeological sites are also of interest to the general public form the standpoint of aesthetics, history, science, or recreation. Finally, some sites are significant for their importance in the context of certain themes, patterns or trends in American history.

2.7.3 Native Peoples

Cultural resources have significance to Native Americans some of which may be contemplated in guidelines provided in Bulletin 38.

> *A traditional cultural property, then, can be defined generally as one that is eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that: (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community.*

The Tribes have expressed to the CRWG their view that the Columbia River itself is a sacred traditional resource, as well as the lands and natural resources in, around or associated with the river. For example, the Yakama Indian Nation submittal noted in Chapter 1 explained that the full scope of cultural resources included water, air, rock, streams, plants, animals, and birds, as well as the people and their sacred objects and traditions, including the graves of their ancestors. Rather than viewing particular components of their lives, heritage or natural environment as more or less significant than other components, traditional Yakama people prefer to recognize and protect all these things equally: "The cultural and spiritual components of resources cannot be separated from other aspects of the resources. The proper balance must be nourished and renewed between the People and the continuing creation of the Earth." (Exhibit G.)

Since Tribal cultural resources embrace a broad spectrum of natural resources, the reader's attention is directed to other technical appendices of the SOR EIS, such as Resident Fish, Wildlife, Soils, Anadromous Fish and Water Quality. These technical appendices discuss in detail how each of these resources are affected by the proposed SOSs and indicate the interrelationships among the different resources and river uses.

2.7.4 Intrinsic Values

Cultural resources are valued for many reasons including their contributions to aesthetics, artistic expression, humanistic experience, and recreation opportunities. Some of these public values conflict with the need to protect cultural sites. This necessitates at public interpretation and education to foster better appreciation and understanding of the resources, on the one hand, while actively managing resource protection programs to prevent the destruction of the resources, on the other.

2.7.5 Euroamerican/Asianamerican Site Significance

Some cultural sites are historically significant and of special interest in relation to the period of Euroamerican exploration, the fur trade, military history, mining, navigation, agriculture, and early settlement. The Columbia River system provided the first vehicle for Euroamerican exploration, travel and settlement of the Pacific Northwest. Navigation of the river led to exploitation of its resources and establishment of today's settlements. There are many historical sites that are significant because they document this course of development. Examples of transportation developments include the remains of the Cascades Canal and Locks and The Dalles–Celilo Falls Canal and Locks at the Bonneville Dam and The Dalles Dam projects, respectively. Also of interest is the role of the Chinese in the early mining and railroad history of the region, and other Asian cultures in the development of the workforce for fish canneries on the lower Columbia River.

Other examples include historical sites significant to the study of the fur trade era in the Northwest, such as Hudson's Bay Company Fort Vancouver at Vancouver, Washington; the site of North West Fur Trading Company's Fort Nez Perce at McNary Dam project; Hudson's Bay Company Fort Colville at Coulee Dam project; the historical river crossing at Sineacquoteen on the Pend Orieille River at Albeni Falls Dam project; and Fort Kootenay sites at Libby Dam project. Sites reflecting the work of missionaries in the affected area include the Catholic mission established near Kettle Falls and the Protestant Whitman Mission on the Walla Walla River. Examples of army installation representing the military impact in the affected area include Forts Spokane, Walla Walla, and The Dalles. Finally, Bonneville and Coulee Dams represent engineering and design achievements listed in the National American Engineering Record, while the Bonneville Dam is also a National Historic Landmark.

2.8 CULTURE HISTORY

Culture history refers to events in the history of a culture, particularly the sequence and age of those events. In such inquiries, the determination of the age of deposits through stratigraphy, radiocarbon dating, and use of volcanic ash, and the age of landforms, such as river terraces, is important. Certain cultural sites become significant for the time period that they represent. Examples of sites important for culture history include Marmes Rockshelter in Lower Monumental Dam Reservoir, Windust Caves in Ice Harbor Reservoir, and Granite Point in Lower Granite Reservoir. These sites are significant because they contain evidence for the earliest human occupations in the lower Snake River canyon between 9,800 and 10,200 years ago. These sites are attributed to the Windust Phase, an archaeological period of time, for the lower Snake River region (Leonhardy and Rice 1970, 1980).

2.9 CULTURE PROCESS

Culture process refers to how people in the past carried out certain kinds of activities. The functional significance of features and artifact is paramount. Frequently, time is held as a constant, or sites are viewed independently of their chronology to determine how they may be functionally different in the content of their artifacts and features. An example might be a study into the economic factors related to settled life at housepit sites in upper McNary pool (Schalk 1983). Rigorous comparison of the subsistence content of prehistoric pithouses helped to identify seasonality and changing reliance upon certain kinds of subsistence resources.

2.10 ENVIRONMENTAL HISTORY

Some archeological sites are significant for their association with natural events such as floods, volcanic eruptions, mud slides, buried soils, and forest fires. In such cases, the sites contain sediments or are located on landforms that relate to broader environmental events within the region. This kind of information is important in the reconstruction and interpretation of past environments and provides part of the context for archeological sites themselves. The geological framework of terraces, volcanic ashes, and sediments in the middle Kootenai River at Libby Dam project is an example of the relationship of an archeological site to geological events (Mierendoft 1984). An understanding of human adaptations to local environment depends upon this kind of information. Additionally, the preservation of particular fossil animal bones or plant seeds/pollen contained in an of archeological site may provide critical information regarding resource availability and human subsistence technology and use. Examples of such finds include the botanical assemblage recovered from archeological sites in the Chief Joseph Dam project (Stenholm 1985), freshwater mollusks found at archeological sites in the lower Snake River region (Lyman 1980), Holocene salmonid resources of the upper Columbia River (Butler and Schalk 1986), and the mammalian faunal sequence at Marmes Rockshelter at Lower Monumental Dam project (Gustafson 1972).

2.11 CULTURAL RESOURCES: EXISTING CONDITIONS

2.11.1 Affected Area

Cultural resources are found throughout the Columbia River system. Most scientific information generated about them has been the result of archeological studies associated with the construction of Federal dams in the area of this study. There is, however, more than one view of what constitutes cultural resources. The academic and legal definitions, while including many aspects of culture, tend to focus on tangible evidence, such as sites and artifacts. Many Native Americans find these definitions too narrow. They view their entire heritage, and their spiritual relationship to the earth and natural resources, as a cultural resource.

The following discussion is based on the more narrow definition of cultural resources. However, the SOR agencies have attempted to incorporate the Tribes' views in the impact analysis and will likewise seek Tribal involvement in the development of individual management or treatment plans at specific Federal projects.

The affected area of this study is centered on the 14 Federal hydroelectric projects identified in Figure P–1. Projected effects at other non–Federal projects in Hell's Canyon and at the projects operated by the middle Columbia utilities, are not in the scope of the study. Major effects on historic properties of the Columbia River system are projected at both storage projects (Hungry Horse, Libby, Albeni Falls, Dworshak, and Grand Coulee Dam) and at the run–of–river projects which function principally to pass water through the system.

2.11.2 Archeological Overview of the Affected Area

For purposes of this overview, the CRWG divided the study area into the following geographical/cultural divisions (see Table 2–1).

Upper Columbia, Kootenai, Pend Oreille, and Flathead Rivers (Includes Grand Coulee, Hungry Horse, Libby, Albeni Falls, and Chief Joseph projects.)

Most archeological evidence indicates that humans first occupied the upper Columbia River Basin following the retreat of the Cordilleran ice sheet. Cultural material as old as 10,000 years before the present (BP) has been recovered from archeological sites in the region. In contrast to development of large populations on the lower Columbia, the upper Columbia region appears to have fewer large sites (Grabert 1968). It suggests that emphasis on hunting and plant foods was typical of the people of the area between 8,000 to 6,000 years BP (Sanger 1968).

Table 2–1. Cultural Chronologies of the Columbia River System

YEARS B.P.	NORTHERN PLAINS		PURCELL TRENCH	MIDDLE KOOTENAI RIVER	PEND OREILLE LAKE	KETTLE FALLS	UPPER MIDDLE COLUMBIA	MID–COLUMBIA	LOWER SNAKE RIVER	LOWER MIDDLE COLUMBIA	THE DALLES	LOWER COLUMBIA	YEARS B.P.
	HISTORIC PROTOHISTORIC	Old Women's	LOWER KUTENAI		HISTORIC PROTOHISTORIC	Shwayip			Numipu	Historic	Historic	Historic	
250 –				Yamell									250 –
1000 –	LATE PREHISTORIC	Avonlea	?	Warex	LATE	Sinalkst	Coyote Creek	Cayuse	Harder	Quinton	Full Protohistoric	Ilwaco	1000 –
		Besant		Stonehill						Wildcat			
2000 –	(LATE)			Kavella		Takumakst							2000 –
		Pelican Lake	INISSIM COMPLEX	?			Hudnut	Quilomene Bar					
		Hannah				Skitak			Tucannon		Initial Protohistoric	Sea Island	
4000 –	MIDDLE	Duncan	BRISTOW COMPLEX	Calx				Frenchman Springs		?			4000 –
		McKean				Kaunku							
5000 –	PREHISTORIC	Oxbow Bitteroot		Bristow									5000 –
						?	Kartar						
6000 –					MIDDLE								6000 –
			GOATFELL COMPLEX			Slawntehus				Canyon	Transitional		
7000 –	(Early)			?				Vantage	Cascade	?		Young's River Complex	7000 –
		Lusk				?							
8000 –	EARLY												8000 –
		Frederick						Windust	Windust	Phillippi	Early		
9000 –	PREHISTORIC	Cody				Shonitkwu							9000 –
		Alberta			EARLY								
10,000–													10,000–
		Hell Gap Agate Basin	..?..										
11,000–													11,000–
		Folsom											
		Clovis											
Source:	Reeves (1983)	Reeves (1983) Frison (1978)	Choquette (1984)	Roll (1982)	Miss and Hudson (1987)	Chance and Chance (1985)	Campbell (1985)	Golm (1981) Nelson (1969)	Leonhardy & Rice (1970), (1980)	Diamond and Minor (1983)	Crossman (1960)	Pettogrew (1990)	

Archeological excavations at Kettle Falls indicate that the culture history of Lake Roosevelt extends back about 10,000 years and is represented by seven major phases (Table 2–1). These investigations reveal that the Kettle Falls locality has been important for Indian subsistence and culture throughout this time period. While little is known about the prehistory of other parts of Lake Roosevelt, archeologists believe that prehistoric populations in this area were semisedentary hunters and gatherers who utilized locally available natural resources from the river flood plain and adjacent uplands, as well as more removed upland areas. Ethnographic studies of the Sanpoil and Nespelem indicate they occupied permanent winter villages along the Columbia and its major tributaries. From spring through fall, groups moved between temporary camps from which small game was hunted, shellfish gathered, and edible roots procured. Salmon occurred in later archeological sites suggesting that fishing techniques may have diffused northward from Sahaptin peoples. Although archeological evidence reveals strong similarities in cultural patterns, Tribal representatives stress that each tribe preserves and practices its own distinctive lifeways.

At the time of European contact, the Kootenai and Flathead River region was used principally by the Kootenai Indians, but the area was also frequented by the Kalispel and Flathead (Salish). These Tribes were all highly mobile hunter–gatherers who ranged over large areas to gather seasonally available plant and animal resources. Seasonal use focused on the rivers and lakes, where anadromous and resident fish were harvested roots along with berries and other plant materials. During summer and fall, smaller parties moved upriver to follow ripening plants into uplands as well as to hunt and collect other plant and animal resources. Family groups also made annual trips to eastern Montana and Wyoming to hunt buffalo.

Portions of the Snake River from Brownlee project downstream.

The oldest cultural material known in the upper Snake River region predates 12,000 years BP (Butler 1978). Hunting of large animals was the most important economic activity of these early peoples.

The early "big game" hunters were followed by "archaic" level cultures noted for their diversified economies of hunting, fishing, gathering, and collecting (Pavesic 1978). A number of traits similar to Columbia Plateau cultures appear in the region, most notable a complex salmon fishing technology and use of the Plateau–like semisubterranean pit house. The first major Euroamerican settlements in the area occurred between 1866 and 1870 as a result of the discovery of gold in the area.

Lower Snake River (Includes Ice Harbor, Lower Monumental, Little Goose, Lower Granite, and Dworshak projects.)

During the earliest period of human occupation, 10,000 to 8,000 years BP, people occupying this area are believed to have foraged for a wide variety of food resources located in different topographic zones. The next period (8,000 to 4,000 years BP) witnessed a warming trend and a shift toward more use of plant foods and aquatic resources including salmon and freshwater clams. From 4,500 to 2,500 years BP, people in this area developed pit house (a semisubterranean dwelling) villages and intensified the use of plant foods and clams. From 2,500 to 250 years BP, the number of pit house village sites expanded as did the use of salmon and plant foods. The bow and arrow was introduced during this time. The last 250 years coincide with the historic and ethnographic period from the acquisition of the horse by native peoples in the early 18th century to their displacement to reservations in the late 19th century and the settling of the area by Euroamericans.

Ethnographically, the area was occupied by numerous bands of Indians who spoke a Sahaptin language. They lived in villages along intermediate and major sized streams. Temporary camps were also used but only for short periods of time or for special purposes. Political organization consisted of loosely associated bands, each with its own territory and headman. These bands shared similar customs, language, subsistence activity sites, and would come together for mutual defenses. Otherwise, they remained fairly distinctive. Food resources consisted of various species of fish (primarily salmon and steelhead), plants, and animals collected during an annual subsistence round based on the time of–year each food source was available. With the introduction of the horse in the mid–1700s, the range of trade and subsistence rounds for some bands (e.g., Nez Perce) greatly increased. Bison hunting on the plains became an annual or frequent activity which also resulted in elements of the Plains culture being introduced into the plateau area.

Lower Columbia River (Includes McNary, John Day, The Dalles, and Bonneville projects.)

Archeological work clearly shows that human occupation along the Lower Columbia River goes back to around 10,000 years. In some locations (e.g., the Bonneville section of the Columbia Gorge), extant archeological data reflects a relatively short period of occupation. This situation can be attributed to large–scale landslides and erosion, which removed most evidence of early sites prior to about 830 years ago (Draper 1992), as well as the scouring associated with the great Pleistocene floods which raged through the Columbia River Gorge.

Present data suggest that between 10,000 and 8,000 BP, the occupants of this area were nomadic hunter–gatherers who relied on big game animals. Fishing became an important part of the subsistence pattern by around 8,000 BP, if not earlier. The importance of plant resources to the overall subsistence pattern of early groups, though, has not yet been established (Draper 1992).

From habitation structures and the association of solidified burial localities, there is some evidence of increased sedentism among groups between 8,000 to 2,000 BP. However, the initial appearance of Plateau house forms has yet to be demonstrated. Burial data suggest that semisedentary village or residential patterns may be at least 3,500 to 3,000 years old. Archeological evidence for the period after 2,000 BP suggests nonutilitarian goods or "wealth" items indicative of class distinctions, while the presence of house forms are similar to those described during the historic period, and the intensive use of fish (e.g., salmon), animals and root crops is present. Villages are somewhat large and autonomous, with no well defined authority as in the European definition. It is possible that shared fisheries and resources may have led to a cooperative sociopolitical structure with an influential leader or this role was filled by a religious leader.

Both summer and winter villages were constructed by the Upper Chinookan speakers. This includes all villages on both sides of the Columbia River from the mouth of the Willamette River up to and including the Cascades and villages on both sides of the Columbia from just below the mouth of the Hood River upstream to near The Dalles. Winter villages contained groups of large semisubterranean, multifamily plank houses. Summer houses were a mat–over pole framework construction and served as shelters as well as food–drying areas. Overall, the late prehistoric record of the area shared many similarities with that documented with more traditional Northwest Coast groups not discussed here (Draper 1992). The harvest of abundant river resources supported a high population density.

Although many of the most significant archeological sites, such as Fivemile Rapids and Wakemap Mound, were inundated beneath Lake Celilo, formed by The Dalles Dam, other sites remain above the reservoir pool and have great potential for expanding the knowledge about the prehistoric inhabitants of the region. Archeologists have noted that the area around Celilo Falls served as a major focus of Native American occupation at time of historic contact, with villages located on both the Oregon and Washington shores. This locale functioned as a well–known trading center and one of the principal fisheries for numerous tribes in the Pacific Northwest.

2.11.3 Native Peoples

Six major linguistic stocks are represented among the peoples of the Columbia Plateau and Northern Great Basin: Chinookan, Salishan, Sahaptin, Cayuse, Kootenai, and Shoshonean. These languages are spoken today, although Cayuse and Chinookan have few remaining speakers. The Algonquian–speaking Blackfeet are located just outside of the study area on the Great Plains to the northeast.

At the time Euroamericans arrived in the Pacific Northwest they found numerous Indian groups living throughout the Columbia River Basin (Figure 2–1). The native peoples led a life of foraging, with a winter village focus in the major river basins, and seasonal camps and subsistence sites throughout the uplands. The Columbia River valleys (including the Snake River) were an important winter refuge and the primary source of subsistence fishing during the spring and fall. Fall and winter big game activity and spring root digging activities completed the seasonal round of life of the regional Indian populations. Trade contacts evened out some of the inequities of resource availability in the natural landscape and bonded Indian groups together into a large interrelated societies that were internally pacifistic, but intensely warlike towards outside Indian groups from the Great Plains and the Great Basin.

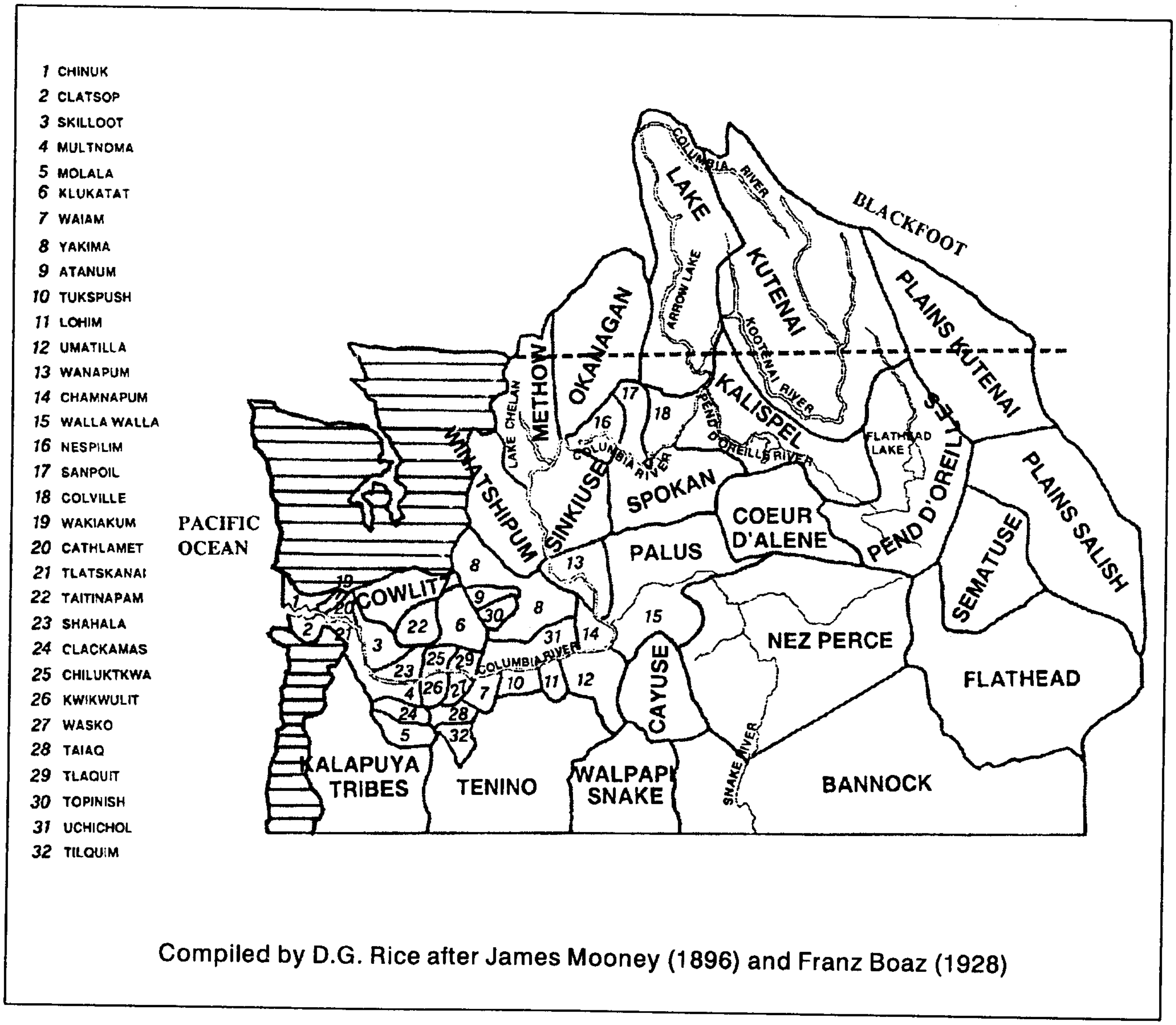

Figure 2–1. 19th Century Distribution of Tribes of the Columbia Region in Washington, Oregon, Idaho, Montana, and British Columbia

Beginning in the early 1850's, United States Government entered into treaties with many of the Columbia River and Plateau Tribes. Some regional Tribes participated in treaty councils held by Washington Territorial Governor Isaac Stevens at Hells Gate and Walla Walla in 1855. The Wasco plateau treaty Tribes include the Middle Oregon (today known as the Warm Springs), Umatilla, Yakama, Nez Perce and Salish–Kootenai of the Flathead. In the northern Great Basin of Idaho and Oregon, a series of peace treaties were conducted with several Shoshone and Bannock groups beginning in 1863 and culminating with the Fort Bridger Treaty of 1868. The Fort Hall reservation became the principal home for most of these groups. As settlers and miners began moving into the region between 1855 and 1880, conflicts arose with the Tribes, resulting in the Indian wars of 1855–58, the Snake War of 1866–68, the Nez Perce War of 1877, and the Bannock–Paiute War of 1878. Treaty Tribes were required or forced to relinquish part of their treaty lands, known as ceded lands (Figure 2–2), due to incursions made by miners and ranchers. These Tribes, however, retained certain rights on ceded lands allowing them to fish and hunt at usual and accustomed areas, to dig roots and to pasture livestock on open and unclaimed lands.

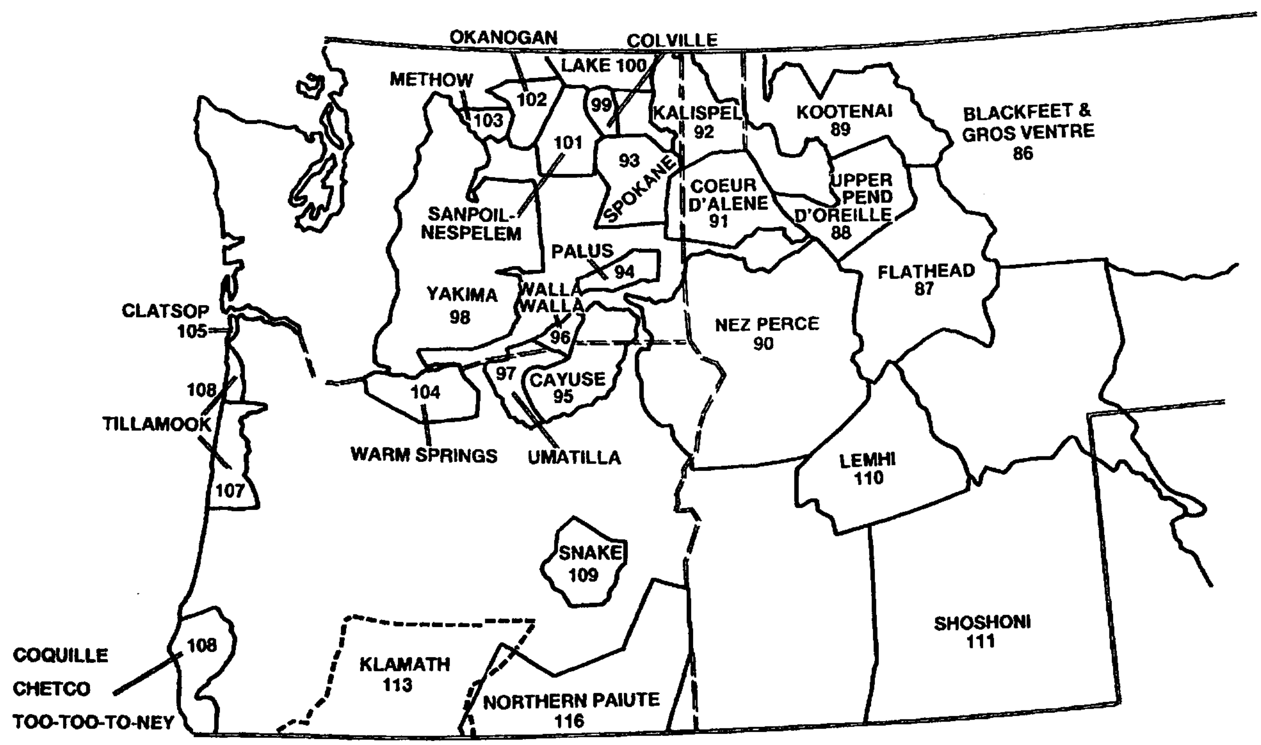

Figure 2–2. Indian Ceded Lands (Numbers Refer to Indian Claims Commission Docket Numbers)

The U.S. Government's methods of dealing with Indian Tribes tended to favor the interests of white settlers while creating great hardship for Tribal members. The following account is one example of this and was provided by the Burns–Paiute Tribe.

> *In 1883, while the Paiutes were still at Fort Simcoe or Fort Vancouver (Oits, [a Paiute medicine man] was moved there), the government declared their reservation public domain. One reason given was "There weren't any Indians living on the Reservation." Settlers had began homesteading and grazing the reservation lands when they became public domain.*
>
> *In 1887, the Paiutes were asked if they wanted to return to Harney County. Many, suspicious of the offer, opted to remain at Fort Simcoe or go to other reservations such as Warm Springs, Fort McDermitt and Duck Valley, Nevada. Oits Johnson went to live on the Warm Springs Reservation. Others went to Duck Valley and settled in the area known as Miller Creek.*
>
> *Under the 1887 Allotment Act, the remaining 115 Paiute heads of household were allotted 160 acres. The land that they were given to live on and grow their food was alkaline, covered in greasewood and sagebrush, and lacked water. To subsist many Indian men hired out as ranch hands while the women did washing and domestic services in town. Indians without homes on the allotments lived in makeshift tents next to the Burns city dump. Living in poor conditions, with no land on which to roam, among people who looked down on them, the Indians felt all hope was gone.*
>
> *In 1924, some changes began to take place. The Indian Citizenship Act of 1924 conferred American Citizen status on all Indians. In addition, a Catholic priest, Father Huel, became interested in the plight of the Burns Paiute Indians. The Indians considered Father Hue a friend and agreed to let him intervene on their behalf with the agents at Warm Springs. Because of his intervention, 10 acres of land and army tents were donated to the Paiutes in 1925. A school and homes were built and many Indians moved from the allotments to the 10 acres known as "Old Camp."*
>
> *In 1935, the Federal Government purchased 771 acres from the Brown Land and Title to be held in trust for the Paiute Indians by the Bureau of Indian Affairs. The school and the larger Indian families relocated to the new land known as "New Village." The Tribe also adopted the Indian Reorganization Act and established a Business Committee. Five men were elected members of the committee and they would meet on issues concerning the Tribe.*[7]

The United States established Executive Order Indian reservations late in the 19th century as a result of Congress dealing with Indian Tribes in a fundamentally different way. This was also a way to deal with those Indian treaties that were not ratified. Tribes with Executive Order reservations include: Colville, Spokane, Coeur d'Alene, Kalispel, Kootenai of Idaho, Duck Valley Shoshone–Paiute, and Burns Paiute.

The Colville Indian Reservation, created in 1872 demonstrates the complexities involved in the creation of the Executive Order reservations. Twelve tribes presently reside on the reservation, including the Wenatchee, Chelan, Entiat, Methow, Okanogan, Nespelem, Sanpoil, Lakes, Colville, Moses (Columbia), Palouse (Snake River band), and the Chief Joseph band of the Nez Perce. Late in the 19th century, Chief Joseph's band was moved to the Colville Indian reservation from exile in the southwest. Several small federally unrecognized Tribes once resident on the east shore of the Columbia in the Creston and Wilbur areas also reside on the Colville Indian Reservation or close to it. Originally, the Spokane Indian Reservation was included in the Colville Reservation, although the Spokane were recognized as a separate group in an 1858 treaty. In 1881, an executive order removed lands from the Colville Reservation to create the separate Spokane Indian Reservation.

[7]Excerpts from "Prehistory of the Far West, Homes of Vanished Peoples." Luther S. Cressman's studies of Anthropology, University of Oregon 1929 –1963. This material was provided specifically for this document by the Burns–Paiute Tribe.

In the 20th century, some tribes have petitioned the courts for Tribal recognition. Successful groups include: the Burns–Paiute and the Duck Valley Shoshone–Paiute. Today, there are 14 tribal reservations recognized by the Federal government in the Columbia–Snake Basin (Figure 2–3).

Figure 2–3. Indian Reservations within the System Operation Review Study Area

2.11.4 History of Cultural Resources Surveys

The United States National Museum (H. W. Krieger 1927, 1933) conducted the earliest professional studies describing cultural resources in specific Columbia River Basin reservoirs. This research stemmed from the construction of Bonneville Dam. University–based studies were carried out at The Dalles and Deschutes River areas (Strong, Schenk and Steward 1930) and at Grand Coulee Dam (Collier, Hudson and Ford 1942).

The Federal government did not actively participate in cultural resources activity in the Columbia River Basin until the Army Corps of Engineers, the National Park Service, and the Smithsonian Institution signed the 1945 Interagency Archeological Salvage Agreement. Between 1947 and 1954, most of the planned dam sites and reservoirs for the Columbia River system were surveyed by Smithsonian archeologists. Salvage operations were then carried out at The Dalles and McNary Dam projects. The Smithsonian conducted these early archeological surveys, known as the River Basin Surveys, from a field office at the University of Oregon. During this era, about 10 percent of the inventoried sites were partially excavated prior to inundation or construction impacts.

After 1955, the National Park Service administered archeological surveys in this area from its Western Regional Office in San Francisco. Working through regional colleges and universities, these activities prompted the major universities to establish and maintain an inventory of archeological site records. Most of this original inventory information was passed on to the respective State Historic Preservation Offices during the 1970s, following their creation under the NHPA. During this time, about 5 percent of sites inventoried in the project areas were sampled before they were destroyed or inundated. Since the 1974 amendment to the Reservoir Salvage Act of 1960, the individual Federal agencies have professionally managed and funded cultural resources activities under their jurisdiction at the Federal reservoirs.

During the 1970s, the National Park Service conducted a reservoir inundation study. This study examined the effects of inundation on cultural resources sites at a number of Federal projects in the West, including Grand Coulee Dam and Libby Dam. The findings of the study revealed that many cultural sites survived inundation and that the specific effects of shoreline slump age and erosion could often be offset by stabilization measures. In fact, archeological surveys conducted after reservoir inundation disclosed significantly more sites during deep draft drawdown than were originally inventoried prior to construction. The sites were exposed by the erosive actions of the reservoirs. More recent reservoir drawdown studies conducted at Grand Coulee, Dworshak, Albeni Falls, Libby, and Chief Joseph Dams and along the lower Snake River have identified new sites as well as continuing project effects. Thus, present operations can be shown to have continuing effects on significant cultural properties.

2.11.5 Archeological Inventory

A complete survey and evaluation of all known sites has not been accomplished at any Federal project. The archeological information available for each of the identified SOR reservoir projects varies considerably. This difference is attributed to the varying levels of archeological investigations which have been conducted at each of the projects. A general overview, gathered from what is currently known, is presented here.

2.11.6 Hungry Horse Dam, Montana

Introduction

Hungry Horse Dam and Reservoir is operated by the Bureau of Reclamation. It was completed in 1951 and inundated 23,000 acres of land. The reservoir is about 36 miles long with approximately 100 miles of shoreline. It is located within the Flathead National Forest (FNF) which administers the reservoir lands for all nonoperational purposes.

At the time of European contact, the area north of Flathead Lake was primarily used by members of the Kootenai Tribe, who now reside on the Flathead Indian Reservation in Montana and the Kootenai

Reservation in northern Idaho. The area was also frequented by the Pend d'Oreille, bands of Kalispel, and was also used by other Indians, including the Flathead (Salish).

Previous Inventories

In 1949, before reservoir construction, the River Basin Survey completed a reconnaissance of the proposed Hungry Horse pool. Methods were cursory, and a single site was recorded. Considered to be of no scientific value, it was not test excavated. Between 1940 and 1993, FNF surveyed approximately 5 percent of the shoreline area and completed a reconnaissance of high probability areas. They identified six prehistoric sites, none of which have been test excavated. In the reservoir vicinity, recorded sites associated with Native American use include occupation sites, scarred trees, burials, pictographs, and "battlepits." Other resources of Euroamerican origin in the area include cabins, trails, and roads, and USFS administrative structures.

In a 1991 Programmatic Agreement, BPA and the Bureau of Reclamation committed to a systematic inventory and evaluation of cultural, traditional, and ethnographic resources around the reservoir. In 1993, another agreement was executed with the FNF to implement the terms of the PA, with the involvement of the Confederated Salish and Kootenai Tribes. According to this agreement, the FNF will conduct a 4–year survey of the reservoir, evaluate archeological sites for National Register eligibility, and develop action plans for site monitoring and treatment. This intensive archeological inventory began in 1994. To date, FNF has surveyed 50 to 70–percent of the lands between 3560 foot (maximum pool) and 3500 foot (low water) elevations that have a slope of less than 30 percent. They have recorded 11 new sites and re–recorded the 6 known sites as well as identifying isolated finds that may indicate buried sites. Limited shovel testing has revealed potential for subsurface deposits at several sites. Reservoir–deposited silts may be obscuring additional sites. All sites found to date are lithic scatters that probably represent temporary camps, lithic workshops, and/or game lookouts. They indicate use of this area between 9,000 and 3,000 years ago. Preliminary assessments indicate the sites have the possibility to also yield valuable paleoecological information.

No inventory of traditional or ethnographic resources of value to Indian people has been done. Future actions under the BPA/Reclamation PA will include identification of these ethnographic and traditional resources of value to the Tribes.

Existing Conditions

Hungry Horse Reservoir is largely operated for power generation. The reservoir is frequently drawn down to low elevations, exposing at least three terraces below high water. FNF staff have observed that present operations are causing surface erosion on the uppermost terrace within the drawdown zone and severe loss of soil on banks around the pool rim. This has exposed archeological sites to vandalism, and has horizontally and vertically displaced cultural material. The Salish and Kootenai Tribes have notified the FNF and Reclamation of their concerns about damage to the archeological sites by reservoir operations, vandalism, and relic collection.

Initial observations indicate that current operations are leading to deposition of sediments onto some areas of the two lower terraces exposed by annual drawdowns, particularly where the valley terrain is steep. Presumably, this indicates that soil is not being stripped from the lower terraces, and that sites located there are less endangered under present operating conditions. This sedimentation may also protect these sites from casual relic collection.

Effects of Alternatives

Insufficient information is available about existing sites and geomorphological conditions to more than briefly address possible effects of proposed alternatives. However, it is clear that current operations are presently affecting these sites around the reservoir margins, both through erosion and exposure to vandalism. Logic indicates that alternatives that would leave the pool at higher elevations for longer periods of time would reduce opportunities for looting and vandalism. Higher winter and springtime elevations might also reduce bank undercutting by ice, surface erosion from snow melt, and rain over exposed, unvegetated banks. The actual effects of any operating strategy though, can only be assessed through systematic resource inventory and monitoring of ongoing conditions.

2.11.7 Libby Dam (Lake Koocanusa), Montana and British Columbia

Libby Dam is the only United States reservoir on the Columbia River that straddles the international boundary. The reservoir extends about 70 miles (112.63 kilometers) north of the dam, 30 miles (48.27 kilometers) into Canada. Canadian authorities have conducted cultural resources surveys and data recovery work in the Canadian section of the reservoir during the early 1970s. Surveys conducted in the American segment of Lake Koocanusa in 1980–81 identified 249 archeological sites (Thoms 1984). Among these sites, 169 are prehistoric, 27 historic, and 53 have both historic and prehistoric components. Additional reservoir monitoring conducted by Kootenai National Forest (KNF) between 1985 and 1993 has added 88 new sites to the inventory for a total of 347 sites at Lake Koocanusa in the United States. Project lands below Libby Dam include another 17 sites. The prehistoric sites are mostly seasonal procurement camps with a few pictographic rock art sites also present. The camp sites show very limited variation in tools. The historic sites include forestry and mining–related structures, ferry landings, homestead sites, and possible 19th century fur trade sites. There are 53 historic trash dump sites which are superimposed upon prehistoric aboriginal sites. In 1985, KNF nominated the known sites in Lake Koocanusa to the National Register of Historic Places as the Middle Kootenai Archeological District Below Libby Dam, the 17 archeological sites on Corps of Engineer lands were determined eligible for the National Register in 1978 as part of the Libby–Jennings Archeological District.

2.11.8 Albeni Falls Dam (Lake Pend Oreille), Idaho

Based on surveys conducted over the last 8 years, 374 prehistoric and historic sites are found within the reservoir of Albeni Falls Dam. Most of these sites are prehistoric and include petroglyphs, open camp sites, and villages. The earliest sites contain materials that are 8,000 to 10,000 years old. As yet, very little is known about the prehistoric occupation at Lake Pend Oreille. Indian Tribes that used the area historically include the Upper and Lower Kalispel, Kootenai, Coeur d'Alene, and Spokane. Historic sites include David Thompson's 1809 Kulleyspell House, a Hudson's Bay Company village, ferry landings, railroad construction camps, and forestry and mining–related structures. Few of these sites have been evaluated for National Register eligibility.

Data collected by the Kalispel Tribe of Indians under an SOR contract with the Resident Fish Work Group strongly indicates that the water level of Box Canyon Reservoir is controlled by Albeni Falls outflows. The Tribe feels that since the area downstream of Albeni Falls was not included in the Area of Potential Effect, a downstream study may be required to determine the effects on cultural resources in the upper portions of the Box Canyon reservoir.

2.11.9 Grand Coulee Dam (Lake Roosevelt), Washington

Introduction

Grand Coulee Dam was completed in 1941. The reservoir inundated 82,300 acres. High water is 380 feet above the river channel at the dam.

At the time of European contact, the present–day reservoir area was primarily used by the Colville, Sanpoil, Nespelem, and Spokane people. After creation of the Colville and Spokane Reservations, in 1872 and 1881, many Indians continued to practice essentially traditional lifeways. English was spoken as a second language; fish, game, and native plants remained dietary staples; traditional religion and medicine was practiced; and annual gatherings of the various bands and Tribes continued to occur.

Euroamericans arrived in the early 1800's. In 1832, the Hudsons Bay Company established Fort Colville at Kettle Falls and, in 1847, and Catholic mission was built nearby. In 1882, Fort Spokane was built at the confluence of the Spokane and Columbia Rivers.

Euroamerican settlement began in the last quarter of the 19th century. By 1900, perhaps as much as 75 percent of the river corridor was cultivated as orchards. Construction of Grand Coulee Dam brought another influx of settlers to the area.

Many of the Tribes' traditional lifeways were disrupted or made impossible by construction of Grand Coulee Dam. The reservoir inundated nearly all of their religious and ceremonial areas; made traditional food collection rounds impossible through disruption of fish runs and inundation of plant collecting locations; and submerged the places where annual community gatherings were held.

Previous Investigations

Various cultural resource investigations have been done at the reservoir. Many of these are poorly documented; the more extensive are outlined below. Prior to 1995, perhaps as much as 90 percent of the reservoir lands have never been systematically surveyed for archeological resources. Further, few investigations have addressed ethnographic or traditional resources valued by the Tribes. In 1994, an overview of the reservoir was done as the first step in an inter–agency and Tribal inventory effort (Galm et al. 1995). The overview includes a review of past research and management activities at the reservoir, outlines historic development, and provides a bibliographic listing. Concurrently, surveys for the Colville and Spokane areas of the reservoir are being implemented.

In 1939 – 1940, prior to filling the reservoir, limited archeological surveys and excavations occurred under the direction of the Columbia Basin Archeological Survey (CBAS). Approximately 39 sites were recorded. Of these, 36 were test excavated. Many of these were considered of little value because they lacked artifacts suitable for display. Undoubtedly, today most or all of those sites would be considered significant. Excavations focused on Indian burials, to maximize collection of display artifacts. A single report was prepared (Collier Hudson, and Ford 1942) describing only a portion of the work, and is limited to artifact descriptions. Concurrently, Ball & Dodd Funeral Home was employed to relocate human burials endangered by the reservoir. They visited approximately 50 cemeteries, many representing Indian burial grounds, and removed 1,388 graves for reinterrment above the pool. Few reliable records remain to identify the areas CBAS surveyed or the site locations.

From 1966 – 1978 Washington State University and the University of Idaho completed extensive surveys, test excavations, and data recovery of sites exposed by reservoir drawdown. The surveys covered all of the reservoir, recording more than 150 new archeological sites. Test excavations focused on sites on the Spokane arm and the Kettle Falls area. Most data recovery was done at Kettle Falls. Some of the sites retained remarkable contextual integrity, despite nearly 30 years of cyclic inundation and exposure, while others exhibited severe damage. From excavation results, the University of Idaho developed a culture chronology and a model of culture change. The investigations are discussed in numerous project reports and research papers.

Investigations have identified 340 prehistoric and historic archaeological sites. Prehistoric site types include short and long–term occupation sites, rock cairns, fishing stations, storage pits, pictographs, and burials. Historic sites include farmsteads, towns, transportation features, mines, and remnants of Fort Colville and Fort Spokane. Of these, 28 sites have been determined eligible for listing on the National Register. Two National Register Districts (see Table 2–2) are located in the area, and include 26 of these 28 sites. Fort Spokane has been nominated to the National Register, and the dam itself is eligible for listing. Insufficient information is available for most of the other recorded sites to determine if they are eligible for the National Register.

A significant factor is that many recent surveys continue to document the presence of additional sites in unsurveyed or inadequately surveyed areas. If density of human use was equal over the inundated area, at least 2,300 sites might once have been present. However, many of these sites may have been destroyed by reservoir actions, are permanently beyond reach under the reservoir pool, or are buried under the silts.

Although prior investigations have greatly expanded understanding of culture history at Lake Roosevelt, deficiencies in site recordation have been identified. Many site records lack maps showing site location, have inaccurate elevation data, or provide little essential information about site content and soil or landform characteristics. Further, many of the sites have not been revisited since they were recorded, and they may have been destroyed. These factors result in a data base with limited usefulness for making reliable management decisions or study plans.

To date, little inventory at this reservoir has occurred that identified ethnographic or traditional resources of value to Native Americans. In the early 1980s Bouchard and Kennedy (1984) completed some informant–based ethnographic research, including place–names, village locations, and resource use, although the Colville have expressed concern about the accuracy of some of the information. The Spokane Tribe has completed an ethno–archeological inventory of sites on the reservation that were identified by Tribal members. This confidential inventory is held by the Tribe.

Reservoir Management

In 1990 a Cooperative Management Agreement by Reclamation, the National Park Service (NPS), the Colville Confederated Tribes, the Spokane Tribe of Indians, and the Bureau of Indian Affairs. It recognized joint management and transferred ownership of "Indian" archeological collections to the Colville and the Spokane Tribes. In a 1991 Programmatic Agreement, BPA and Reclamation committed to the systematic inventory and management of cultural, traditional, and ethnographic resources around the reservoir. Since 1992, the NPS has acted as lead agency to coordinate the investigations, in partnership with Reclamation, BPA, the Colville Confederated Tribes, the Spokane Tribe, and BIA. However, the Tribes retain primary authority to guide or implement investigations on their respective shorelines.

Existing Conditions

Grand Coulee Dam has historically been operated for power generation and flood control. Recently, operational changes have been implemented in response to concerns about endangerment of salmon species. Regardless, past operations have been largely characterized by low and frequently fluctuating springtime elevations, and higher and more stable mid– and late–summer elevations.

No systematic geomorphological surveys have occurred at Lake Roosevelt. However, cursory examinations indicate that much of the area consists of poorly cemented silty and sandy soils (glacial till). Much of the pool is surrounded by steep and unstable slopes, and even the more level terraces in the Inchelium and Kettle Falls areas exhibit erosion extending above the maximum pool. During drawdown, a series of terraces and knolls are exposed separated vertically by abrupt slopes of unstable soils. Prehistoric practice seems to have focused burial of human remains on the edges of these terraces, in locations now most vulnerable to continued erosion.

Annual inspections of selected burial sites, started in 1989, have contributed important information about the effects of operations on cultural sites and landforms. They noted that, in a single location, rock features and cultural material may be exposed 1 year, may be buried under silt the next; while half of the landform may have been entirely eroded away by the third year. The cause of such instability may be attributable to the interaction of the unstable soils with fluctuating pool elevations. The inspections indicate that no significant slope equilibrium has occurred in many areas of the pool, and that geomorphological processes operating at Lake Roosevelt are more complex than modeled for this study.

Observation also indicates that low water elevations in the winter and spring are particularly devastating. Low winter elevations allow ice to cut into banks far down in the pool which can lead to mass wasting of the slopes above the cut. In the spring, surface runoff and rain on the unvegetated slopes greatly accelerates erosion. Springtime erosion is further exacerbated by frequent elevation fluctuations that destabilize the unconsolidated sediments. Another active erosion factor at Grand Coulee is bank slumping. Wind scour across the face of the slopes has also been observed to further destabilize slopes.

Looters are highly active around Lake Roosevelt. Human burials are particularly targeted for collectable grave goods. During low water, many people comb the Kettle Falls area for beads and other material from Fort Colville. Site inspectors have noted fresh looker holes, rake marks, abandoned screens, and stacked artifacts on exposed sites. NPS and Tribal efforts to control looting are limited due to the small staff available.

2.11.10 Chief Joseph Dam (Lake Rufus Woods), Washington

Professional archeological work at this project began with the Smithsonian Institutions' River Basin Surveys in the early 1950s. The National Park Service sponsored an inventory and evaluation of these areas in the late 1960s and early 1970s to identify significant sites that might be affected by a 10–foot (3.05 meters) rise in pool elevation. Since the mid–1970s, the Seattle District of the Army Corps of Engineers has carried out a program to identify, test, and recover data from areas that could be affected by project operation. Nearly 300 prehistoric and historic sites are present. The University of Washington tested over 100 of these to identify their age and importance. They performed major excavations at 18 of the most important prehistoric sites. Between 1982 and 1984, Central Washington University tested several more sites in the upper reach of the project near Columbia River mile (R.M.) 590. Nineteen sites recommended earlier for data recovery but which could not be investigated further have been monitored since the pool was raised in 1981. Burial relocation or site evaluations have been carried out at three sites since the pool was raised. The reservoir is included within the Rufus Woods Archeological District, determined eligible for the National Register in 1978. A cultural resource management plan has also been developed for this project.

2.11.11 Brownlee Dam, Oregon–Idaho

Historic and archeological resources in the Snake River Canyon area, including Brownlee Reservoir, are of major significance in defining and understanding the cultural history of the region over the last 8,000 years. Site types and themes include prehistoric sites as well as historic Chinese settlements, mining, transportation, ranching, homesteading, and Native American and Euroamerican contacts.

Prehistoric sites include pithouse villages, seasonal campsites, rock cairns, pictographs, petroglyphs, fish walls, and sweat lodges. The prehistoric cultural resources of the Snake River Canyon provide a valuable perspective on the adaptation and movement of prehistoric populations; the diffusion of cultural traits and elements between the Great Basin, Plateau and Plains cultural areas; the development of Plateau cultures; and the development and change in Nez Perce subsistence and social patterns over time.

Currently, there are 13 prehistoric and seven historic sites inundated or located between high and low pool elevations in the Brownlee Reservoir. A complete inventory of historic or prehistoric sites, however, has not been conducted in the reservoir area.

2.11.12 Dworshak Dam and Lower Snake River Dams

A total of 289 known archeological sites are located within the four Lower Snake run–of–river reservoirs (Lower Granite–136; Little Goose–76; Lower Monumental–42; and Ice Harbor–35), and 210 within the Dworshak Reservoir which is only partially surveyed. Identified prehistoric sites include villages, fishing sites, burials, rock art (pictographs and petroglyphs), storage pits, and temporary camps. Historic sites include homesteads, mining sites, forts, town, and trading posts. At present, two archeological districts (Windust Caves and Palouse Canyon) and two sites (Marmes Rockshelter, and Hasatino) are listed on the National Register of Historic Places. In addition to National Register status, Marmes Rockshelter is also a designated National Historic Landmark.

2.11.13 Lower Columbia River Dams

There are a total of 424 known archeological sites within the four Corps reservoirs on the lower Columbia River (MCNary–124; John Day–224; The Dalles–56; and Bonneville–20). The identified prehistoric and historic site types are the same as for Dworshak and the lower Snake River projects. There are two historic properties on the National Register of Historic Places at the Bonneville project: the Bonneville Dam Historic District and the North Bonneville Archeological District. There is one listed property at the John Day project: the John Day Archeological District. McNary project has four properties on the National Register: the Tri–Cities and Lower Snake River Archeological Districts and site 45FR5 (Strawberry Island) and 35–UM–64 (Box Canyon).

2.11.14 National Register Sites and Districts

Table 2–2 contains the names of the National Register sites and listed or eligible districts at Federal Columbia River system dams and affected reaches. Chapter 4 addresses potential impacts to these sites.

Table 2–2. National Register Sites and Districts at the 14 Federal Projects

1. Bonneville Dam Reservoir (Portland District, Corps of Engineers)
   a. Bonneville Dam Historic District (listed)
   b. North Bonneville Archeological District (listed)
   c. Columbia River Highway Historic District (listed)
   d, Cascade Locks Marine Park (listed)
2. The Dalles Dam Reservoir (Portland District, Corps of Engineers)
   a. Five Mile Rapids Archeological Site (35–WS–4) (listed)
   b. Indian Shaker Church and Gulick Homestead (listed)
   c. Wishram Indian Village Site (listed)
   d. Memaloose Island (listed)
3. John Day Dam Reservoir (Portland District, Corps of Engineers)
   a. Umatilla archeological site (35–UM–1) (listed)
   b. Telegraph Island Petroglyphs (listed)
   c. Plymouth, Port of Benton (determined eligible)
   d. Crow Butte (nominated)
   e. Wildcat Canyon archeological site (nominated)
4. McNary Dam Reservoir (Walla Walla District, Corps of Engineers)
   a. Lower Snake River Archeological District (listed)
   b. Tri–Cities Archeological District (listed)
   c. Martindale Island (determined eligible)
   d. Strawberry Island Village Archeological Site (listed)
   e. Box Canyon Archeological Site (35–UM–64)
5. Ice Harbor Dam Reservoir (Walla Walla District, Corps of Engineers)
   a. Windust Caves Archeological District (listed)
6. Lower Monumental Dam Reservoir (Walla Walla District, Corps of Engineers)
   a. Palouse Canyon Archeological District (listed)
   b. Marmes Rockshelter (National Historic Landmark)
7. Little Goose Dam Reservoir (Walla Walla District, Corps of Engineers)
   a. (None presently determined eligible)

Table 2–2. Cultural Resource Sites and Districts of the Federal Columbia River – CONT

8. Lower Granite Dam Reservoir (Walla Walla District, Corps of Engineers)
   a. Hasotino Archeological Site (listed)
   b. Archeological sites 45–WT–78/79 (determined eligible)

9. Dworshak Dam Reservoir (Walla Walla District, Corps of Engineers)
   a. (None presently determined eligible)

10. Chief Joseph Dam Reservoir (Seattle District, Corps of Engineers)
    a. Rufus Woods Lake Archeological District (listed)

11. Grand Coulee Dam Reservoir (U.S. Bureau of Reclamation)
    a. Kettle Falls Archeological District (listed)
    b. Fort Spokane historic site (listed)
    c. Highway bridge at Grand Coulee (listed)

12. Albeni Falls Dam Reservoir (Seattle District, Corps of Engineers)
    a. Archeological sites 10–BR–94 and 10–BR–99 (determined eligible)
    b. Archeological sites 10–BR–42 (determined eligible)
    c. Archeological sites 10–BR–10 and 10–BR–20 (determined eligible)
    d. East Pend Oreille Lake Rock Art District (nominated)

13. Libby Dam Reservoir (Seattle District, Corps of Engineers)
    a. Libby–Jennings Archeological District (determined eligible)
    b. Middle Kootenai River Archeological District (determined eligible)

14. Hungry Horse Dam Reservoir (U.S. Bureau of Reclamation)
    a. (None presently determined eligible)

CHAPTER 3

STUDY METHODS

This study intended to approach the analysis of the operating strategies' impacts on cultural resources from three principal directions. These are: 1) a geomorphic analysis of reservoir landform change; 2) a computer simulation model of shoreline erosion, drawdown zone exposure, and inundation at known sites; and 3) a discussion of traditional cultural properties and traditional use resources in the project region. The geomorphic analysis studies the alternatives' potential to accelerate erosion and landform change in ways that affect both known and unknown cultural resources. The computer simulation compares the reservoirs and alternatives in terms of their potential effects on the known cultural resources. Discussion of traditional, Native American cultural properties is nonspecific, to protect the confidentiality of traditional practitioners and traditional practice and use locations, and is rather brief. More information on Native American values and viewpoint can be found in the exhibits at the end of this Appendix.

Each of these study approaches recognizes that system effects on cultural resources are continuous and mostly adverse, particularly within or near the reservoir pools. Despite this, investigations have shown that many of the cultural resources at the projects retain resource values, including scientific, educational, or cultural and heritage values. The deleterious effects of reservoir operation have acted and continue to act slowly upon cultural resources.

The geomorphic analysis relies on the sensitivity of reservoir environments to geomorphic processes. It uses a broad definition of cultural resources to ensure that the effects of all reservoir processes are taken into account. Native Americans define cultural resources in much the same broad way by including the total physical and ecological context of the environment.

The geomorphic analysis assesses the operational characteristics of the alternatives and the erosional processes that these could stimulate or increase. It identifies system operation processes that may cause major or minor losses of archeological and other cultural resources through landform change. This approach includes a general consideration of geology, soils, hydrology, vegetation, and landform conditions at the reservoirs, as well as the first–hand observations of cultural resources managers regarding erosion and deposition as significant forces affecting cultural resources.

The computer simulation study begins with the available information about archeological and historic sites within the reservoir pools. It compares the effects of the system operation alternatives on these sites by simulating how the up and down movement of the reservoir shorelines during a yearly operation cycle could change the ongoing rates of reservoir impact.

The computer simulation assesses rates of potential operation effects on archeological sites in terms of the lengths of time that the known sites in a reservoir pool would be directly subject to: 1) shoreline waves; 2) exposure to the open air within a reservoir drawdown zone; and 3) complete inundation. Because reservoir operation patterns differ from year to year, depending on precipitation amounts and the previous year's remaining water storage, the computer model simulates the cumulative effects on archeological sites of operating the system over a 50–year period. This accounts for year–to–year variations in system operation. Comparison of the three impact measures between reservoirs and alternatives indicates where the cumulative potential effects of system operation might occur most rapidly over a 50–year period. This comparison helps to explain to the decisionmakers and the public how the reservoirs can affect cultural resources. It also helps in setting priorities for resource management under the selected new operation system.

The SOR agencies were not able to conduct a complete and comprehensive analysis of impacts on traditional cultural resources. The discussion of traditional cultural resources broadly identifies the nature of traditional cultural practice in the region and in the vicinity of the projects. It was intended to express the broader Native American view of cultural resources and to give examples of some types of traditional practice and the impacts of dam operation. Because traditional practice and use locations and some practices are often religious in nature and may be confidential, this discussion does not identify specific locations or sites as resources to be managed.

These three avenues of study would complement each other to provide a comprehensive picture of potential reservoir operation effects. The geomorphic analysis shows the overall potential for erosive processes that may damage cultural resources in their path. It helps compensate for incomplete cultural resources inventories, and considers complex geomorphic processes such as slumping, mass wasting, and nearshore current erosion. The computer simulation model shows how reservoir operation might accelerate damage to known archeological sites over a long period of time and simulates potential rates of resource loss at the individual reservoirs. An analysis of traditional cultural resource impacts would identify and discuss the value, integrity, and significance of affected resources. All three approaches are needed for a balanced look at the continuing effects of system operations on cultural resources of all types, and for a balanced comparison of the alternatives.

Some members of the CRWG disagreed with the study methods or expressed strong concern about adequacy of the data. As an example of the concerns and the different opinions regarding study method, the following paragraphs are excerpted from reports of two of the Tribes. The full reports are printed in the exhibits section at the end of this Appendix. (Note, references to page numbers in these excerpts refer to the Draft EIS version of Appendix D.)

From the Spokane Tribe of Indians:

In order to determine what percentage of cultural alternatives the alternatives would affect, the Cultural Resources Work Group used the recorded elevations for recorded archeological sites in the reservoirs. First, this then only considers impacts to recorded sites, which is a minute portion of actual sites, without any attempt to predict how many more resources there are unrecorded. Second, they made no attempt to predict how may, where, or how other types of cultural resources would be affected. Third, they used elevations that most often are inaccurate (from eye–balling in the field, or guessing after the fact), and often recorded as a single elevation for a site that may cover a mile of ground surface. Fourth, sites that do have highest and lowest elevations recorded (and these are in the minority) which extend below the reservoir level on the day of recording have recorded lower elevations that reflect only the reservoir level of that particular day, not the actual lowest elevation of the site. Fifth, recorded sites are all counted as "one incident," whether that site be 1 meter in diameter, or a mile long. Sixth, the recorded surveys are admittedly biased toward areas of interest for federal development. There is no way that an analysis based on this data can have meaningful results to compare impacts on cultural resources.[1]

"The hydroregulation models assume a constant rate of reservoir change from month to month with no interim fluctuation, which is not necessarily accurate." While this statement is true, it assumes away a critical variable to cultural resources that require greater consideration.

First, actual fluctuation may very considerably from the monthly averages constructed. While decades of inundation studies have recognized the destructive forces within the fluctuation zone, this factor is only grossly considered in the "days exposed" field of this

[1]Review of SOR Draft EIS Appendix D. Cultural Resources, Page 3–5, 2d column, Section 3.2.1, letter dated September 26, 1995.

study. There is no consideration of the quantity of variation that may actually occur from the monthly average. Dealing with monthly averages greatly underestimates the impacts caused by actual fluctuation.

A site may be exposed and inundated many more times than suggested by "monthly averages" due to daily fluctuations. Negative impacts by mechanical processes are maximized in quickly fluctuating zones. Both common sense and field experience show that sites that are exposed and re–inundated quickly and frequently receive a great amount of erosional impact caused by fluctuation of reservoir levels. Common sense and field observations tell us that sites which are inundated and exposed once per month receive less mechanical impact caused by fluctuation than do sites which are inundated and exposed ten times per month.[2]

From the Confederated Tribes of the Umatilla Indian Reservation:

The entire cultural resource analysis is fatally flawed because of the lack of tribal participation in the identification of significant resources from the beginning of the SOR process. Most cultural resources are discussed in terms of scientific value and very little has been done to address, and identify traditional concerns.

The SOR study uses arbitrary and capricious standards for evaluating the effects of the SOR alternatives on Cultural Resources. The decisions were based on misleading and erroneous assumptions as well as groundless conclusions. Among these conclusions is, "The analysis assumes that inundation is a relatively benign impact, since it prevents most kinds of erosion and site exposure."[3]

Inundation has long been known to the tribes as an adverse effect by even in the last several decades archaeologist have also recognized that inundation is an adverse effect on cultural properties. The National Reservoir Inundation Study (NRIS) concluded after 5 years of study that "1) the effects of fresh water inundation is overwhelmingly detrimental; 2) some resources are more susceptible to adverse impact than others; 3) site protection is a viable mitigation alternative to excavation only in limited circumstances; and 4) archaeological mitigation plans should be incorporated into reservoir construction plans as early as possible (Nickens 1990:1)." The results of the SOR analysis further substantiate many of these destructive qualities of hydro–operations and cultural resource sites.[4]

[The analysis presents] no comparison or idea of what the relative magnitude of each type of impact (i.e. exposure, shoreline erosion, inundation) to the narrowly defined cultural resources is or would be.

This is all the more diconcerting in that Cultural Resources was supposed to be (according to SOR agencies) the key issue for "Native American."

A three–dimensional analysis is needed to understand the impacts to <u>all cultural resources</u> (cultural resource type x project x type of impact) for each alternative which includes a weighting (agreed to by the Tribes) of the relative magnitude of each type of impact (inundation, erosion, exposure) and a comparison against a "no project" condition to ascertain where in the world of impacts we have been, where we are, where the agencies propose we go, and where the CTUIR can send us.[5]

The analysis is based entirely upon models and theories using two different types of reservoirs (flow and storage) as models. The results of these analysis will be used to make long term management decisions about all 14 federal projects. The reality is that data from only two reservoirs John Day and Dworshak were used to make broad based assumptions for all 14 facilities. A review of site forms house at the CTUIR archives indicates that

[2]Review of SOR Draft EIS Appendix D. Cultural Resources, Page 3–11, 2d column, 4th para, letter dated September 26, 1995.

[3]Review of SOR Draft EIS Appendix D. Cultural Resources, Pages 3–11.

[4]Review Cultural Resources Concerns of the Systems Operations Review SOR Draft EIS Appendix D. Cultural Resources, October 12, 1995.

[5]CTUIRs Analysis of the Review of SOR Draft EIS Appendix D. Cultural Resources, September 27, 1995.

sites recorded within many of the reservoirs were incompletely recorded and many have never been evaluated. Many archaeological sites have never been seen since they were recorded and the condition of the sites is essentially unknown.

Computer models cannot assess all qualities and values of cultural resource properties. This can only be accomplished by going through the Section 106 process outline in the National Historic Preservation Act, 36CFR800, or an Agreement document of some magnitude. The land managing agencies must first identify the properties and then assess values such as integrity and this cannot be completed without "ground truthing" the models. Scientific value/integrity and tribal/traditional significance of cultural resource properties cannot be generated by a computer model. This requires Tribal elders members as well as the anthropologists and archaeologist to determine significance.[6]

3.1 GEOMORPHIC ANALYSIS

There are strong relationships between geomorphic, ecological and cultural elements of the environment. In addition, although many of the cultural and ecological values have not been studied in detail or may not be widely understood, geomorphic conditions are generally studied and reasonably well understood. The geomorphic analysis procedure can also be adequately performed at the level of detail appropriate for an EIS without the need to undertake additional investigation. For instance, the soil and geologic materials and physiography have been mapped and generally analyzed at a regional level (see Chapter 2, Appendix L, of this EIS). Regional hydrology is also well documented in Appendices A, E, L, and M of the EIS. Finally, using the information from the geomorphic analysis procedure, the formulation of management and protection plans as presented in Exhibit A of this appendix can be undertaken.

The geomorphic analysis procedure parallels the approach used during the National Reservoir Inundation Study (NRIS) (Lenihan et al. 1981, Ware 1989), conducted by a multiagency team to assess the effects of reservoir inundation on cultural resources. Like the NRIS, the geomorphic analysis procedure uses a hierarchical array of values that encompasses the entire cultural and environmental system. Both procedures separate information into three manageable segments including large-scale, medium-scale and small-scale values.

Large-scale resource values are regional in scope. They include regional ecological patterns, geomorphological conditions, cultural relationships, and cultural features. Reservoir construction and subsequent inundation of a significant reach of a river valley constitutes an important large-scale effect on the environmental context of the resource database. Replacement of the riverine and terrestrial environments with a reservoir transforms these into a single lacustrine environment. A significant body of information about the former ecosystems - including much of the cultural and geomorphological data connected to these systems lying both inside and outside the direct impact zone of the reservoir - is lost during the transformation. For example, the relationships between sites in the reservoir that are directly affected and those sites lying outside the reservoir that are indirectly affected by operation of the pool are altered or possibly destroyed.

Medium-scale values include local patterns of human use, vegetation assemblages, or geomorphic features. That is, sites or places where evidence of human use or a particular array of vegetation types or evidence of a geomorphic process can be found. A site is described as an assemblage of objects and their relationships with other objects in the ecosystem. For instance, the archeological context of a site is a set of ordered relationships that result from nonrandom output of human activities arrayed in the same time and space. Superimposing a reservoir on a site can alter these relationships by changing the environmental context of the site through acceleration of erosion. The long-term action of erosive waves and currents along the pool shoreline

[6] Review of Cultural Resources Concerns of the Systems Operations Review, SOR Draft EIS Appendix D. Cultural Resources, October 12, 1995.

redistributes objects, altering their spatial context. If enough material is eroded away and objects are displaced from the strata in which they were originally deposited, their time context is also altered.

Small–scale values include the objects on a site, such as the artifacts and features of the site. Since analysis techniques rely on objects or their attributes, the concern is focused on the effects of reservoir processes on objects or artifact assemblages and attributes. Each object, artifact, and feature has a set of measurable characteristics and attributes which carries some information about aspects of human behavior. A significant effect of reservoir inundation on artifacts and facilities is the loss of behavioral information their attributes can reveal. Other objects may respond to inundation by simple displacement; disaggregation; or changes in size and weight, shape, or chemical composition. However, such small–scale effects are cumulative and tend to gain significance over time. An example is the initiation of soil mass movement which begins at the soil particle level as water within the soil pores flows away from high pressure areas to lower pressure areas during rapid lowering of a reservoir. As water flows among the soil particles, some are moved. This creates larger and larger pore spaces which overlying soil moves to refill. The cumulative result of this small–scale movement is slumping or mass movement downslope. This changes the character of the site as well as some attributes of the objects on the site.

The geomorphic analysis focuses on how the alternatives can cause or accelerate erosion and landform change that can affect cultural resource values at all scales. The procedure is based on deductive reasoning. It will predict how certain material elements of the cultural resources will respond when geomorphic processes act on them. This is partly a qualitative, rather than quantitative, analysis because it involves making judgments from experience about the susceptibility of different landforms to erosional effects, the propensity of system operational features to cause these effects, and the density of cultural resource values that would eventually be discovered and recorded on these landscapes. To some extent, it depends on institutional knowledge or operational lore as the basis for generalizations about how the system operates and what the effects of the operational features could be. This knowledge is the result of accumulated experience with the system facilities and their operation.

The analysis also assumes that cultural resource values are a fundamental part of the environment and whatever affects one part will also affect all the other parts. Because of this broad definition of cultural resources and their complex interrelationship, significant cultural values occur on all landform types. Landforms that are too steep for habitation, for example, may have spiritual significance stemming partly from their inhospitable or inaccessible location. Cultural resource values associated with such sites may be particularly significant because of their rarity. These sites also have archeological significance because they can provide information about specialized activities and events that would remain unknown if such areas were overlooked. Inundation, erosion and landform change at any place in a reservoir is therefore a potential concern for cultural resource management.

This part of the analysis has two parts: 1) a brief discussion of erosion and sedimentation processes in reservoirs, and 2) a description of the operational features that the alternatives employ, and their potential generic effects on landforms and erosive processes that affect cultural resource values at all scales. This analysis is partly based on discussions of erosion and sedimentation in Appendix L, Soils, Geology and Groundwater.

3.1.1 Erosion and Sedimentation Processes

The effects of a reservoir on its environment begin before the impoundment is filled. The effects of vegetation clearing and earthmoving are primarily mechanical. They are to some extent temporary in nature, although the rearrangement of certain physical elements of the environment is permanent.

Because this study addresses only changes in the operational strategies of the reservoirs, the initial impacts of reservoir construction are considered only to the extent that the assumption is made that cultural resource values are sustaining ongoing, adverse impacts from inundation and other currently existing operational actions. It is also assumed that the level of impacts due to reservoir operation changes through time. For minimizing the impacts of a reservoir on the environment, the ideal operational strategy would be one in which the pool is filled rapidly, without fluctuations, and the entire direct impact zone (Figure 3–1) is a gently sloping, stable slope with protective vegetation cover or is composed of solid rock. Under such an ideal scenario, adverse effects to cultural resources would be confined to inundation. Interestingly, portions of the run–of–river projects on the Columbia Plateau approach this ideal.

Within the permanent pool, the dominant effects on cultural resources are from inundation and the biochemical processes that are active in that environment, although sedimentation and subaqueous erosion processes are also active in this zone of the reservoir. The geomorphic analysis views the cultural resources in the permanent pool as being protected, but not necessarily preserved. In terms of the adverse effects on cultural values this portion of the environment sustains, the inaccessibility due to inundation and burial in sediment have the greatest impact. The two geomorphic processes that dominate in this environment are mass wasting and fluvial and lacustrine deposition.

Within the zone of fluctuation (Figure 3–1), the predominant impact is erosion from the mechanical effects of wind, ice and water motion; waves, currents and water level changes. The zone of fluctuation is also subject to biochemical and anthropogenic impact, both of which produce widely varying degrees of adverse effect. This zone is where geomorphic processes are most active and where these processes cause the most impact on cultural resources. The erosional geomorphic processes that predominate in the zone of fluctuation include mass wasting, sheetwash, channeled flow, wave wash, ice gouging, and deflation (wind erosion). Depositional geomorphic processes active in this zone include mass wasting (mostly in the form of bank caving and sloughing), fluvial deposition from tributary streams and, when the pool is elevated, lacustrine deposition from the reservoir. Aeolian deposition is also an important sedimentary process in the fluctuation zones of the projects located on the Columbia Plateau.

The zone of indirect impact lies above the normal high water line. It is variable in extent and is primarily affected by susceptibility of the soils to erosion and mechanical impacts stemming from human use of the land. This zone is often overlooked when considering operational strategies because it is seldom or never in direct contact with the pool. However, reservoir levels directly influence such things as human access to the zone, stability of backshore soils, groundwater fluctuations and biological composition. Sediment issuing from this zone makes a major contribution to the total sediment load entering the reservoir. Erosion is the primary geomorphic process acting in the indirect impact zone. The adverse effects are mostly from mass wasting, sheetwash, channeled flow and direct rainfall impact, although erosion susceptibility factors condition the degree to which these processes affect cultural resources.

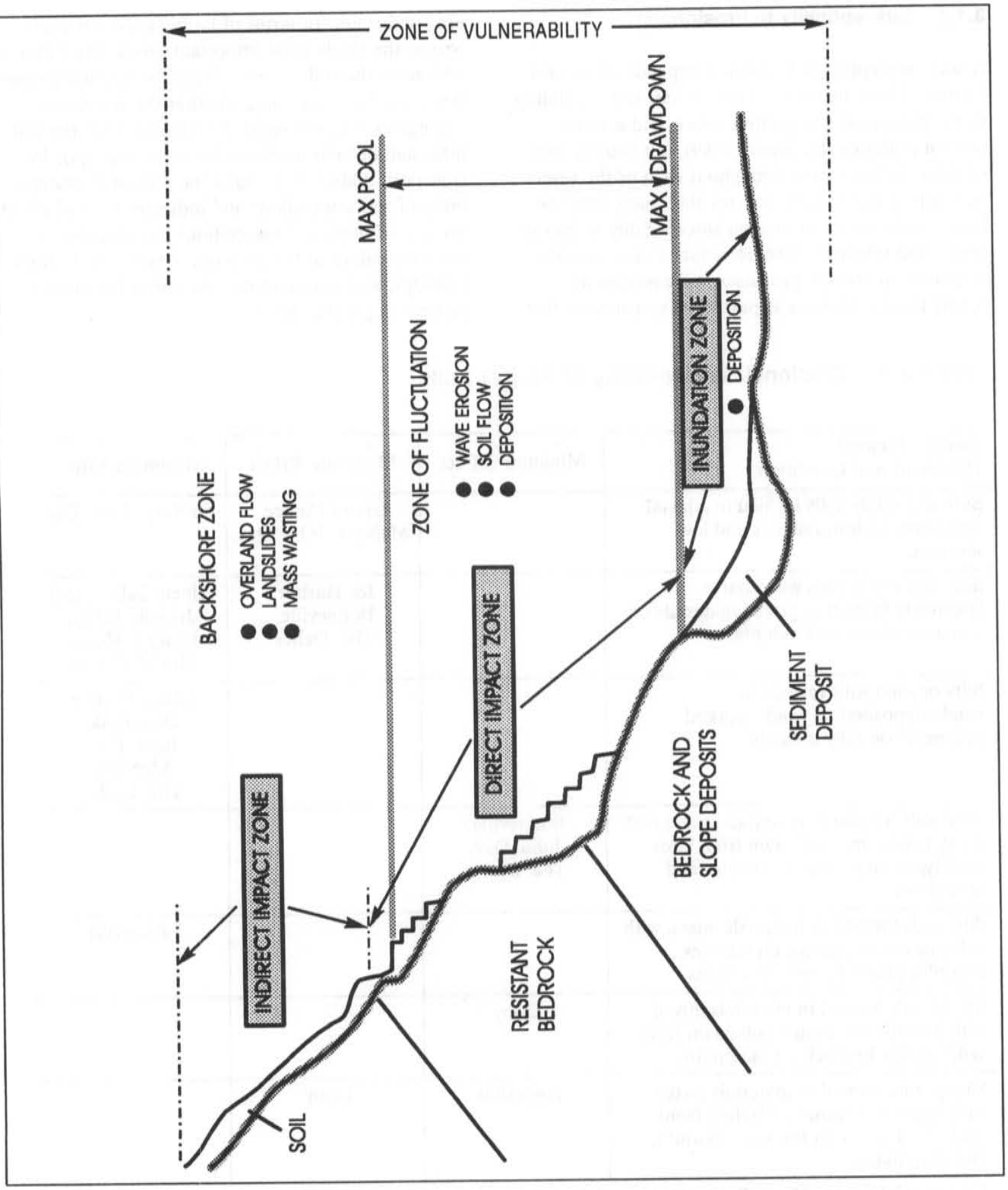

Figure 3–1. Geomorphic Process Areas in a Typical Storage Reservoir

3.1.2 Susceptibility to Erosion

A soil's susceptibility to erosion depends on several factors. These include rainfall effects, soil erodibility, slope, topography, vegetative cover, and erosion control practices (Buckman, 1969). Of course, each of these factors varies throughout each of the reservoir impact zones such that, for this study, only the large–scale aspect of erosion susceptibility is considered. Soil scientists have determined characteristic responses to erosion processes and customarily report these responses as part of all soil surveys that are conducted. In terms of large–scale considerations, the single most important erodibility factor to address is the soil texture. From the textural properties it can be determined whether the soil forms aggregates that will resist detachment from the soil mass and become available for wind, water, or ice transport. Table 3–1 shows the erosional susceptibility of soil associations and indicates level of effect erosion of these soil associations has on cultural resource values of the projects. (Appendix L, Soils, Geology, and Groundwater, describes the erosion process in greater detail.)

Table 3–1. Erosional Susceptibility of Project Soils

Erosion Factors/ Dominant Soil Condition	Minimum Effect	Moderate Effect	Maximum Effect
Silty and sandy soils formed in alluvial sediments on bottomlands and low terraces.		Grand Coulee, McNary, John Day	McNary, John Day
Silty and sandy soils with coarse fragments formed in glacial materials on terraces, plains, and mountains.		Ice Harbor, Bonneville, The Dalles	Albeni Falls, Chief Joseph, Libby, Hungry Horse, Grand Coulee
Silty or sand soils formed in wind–deposited or wind–worked sediments on hilly uplands.			Grand Coulee, Dworshak, John Day, McNary, The Dalles
Silty soils formed in materials mixed with rocky residuum–colluvium from basic rock types on plateaus, canyons, and mountains.	Bonneville, John Day, The Dalles		
Silty soils formed in materials mixed with volcanic ash or pumice on terraces, foothills, plateaus, and mountains.			Bonneville
Sandy soils formed in materials mixed with gravelly residuum–colluvium from sedimentary bedrock on mountains.	Libby		
Sandy soils formed in materials mixed with rocky residuum–colluvium from acidic rock types on terraces, foothills, and mountains.	Dworshak	Libby	

Source: "Columbia–North Pacific Region, Comprehensive framework study," Appendix IV, Vols. 1 and 2, Land & Mineral Resources; Pacific Northwest River Basins Commission; 1970.

Soils and landforms differ in their susceptibility to erosion at the various projects. Generally speaking, soils of the Columbia Basalt Plain physiographic province, on which the lower Snake and lower Columbia River projects (except Bonneville) are located, are derived from glacio–fluvial deposits. They are light soils, highly susceptible to erosion by water and wind (Pacific Northwest River Basins Commission, 1970). The lower Snake projects have steep slopes that are somewhat susceptible to slumping and landsliding. The lower Columbia projects have relatively shallow reservoirs, mostly without steep slopes, and are less susceptible to slope failure.

By contrast, soils in the Rocky Mountain physiographic province, within which are located many of the storage reservoirs such as Libby, Hungry Horse, and Dworshak, tend to be shallow and rocky. These soils are moderately susceptible to erosion. Many of these projects contain steep mountain slopes that are subject to landslides and slumps.

Soils in the transition zone between the Columbia Plateau and the Rocky Mountain physiographic province, where the Grand Coulee and Chief Joseph projects are located, are a special case. Large portions of these reservoirs are covered in sedimentary deposits of glacial Lake Columbia; these silts and sands are highly erodible.

Further studies of soil conditions at the 14 projects would lead to a clearer understanding of their individual susceptibility to erosion and landform change that would help in assigning priorities for monitoring and mitigation plans. A study of land–form change and cultural resources that the Corps of Engineers Waterways Experiment Station is conducting focuses specifically on these issues at the John Day and Dworshak projects.

Shoreline equilibrium is another important concept applicable to the geomorphic analysis. Under consistent operating conditions, and where soils are less susceptible to erosion, reservoir shorelines can reach a state under which further erosion and sedimentation are stable or nearly stable. By the time this happens, cultural resources in the stable shore zone will have been largely destroyed. If the reservoir stays at or returns to this level, however, the erosion of nearby areas can slow. If reservoir operations establish a new stable stand, the shoreline equilibrium can be upset, and major new impacts can occur.

Several factors account for the shoreline equilibrium state. Waves will cut benches through softer soils to bedrock, for example, after which erosion of the bedrock occurs at a much slower pace than before. As waves dissolve finer and looser soil elements, heavier and less transportable rock pieces accumulate on the shoreline. These eventually armor the underlying softer soil from wave action, slowing erosion considerably.

Shorelines can also reach a point of equilibrium due to the completion of slope failure cycles. Due to the repeated action of on–shore waves, a stable reservoir shoreline will begin to cut a bench or notch in a hill slope. Depending on the strength of the shoreline soil material, wave erosion may cut a vertical bank. In clayey or gravelly soils, this bank may reach tens of meters in height. At some point, continued erosion at the slope's toe or loss of stability due to groundwater pressures may cause this cut–bank to fail. This may also occur due to rapid drawdowns, when water held within the soil mass weighs down the soil in the bank, causing it to slump into the reservoir. These failures produce spectacular slides, mudflows, and slumps along reservoir shorelines. Groundwater flow can also cause these slope failures. Cultural resources located on slumping landforms are often destroyed.

A similar erosion mechanism along reservoir shorelines is landsliding. This can occur especially in areas with steeply sloping bedrock and shallow soils. In such places, groundwater flow between soil and rock can exert enough pressure to lift the soil away from the rock surface. This can occur where waves have cut a notch or bench at the bottom of the slope, removing the slope's supporting base. Landslides are often set off by rainfall or snowmelt which saturates soil pores, raising their water pressure. Hillslopes in a reservoir drawdown zone are particularly susceptible to landsliding, because they are devoid of vegetation that would otherwise help to hold the soil mass together.

A wave–cut bank may never develop in silts, sands, or other low–strength soils because the soil materials do not possess sufficient strength to support vertical banks. In these cases, wide, gently sloping beaches form. Such soils are particularly susceptible to internal erosional processes, such as piping, that are especially aggravated by rapid reservoir fluctuations. Hummocky ground, potholes, linear ridges, and depressions along the reservoir shorelines are characteristic of such soils. Fluctuations and rapid drawdowns can cause the buildup of high fluid pressures within the soil pores. When the reservoir level drops, the soil releases this water rapidly, resulting in small–scale slumping, piping, and wasting.

Sheet erosion is another problem that can become serious under some conditions. In devegetated reservoir drawdown zones, runoff from rainfall can concentrate in rills and gullies on long or steep slopes. Run–of–river reservoirs generally do not develop this type of erosion, since they never have substantial areas of exposed reservoir slopes, and exposed slope lengths are short.

A small percentage of reservoir erosion is directly anthropogenic, or human–caused. Boat wakes and dredging cause minor and generally localized erosion. In some reservoirs, road cuts and side–cast fills become erosion sites when shorelines impinge upon them, although these are generally stabilized and repaired.

3.2 COMPUTER SIMULATION ANALYSIS

The CRWG designed the computer simulation study to meet several goals related to the SOR. One goal is to compare the potential effects of each alternative as NEPA requires. The Group understood that project effects on cultural resources are ongoing, and that archeological and historic sites and traditional cultural properties in and near the reservoirs will continue to deteriorate under any of the alternatives chosen. Nevertheless, the alternatives for operation would manage reservoir water levels and flow rates very differently and in ways that differ significantly in their overall effects on the resources.

Another goal of the CRWG is to compare potential rates of ongoing impact among reservoirs, as an aid in planning the operations phase of the SOR. Impacts could occur more rapidly at some reservoirs than others because of system operation modes and archeological and historic site locational patterns.

A third goal of the SOR is to make the best use of available data, since a "complete" analysis of cultural resources and potential effects would not be feasible for the SOR EIS. Such an analysis would require a complete archeological survey of each reservoir pool and adjacent backshore areas, the testing of hundreds of archeological sites, and individual analyses of the susceptibility to project effects of each of the hundreds of sites likely to be found significant. Such an effort would be far too costly and time–consuming to meet the SOR objectives. These activities are planned as part of ongoing resource management efforts at each reservoir.

A final goal of the SOR and CRWG is to summarize and simplify the SOR and its effects, with its 14 major projects and 13 operational alternatives (21 draft alternatives), more than 2,250 known archeological and historic sites, and a multitude of traditional cultural properties.

Some members of the CRWG object to the computer simulation model on the basis that not all reservoirs have completed archeological inventories and some archeological records for others are dated or of poor quality. Results may, therefore, be misleading. The following discussion addresses these concerns in two ways. First, it includes as much information as is available about data completeness and quality. Second, it cautions that the results of the simulation should not be extrapolated or extended to apply to cultural resources in areas that have not been inventoried. When discussing reservoirs having incomplete data, it provides cautionary notes about interpreting the simulation results.

3.2.1 Purpose of Simulation

The computer simulation provides a powerful analytical tool to meet the SOR objectives. Computer simulations are logical models that summarize the fundamental aspects of complex systems. They are made of: 1) logical definitions of relationships between variables in the real system, and 2) changes in the values of variables in response to changing conditions. The logical relationships are defined in computer language in a computer program. The values are fed to the program from a data base. The simulation defines relationships between certain variables as important or key relationships, and changes their values to see how they interact over simulated time. Data fed into a simulation can be data that is collected or estimated from real systems, or it can be hypothetical.

In scientific practice, a simulation study is not meant to be a hypothesis testing tool, but rather an exploration, modeling, or planning tool. The primary value and function of simulation studies is that they allow a researcher to test intuitive assumptions about logical relationships in real systems for consistency. Simulations, however, frequently produce results that are unexpected or counter–intuitive. For this reason, they can be powerful tools for generating hypotheses to be tested against carefully controlled data from real systems or for planning system operation or management.

A simulation model is a simplification of a real system. This is a strength in that the model can filter out the "noise" of an extraneous or misleading variation in the real system that does not have a major effect on how the system works or on the variables under study. The limits that modeling simplifications impose should be stated clearly, however, so that the results can be interpreted with these limits in mind.

The hydroregulation model that the River Operation Simulation Experts (ROSE) developed for the SOR is itself a simulation and a planning tool. It simulates how each of the reservoirs would operate (in terms of outflow, elevation, and other data) under each of the alternatives over a 50–year period. Since reservoir operations vary depending on the precipitation and snowmelt cycle, the hydroregulation model uses recorded riverflow data from 1929–1978 to simulate a 50–year period in the future. Though no future 50–year time span would provide exactly the same precipitation and runoff as the 1929–1978 time period, the model period is the best estimate of any given 50–year period that might occur. It is a long enough period to encompass both dry and wet years. Using this model data to simulate reservoir operations allows the system operators to show how flows and reservoir elevations would vary in relation to one another at the projects, given these conditions.

3.2.2 Components of the Simulation

The CRWG simulation model incorporates: 1) data inputs from two sources, and 2) program statements that process the data according to logical rules to calculate the output values (Figure 3–2). The model uses the 50–year ROSE hydroregulation data to simulate reservoir fluctuations as one input data base. It also uses a database that the CRWG developed that contains information about each archeological and historical site. The ROSE data is based on measurements of waterflows at each of the 14 projects over the past 50 years. The archeological data includes the elevations of the upper and lower boundaries of each known archeological or historic site located within the reservoir and backshore areas at each project.

The computer model simulates the rising and falling of reservoir shorelines and their potential effects on the known archeological or historical sites. It does so by tracking the movement of each reservoir shoreline from month–to–month across the 50–year hydroregulation model timespan. For each archeological or historic site, it calculates the potential effects of reservoir operation on the site as: 1) the number of days in the 50–year simulation period that a shoreline would be within site boundaries; 2) the number of days that a shoreline would be below the site's upper boundary, thereby exposing it to erosion and vandalism in the drawdown zone; and 3) the number of days that the site would be completely underwater and subject to siltation, chemical change, and inaccessibility.

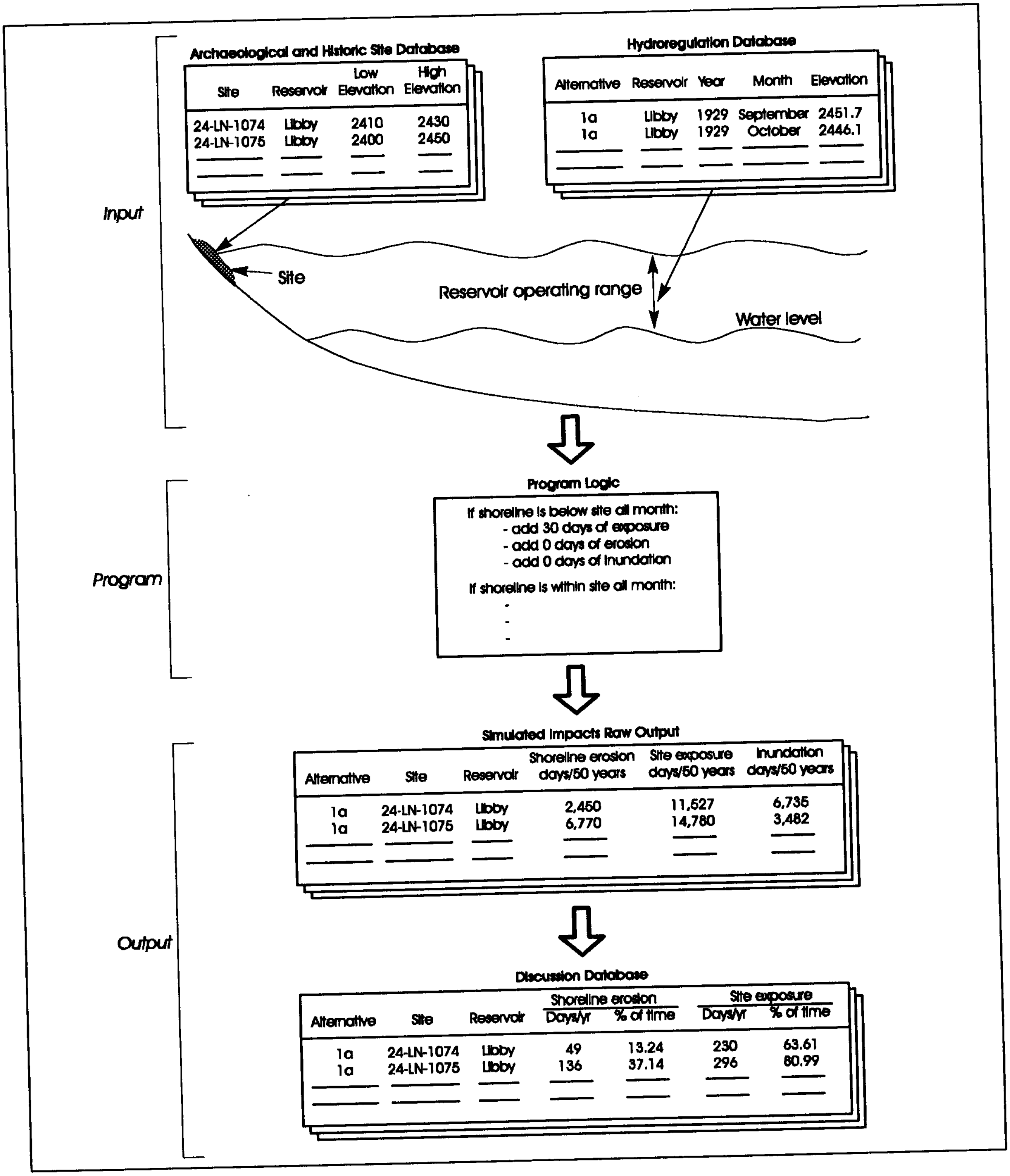

Figure 3–2. Schematic Diagram of the Computer Simulation Study Inputs and Outputs

The model does this by matching the archeological or historical site's upper and lower elevational boundaries with monthly reservoir elevations from the hydroregulation data base. To compare reservoirs and alternatives, it adds up the estimated effects at all the archeological and historic sites within each reservoir and for each alternative. The simulation program records the gross number of days within the 50–year period that the three impacts would occur (18,262 days possible). To make the results more understandable, it then converts the raw figures into percentages of time affected, and average days of impact per year.

3.2.3 The Hydroregulation Data

As already mentioned, one data input to the model is a component of ROSE's simulation of the operation of the 14 SOR reservoirs. This component is the end–of–month reservoir elevation estimate. Other components of the hydroregulation model, such as inflows and outflows, are not part of the CRWG simulation.

The reservoir elevations data base contains a separate data file for each alternative. Each file contains reservoir elevations for each system reservoir at 14 times during each of 50 years. The time periods correspond with the ends of the months, except for April and August. These 2 months are divided into two time periods since water levels can change rapidly during them. The model period is based on actual streamflows from September 1929 through August 1978. For each SOS, these elevations estimate the ways in which the reservoirs would fluctuate in a future 50–year period exactly like the model period.

Hydroregulation Data Limitations

Because its purpose is to capture the essentials of system operation, the hydroregulation data incorporates certain simplifications when compared with the real system. Following are some of those simplifications:

(1) The hydroregulation model assumes a constant rate of reservoir level change from month–to–month. In the real system, the rates of elevation change are not always constant and one–directional.

(2) The ROSE simulation does not include significant weekly or daily fluctuations in reservoir operations. In the real system, the operators can "fine tune" reservoir levels by imposing minor fluctuations while meeting overall monthly goals.

(3) The hydroregulation model holds reservoir pool levels at several reservoirs constant. These are: Chief Joseph, McNary, Bonneville, and The Dalles. The real reservoirs can fluctuate up to 5 feet (1.5–meter) per day. This is done for fine tuning of system operations.

These simplifications would probably not significantly bias the outcome of the simulation model results. This is because real fluctuations in rates of elevation change, and daily or weekly system tuning would probably not differ among SOS alternatives. Nevertheless, these simplifications should be kept in mind when interpreting the results.

3.2.4 The Archeological and Historic Site Data

Archeological and historic site data input to the simulation model consists of the site numbers and elevations at the upper and lower boundaries of each site. This data base is the most recent compilation of all available site data at the projects, as prepared by the CRWG. It includes information about prehistoric and historic archeological sites and historic architecture. It does not contain information specifically about traditional cultural properties or traditional Native American use resources.

The data stems from the archeological inventory that have occurred at various times since the projects were constructed. The history of site inventory work is summarized in Chapter 2 and the data itself is summarized in Appendix B. Table 3–2 is

Table 3–2. Archaeological and Historic Sites Database of Currently Recorded Sites

Project	CRWG Database	Complete Data	Above Pool	Within Pool	Always Inundated*	Percent Surveyed**	Comment
Hungry Horse	30	24	0	24	0	~15	Systematic inventory of slopes 30 percent above minimum pool (in progress).
Libby	250	249	18	231	15	>90	Systematic and intensive inventory 1970s–80s of land above minimum pool; spot check (5 percent?) of lands below minimum pool in early 1960's.
Albeni Falls	375	369	8	361	0	>90	Systematic inventory in mid–1980s of land above minimum pool.
Grand Coulee	338	273	93	180	38	<40	Inventory of land surfaces above minimum pool in progress; numerous spot checks in 1960's of areas above minimum 3rd powerhouse–construction pool; land below minimum pool spot checked in late 1930s.
Chief Joseph	347	311	140	171	76	>95	Inventoried systematically above 945 in late 1970s; 900–945 checked in late 1940s and augmented by photointerpretive inventory in 1980s.
Dworshak	214	185	2	183	33	~60	Systematic inventory in late 1980s of areas above minimum pool. Earlier inventory of lands near river level.
Lower Granite	138	135	21	114	0	>90	Extensive but not systematic inventory of areas below minimum pool in late 1960s; several rechecks of current shorelines in 1970s, 80s. Aggregate inventoried area probably is between 20 and 60 percent of total project land area.
Little Goose	76	76	1	75	0	>90	Spot checks of land below minimum pool in 1940s and early 1950s. More extensive checking in 1960s. Several rechecks of current shorelines in 1970s, 80s. Aggregate inventoried area probably is between 10 and 50 percent of total project land area.
Lower Monumental	38	38	28	10	0	>90	Spot checks of land below minimum pool in 1940s and early 1950s. More extensive checking in 1960s. Several rechecks of current shorelines in 1970s, 80s. Aggregate inventoried area probably is between 20 and 60 percent of total project land area.
Ice Harbor	33	32	7	25	1	>90	Spot checks of land below minimum pool in 1940s and early 1950s; spot checks in 1970s–1990s. Aggregate inventoried area probably is between 10 and 30 percent of total project land area.
McNary	127	120	15	105	81	<1	Spot checks of land below minimum pool in 1940s and early 1950s; spot checks in 1970s–1990s. Aggregate inventoried area probably is between 10 and 30 percent of total project land area.

Table 3–2. Archaeological and Historic Sites Database of Currently Recorded Sites – CONT

John Day	203	187	57	130	45	<1	Spot checks of land below minimum pool in 1940s and early 1950s; spot checks in 1970s–1990s. Aggregate inventoried area probably is between 10 and 30 percent of total project land area.
The Dalles	57	54	33	20	10	<1	Spot checks of land below minimum pool in 1940s and early 1950s; spot checks in 1970s–1990s. Aggregate inventoried area probably is between 10 and 30 percent of total project land area.
Bonneville	21	21	7	14	1	<1	Never inventoried; a few spot checks of areas above minimum pool from 1930s through the 1980s.
Totals	2,247	2,074	430	1,643	300		

* Below the lowest simulated pool levels for any alternative.

** Percent of reservoir operating pool (above minimum operating pool and below maximum pool) surveyed.

summary of this data base, showing the numbers of recorded sites per project, those with elevation data available, and those located above the maximum pool level in the backshore area. Only data for sites with known elevations located within the reservoir pool were entered into the simulation model. Sites above the pool are also subject to impacts from vandalism and looting. These effects would probably not vary between alternatives, though they would vary from project to project because of differences in accessibility and levels of recreational use.

Archeological inventory coverage of the reservoir operating pool is relatively complete at some projects, and not as complete at others. Table 3–2 shows the estimated completeness of the data, based on a survey of the literature and discussions with archeologists having experience at the projects. These estimates of completeness are necessarily rough, since the inventories were completed at different times and under different methodologies; with different standards of adequacy and assumptions regarding what might be found. In general, however, it is fair to say that inventories are mostly complete at the Libby, Chief Joseph, and Albeni Falls Projects, except for areas below minimum pool. Inventory of the lower Snake River projects (Lower Granite, Little Goose, Lower Monumental, and Ice Harbor) are also fairly complete, both for lower pool zones near the river and for the drawdown zones. More recent inventories that have been made along the shoreline and in the drawdown zone have probably been more intensive, however, than the pre–dam inventories that encompassed the entire river canyon. The lower Columbia projects (McNary, John Day, The Dalles, and Bonneville) had little or only cursory survey before the dams were built. Subsequent inventories in the operating pools have filled in some of these gaps, although Bonneville, in particular, is poorly understood. The data for Grand Coulee is not complete and is of poor quality, and a project is currently ongoing to complete additional inventory of this large reservoir and update the extant site records. Recent inventories have greatly improved the data from Hungry Horse and Dworshak. The former is about 15 percent inventoried; the latter, about 60 percent.

Site Incidence Analysis

Analysis of the distribution of archeological and historic resources in relation to reservoir features demonstrates clearly that existing inventories focused mainly on the reservoir operating pools, rather than the backshore areas or below minimum operating pool. The CRWG demonstrated this by calculating the frequency of archeological deposits by elevation at each reservoir. Figures 3–3 and 3–4 demonstrate this graphically for John Day and Dworshak Reservoirs, representing run–of–river and storage reservoirs, respectively.

Some archeological sites extend over a broader range of elevations than others. Sites located on steeper slopes, for example, might be more subject to wave erosion than those on relatively flat land. Because of this, the CRWG divided the sites into 5–foot (1.5–meter) elevational increments called site incidences. A site with a recorded elevation of 1,400 feet (427 meters), for example, has one site incidence. A site with the recorded elevations of 1,400 through 1,420 has a site incidence of four, since it spans four 5–foot (1.5–meter) increments. Citing John Day Reservoir as an example, there are 203 individual recorded sites, and 642 site incidences.

The site incidence analysis focuses on the system operation effects that would occur within a zone of vulnerability" that extends between 15 feet (4.6 meters) below Minimum Operating Pool (MOP) and 20 feet (6 meters) above Maximum Operating Pool (MAX). This is the zone within which would occur most of the effects of recreational use, shoreline erosion from wind– and boat–driven waves, sheet and wind erosion from drawdown zone exposure, and erosion from near–shore currents.

Figures 3–3 and 3–4 illustrate that, for John Day and Dworshak Reservoirs, the known cultural resources sites are disproportionately from within the reservoirs' operating zones. This is because reservoir operations have caused sufficient erosion at these projects to make the sites more visible for recording. It is also because survey efforts have focused mostly in this zone.

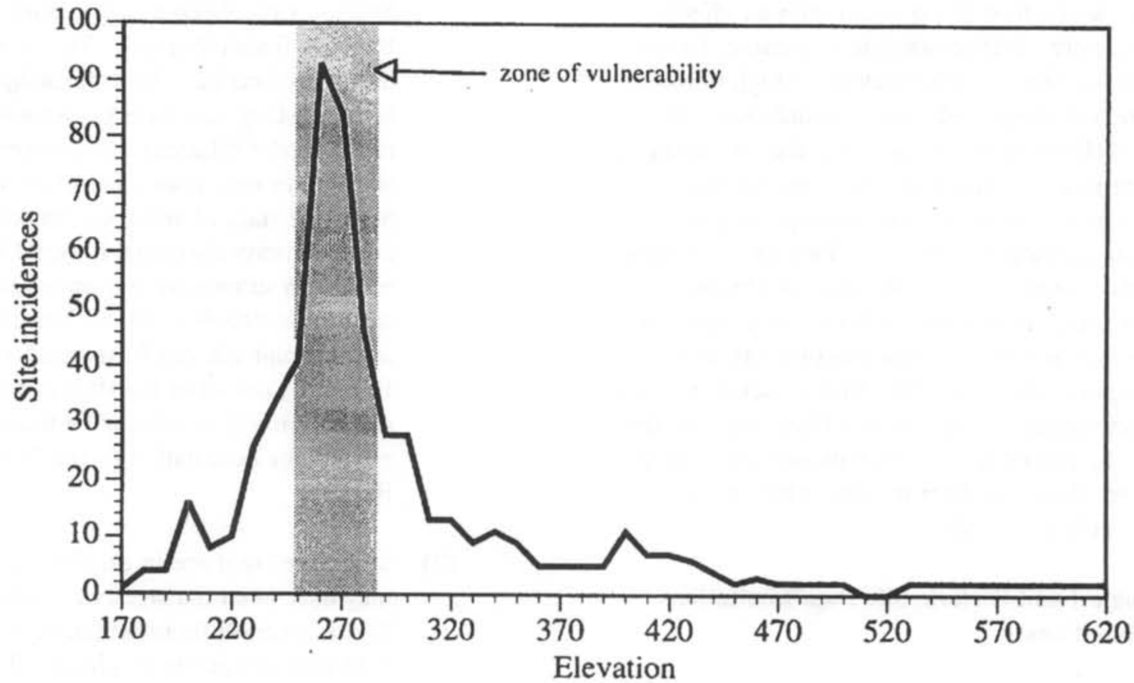

Figure 3–3. Number of Site Incidences per 5 Feet of Elevation at John Day Reservoir

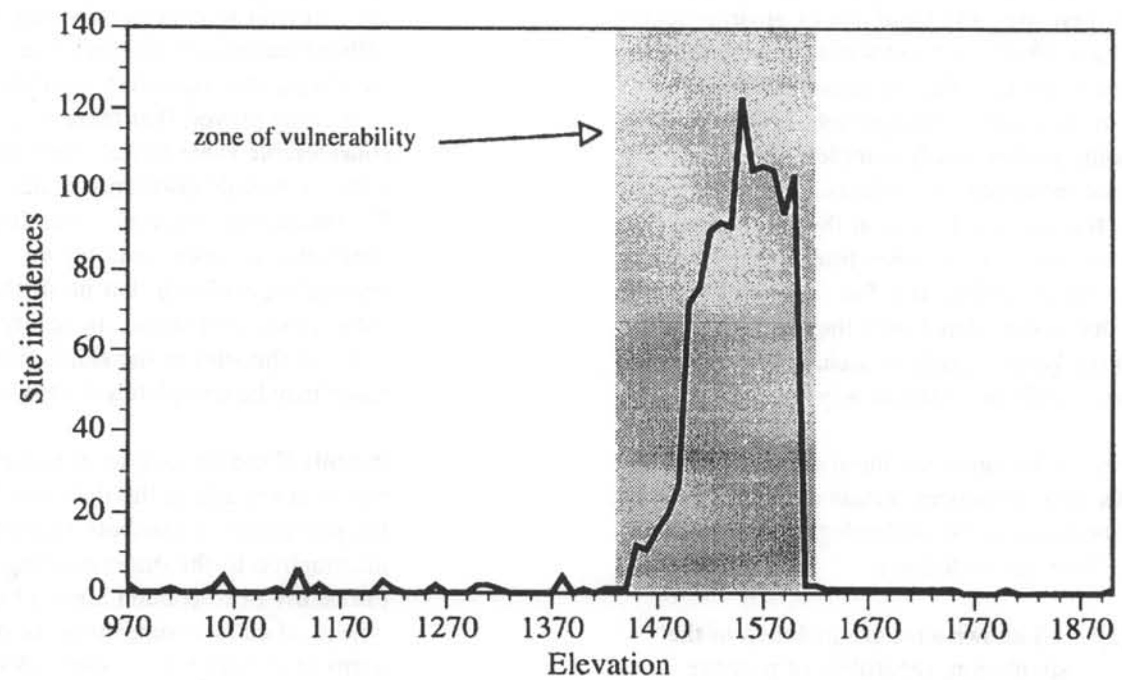

Figure 3–4. Number of Site Incidences per 5 Feet of Elevation at Dworshak Reservoir

The computer simulation analysis also focuses on the operation zone, since this is where project effects are most severe. It is reasonable to assume, however, that actual site densities may be as high in the backshore and deep pool zones. Inundation and backshore effects in these zones are also occurring at a constant rate, and there may be more undiscovered sites in the backshore and deep pools zones than in the operating pool zone. Though the simulation model counts the days of deep pool inundation at known sites, undiscovered sites in the deep pool, particularly in the lower Columbia projects, may remain unaccounted for. Sites in the backshore area are always subject to vandalism and looting, and this effect would probably not vary between alternatives. These facts should be kept in mind when interpreting the simulation results.

Archeological and Historic Site Data Limitations and Assumptions

The ideal data set for input to the simulation would have been gathered under consistent assumptions and methods. It would comprise a complete inventory of the reservoirs, or at least a representative sample of their sites and landform or environmental zones. The available data set was instead gathered at different times by different investigators, using different methods and assumptions. Inventory of the operating pool is nearly complete for some projects and incomplete for others. This does not invalidate the use of this data in the simulation, but it should be kept in mind when interpreting the simulation study results. It is fair to assume that the site data that accumulated over the years was gathered with the general goals of archaeology in mind and is comparable in a general way.

As with the hydroregulation input data, the simulation model also introduces certain assumptions and simplifications about the archeological and historic site data. They are as follows:

(1) All known sites are included in the simulation, regardless of putative National Register status. In a regulatory sense, all sites are potentially eligible for National Register nomination until a SHPO or the Keeper of the National Register finds otherwise. Very few sites in the projects have been formally tested. Many that have been tested were tested under different assumptions about site significance than are currently held. Since the state of archeological knowledge is always changing, it would be unwise to summarily and unnecessarily write off archeological and historic sites at this point without further information. In reality, not all of the sites in the simulation will eventually be found eligible for nomination to the National Register.

(2) Some sites that are in the data base may have been damaged or destroyed. There is very little information in the data base about site condition. The Corps–sponsored monitoring study of a sample of sites in the drawdown zones at Lower Granite and Little Goose (Draper 1992a) showed that it is very difficult to conclusively determine without excavation whether sites in this zone truly are completely destroyed. This study proved that there may be considerable value left at many sites within reservoir drawdown zones. Therefore, sites were removed from the simulation as destroyed only on compelling evidence that no further value could exist there. In reality, only a few of the sites in the simulation study may be completely destroyed.

Despite these limitations, it is generally true that any site in the data base has the potential to contribute significant information to the understanding of prehistory or to contain human burials, objects of cultural patrimony, or other items of importance to Native Americans. Therefore, all sites are included in the simulation.

(3) The simulation model does not account for subtle and local factors affecting susceptibility to erosion because of soil and landform conditions, or to vandalism and artifact theft because of easy access and proximity to population centers. These do vary from reservoir to reservoir and site to site. To some extent, the geomorphic analysis is designed to compensate for the lack of site–specific soil conditions information. Susceptibility to vandalism is highly site–specific, and accurate information about patterns of vandalism is not available. Even reservoir operations could affect susceptibility to vandalism. For example, when reservoir pools are drawn so low that boat ramps are landlocked, there may be less vandalism resulting from water access. The simulation does not model this effect because accurate information about the levels of vandal boat traffic is not available.

(4) It has not been possible to verify all of the site elevation data in the model. The data for Dworshak and the lower Snake projects were checked against the topographic maps in the appendix to the Corps options analysis (Draper 1992b). The data for Grand Coulee was checked against numbers in an appendix to a recent study (Galm 1994). The CRWG data base, however, was recently constructed from existing site records. It should be considered mostly reliable.

One potential problem is that 30 percent of the site records contain only one elevation figure. These may be mostly sites that are on relatively flat land so that the site recorder could not distinguish upper and lower boundary elevations. In the simulation, these sites are given 10 feet of elevation difference between their upper and lower boundaries. The real sites may exhibit more or less variation than this, and the model results are sensitive to the elevation figures. If the real sites have a broader range of elevations than the data base reflects, then the simulation would underestimate shoreline erosion somewhat, and overestimate site exposure slightly.

The lack of highly specific, localized information about susceptibility to vandalism and erosion may bias the simulation results somewhat, but it is difficult to anticipate how it would do so. The model counts days of site exposure to these effects. If one reservoir were more prone to vandalism or to erosion than another, then the model results would be overestimated for the reservoir less susceptible to these effects and underestimated for the more susceptible reservoir. The CRWG depends on the knowledge of those familiar with the reservoirs and their cultural resources to compensate for this potential bias. There is further discussion of potential bias and possible corrective factors in Chapters 4 and 5.

In general, the relationships and trends in the data that the simulation highlights will hold true regarding the differences between reservoirs and alternatives. The level of data precision available to the simulation is suitable for its purposes. These purposes are: 1) to compare the reservoirs and alternatives in terms of their general potential rates of ongoing impact to the known archeological and historic sites, and 2) discover major trends in variables that will assist in future planning.

3.2.5 The Simulation Program

The computer simulation program is a series of computer instructions that process the hydroregulation, archeological, and historic site data and calculate rates of ongoing impact to the known sites. For each site, the program calculates: 1) the number of days and percentage of time (in the 50–year model period) that the reservoir shoreline would be within the site boundary; 2) the number of days and percentage of time the site would be exposed to the open air within the drawdown zone; and 3) the number of days and percentage of time that the site would be inundated.

The computer program performs the calculations for each archeological or historic site in turn. The analyst runs the program separately for each SOS by commanding the program to link the hydroregulation model data file for a particular SOS. The program then determines and stores five essential values. These are: 1) reservoir elevation at the end of the previous month; 2) reservoir elevation at the end of the current month; 3) the site's upper; and 4) lower elevations, and 5) the number of days in the current month or half–month. The program obtains the two reservoir elevations from the hydroregulation database. It obtains the site elevations from the archeological and historic site data base, and it determines the number of days in the current month from a list of months that is stored in the program. It thus assigns 28, 29 (leap year), 30, 31, 15, or 16 days to the month or semimonth at hand. Since April has 30 days, the program assigns its half–month segments each 15 days. August's half–month segments are 15 and 16 days long, respectively.

To calculate rates of effect, the program compares the upper and lower elevations of the archeological or historic site with the reservoir surface elevations for the previous and current months. It then determines which of 10 logical cases applies to the current site and month (Figure 3–5). These cases are:

(1) Shoreline stays above the site all month.

(2) Shoreline stays below the site all month.

(3) Shoreline moves from above site to below site.

(4) Shoreline moves from below site to above site.

(5) Shoreline moves from within site to above site.

(6) Shoreline moves from within site to below site.

(7) Shoreline moves from above site to within site.

(8) Shoreline moves from below site to within site.

(9) Shoreline moves downslope within site.

(10) Shoreline moves upslope within site.

Once the program determines which logical case applies, it calculates the estimated number of days during that month–segment that the site would experience: 1) shoreline erosion; 2) site exposure in the drawdown zone; or 3) inundation. The program estimates the numbers of days for these measures as proportions of the total days in that month or month segment. If the shoreline moved across a site boundary during the month, the proportion applied is the proportion of the total elevational change that month during which the shoreline stayed within the site boundary.

Assume, for example, that Reservoir A rises from 1,000 to 1,100 feet (305 to 335 meters) elevation in a given month and that an archeological site extends between 1,000 and 1,050 feet (305 to 320 meters). If the month in question were September, which is 30 days long, the program would assign 15 days of shoreline erosion to the site for that month because the site takes up half the span of elevational change from the previous month and 15 days is half of the 30–day time span. If the site extended between 1,025 and 1,050 feet (305 to 320 meters), the program would assign 7.5 days of shoreline erosion.

For shoreline erosion, the program thus compares the distance the shoreline moved within the site to the distance the shoreline moved altogether that month. This ratio, multiplied by the number of days in the month or half–month, gives the number of days of shoreline erosion for that month. The program calculates site exposure in the drawdown zone in the same way, except that site exposure occurs when the shoreline is anywhere within or below the site boundary. If this is the case, the program adds the total number of days in that month or half–month to the total for the site.

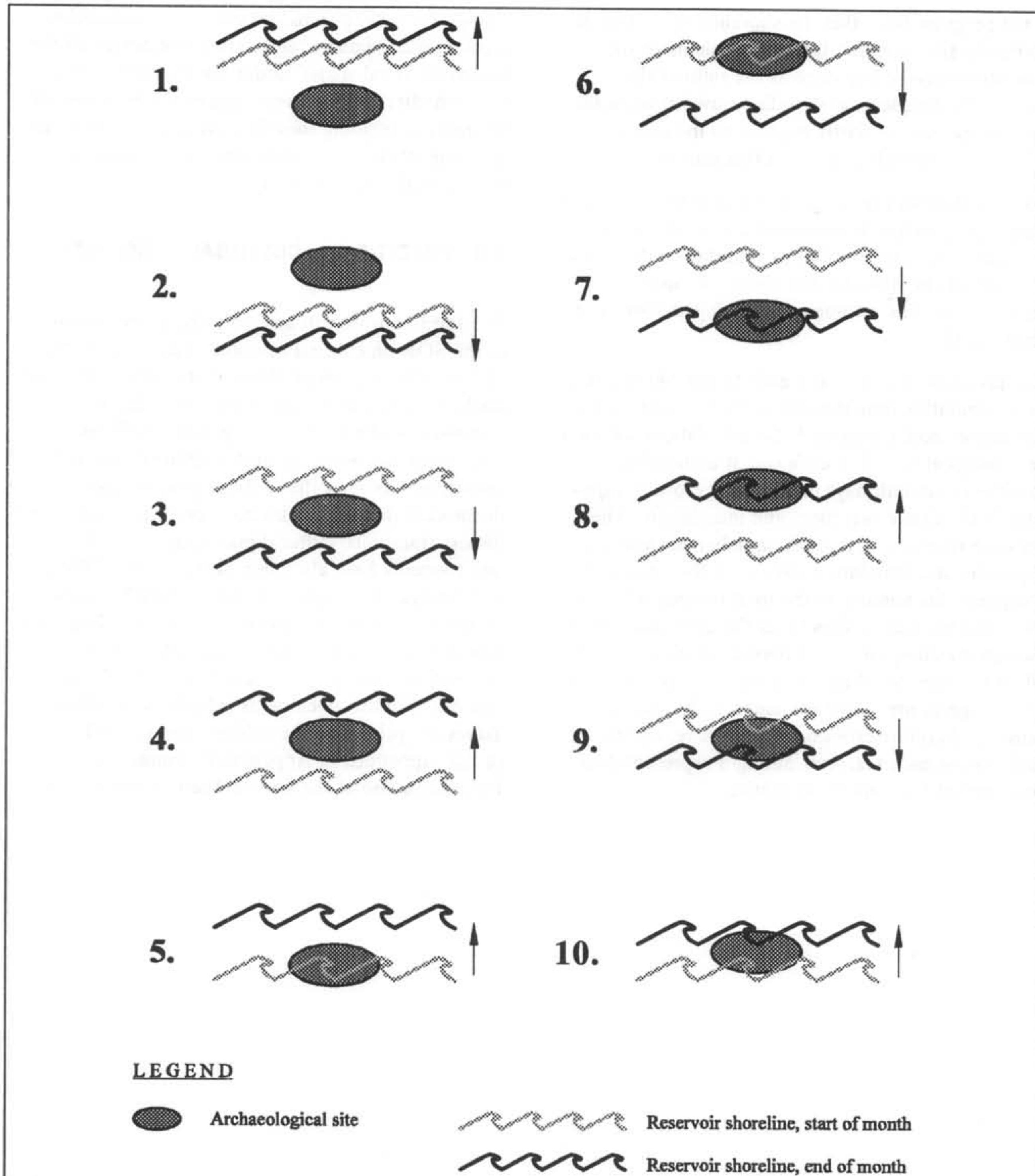

Figure 3–5. Ten Logical Cases of Reservoir Shoreline Movement near Archeological Site Boundaries. The Computer Program Uses the Cases to Determine how to Simulate Reservoir Operation Effects

If the program finds that the shoreline moved from above the site to within the site, it calculates the number of days of exposure as the ratio of the elevational distance the shoreline traveled when the site was entirely or partly exposed to the entire distance the shoreline traveled that month.

For inundation, the program looks at the amount of time the shoreline flooded some part of the site, and calculates the number of inundation days as a fraction of the distance the shoreline moved that month, times the number of days in the month or semimonth.

The program steps through each of the 700 monthly or semimonthly time periods in the 50–year hydroregulation model, making these calculations for each archeological site. For each site, it accumulates the month–to–month days of shoreline erosion, exposure in the drawdown zone, and inundation. Then, for each reservoir, it adds the number of shoreline, exposure, and inundation days at all the sites, and compares this number to the total number of site–days (the number of sites times the total number of days in the 50–year model period, which is 18,262) when the sites could have experienced these effects. These figures are rough estimates of the rates of ongoing shoreline erosion, site exposure, and inundation at each reservoir during a representative time period for a given alternative.

The program then sums the site–days of shoreline erosion, site exposure, and inundation across all the reservoirs as calculated under the hydroregulations for each alternative. These figures are estimates of the rates of ongoing shoreline erosion, site exposure, and inundation under each alternative during a representative time period.

3.3 TRADITIONAL CULTURAL RESOURCES

The third approach to assessing the potential effects of the SOR on cultural resources was to invite the 14 federally recognized Tribes that traditionally used lands in the Columbia and Snake river basins to comment on the SOR and its potential effects on traditional use resources and traditional cultural resources. Some of these Tribes have prepared documents that discuss their concerns and issues and discuss traditional cultural practices. These issues and concerns have also been expressed in CRWG and Analysis Management Group (AMG) meetings. A summary of Tribal concerns is found in Chapter 1. Examples of effects of system operation on traditional values and practices are in Chapter 4, Section 4.6. Various documents submitted by affected Tribes are printed in the exhibits section at the back of this Appendix; in Appendix T, Comments and Responses; and at the back of the EIS Main Report.

CHAPTER 4

ALTERNATIVES AND THEIR IMPACTS

4.1 GENERAL DESCRIPTION OF ALTERNATIVES

Seven alternative System Operating Strategies (SOS) were considered in the Draft EIS. Each of the 7 SOSs contained several options, bringing the total number of alternatives considered to 21. This Final EIS also evaluates 7 operating strategies, with a total of 13 alternatives now under consideration when accounting for options. Section 4.1 of this chapter describes the 13 alternatives and provides the rationale for including these alternatives in the Final EIS. Operating elements for each alternative are summarized in Table 4–1. Later sections of this chapter describe the effects of these alternatives on Cultural Resources.

The 13 final alternatives represent the results of the third analysis and review phase completed since SOR began. In 1992, the agencies completed an initial effort, known as "Screening" which identified 90 possible alternatives. Simulated operation for each alternative was completed for five water year conditions ranging from dry to wet years, impacts to each river use area were estimated using simplified analysis techniques, and the results were compared to develop 10 "candidate SOSs." The candidate SOSs were the subject of a series of public meetings held throughout the Pacific Northwest in September 1992. After reviewing public comment on the candidate strategies, the SOR agencies further reduced the number of SOSs to seven. These seven SOSs were evaluated in more detail by performing 50–year hydroregulation model simulations and by determining river use impacts. The impact analysis was completed by the SOR workgroups. Each SOS had several options so, in total, 21 alternatives were evaluated and compared. The results were presented in the Draft EIS, published in July, 1994. As was done after Screening, broad public review and comment was sought on the Draft EIS. A series of nine public meetings was held in September and October 1994, and a formal comment period on the Draft EIS was held open for over 4 1/2 months. Following this last process, the SOR agencies have again reviewed the list of alternatives and have selected 13 alternatives for consideration and presentation in the Final EIS.

Six options for the alternatives remain unchanged from the specific options considered in the Draft EIS. One option (SOS 4c) is a revision to a previously considered alternative, and the rest represent replacement or new alternatives. The basic categories of SOSs and the numbering convention remains the same as was used in the Draft EIS. However, because some of the alternatives have been dropped, the final SOSs are not numbered consecutively. There is one new SOS category, Settlement Discussion Alternatives, which is labeled SOS 9 (see Section 4.1.6 for discussion).

The 13 alternatives have been evaluated through the use of a computerized model known as HYDROSIM. Developed by BPA, HYDROSIM is a hydroregulation model that simulates the coordinated operation of all projects in the Columbia River system. It is a monthly model with 14 total time periods. April and August are split into two periods each, because major changes can occur in streamflows in the first and second half of each of these months. The model is based on hydrologic data for a 50–year period of record from 1928 through 1978. For a given set of operating rule inputs and other project operating requirements, HYDROSIM will simulate elevations, flows, spill, storage content and power generation for each project or river control point for the 50–year period. For more detailed information, please refer to Appendix A, River Operation Simulation.

The following section describes the final alternatives and reviews the rationale for their inclusion in the Final EIS.

Table 4–1. SOS Alternative–1

Summary of SOS

SOS 1 Pre-ESA Operation	SOS 2 Current Operations	SOS 4 Stable Storage Project Operation
SOS 1 represents system operations before changes were made as a result of the ESA listing of three Snake River salmon stocks. SOS 1a represents operations from 1983 through the 1990–91 operating year, influenced by Northwest Power Act; SOS 1b represents how the system would operate without the Water Budget and related operations to benefit anadromous fish. Short-term operations would be conducted to meet power demands while satisfying nonpower requirements.	SOS 2 reflects operation of the system with interim flow improvement measures in response to the ESA salmon listings. It is consistent with the 1992–93 operations described in the Corps' 1993 Interim Columbia and Snake River Flow Improvement Measures Supplemental EIS. SOS 2c represents the operating decision made as a result of the 1993 Supplemental EIS and is the no action alternative for the SOS. Relative to SOS 1a, primary changes are additional flow augmentation in the Columbia and Snake Rivers and modified pool levels at lower Snake and John Day reservoirs during juvenile salmon migration. SOS 2d represents operations of the 1994-98 Biological Opinion issued by NMFS, with additional flow aumentation measures compared to SOS 2c.	SOS 4 would coordinate operation of storage reservoirs to benefit recreation, resident fish, wildlife, and anadromous fish, while minimizing impacts to power and flood control. Reservoirs would be managed to specific elevations on a monthly basis; they would be kept full longer, while still providing spring flows for fish and space for flood control. The goal is to minimize reservoir fluctuations while moving closer to natural flow conditions. SOS 4c attempts to accommodate anadromous fish needs by shaping mainstem flows to benefit migrations and would modify the flood control operations at Grand Coulee.

Actions by Project

	SOS 1	SOS 2	SOS 4
LIBBY	**SOS 1a** Normal 1983–1991 storage project operations **SOS 1b** • Minimum project flow 3 kcfs • No refill targets • Summer draft limit of 5–10 feet	**SOS 2c** Operate on system proportional draft as in SOS 1a **SOS 2d** • Provide flow augmentation for salmon and sturgeon when Jan. to July forecast is greater than 6.5 MAF • Meet sturgeon flows of 15, 20, and 12.5 kcfs in May, June, and July, respectively, in at least 3 out of 10 years	**SOS 4c** • Meet specific elevation targets as indicated by Integrated Rule Curves (IRCs); IRCs are based on storage content at the end of the previous year, determination of the appropriate year within the critical period, and runoff forecasts beginning in January • IRCs seek to keep reservoir full (2,459 feet) June-Sept; minimum annual elevation ranges from 2,399 to 2,327 feet, depending on critical year determination • Meet variable sturgeon flow targets at Bonners Ferry during May 25-August 16 period; flow targets peak as high as 35 kcfs in the wettest years

KAF = 1.234 million cubic meters

MAF = 1.234 billion cubic meters

Table 4–1. SOS Alternative–1

SOS 5 Natural River Operation	SOS 6 Fixed Drawdown	SOS 9 Settlement Discussion Alternatives	SOS PA
SOS 5 would aid juvenile salmon by increasing river velocity. The four lower Snake River projects would have new outlets installed, allowing the reservoirs to be drawn down to near the original river elevation. The "natural river" operation would be done for 4 1/2 months in SOS 5b and year-round in SOS 5c. John Day would also be operated at MOP for 4 months, and flow augmentation measures on the Columbia River portion of the basin would continue as in SOS 2c.	SOS 6 involves drawing down lower Snake River projects to fixed elevations below MOP to aid anadromous fish. SOS 6b provides for fixed drawdowns for all four lower Snake projects for 4 1/2 months; SOS 6d draws down Lower Granite only for 4 1/2 months. John Day would also be operated at MOP for 4 months, and flow augmentation measures on the Columbia River portion of the basin would continue as in SOS 2c.	SOS 9 represents operations suggested by the USFWS, NMFS, the state fisheries agencies, Native American tribes, and the Federal operating agencies during the settlement discussions in response to the *IDFG v. NMFS* court proceedings. This alternative has three options, SOSs 9a, 9b, and 9c, that represent different scenarios to provide increased river velocities for anadromous fish by establishing flow targets during migration and to carry out other actions to benefit ESA-listed species. The three options are termed the Detailed Fishery Operating Plan (9a), Adoptive Management (9b), and the Balanced Impacts Operation (9c).	SOS PA represents the operation recommended by NMFS and the USFWS Biological Opinions issued March 1, 1995. This SOS supports recovery of ESA-listed species by storing water during the fall and winter to meet spring and summer flow targets, and protects other resources by setting summer draft limits to manage negative effects, by providing flood protection, and by providing for reasonable power generation.

SOS 5	SOS 6	SOS 9	SOS PA
SOS 5b Operate on system proportional draft as in SOS 1a **SOS 5c** Operate on system proportional draft as in SOS 1a	**SOS 6b** Operate on system proportional draft as in SOS 1a **SOS 6d** Operate on system proportional draft as in SOS 1a	**SOS 9a** • Operate on minimum flow up to flood control rule curves year-round, except during flow augmentation period • Provide sturgeon flow releases April-Aug. to achieve up to 35 kcfs at Bonner's Ferry with appropriate ramp up and ramp down rates **SOS 9b** • Operate on minimum flow up to flood control rule curves year-round, except during flow augmentation • Provide sturgeon flow releases similar to SOS 2d • Can draft to elevation 2,435 by end of July to meet flow targets **SOS 9c** • Operate to the Integrated Rule Curves and provide sturgeon flow releases as in SOS 4c	**SOS PA** • Operate on minimum flow up to flood control rule curves beginning in Jan., except during flow augmentation period • Strive to achieve flood control elevations in Dec. in all years and by April 15 in 75 percent of years • Provide sturgeon flows of 25 kcfs 42 days in June and July • Provide sufficient flows to achieve 11 kcfs flow at Bonner's Ferry for 21 days after maximum flow period • Draft to meet flow targets, to a minimum end of Aug. elevation of 2,439 feet, unless deeper drafts needed to meet sturgeon flows

1 kcfs = 28 cms   1 ft = 0.3048 meter

Table 4–1. SOS Alternative–2
Actions by Project

HUNGRY HORSE

	SOS 1	SOS 2	SOS 4
	SOS 1a	**SOS 2c**	**SOS 4c**
	Normal 1983–1991 storage project operations	Operate on system proportional draft as in SOS 1a	• Meet specific elevation targets as indicated by Integrated Rule Curves (IRCs), similar to operation for Libby • IRCs seek to keep reservoir full (3,560 feet) June-Sept.; minimum annual elevation ranges from 3,520 to 3,450 feet, depending on critical year
	SOS 1b	**SOS 2d**	
	• No maximum flow restriction from mid-Oct. to mid-Nov. • No draft limit; no refill target	Operate on system proportional draft as in SOS 1a	

ALBENI FALLS

	SOS 1	SOS 2	SOS 4
	SOS 1a	**SOS 2c**	**SOS 4c**
	Normal 1983–1991 storage project operations	Operate on system proportional draft as in SOS 1a	Elevation targets established for each month, generally 2,056 feet Oct.–March, 2,058 to 2,062.5 feet April–May, 2,062.5 feet (full) June, 2,060 feet July–Sept. (but higher if runoff high); Oct.–March drawdown to 2,051 feet every 6th year
	SOS 1b	**SOS 2d**	
	No refill target	Operate on system proportional draft as in SOS 1a	

KAF = 1.234 million cubic meters MAF = 1.234 billion cubic meters

Table 4–1. SOS Alternative–2

SOS 5	SOS 6	SOS 9	SOS PA
SOS 5b	**SOS 6b**	**SOS 9a**	**SOS PA**
Operate on system proportional draft as in SOS 1a	Operate on system proportional draft as in SOS 1a	• Operate on minimum flow up to flood control rule curves year-round, except during flow augmentation period	• Operate on minimum flow up to flood control rule curves year-round, except during flow augmentation period • Strive to achieve flood control elevations by April 15 in 75 percent of the years • Draft to meet flow targets, to a minimum end-of-August elevation of 3,540 feet
SOS 5c	**SOS 6d**	**SOS 9b**	
Operate on system proportional draft as in SOS 1a	Operate on system proportional draft as in SOS 1a	• Operate on minimum flow up to flood control rule curves year-round, except during flow augmentation • Can draft to meet flow targets, to a minimum end-of-July elevation of 3,535 feet	
		SOS 9c	
		• Operate to the Integrated Rule Curves as in SOS 4c	

SOS 5	SOS 6	SOS 9	SOS PA
SOS 5b	**SOS 6b**	**SOS 9a**	**SOS PA**
Operate on system proportional draft as in SOS 1a	Operate on system proportional draft as in SOS 1a	Operate on minimum flow up to flood control rule curves year-round, except during flow augmentation period	• Operate to flood control elevations by April 15 in 90 percent of the years • Operate to help meet flow targets, but do not draft below full pool through Aug.
SOS 5c	**SOS 6d**	**SOS 9b**	
Operate on system proportional draft as in SOS 1a	Operate on system proportional draft as in SOS 1a	• Operate on minimum flow up to flood control rule curves year-round, except during flow augmentation period • Can draft to meet target flows, to a minimum end-of-July elevation of 2,060 feet	
		SOS 9c	
		• Elevation targets established for each month, generally no lower than 2,056 feet Dec.—April, no lower than 2,057 feet end of May, full (2,062.5 feet) June—Aug., 2,056 feet Sept.—Nov.	

1 kcfs = 28 cms 1 ft = 0.3048 meter

Table 4–1. SOS Alternative–3
Actions by Project

	SOS 1	SOS 2	SOS 4
GRAND COULEE	**SOS 1a** • Operate to meet Water Budget target flows of 134 kcfs at Priest Rapids in May 1/ • Meet minimum elevation of 1,240 feet in May **SOS 1b** • No refill target of 1,240 feet in May • Maintain 1,285 feet June–Sept.; minimum 1,220 feet rest of year • No May–June flow target	**SOS 2c** • Storage of water for flow augmentation from January through April • Supplemental releases (in conjunction with upstream projects) to provide up to 3 MAF additional (above Water Budget) flow augmentation in May and June, based on sliding scale for runoff forecasts • System flood control space shifted from Brownlee, Dworshak **SOS 2d** • Contribute, in conjunction with upstream storage projects, up to 4 MAF for additional flow augmentation • Operate in summer to provide flow augmentation water and meet downstream flow targets, but draft no lower than 1,280 feet	**SOS 4c** • Operate to end-of-month elevation targets, as follows: 1,288 Sept.-Nov 1,287 Dec. 1,270 Jan. 1,260 Feb. 1,270 Mar. 1,272 Apr. 15 1,275 Apr. 30 1,280 May 1,288 Jun.-Aug. • Meet flood control rule curves only when Jan.-June runoff forecast exceeds 68 MAF
PRIEST RAPIDS	**SOS 1a** • Meet May-June flow targets 1/ • Maintain minimum flows to meet Vernita Bar Agreement 2/ **SOS 1b** • No May flow target • Meet Vernita Bar Agreement	**SOS 2c** Operate as in SOS 1a **SOS 2d** Operate as in SOS 1a	**SOS 4c** Operate as in SOS 1a

1/ Flow targets are weekly averages with weekend and holiday flows no less than 80 percent of flows over previous 5 days.
2/ 55 kcfs during heavy load hours October 15 to November 30; minimum instantaneous flow 70 kcfs December to April
KAF = 1.234 million cubic meters MAF = 1.234 billion cubic meters

Table 4–1. SOS Alternative–3

SOS 5	SOS 6	SOS 9	SOS PA
SOS 5b Operate on system proportional draft and provide flow augmentation as in SOS 2c **SOS 5c** Operate on system proportional draft and provide flow augmentation as in SOS 2c	**SOS 6b** Operate on system proportional draft and provide flow augmentation as in SOS 2c **SOS 6d** Operate on system proportional draft and provide flow augmentation as in SOS 2c	**SOS 9a** • Operate to meet flood control requirements and Vernita Bar agreement • Provide flow augmentation releases to help meet targets at The Dalles of 220-300 kcfs April 16-June 15, 200 kcfs June 16-July 31, and 160 kcfs Aug. 1-Aug.31, based on appropriate critical year determination • In above average runoff years, provide 40% of the additional runoff volume as flow augmentation **SOS 9b** • Operate on minimum flow up to flood control rule curves year-round, except during flow augmentation period • Can draft to meet flow targets, bounded by SOS 9a and 9c targets, to a minimum end-of-July elevation of 1,265 feet **SOS 9c** • Operate to meet McNary flow targets of 200 kcfs April 16-June 30 and 160 kcfs in July • Can draft to meet flow targets, to a minimum end-of-July elevation of 1,280 feet • Contribute up to 4 MAF for additional flow augmentation, based on sliding scale for runoff forecasts, in conjunction with other upstream projects • System flood control shifted to this project	**SOS PA** • Operate to achieve flood control elevations by April 15 in 85% of years • Draft to meet flow targets, down to minimum end-of-Aug. elevation of 1,280 feet • Provide flow augmentation releases to meet Columbia River flow targets at McNary of 220-260 kcfs April 20-June 30, based on runoff forecast, and 200 kcfs July-Aug.

SOS 5	SOS 6	SOS 9	SOS PA
SOS 5b Operate as in SOS 1a **SOS 5c** Operate as in SOS 1a	**SOS 6b** Operate as in SOS 1a **SOS 6d** Operate as in SOS 1a	**SOS 9a** Operate as in SOS 1a **SOS 9b** Operate as in SOS 1a **SOS 9c** Operate as in SOS 1a	**SOS PA** Operate as in SOS 1a

1 kcfs = 28 cms   1 ft = 0.3048 meter

Table 4–1. SOS Alternative–4

Actions by Project

	SOS 1	SOS 2	SOS 4
SNAKE RIVER ABOVE BROWNLEE	**SOS 1a** Normal 1990—91 operations; no Water Budget flows	**SOS 2c** Release up to 427 KAF (190 KAF April 16—June 15; 137 KAF Aug.; 100 KAF Sept.) for flow augmentation	**SOS 4c** Same as SOS 1a
	SOS 1b Same as SOS 1a	**SOS 2d** • Release up to 427 KAF, as in SOS 2c • Release additional water obtained by purchase or other means and shaped per Reclamation releases and Brownlee draft requirements; simulation assumed 927 KAF available	

	SOS 1	SOS 2	SOS 4
BROWNLEE	**SOS 1a** • Draft as needed (up to 110 KAF in May) for Water Budget, based on target flows of 85 kcfs at Lower Granite • Operate per FERC license • Provide system flood control storage space	**SOS 2c** Same as SOS 1a except for additional flow augmentation as follows: • Draft up to 137 KAF in July, but not drafting below 2,067 feet; refill from the Snake River above Brownlee in August • Draft up to 100 KAF in Sept. • Shift system flood control to Grand Coulee • Provide 9 kcfs or less in November; fill project by end of month • Maintain November monthly average flow December through April	**SOS 4c** Same as SOS 1a except slightly different flood control rule curves
	SOS 1b • No maximum flow restriction from mid-Oct. to mid-Nov. • No draft limit; no refill target	**SOS 2d** Same as SOS 2c, plus pass additional flow augmentation releases from upstream projects	

KAF = 1.234 million cubic meters   MAF = 1.234 billion cubic meters

Table 4–1. SOS Alternative–4

SOS 5	SOS 6	SOS 9	SOS PA
SOS 5b Same as SOS 1a **SOS 5c** Same as SOS 1a	**SOS 6b** Same as SOS 1a **SOS 6d** Same as SOS 1a	**SOS 9a** Provide up to 1.927 MAF through Brownlee for flow augmentation, as determined by Reclamation **SOS 9b** Provide up to 927 KAF through Brownlee as determined by Reclamation **SOS 9c** Provide up to 927 KAF through Brownlee as determined by Reclamation	**SOS PA** Provide 427 KAF through Brownlee for flow augmentation, as determined by Reclamation

SOS 5	SOS 6	SOS 9	SOS PA
SOS 5b Same as SOS 4c **SOS 5c** Same as SOS 4c	**SOS 6b** Same as SOS 4c **SOS 6d** Same as SOS 4c	**SOS 9a** • Draft up to 110 KAF in May, 137 KAF in July, 140 KAF in Aug., 100 KAF in Sept. for flow augmentation • Shift system flood control to Grand Coulee **SOS 9b** • Draft up to 190 KAF April-May, 137 KAF in July, 100 KAF in Sept. for flow augmentation • Shift system flood control to Grand Coulee • Provide an additional 110 KAF in May if elevation is above 2,068 feet and 110 KAF in Sept. if elevation is above 2,043.3 feet **SOS 9c** Same as SOS 9b	**SOS PA** Draft to elevation 2,069 feet in May, 2,067 feet in July, and 2,059 feet in Sept., passing inflow after May and July drafts

1 kcfs = 28 cms   1 ft = 0.3048 meter

Table 4–1. SOS Alternative–5

Actions by Project

	SOS 1	SOS 2	SOS 4
DWORSHAK	**SOS 1a** • Draft up to 600 KAF in May to meet Water Budget target flows of 85 kcfs at Lower Granite • Provide system flood control storage space **SOS 1b** • Meet minimum project flows (2 kcfs, except for 1 kcfs in August); summer draft limits; maximum discharge requirement Oct. to Nov. (1.3 kcfs plus inflow) • No Water Budget releases	**SOS 2c** Same as SOS 1a, plus the following supplemental releases: • 900 KAF or more from April 16 to June 15, depending on runoff forecast at Lower Granite • Up to 470 KAF above 1.2 kcfs minimum release from June 16 to Aug. 31 • Maintain 1.2 kcfs discharge from Oct. through April, unless higher required • Shift system flood control to Grand Coulee April–July if runoff forecasts at Dworshak are 3.0 MAF or less **SOS 2d** • Operate on 1.2 kcfs minimum discharge up to flood control rule curve, except when providing flow augmentation (April 10 to July 31) • Provide flow augmentation of 1.0 MAF plus 1.2 kcfs minimum discharge, or 927 KAF and 1.2 kcfs, from April 10-June 20, based on runoff forecasts, to meet Lower Granite flow target of 85 kcfs • Provide 470 KAF from June 21 to July 31 to meet Lower Granite flow target of 50 kcfs • Draft to 1,520 feet after volume is expended, if Lower Granite flow target is not met; if volume is not expended, draft below 1,520 feet until volume is expended	**SOS 4c** Elevation targets established for each month: 1,599 feet Sept.-Oct.; flood control rule curves Nov.-April; 1,595 feet May; 1,599 feet June-Aug.;

KAF = 1.234 million cubic meters MAF = 1.234 billion cubic meters

Table 4–1. SOS Alternative–5

SOS 5	SOS 6	SOS 9	SOS PA
SOS 5b • Operate to local flood control rule curve • No proportional draft for power • Shift system flood control to lower Snake projects • Provide Water Budget flow augmentation as in SOS 1a • Draft to refill lower Snake projects if natural inflow is inadequate	**SOS 6b** Same as SOS 5b	**SOS 9a** • Remove from proportional draft for power • Operate to local flood control rule curves, with system flood control shifted to Grand Coulee • Maintain flow at 1.2 kcfs minimum discharge, except for flood control or flow augmentation discharges • Operate to meet Lower Granite flow targets (at spillway crest) of 74 kcfs April 16-June 30, 45 kcfs July, 32 kcfs August	**SOS PA** • Operate on minimum flow-up to flood control rule curve year-round, except during flow augmentation period • Draft to meet flow targets, down to min. end-of-Aug. elevation of 1,520 feet • Sliding-scale Snake River flow targets at Lower Granite of 85 to 100 kcfs April 10-June 20 and 50 to 55 kcfs June 21-Aug. 31, based on runoff forecasts
SOS 5c • Operate to flood control during spring • Refill in June or July and maintain through August • Draft for power production during fall	**SOS 6d** Same as SOS 5b	**SOS 9b** • Similar to SOS 9a, except operate to meet flow targets at Lower Granite ranging from 85 to 140 kcfs April 16-June 30 and 50-55 kcfs in July • Can draft to meet flow targets to a min. end-of-July elevation of 1,490 feet	
		SOS 9c • Similar to SOS 9a, except operate to meet Lower Granite flow target (at spillway crest) of 63 kcfs April-June • Can draft to meet flow targets to a min. end-of-July elevation of 1,520 feet	

1 kcfs = 28 cms 1 ft = 0.3048 meter

Table 4–1. SOS Alternative–6
Actions by Project

	SOS 1	SOS 2	SOS 4
LOWER SNAKE	**SOS 1a** • Normal operations at 4 lower Snake River projects (within 3 to 5 feet of full pool, daily and weekly fluctuations) • Provide maximum peaking capacity of 20 kcfs over daily average flow in May **SOS 1b** Same as 1a, except: • No minimum flow limit (11,500 cfs) during fall and winter • No fish-related rate of change in flows in May	**SOS 2c** • Operate reservoirs within 1 foot above MOP from April 16 to July 31 • Same as SOS 1a for rest of year **SOS 2d** Same as SOS 2c	**SOS 4c** Same as SOS 2c

	SOS 1	SOS 2	SOS 4
LOWER COLUMBIA	**SOS 1a** • Normal operations at 4 lower Columbia projects (generally within 3 to 5 feet of full pool, daily and weekly fluctuations) • Restricted operation of Bonneville second powerhouse **SOS 1b** Same as 1a, except no restrictions on Bonneville second powerhouse	**SOS 2c** Same as SOS 1a except: lower John Day to minimum irrigation pool (approx. 262.5 feet) from April 15 to Aug. 31; operate within 1.5 feet of forebay range, unless need to raise to avoid irrigation impacts **SOS 2d** Same as SOS 2c	**SOS 4c** Same as SOS 2c, except operate John Day within 2 feet of elevation 263.5 feet Nov. 1 through June 30

KAF = 1.234 million cubic meters   MAF = 1.234 billion cubic meters

Table 4–1. SOS Alternative–6

SOS 5	SOS 6	SOS 9	SOS PA
SOS 5b • Draft 2 feet per day starting Feb. 18 • Operate at natural river level, approx. 95 to 115 ft below full pool, April 16-Aug. 31; drawdown levels by project as follows, in feet: Lower Granite 623 Little Goose 524 L. Monumental 432 Ice Harbor 343 • Operate within 3 to 5 ft of full pool rest of year • Refill from natural flows and storage releases	**SOS 6b** • Draft 2 feet per day starting April 1 • Operate 33 feet below full pool April 16-Aug. 31; drawdown levels by project as follows, in feet: Lower Granite 705 Little Goose 605 L. Monumental 507 Ice Harbor 407 • Operate over 5-foot forebay range once drawdown elevation reached • Refill from natural flows and storage releases • Same as SOS 1a rest of year	**SOS 9a** • Operate 33 feet below full pool (see SOS 6b) April 1-Aug. 31 to meet L. Granite flow targets (see Dworshak); same as SOS 1a rest of year • Spill to achieve 80/80 FPE up to total dissolved gas cap of 120% daily average; spill cap 60 kcfs at all projects	**SOS PA** • Operate at MOP with 1 foot flexibility between April 10 - Aug. 31 • Refill three lower Snake River pools after Aug. 31, Lower Granite after Nov. 15 • Spill to achieve 80% FPE up to total dissolved gas cap of 115% 12-hour average; spill caps range from 7.5 kcfs at L. Monumental to 25 kcfs at Ice Harbor
SOS 5c Same as SOS 5b, except drawdowns are permanent once natural river levels reached; no refill	**SOS 6d** • Draft Lower Granite 2 feet per day starting April 1 • Operate Lower Granite near 705 ft for 4 1/2 months, April 16-Aug. 31	**SOS 9b** • Operate at MOP, with 1 foot flexibility April 1-Aug. 31; same as SOS 1a rest of year • Spill to achieve 80/80 FPE up to total dissolved gas cap of 120% daily average; spill caps range from 18 kcfs at L. Monumental to 30 kcfs at L. Granite	
		SOS 9c • Operate 35 to 45 feet below full pool April 1-June 15 to meet L. Granite flow targets (see Dworshak), refill by June 30; same as SOS 1a rest of year • Spill to achieve 80/80 FPE, as in SOS 9b	

SOS 5	SOS 6	SOS 9	SOS PA
SOS 5b Same as SOS 2, except operate John Day within 1.5 feet above elevation 257 feet (MOP) from May 1 through Aug. 31; same as SOS 2c rest of year	**SOS 6b** Same as SOS 5	**SOS 9a** • Same as SOS 5, except operate John Day within 1 foot above elevation 257 feet April 15-Aug. 31 • McNary flow targets as described for Grand Coulee • Spill to achieve 80/80 FPE, up to total dissolved gas cap of 120% daily average, as derived by agencies	**SOS PA** • Pool operations same as SOS 2c, except operate John Day at 257 feet (MOP) year-round, with 3 feet of flexibility March-Oct. and 5 feet of flexibility Nov.-Feb. • Spill to achieve 80% FPE up to total dissolved gas cap of 115% 12-hour average; spill caps range from 9 kcfs at John Day to 90 kcfs at The Dalles
SOS 5c Same as SOS 5b	**SOS 6d** Same as SOS 5	**SOS 9b** • Same as SOS 2, except operate John Day at minimum irrigation pool or 262.5 feet with 1 foot of flexibility from April 16-Aug. 31 • McNary flow targets as described for Grand Coulee • Spill to achieve 80/80 FPE, up to total dissolved gas cap of 120% daily average, as derived by Corps	
		SOS 9c Same as SOS 9b, except operate John Day at minimum operating pool	

1 kcfs = 28 cms

1 ft = 0.3048 meter

4.1.1 SOS 1-Pre–ESA Operation

This alternative represents one end of the range of the SOR strategies in terms of their similarity to historical system operations. This strategy reflects Columbia River system operations before changes were made as a result of the ESA listing of three Snake River salmon stocks. This SOS has two options:

- **SOS 1a (Pre–Salmon Summit Operation)** represents operations as they existed from 1983 through the 1990–91 operating year, including Northwest Power Act provisions to restore and protect fish populations in the basin. Specific volumes for the Water Budget would be provided from Dworshak and Brownlee reservoirs to attempt to meet a target flow of 85 kcfs (2,380 cms) at Lower Granite Dam in May. Sufficient flows would be provided on the Columbia River to meet a target flow of 134 kcfs (3,752 cms) at Priest Rapids Dam in May. Lower Snake River projects would operate within 3 to 5 feet (0.9 to 1.5 m) of full pool. Other projects would operate as they did in 1990–91, with no additional water provided from the Snake River above Brownlee Dam.

- **SOS 1b (Optimum Load–Following Operation)** represents operations as they existed prior to changes resulting from the Northwest Power Act. It is designed to demonstrate how much power could be produced if most flow–related operations to benefit anadromous fish were eliminated including: the Water Budget; fish spill requirements; restrictions on operation of Bonneville's second powerhouse; and refill targets for Libby, Hungry Horse, Grand Coulee, Dworshak, and Albeni Falls. It assumes that transportation would be used to the maximum to aid juvenile fish migration.

4.1.2 SOS 2-Current Operations

This alternative reflects operation of the Columbia River system with interim flow improvement measures made in response to ESA listings of Snake River salmon. It is very similar to the way the system operated in 1992 and reflects the results of ESA Section 7 consultation with NMFS then. The strategy is consistent with the 1992–93 operations described in the Corps' *1993 Interim Columbia and Snake Rivers Flow Improvement Measures Supplemental EIS* (SEIS). SOS 2 also most closely represents the recommendations issued by the NMFS Snake River Salmon Recovery Team in May 1994. Compared to SOS 1, the primary changes are additional flow augmentation in the Columbia and Snake Rivers and modified pool levels at lower Snake and John Day reservoirs during juvenile salmon migration. This strategy has two options:

- **SOS 2c (Final SEIS Operation- No Action Alternative)** matches exactly the decision made as a result of the 1993 SEIS. Flow augmentation water of up to 3.0 MAF (3.7 billion m^3) on the Columbia River (in addition to the existing Water Budget) would be stored during the winter and released in the spring in low–runoff years. Dworshak would provide at least an additional 300 KAF (370 million m^3) in the spring and 470 KAF (580 million m^3) in the summer for flow augmentation. System flood control shifts from Dworshak and Brownlee to Grand Coulee would occur through April as needed. It also provides up to 427 KAF (527 million m^3) of additional water from the Snake River above Brownlee Dam.

- **SOS 2d (1994–98 Biological Opinion)** matches the hydro operations contained in the 1994–98 Biological Opinion issued by NMFS in mid–1994. This alternative provides water for the existing Water Budget as well as additional water, up to 4 MAF, for flow augmentation to benefit the anadromous fish migration. The additional water of up to 4 MAF would be stored in Grand Coulee, Libby and Arrow, and provided on a sliding scale tied to runoff forecasts. Flow targets are established at Lower Granite and McNary.

In cases such as the SOR, where the proposed action is a new management plan, the No Action Alternative means continuing with the present course of action until that action is changed (46 FR 13027). Among all of the strategies and options, SOS 2c best meets this definition for the No Action Alternative.

4.1.3 SOS 4-Stable Storage Project Operation

This alternative is intended to operate the storage reservoirs to benefit recreation, resident fish, wildlife, and anadromous fish while minimizing impacts of such operation to power and flood control. Reservoirs would be kept full longer, but still provide spring flows for fish and space for flood control. The goal is to minimize reservoir fluctuations while moving closer to natural flow conditions. For the Final EIS, this alternative has one option:

- **SOS 4c (Stable Storage Operation with Modified Grand Coulee Flood Control)** applies year–round Integrated Rule Curves (IRCs) developed by the State of Montana for Libby and Hungry Horse. Other reservoirs would be managed to specific elevations on a monthly basis; they would be kept full longer, while still providing spring flows for fish and space for flood control. The goal is to minimize reservoir fluctuations while moving closer to natural flow conditions. Grand Coulee would meet elevation targets year–round to provide acceptable water retention times; however, upper rule curves would apply at Grand Coulee if the January to July runoff forecast at the project is greater than 68 MAF (84 billion m^3).

4.1.4 SOS 5-Natural River Operation

This alternative is designed to aid juvenile salmon migration by drawing down reservoirs (to increase the velocity of water) at four lower Snake River projects. SOS 5 reflects operations after the installation of new outlets in the lower Snake River dams, permitting the lowering of reservoirs approximately 100 feet (30 m) to near original riverbed levels. This operation could not be implemented for a number of years, because it requires major structural modifications to the dams. Elevations would be: Lower Granite – 623 feet (190 m); Little Goose – 524 feet (160 m); Lower Monumental – 432 feet (132 m); and Ice Harbor – 343 feet (105 m). Drafting would be at the rate of 2 feet (0.6 m) per day beginning February 18. The reservoirs would refill again with natural inflows and storage releases from upriver projects, if needed. John Day would be lowered as much as 11 feet (3.3 m) to minimum pool, elevation 257 feet (78.3 m), from May through August. All other projects would operate essentially the same as in SOS 1a, except that up to 3 MAF (3.7 billion m^3) of water (in addition to the Water Budget) would be provided to augment flows on the Columbia River in May and June. System flood control would shift from Brownlee and Dworshak to the lower Snake River projects. Also, Dworshak would operate for local flood control. This alternative has two options:

- **SOS 5b (Four and One–half Month Natural River Operation)** provides for a lower Snake River drawdown lasting 4.5 months, beginning April 16 and ending August 31. Dworshak would be drafted to refill the lower Snake River projects if natural inflow were inadequate for timely refill.
- **SOS 5c (Permanent Natural River Operation)** provides for a year–round drawdown, and projects would not be refilled after each migration season.

4.1.5 SOS 6-Fixed Drawdown

This alternative is designed to aid juvenile anadromous fish by drawing down one or all four lower Snake River projects to fixed elevations approximately 30 to 35 feet (9 to 10 m) below minimum operating pool. As with SOS 5, fixed drawdowns depend on prior structural modifications and could not be instituted for a number of years. Draft would be at the rate of 2 feet (0.6 m) per day beginning April 1. John Day would be lowered to elevation 257 feet (78.3 m) from May through August. All other projects would operate essentially the same as under SOS 1a, except that up to 3 MAF (3.7 billion m^3) of water would be provided to augment flows on the Columbia River in May and June. System flood control would shift from Brownlee and Dworshak to the lower Snake projects. Also, Dworshak would operate for local flood control. This alternative has two options:

- **SOS 6b (Four and One–half Month Fixed Drawdown)** provides for a 4.5–month drawdown at all four lower Snake River projects beginning April 16 and ending August 31. Elevations would be: Lower Granite – 705 feet (215 m); Little Goose – 605 feet (184 m); Lower Monumental – 507 feet (155 m); and Ice Harbor – 407 feet (124 m).
- **SOS 6d (Four and One–half Month Lower Granite Fixed Drawdown)** provides for a 4.5–month drawdown to elevation 705 feet at Lower Granite beginning April 16 and ending August 31.

4.1.6 SOS 9-Settlement Discussion Alternatives

This SOS represents operations suggested by USFWS and NMFS (as SOR cooperating agencies), the State fisheries agencies, Native American tribes, and the Federal operating agencies during the settlement discussions in response to a court ruling in the *IDFG v. NMFS* lawsuit. The objective of SOS 9 is to provide increased velocities for anadromous fish by establishing flow targets during the migration period and by carrying out other actions that benefit ESA–listed species. The specific options were developed by a group of technical staff representing the parties in the lawsuit. The group was known as the Reasonable and Prudent Alternatives Workgroup. They developed three possible operations in addition to the 1994–98 Biological Opinion. This strategy has three options:

- **SOS 9a (Detailed Fishery Operating Plan [DFOP])** establishes flow targets at The Dalles based on the previous year's end–of–year storage content, similar to how PNCA selects operating rule curves. Grand Coulee and other storage projects are used to meet The Dalles flow targets. Specific volumes of releases are made from Dworshak, Brownlee, and upper Snake River to try to meet Lower Granite flow targets. Lower Snake River projects are drawn down to near spillway crest level for 4 1/2 months. Specific spill percentages are established at run–of–river projects to achieve no higher than 120 percent daily average total dissolved gas. Fish transportation is assumed to be eliminated.
- **SOS 9b (Adaptive Management)** establishes flow targets at McNary and Lower Granite based on runoff forecasts. Grand Coulee and other storage projects are used to meet the McNary flow targets. Specific volumes of releases are made from Dworshak, Brownlee, and the upper Snake River to try to meet Lower Granite flow targets. Lower Snake River projects are drawn down to minimum operating pool levels and John Day is at minimum irrigation pool level. Specific spill percentages are established at run–of–river projects to achieve no higher than 120 percent daily average for total dissolved gas.
- **SOS 9c (Balanced Impacts Operation)** draws down the four lower Snake River projects to near spillway crest levels for 2 1/2 months during the spring salmon migration period. Full drawdown level is achieved on April 1. Refill begins after June 15. This alternative also provides 1994–98 Biological Opinion flow augmentation (as in SOS 2d), IRC operation at Libby and Hungry Horse, a reduced flow target at Lower Granite due to drawdown, limits on winter drafting at Albeni Falls, and spill to achieve no higher than 120 percent daily average for total dissolved gas.

4.1.7 SOS PA-Preferred Alternative

This SOS represents the operation recommended by NMFS and USFWS in their respective Biological Opinions issued on March 1, 1995. SOS PA is intended to support recovery of ESA–listed species by storing water during the fall and winter to meet spring and summer flow targets, and to protect other resources by managing detrimental effects through maximum summer draft limits, by providing public safety through flood protection, and by providing for reasonable power generation. This SOS would operate the system during the fall and winter to achieve a high confidence of refill to flood control elevations by April 15 of each year, and use this stored water for fish flow augmentation. It establishes spring flow targets at McNary and Lower Granite based on runoff forecasts, and a similar sliding scale flow target at Lower Granite and a fixed flow target at McNary for the summer. It establishes summer draft limits at Hungry Horse, Libby, Grand Coulee, and Dworshak. Libby is also operated to provide flows for Kootenai River white sturgeon. Lower Snake River projects are drawn down to minimum operating pool levels during the spring and summer. John Day is operated at minimum operating pool level year–round. Specific spill percentages are established at run–of–river projects to achieve 80–percent FPE, with no higher than 115–percent 12–hour daily average for total dissolved gas measured at the forebay of the next downstream project.

4.1.8 Rationale for Selection of the Final SOSs

Table 4–2 summarizes the changes to the set alternatives from the Draft EIS to the Final EIS. SOS 1a and 1b are unchanged from the Draft EIS. SOS 1a represents a base case condition and reflects system operation during the period from passage of the Northwest Power Planning and Conservation Act until ESA listings. It provides a baseline alternative that allows for comparison of the more recent alternatives and shows the recent historical operation. SOS 1b represents a limit for system operation directed at maximizing benefits from development–oriented uses, such as power generation, flood control, irrigation and navigation and away from natural resources protection. It serves as one end of the range of alternatives and provides a basis for comparison of the impacts to power generation from all other alternatives. Public comment did not recommend elimination of this alternative because it serves as a useful milepost. However, the SOR agencies recognize it is unlikely that decisions would be made to move operations toward this alternative.

In the Draft EIS, SOS 2 represented current operation. Three options were considered. Two of these options have been eliminated for the Final EIS and one new option has been added. SOS 2c continues as the No Action Alternative. Maintaining this option as the No Action Alternative allows for consistent comparisons in the Final EIS to those made in the Draft EIS. However, within the current practice category, new operations have been developed since the original identification of SOS 2c. In 1994, the SOR agencies, in consultation with the NMFS and USFWS, agreed to an operation, which was reflected in the 1994–98 Biological Opinion. This operation (SOS 2d) has been modeled for the Final EIS and represents the most "current" practice. SOS 2d also provides a good baseline comparison for the other, more unique alternatives. SOS 2a and 2b from the Draft EIS were eliminated because they are so similar to SOS 2c. SOS 2a is identical to SOS 2c except for the lack of an assumed additional 427 KAF of water from the upper Snake River Basin. This additional water did not cause significant changes to the effects between SOS 2a and 2c. There is no reason to continue to consider an alternative that has impacts essentially equal to another alternative. SOS 2b is also similar to SOS 2c, except it modified operation at Libby for Kootenai River white sturgeon. Such modifications are included in several other alternatives, namely SOS 2d, 9a, 9c, and the Preferred Alternative.

SOS 3a and 3b, included in the Draft EIS, have been dropped from consideration in the Final EIS. Both of these alternatives involved anadromous fish flow augmentation by establishing flow targets based on runoff forecast on the Columbia and Snake Rivers. SOS 3b included additional water from the upper Snake River Basin over what was assumed for SOS 3a. This operation is now incorporated in several new alternatives, including SOS 9a and 9b. Public comment also did not support continued consideration of the SOS 3 alternatives.

Table 4-2. Summary of Alternatives in the Draft and Final EIS

Draft EIS Alternatives	Final EIS Alternatives
SOS 1 Pre-ESA Operation	SOS 1 Pre-ESA Operation
SOS 1a Pre-Salmon Summit Operation	SOS 1a Pre-Salmon Summit Operation
SOS 1b Optimum Load Following Operation	SOS 1b Optimum Load Following Operation
SOS 2 Current Practice	SOS 2 Current Practice
SOS 2a Final Supplemental EIS Operation	SOS2c Final Supplemental EIS Operation – No-Action Alternative
SOS 2b Final Supplemental EIS with Sturgeon Operations at Libby	**SOS 2d 1994-98 Biological Opinion Operation**
SOS2c Final Supplemental EIS Operation – No-Action Alternative	
SOS 3 Flow Augmentation	
SOS 3a Monthly Flow Targets	
SOS 3b Monthly Flow Targets with additional Snake River Water	
SOS 4 Stable Storage Project Operation	SOS 4 Stable Storage Project Operation
SOS 4a1 Enhanced Storage Level Operation	**SOS 4c Enhanced Operation with modified Grand Coulee Flood Control**
SOS 4a3 Enhanced Storage Level Operation	
SOS 4b1 Compromise Storage Level Operation	
SOS 4b3 Compromise Storage Level Operation	
SOS 4c Enhanced Operation with modified Grand Coulee Flood Control	
SOS 5 Natural River Operation	SOS 5 Natural River Operation
SOS 5a Two Month Natural River Operation	SOS 5b Four and One Half Month Natural River Operation
SOS 5b Four and One Half Month Natural River Operation	**SOS 5c Permanent Natural River Operation**
SOS 6 Fixed Drawdown	SOS 6 Fixed Drawdown
SOS 6a Two Month Fixed Drawdown Operation	SOS 6b Four and One Half Month Fixed Drawdown Operation
SOS 6b Four and One Half Month Fixed Drawdown Operation	SOS 6d Four and One Half Month Lower Granite Drawdown Operation
SOS 6c Two Month Lower Granite Drawdown Operation	
SOS 6d Four and One Half Month Lower Granite Drawdown Operation	
SOS 7 Federal Resource Agency Operations	**SOS 9 Settlement Discussion Alternatives**
SOS 7a Coordination Act Report Operation	**SOS 9a Detailed Fishery Operating Plan**
SOS 7b Incidental Take Statement Flow Targets	**SOS 9b Adaptive Management**
SOS 7c NMFS Conservation Recommendations	**SOS 9c Balance Impacts Operation**
	SOS Preferred Alternative

Bold indicates a new or revised SOS alternative

SOS 4 originally included 5 options in the Draft EIS. They were similar in operation and impact. In SOS 4a and 4b, the primary feature was the use of Biological Rule Curves for Libby and Hungry Horse reservoirs. SOS 4c also included these rule curves but went further by optimizing the operation of the other storage projects, particularly Grand Coulee and Dworshak. For the Final EIS, the SOR agencies have decided to update the alternative by substituting the IRC for the Biological Rule Curves and by eliminating SOS 4a and 4b. The IRCs are a more recent, acceptable version of minimum elevations for Libby and Hungry Horse. Significant public comment in support of this alternative with IRCs was received. Similar to SOS 2 above, SOS 4a and 4b were not different enough in operation or impacts to warrant continued consideration.

The Natural River (SOS 5) and the Spillway Crest Drawdown (SOS 6) alternatives in the Draft EIS originally included options for 2 months of drawdown to the appropriate pool level and 4 1/2 months of drawdown. The practicality of 2–month drawdowns was questioned during public review, particularly for the natural river. It did not appear that the time involved in drawing down the reservoirs and later refilling them provided the needed consideration for other uses. Flows are restricted to refill the reservoirs at a time when juvenile fall chinook are migrating downstream and various adult species are returning upstream. The 2 1/2 month drawdown strategies (SOS 5a, 6a, and 6c) have been dropped from the Final EIS. However, 2 1/2 month spillway crest drawdown at all four lower Snake projects is still an element in SOS 9c, so the impacts associated with this type of operation are assessed in the Final EIS.

A new option was added to SOS 5, namely SOS 5c. This option includes natural river drawdown of the lower Snake River projects on a permanent, year–round basis. The Corps received comment on this type of alternative during the review of Phase I of the SCS, a reconnaissance assessment of potential physical modifications for the system to enhance fish passage. Many believe the cost for such modification would be less than that required for periodic, temporary drawdowns, which would require specialized facilities to enable the projects to refill and operate at two different pool elevations.

SOS 7 Federal Resource Agencies Operations, which included 3 options in the Draft EIS, has been dropped from the Final EIS and replaced with an alternative now labeled as SOS 9 that also has 3 options. SOS 7a was suggested by the USFWS and represented the State fishery agencies and tribes' recommended operation. Since the issuance of the Draft EIS, this particular operation has been revised and replaced by the DFOP (SOS 9a). The SOR agencies received comment that the DFOP was not evaluated, but should be. Therefore, we have included this alternative exactly as proposed by these agencies; it is SOS 9a. SOS 7b and 7c were suggested by NMFS through the 1993 Biological Opinion. This opinion suggested two sets of flow targets as a way of increasing flow augmentation levels for anadromous fish. The flow targets came from the Incidental Take Statement and the Conservation Recommendation sections of that Biological Opinion. The opinion was judged as arbitrary and capricious as a result of legal action, and these operational alternatives have been replaced with other alternatives that were developed through settlement discussions among the parties to this lawsuit. SOS 7b and 7c have been dropped, but SOS 9b and 9c have been added to represent operations stemming from NMFS or other fishery agencies. In particular, SOS 9b is like DFOP but has reduced flow levels and forgoes drawdowns. It is a modification to DFOP. SOS 9c incorporates elements of operation supported by the State of Idaho in its "Idaho Plan." It includes a 2 1/2–month spillway crest drawdown on the lower Snake River projects and several other elements that attempt to strike a balance among the needs of anadromous fish, resident fish, wildlife and recreation.

Shortly after the alternatives for the Draft EIS were identified, the Nez Perce Tribe suggested an operation that involved drawdown of Lower Granite, significant additional amounts of upper Snake River water, and full pool operation at Dworshak (i.e., Dworshak remains full year round). It was labeled as SOS 8a. Hydroregulation of that operation was completed and provided to the Nez Perce Tribe. No technical response has been received from the Nez

Perce Tribe regarding the features or results of this alternative. However, the elements of this operation are generally incorporated in one or more of the other alternatives, or impose requirements on the system or specific projects that are outside the range considered reasonable. Therefore, this alternative has not been carried forward into the Final EIS.

The Preferred Alternative represents operating requirements contained in the 1995 Biological Opinions issued by NMFS and USFWS on operation of the FCRPS. These opinions resulted from ESA consultation conducted during late 1994 and early 1995, which were a direct consequence of the lawsuit and subsequent judgement in *Idaho v. NMFS*. The SOR agencies are now implementing this operating strategy and have concluded that it represents an appropriate balance among the multiple uses of the river. This strategy recognizes the importance of anadromous fish and the need to adjust river flows to benefit the migration of all salmon stocks, as well as the needs of resident fish and wildlife species at storage projects.

In addition to alternatives discussed here, the SOR managers received a proposed alternative from the Confederated Tribes of the Umatilla Indian Reservation, designated SOS 9d. Please refer to Chapter 4 of the Main Volume of this EIS for description and analysis of SOS 9d (Section 4.1.10, subsections on CTUIR alternative, cultural resources, and Native Americans).

4.2 GENERIC CULTURAL RESOURCES IMPACTS

This section discusses direct and indirect impacts on historic and cultural properties that are typically associated with river system operations. Changing water levels and flows can cause wave action, inundation, and exposure of reservoir drawdown zones, all of which can affect cultural resources. System operations can also cause indirect impacts to cultural resources as a result of changes in the human use and aesthetics of the shoreline and drawdown zones.

Some SOSs involve the construction or modification of structural facilities, such as fish passage facilities at Corps projects, which could cause direct impacts to historic or cultural properties. These structural elements are not considered in the SOR. Instead, they are addressed in the Corps' System Configuration Study (see "Columbia River Salmon Mitigation Analysis System Configuration Study, Phase 1," April 1994 draft).

4.2.1 Direct Impacts

Impacts within the reservoir pool occur most often to nonstructural cultural deposits, since initial reservoir construction and filling usually removed or damaged above–ground or structural cultural resources such as historic architecture. Nonstructured sites affected include archeological sites, human burials, and perhaps also landscape or other values of significance to Tribes. Direct impacts to archeological deposits resulting from reservoir shoreline fluctuations occur differently in each of three reservoir zones: 1) the littoral (exposed beach); 2) wave–impact; and 3) inundation zones (Figure 4–1).

Exposed archeological deposits within the littoral zone are subject to direct impacts that are mechanical, human, and animal in origin. Because inundation removes vegetation, wind and water (runoff) erosion deflates archeological sites in this zone. Deflation is the removal of the archeological soils, leaving heavier items and artifacts behind, and altering their contextual relationship in the site. Water running over unvegetated slopes also causes erosional rills and gullies.

The movement of artifacts and site features within or away from the site decreases its scientific integrity and value because it becomes more difficult to reconstruct the site's original features and the original placement of artifacts. The littoral zone is also subject to repeated cycles of wetting and drying, which cause deterioration of organic deposits, such as bone, and some artifacts, such as ceramics. In certain soils, rapid drawdown can cause mass wasting (e.g., slumping or landslides) of slopes in or above the reservoir. This occurs as water rapidly vacates the pores between soil particles, causing the soil to lose cohesion. Soil slumps on beach cut–banks form erosion fronts that slowly advance landward. Section 4.4 (Geomorphic Analysis) discusses these processes in greater detail.

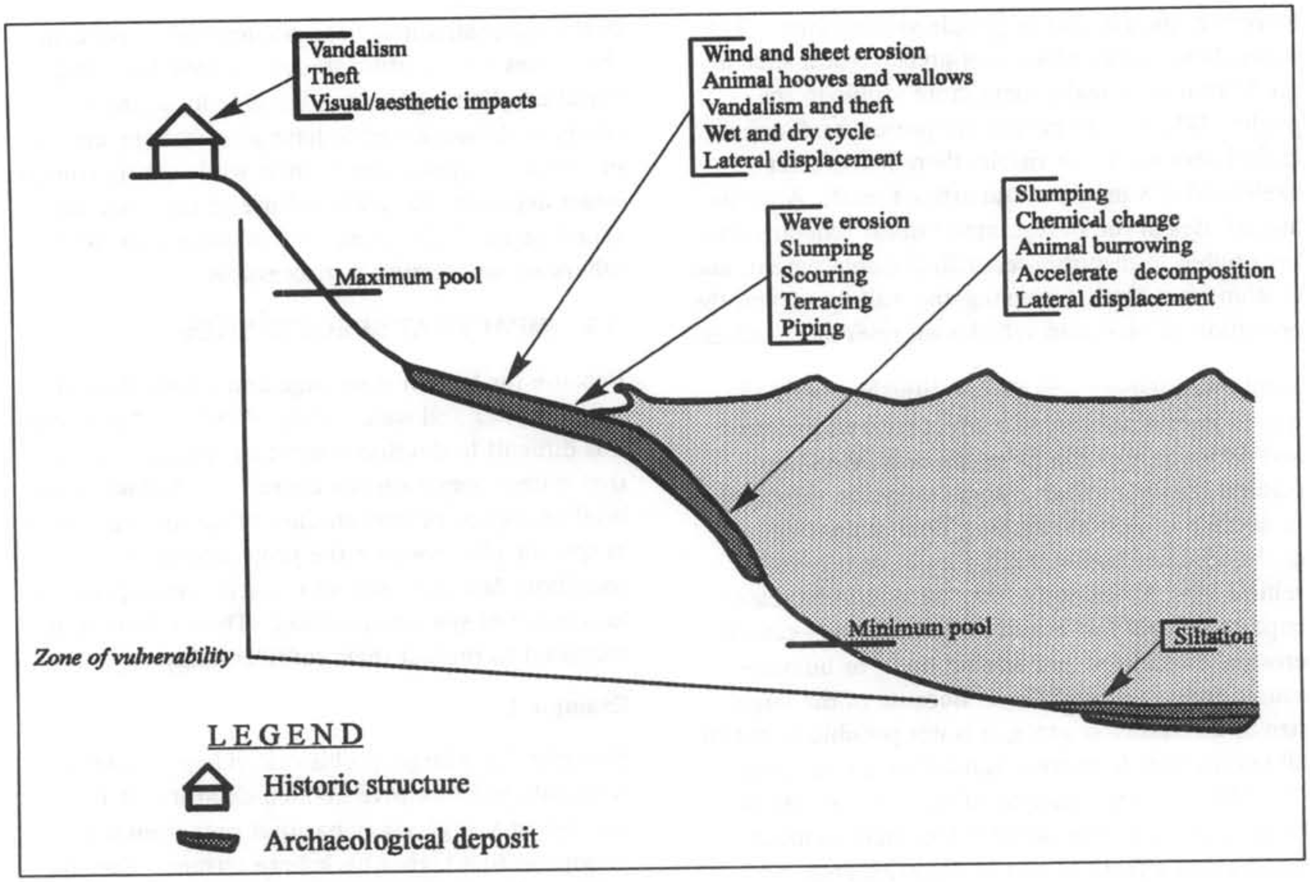

Figure 4–1. Reservoir Impact Zones and Potential Impacts on Historic and Cultural Properties

Wind– and powerboat–generated wave action erodes and deflates archeological sites. It may also stimulate geomorphic changes that can destroy intact archeological deposits. These changes can include slumping, scouring, terracing, and piping.

Direct impacts on archeological deposits that occur in the inundation zone include underwater erosion, chemical change, damage by aquatic organisms, accelerated decomposition, and siltation (Lenihan et al., 1981). Underwater currents can cause slumping, or displace materials and artifacts already brought to the surface by wind– and water–caused erosion. For example, at Kettle Falls in Lake Roosevelt, underwater eddies continue to affect archeological sites. Reservoir water dissolves organic materials and ceramics, and changes chemical attributes such as pH, phosphate, and nitrogen levels of deposits.

Aquatic organisms, such as burrowing clams, can churn archeological deposits by moving artifacts within them. An accumulation of organic acids accelerates the decomposition of organic materials and ceramics.

Both underwater siltation and inundation prevent access to archeological sites, although they can protect the sites from accelerated decomposition and vandalism. This inaccessibility prevents the scientific study of site as well as traditional cultural practice.

4.2.2 Indirect Impacts

Indirect impacts to historic and cultural properties from system operating strategies result mainly from changes in the human use of the shore and littoral zones. For example, reservoir operations influence the recreational attractiveness of reservoirs and therefore, the number of people visiting them. The devegetation and deflation of archeological sites in the littoral zone make them more visible to the public. When more people are present and archeological sites are more visible, there is a greater likelihood of vandalism and artifact theft. Archeological sites in the devegetated littoral zone are also susceptible to disturbance, artifact displacement, and erosion from cattle trampling and wallowing, and the operation of off–road vehicles on reservoir beaches.

Land management actions not directly related to system operations can also affect recreational use, and different uses can have different effects on cultural resources near system reservoirs. Decisions to develop or permit camping, boat ramps and docks, summer homes, hiking trails, or off–road vehicle uses, for example, may all lead to increased impacts on cultural resources from human–caused erosion, vandalism, and artifact theft; or human–caused forest or brush fires. Because of the large size of the reservoir areas, it is not possible to patrol all known sites to prevent vandalism and lootings. Cumulative impact analysis of operational effects must, therefore, also consider land management actions that affect projects in the SOR area.

System operating strategies that change the intensity of land use might also indirectly cause changes to the integrity of feeling or character associated with a historic or cultural property. For example, an increase in nearby recreational uses might adversely affect a traditional cultural property, such as a Native American ritual site, by increasing sights and sounds incompatible with ritual use. Reservoir drawdown might adversely affect the visual integrity of a historic site or traditional cultural property by introducing an element that is inconsistent with its historic or cultural character.

4.2.3 Existing and Future Operational Impacts

All of the SOSs would continue to have an adverse effect on cultural resources, although some of these effects would be more dramatic than others. Sites that are covered in reservoir siltation, for example, are to some extent protected from the effects of erosion and vandalism, although chemical changes in the soil matrix may have occurred and access to these sites for scientific study may have been lost or curtailed. Some sites in vulnerable locations in the reservoir drawdown zone have already been eroded or deflated beyond significance, while others contain intact deposits. Recreational use of the reservoir shoreline has led to vandalism at some sites, while others remain relatively inaccessible.

4.3 IMPACTS AT SPECIFIC SITES

Because the system is so large and would affect a large number and wide variety of cultural resources, it is difficult to develop a sense of specific impacts that system operation can cause. The following are brief examples, or case studies, of cultural resources at specific places within the project area, their condition, and the kinds of impacts they experience as a result of system operation. Their locations are disguised to protect their confidentiality.

Example 1

Example 1 is a large, prehistoric village site with housepits and extensive midden deposits. It is located on a large sandy bar that rises from the floodplain to a higher backshore terrace. The site was tested in 1974, yielding a variety of late prehistoric artifacts. Additional excavations reported in 1985 yielded fishing net weights, a large number of fish remains, and radiocarbon dates demonstrating that the site was occupied 4,000 years ago. Hearth and house pit features are eroding from the site within the drawdown zone.

Example 1 spans the reservoir shoreline, and has experienced some cutbank erosion at the shoreline's edge. Recent monitoring of the site demonstrated that vandals had dug into the cutbank, increasing erosion. The site is easily accessible, exacerbating archeological vandalism as an adverse effect. There is also cutbank erosion caused by pedestrian and horse traffic along the reservoir shore. The backshore portions of the site are somewhat protected by grassy vegetation.

Example 2

Example 2 is a series of waterfalls, narrows, and rapids which formed a natural fishing station for harvesting the great runs of salmon during their annual migrations on the Columbia River. Since time immemorial, people caught chinook salmon and other food salmon at this place, as the giant fish struggled to make their way upstream through the rocky barriers and swift narrow channels of tumbling water. The salmon has always been the staff of life to the Columbia River Indians. To them, it is one of the blessings of the Creator and is used in religious ceremonies as evidence of the Creator's bounty - a sacred gift and a source of spiritual and material food.

While this location is not a single identifiable property, it consists of places used seasonally and evidenced by the ashes of camp fires, tools, and items or adornment, sanctuaries for the dead, and samples of art. During fishing season, the river shores here were lined with Indian lodges and camps. Scaffolds were built atop the vertical walls from which spears and dip nets were thrust into the turmoil below where legions of salmon thrashed their way upstream to spawn. The abundance of food also brought people from far away, creating one of history's great centers for religious ceremonies, trade, feasting, and other means of social interaction. This place is a cultural landscape that, to this day, provides a means for cultural maintenance and renewal for Native Americans.

Embodied in this place are the oral histories of the Columbia River Indians which explain the world and how one is to live. The setting of this place has changed because of reservoir construction, yet echoes of the falling water still live in the hearts, traditions, and religions of the Columbia River Indians. This place is their very soul.

Example 3

Example 3 is a very large scatter of stone tool waste, animal bone, and groundstone located on a prominent sand and gravel bar. The site deposits extend for a kilometer along the bar and from the high water line to within 30 meters of the pre–reservoir river channel. This site was originally recorded as two sites. After inundation had exposed more site deposits to erosion, archeologists learned that there is a continuous scatter of material between the two major artifact concentrations.

Limited test excavations determined that the site contains stone tool waste, fire–cracked rock, mussel shell, and cobble tools. Site monitoring during a reservoir drawdown revealed several site features, including hearths, rock–lined ovens, shell lenses, and large midden (refuse disposal) areas. The monitors also observed a large number of stone artifacts, including projectile points, bone and antler tools, and a historic–era glass trade bead. They also observed several pestles, a hopper mortar base, edge–ground cobbles, and deer bone.

The monitoring program demonstrated that reservoir shoreline waves at the high water level are undermining the sandy banks and causing them to slump. Redeposited sand and silt covers some of the site deposits. Sheetwash and reservoir terracing is also a problem along portions of the site. The monitors also observed eight persons hunting for artifacts on the site during a reservoir drawdown. The site is easily accessible by road from a nearby town.

Example 4

Example 4 is an extensive deposit of prehistoric and historic occupation debris on a broad terrace along a tributary of the Columbia River. The site is on very hard clay and fine silt soils with volcanic ash, overlain by a coarser and looser deposit of silt and fine sand. The site has three cultural components: 1) one below the Mazama volcanic ash layer (dated about 7,000 years ago), which may be up to 10,000 years old; 2) another dating from about 6,000 to around 2,000 years ago; and 3) a recent historic occupation. The younger prehistoric component is currently considered to be a habitation site, most likely a central base.

The site is being affected by bank erosion involving processes of wave attack, block slumpage, overland flow and piping, and mass wasting. Because the clay soil structure is well developed, shrinkage cracks can expand along internal blocks. Attack by wind–driven waves is fairly slow, but may be increasing during the full pool period as the frequency and size of wakes from recreational boating grows. The site is accessible to the public, and looting periodically takes place.

The managing agency has begun a monitoring program to observe conditions at this and other sites. The monitors also retrieve significant archeological information that is exposed along the shorelines. Future plans for the site include a study (along with other Register–eligible sites) to determine the technical feasibility and costs of installing active bank protection to prevent the loss of both cultural and fish and wildlife values at the site.

Example 5

Example 5 is a medium–sized prehistoric site on a broad terrace formed by the reworking of old landslide deposits. The site has a prehistoric midden deposit and the remains of semisubterranean houses—radiocarbon dated at 2,000 to 150 years ago. Example 5 contained a historic cemetery that the managing agency relocated in cooperation with a Native American tribe. The site is a contributing member to a National Register historic district.

Example 5 is relatively difficult to reach and has no recent, documented incidents of vandalism. However, its poorly consolidated sediments are vulnerable to several kinds of erosion, including mass wasting, piping through the many rodent burrows found at the site, and block slumping after wave attack undercuts the site's steep reservoir bank. Wave attack on the soft sediments is the greatest threat because the prevailing winds cross a wide expanse of water.

Although outlying parts of the site are eroding slowly, erosion has not yet taken significant parts of the site. The managing agency has been monitoring the site since the early 1980s to identify any need for active measures to retard or prevent further bank erosion.

4.4 GEOMORPHIC ANALYSIS

The geomorphic analysis of SOS impacts to cultural resources focused on operational features of the various SOSs that could affect landforms on which cultural resources are located (Chapter 3). Although the alternatives serve primary functional objectives (optimum load–following, fish passage, recreation and resident fish, etc), each reservoir in the system operates with several subordinate functional objectives as well. The reservoirs are constantly adjusted to meet various target flows and storage levels as the system is balanced to conform to project purposes, including power production, navigation, flood storage, water supply, and fish and wildlife habitat maintenance.

Table 4–3 summarizes the effects of operational features of the SOS alternatives on landforms. Operational features listed in the left hand column of the table are common to several alternatives. Flow augmentation, for example, is a feature of alternatives including the baseline (SOS 1a).

4.4.1 Storage Reservoirs

The system's storage reservoirs have much larger capacity than the run–of–river reservoirs. These reservoirs fluctuate much more dramatically than do the run–of–river reservoirs because system operators use them to even out the natural fluctuations in precipitation and runoff. The storage reservoirs also provide flows to meet specific purposes such as fish passage, navigation, and power generation. The number of feet of elevation change that actually occurs at these reservoirs, however, has to do with their shape. Because Albeni Falls is a long, narrow reservoir, it can change dramatically in storage volume when drawn down only a few feet. The shorelines of Hungry Horse, Libby, and Dworshak, on the other hand, fluctuate much more because they are compact and deep reservoirs. Hungry Horse, for example, operates over an elevational range of 224 feet (68 meters).

One of the main differences between past operational strategies and those proposed under the SOR would be the shifting of storage and release functions and targets from one part of the system to another. Also, SOS alternatives, other than SOS 1a, would require selected reservoirs to perform system–balancing functions to a greater extent than they have in the past.

Table 4–3. Qualitative Summary of Effects of the Operational Features

Operational Feature	Effect on Erosion	Effect on Sedimentation	Effect on Cultural Resources
Natural River Operation	Exposes denuded slopes of Reservoir to sheet, rill, gully, wave, wind erosion freeze/thaw action.	Exposes sediment on reservoir slopes to subaerial erosion agents.	Maximum potential for displacement, deep burial by sediment,weathering, exploitation.
	Restarts erosion cycle across entire former drawdown zone.	Until banks stablize or revegetat; displaces, relocates sediment downslope, downstream.	
	High potential for damage to reservoir resources until banks stabilize, then low.	High potential for damage due to exposure, deep burial in relocatedsediment.	Provides access for research or traditional uses to sites presently permanently underwater.
New Reservoir Levels	Exposes shoreline to erosion in newelevation.	Relocates, displaces sediment downslope, downstream.	High potential for displacement, burial of culturalresources.
	Restarts erosion cycle at shoreline and exposed former drawdownzone.	Renews sedimentation process.	
	High potential for adversely affecting resources in zone of newshoreline.	Low potential for adversely affectingresources.	
Rapid Fluctuation	Promotes slide features, wave erosion.	Promotes displacement of sediment.	High potential to adversely affect cultural resources by displacement or burial.
	Accelerates erosion cycle, enlarges zone of vulnerability upslope.	New sediments added to reservoir area.	
	High potential for damage in silty, some clayey soil; moderate in other soils.	Moderate potential for burial by sediment.	
Rapid Drawdown	Promotes slide failures.	Relocates sediments downslope, downstream.	High to moderate adverse impact on cultural resources, severity depends on soil texture.
	Greatly expands zone of vulnerability.	New sediment added to reservoir.	High potential for cultural resource displacement.
	High potential for damage in silty, clayey soils, moderate in other soils.	High potential for deep burial by displaced sediment.	
Flow Augmentation	Promotes shoreline erosion.	Renewed sedimentation process.	
	Renews erosion cycle.	Low potential for deep burial of cultural resources.	Level of impact depends on erosion at shoreline and density of sites.
	Moderate potential for increased damage along reservoir shoreline.		

4.4.2 Run–of–River Reservoirs

Reservoir pools at run–of–river projects often are operated to meet short–term objectives for the river system. Control rooms routinely make instantaneous adjustments to accommodate specific user requirements. These pools operate within a narrow elevational range and, because they occupy narrow reaches of the river valley, they have a short flow–through time. Run–of–river reservoirs are long and narrow and hold much less water than storage reservoirs.

Among run–of–river projects, water is stored only at John Day. This storage is available only for flood control in the Portland–Vancouver area. It has not been necessary to use John Day for flood control since its construction in 1968.

A run–of–river reservoir's cross–sectional area is sensitive to the amount of water passing through it. When flow augmentation occurs, water flows faster through the pool and, as discussed in Chapter 3, this can upset the existing geomorphic equilibrium of the reservoir. Subtle changes in landforms triggered by such modifications in operation can set off a chain reaction of additional changes. This situation occurred when Bonneville Dam's operation was changed during the 1970s to supply hydropower at peak demand periods (called a load–following strategy). As currently operated, the Bonneville pool fluctuates rapidly within a 6–foot (2–meter) zone, causing accelerated erosion along shorelines and sedimentation at stream mouths and other slackwater areas of the pool.

Both Lower Granite and Chief Joseph also undergo periodic equilibrium changes as a result of being used to reregulate or smooth out the respective flows from Dworshak and Grand Coulee. Although Lower Granite and Chief Joseph Reservoirs have operated in this capacity for many years, neither has reached an equilibrium state between reservoir flow regime and geomorphic processes of erosion and sedimentation. The resulting damage to cultural resources at these projects is severe.

4.4.3 Discussion of Alternatives

SOS 1

Under SOS 1a, project reservoirs would operate as originally designed, with pool levels changing over a range of about 50 to 230 feet (15 to 70 meters), depending on runoff forecasts and downstream water needs. For the most part, geomorphic processes have already reached a near–equilibrium under past operations. SOS 1b would result in about the same level of ongoing deterioration in cultural resources as SOS 1a. Pool adjustments to optimize hydropower production have caused isolated instances of accelerated shoreline sloughing. The erosion and sloughing problems probably resulted from a loss of soil stability during the rapid drawdown associated with sudden lowering of a storage reservoir to met hydropower demands.

Because the system operated under SOS 1a for many years, ongoing erosion has stabilized to some extent at run–of–river reservoirs. Some of this stabilization is due partly to the rip–rapping of reservoir shorelines to halt erosion. There are some instances of revetting reservoir slopes specifically to protect cultural resources from deterioration due to normal reservoir operation. In other cases, water action has destroyed cultural resources. Under SOS 1b, shoreline erosion that would affect cultural resources would accelerate due to rapid fluctuation in flows, sudden drawdowns, and the lack of fixed winter minimum pool levels. This occurred at Bonneville under operation for load–following during the 1970s.

SOS 2

Under SOS 2c, water to augment flows is taken from upper Snake, Dworshak and Brownlee with flow targets at Lower Granite. Experience with this type of operation during the 1992–93 operational test indicates that, when releases are made to augment flows downstream, the high release volumes from individual storage projects lower the storage pools rapidly. Though this is not technically a "rapid drawdown," low–strength sandy soils at both Brownlee and Dworshak would respond by sloughing and shallow landsliding. This is judged a severe impact on shoreline soils as well as on any historic properties located in these soils.

SOS 2d is a more complicated strategy which features flow augmentation water drawn from Libby, Grand Coulee, Dworshak, Brownlee, and upper Snake projects. All of these projects have slide–prone soils except the upper Snake reservoirs which share in the flow augmentation volume, and are expected to exhibit slope failures as the pools are drawndown or fluctuate over a short time to meet flow targets downstream. Lower Snake reservoirs are held at new lower pool levels under SOSs 2c and 2d. This would result in the adjustment of the shoreline to a new equilibrium condition, causing accelerated shoreline erosion. This is likewise a severe impact to historic properties located within the shoreline soils.

SOS 4

The SOS 4c strategy is to provide a stable storage condition at system storage reservoirs. Storage reservoirs are managed to minimize reservoir fluctuations while moving closer to natural flow conditions. When forebay elevation is less than 2 feet (0.6 meter) between minimum and maximum rule curves, the short–term operation defines daily elevation changes within a range of less than 2 feet (0.6 meter) between end–of–month pool elevations, with power–based flows not to exceed 1 foot in any 24–hour period. Storage reservoirs at Libby, Hungry Horse, Grand Coulee, and Albeni Falls operate to meet pool elevation targets. In addition, Dworshak provides instantaneous flows, which causes its pool to fluctuate rapidly. This condition causes severe erosion on reservoir slopes, with adverse effects on historic properties. The lower Snake pools are operated near minimum operating pool from April 16 through July. Operating at this level for a relatively long period of time exposes reservoir slopes to wind and overland flow. Since this occurs as storm activity is decreasing, the net adverse effect from erosion on historic properties would be moderate. However, based on the 1992–1993 drawdown test, adverse effects of shoreline exposure from anthropogenic sources would be severe.

SOS 5

The objective of SOS 5 would be to reduce the four lower Snake River projects to near–natural river bed levels by installing new low–level outlets in each dam. The near river bed operation under SOS 5b would be 4 1/2 months in duration, beginning April 16 each year. Under SOS 5c, the drawdown would be of year–round duration. The adverse effect on historic properties stemming from erosion of reservoir slopes and sedimentation during the refilling period with SOS 5b would be severe under these strategies. This is because lower Snake reservoirs are used for flood control. They would be subject to operation at new pool levels as well as rapid drawdown as flood storage is spilled and pools are returned to near riverbed levels as prescribed for improvement of fish passage. At Grand Coulee and Dworshak, hydropower operation is superimposed on flow augmentation and lower Snake reservoir refill, respectively. This type of operation has combined rapid pool fluctuations with rapid drawdown within a limited elevational range. It caused accelerated shoreline erosion and slope failure (mass wasting) during the 1992–1993 test period and during implementation of other operational strategies which have been instituted over the past several years. Based on these observations, SOS 5 would result in a maximum adverse effect on historic properties at Grand Coulee and Dworshak and the adjacent downstream projects, Chief Joseph and Lower Granite.

SOS 6

The SOS 6 operation is aimed at increasing flow–through in the lower Snake projects by drawing Lower Granite, Little Goose, Lower Monumental, and Ice Harbor Reservoirs down below the current minimum pool levels. Strategy 6b has a 4 1/2 month duration on the lower Snake and a 4–month duration for John Day minimum pool operation. Under SOS 6d, Lower Granite is the only lower Snake pool that operates below minimum and also includes drawdown of John Day to minimum pool for 4 months. The adverse effects on historic properties described in SOS 5 above would also apply to SOS 6b and 6d.

SOS 9

This strategy provides increased flows for anadromous fish by establishing flow targets during the migration period. In addition, Strategy 9 includes various other actions that benefit those fish listed under the Endangered Species Act.

The SOS 9a option establishes flow targets at The Dalles, met by release of stored water at Libby, Grand Coulee, and Hungry Horse; and at Lower Granite, met by storage releases from Dworshak. Lower Snake projects are drawn down to near spillway crest levels and John Day is kept at minimum pool level, all for 4 1/2 months. Severe effects to historic properties under SOS 9a derive from operation at new reservoir levels, increased flow velocities, and pool fluctuations necessitated by specified releases over spillways at main stem Columbia and lower Snake projects, including Brownlee.

Strategy 9b uses a modified flood control rule curve that is suspended for flow augmentation during the migration periods. With this strategy, the storage dams all share in providing flow augmentation. This diminishes the adverse effects of pool fluctuation and rapid drawdown that result when providing augmented flows. Dworshak would operate for flood control but not hydropower, and would provide flow augmentation for the Snake River only when other sources could not. Strategy 9b would therefore produce minimal erosion effects on the historic properties at Dworshak and at John Day, where the pool would be operated as it was in the past. Lower Snake projects would operate at minimum pool. This is expected to result in moderate adverse effect on historic properties from operating the reservoirs at new levels within their customary operating range. Spill targets at both lower Snake and lower Columbia projects have been observed to increase tailrace velocities to the point where significant erosion occurs in the reach immediately downstream from the dam. Historic properties located along the affected reaches would show severe adverse effects from the erosion that results from these increased flows.

Under SOS 9c, projects would operate with new modified flood control rule curves.

SOS PA

The preferred alternative provides for managing the detrimental effects to other resources which result from using stored flood control water to augment flows during fish migration periods. Spring flow targets are established at Lower Granite and McNary but, to meet these targets, drafts from storage pools at Libby, Hungry Horse, Grand Coulee, Albeni Falls are shared. This strategy avoids the serious erosion problems that result from pool fluctuation or deep drawdown associated with drafting from one or two reservoirs. Augmented flows passing through the lower Snake reservoirs, which would be held at minimum operating pool, would sustain increased shoreline erosion. Cultural resources in these pools would be severely impacted by this action, as would those at John Day, which would also be operated at minimum pool. Dworshak drawdown for flow augmentation would be limited to reaching a specified minimum elevation, would not draft for power, and would therefore not be subject to accelerated shoreline erosion. Under this option, cultural resources at Dworshak would undergo moderate adverse impact.

4.5 SIMULATION STUDY

The computer simulation program (see Chapter 3 for a discussion of the mechanics of the simulation) calculated the total number of simulated days within the 50–year model period that a given site within an operating pool would experience: 1) reservoir shoreline erosion within its boundaries; 2) exposure in a reservoir drawdown zone; and 3) inundation in the reservoir pool. To compare reservoirs and alternatives, the program added these shoreline erosion, site exposure, and inundation numbers together for each reservoir, and for each alternative across reservoirs. Because these numbers of days in the 50–year time span are very large and difficult to grasp in concrete terms, the program also rated each reservoir's simulated effects in two additional ways. First, it divided the total number of impact days per reservoir by the number of years in the simulation

(50) and again by the number of sites at the reservoir to obtain the average number of impact days per year per archeological or historic site for that reservoir. Second, the program also calculated this number as a percentage of the total number of days in a year. Tables 4–4 through 4–7 and Figures 4–2 to 4–13, found at the end of this chapter, show these simulation results. The numbers of sites at each reservoir are shown on Table 3–1, and also under the name of each reservoir on Tables 4–4 through 4–6.

The most useful statistic from the simulation for overall discussion of potential operation effects is the average percentage of time that all sites at a given reservoir would experience shoreline erosion, site exposure, or inundation under a given alternative (see Table 4–7). According to the simulation, shoreline erosion would occur between 32 and 38 percent of the time at all the known sites, depending on the alternative. Site exposure would occur between 49 and 65 percent of the time. Inundation would occur 49 to 64 percent of the time. These are average number ranges; individual sites would experience these effects differently.

Looking at the simulation results by project group (Figures 4–2 to 4–4) shows distinctive patterns. Shoreline erosion, which is consistently a serious impact, is much more severe at the storage projects and Columbia River projects than on the lower Snake River. This is because many of the sites at the lower Snake projects are inundated (Figure 4–4). The pattern for exposure in a drawdown zone is similar, with Snake River projects experiencing lower rates of ongoing impact than the other projects. This is because—except for Alternatives 5b and 5c, which entail partial and permanent drawdowns to natural river level, respectively—most alternatives inundate most of the lower Snake River sites most of the time. This fact is borne out in Figure 4–4, which shows average days per site–year of inundation, and is the inverse of the graph for drawdown zone exposure.

The following discussions briefly summarize the potential effects at each individual reservoir, as modeled in the simulation. Chapter 5 compares the alternatives to one another. In the following discussions, the terms very low, low, moderate, high, and very high are used to refer to simulated rates of impact. These mean:

Very low:	Impact would occur 0–20 percent of the time (0 to 73 days per year)
Low:	Impact would occur 21–40 percent of the time (74 to 146 days per year)
Moderate:	Impact would occur 41–60 percent of the time (147 to 219 days per year)
High:	Impact would occur 61–80 percent of the time (220 to 292 days per year)
Very high:	Impact would occur 81–100 percent of the time (293 to 365 days per year)

Note that these impact frequency estimations are summary numbers that combine the results from all sites at a reservoir and for all 50 modeled years. A very low rate of overall impact for the reservoir could entail very high rate of impact at a particular site or sites. To emphasize this, the following project–by–project descriptions also show the number of sites at each reservoir that would sustain very high rates of simulated shoreline erosion or site exposure (80 percent or more). These are listed as "80 percent shoreline erosion" and "80 percent site exposure." Similarly, impact rates would vary somewhat from year to year. Exhibit H contains graphic profiles of the simulated impacts for each reservoir. Simulation output showing the estimated number of shoreline erosion, site exposure, and inundation days that each individual site would accrue in a 50–year period, is being distributed to the cultural resources managers of the respective reservoirs. This output is not included in this volume to protect the confidentiality of the site locations.

4.5.1 Hungry Horse

Hungry Horse would experience very low rates of shoreline impact, and moderate to very high rates of drawdown zone exposure, according to the simulation. Rates of inundation would be low for most alternatives. Inundation would be moderate for SOSs 4c, 9b, and 9c; very low for 9a; and low for the remaining alternatives.

These results should be interpreted with caution since they are based on surveys that are almost entirely from the upper third of the operating pool, due to water levels at the time of survey. Assuming that additional surveys would record more sites in the lower pool, the shoreline erosion rate should be higher, reflecting the impact of shorelines at sites deeper in the pool. This factor may have also inflated the rate of drawdown zone exposure somewhat.

Shoreline erosion:
very low (25 to 60 days per year)

Drawdown zone exposure:
moderate to very high
(198 to 308 days per year)

Inundation:
very low to moderate
(57 to 167 days per year)

80 percent shoreline erosion:
0 sites

80 percent site exposure:
5 to 14 sites

4.5.2 Libby

Libby would experience very low rates of shoreline impact and moderate rates of drawdown zone exposure under all of the alternatives except for SOS 9a, according to the simulation. Rates of inundation would be moderate except for SOSs 4c and 9c, for which they would be high.

These results are based on archeological surveys only for the American portion of Lake Koocanusa. Reservoir impacts would also occur at sites in Canada.

Shoreline erosion:
very low (28 to 36 days per year)

Drawdown zone exposure:
low to high (123 to 240 days per year)

Inundation:
low to high (125 to 242 days per year)

80 percent shoreline erosion:
0 sites

80 percent site exposure:
16 to 91 sites

4.5.3 Albeni Falls

Albeni Falls would experience moderate to high rates of shoreline impact, and high to very high rates of drawdown zone exposure (except for SOS 9a), according to the simulation. Rates of inundation would be very low to low.

This reservoir shows the highest overall rate of impact of any in the simulation except for Bonneville, for which data are spotty and very incomplete. By contrast, survey of Albeni Falls is mostly complete. This is true for both types of severe impact, shoreline erosion and site exposure.

The most likely explanation for this is that Lake Pend Oreille is formed over a large natural lake. The reservoir is very long and narrow, and fluctuates only 13 vertical feet (4 meters). This is in contrast to other storage reservoirs, which are much deeper and fluctuate between 82 (Grand Coulee) and 224 feet (68 meters) (Hungry Horse). The archeological and historic sites in the simulation model are mostly deposits along the shores of the pre–dam lake. Therefore, the shoreline inflicts both shoreline erosion and site exposure damage on most of the known sites as it moves, instead of spreading these effects across sites located across a wider elevation span.

Shoreline erosion:
moderate to high (212 to 268 days per year)

Drawdown zone exposure:
high to very high (280 to 312 days per year)

Inundation:
very low to low (53 to 85 days per year)

80 percent shoreline erosion:
94 to 233 sites

80 percent site exposure:
213 to 262 sites

4.5.4 Grand Coulee

Grand Coulee would experience very low to low rates of shoreline impact and moderate rates of drawdown zone exposure, according to the simulation. Rates of inundation would be moderate.

Shoreline erosion:
very low to low (65 to 90 days per year)

Drawdown zone exposure:
moderate (149 to 186 days per year)

Inundation:
moderate (179 to 212 days per year)

80 percent shoreline erosion:
0 to 10 sites

80 percent site exposure:
43 to 55 sites

These results should be interpreted with caution for several reasons. First, Grand Coulee is a very large reservoir for which a limited data base was available. Some of the existing survey data are of poor quality and survey coverage was spotty. Second, soils in Lake Roosevelt are very unstable and subject to slumping and wave induced erosion. Actual observations indicate that impacts are moderate to high for much of the reservoir in both shoreline and drawdown zones.

4.5.5 Dworshak

Dworshak would experience low to moderate rates of shoreline impact and moderate to high rates of drawdown zone exposure, according to the simulation. Rates of inundation would be low to moderate.

Many of the known sites at Dworshak are located on ridge shoulders that are relatively high in the pool in the downstream two–thirds of the reservoir. Drawdowns, which can reach up to 155 feet at this reservoir, spare many these sites from direct shoreline action, but expose them in thin and highly erodible soils on the ridge–shoulder slopes. In fact, the large elevation range of some of these sites as recorded may be the result of deflation and subsequent downslope movement of artifacts. Because they were located on thin soils to begin with, many of these sites may be badly damaged.

Additional survey shows that if the upper reaches of the reservoir were to contain a high density of river terrace sites, as is the case in most locations, and if these were entered into the simulation, the shoreline erosion rates would probably appear somewhat higher.

Shoreline erosion:
low to moderate (120 to 163) days per year)

Drawdown zone exposure:
moderate to high (204 to 271 days per year)

Inundation:
low to moderate (94 to 161 days per year)

80 percent shoreline erosion:
14 to 47 sites

80 percent site exposure:
92 to 132 sites

4.5.6 Lower Granite

Lower Granite would experience very low rates of shoreline impact. Its rates of drawdown zone exposure would vary dramatically by alternative, according to the simulation. For most alternatives (1a, 1b, 2c, 2d, 4c, 9b), exposure would be very low. For several others (6b, 6d, 9a, and 9c), it would be low. For 5b, the exposure rate would be moderate, and for 5c, it would be total (all sites always exposed). Rates of inundation would be high to very high for all alternatives except 5b (moderate) and 5c (very low).

It is fair to say that Lower Granite, as with the other lower Snake River projects, would experience lower rates of overall impact than would occur at some other reservoirs, particularly the storage reservoirs. The very high rate of site exposure under the natural river operation mode of Alternative 5c would be offset by revegetation of the drawdown zone, which would afford some protection from erosion and vandalism.

Reservoir operation under most alternatives occurs within a relatively narrow range (5 to 33 feet or 1.5 to 10 meters) at Lower Granite. Because most of the known sites are found deeper in the pool than this range, they sustain high rates of inundation and low rates of shoreline erosion and site exposure. Because alternatives 5b and 5c involve drawdowns to natural river level, they invert this pattern, exposing most sites.

Shoreline erosion:
very low (0 to 38 days per year)

Drawdown zone exposure:
very low to very high (29 to 365 days per year)

Inundation:
very low to very high (0 to 336 days per year)

80 percent shoreline erosion:
0 to 8 sites

80 percent site exposure:
9 to 114 sites

4.5.7 Little Goose

The pattern of simulated impact rates for Little Goose is identical to that for Lower Granite, with one exception. Exposure in the drawdown zone would be very low for SOS 6d at Little Goose, while it would be low at Lower Granite. Conversely, inundation would be very high at Little Goose, and high at Lower Granite.

Shoreline erosion:
very low (0 to 53 days per year)

Drawdown zone exposure:
very low to very high (10 to 365 days per year)

Inundation:
very low to very high (0 to 355 days per year)

80 percent shoreline erosion:
0 to 6 sites

80 percent site exposure:
6 to 75 sites

4.5.8 Lower Monumental

The pattern of simulated impact rates for Lower Monumental is nearly identical to that of Lower Granite and Little Goose. In general, it indicates slow rates of impact, compared with other reservoirs, except for SOS 5c.

Shoreline erosion:
very low (0 to 50 days per year)

Drawdown zone exposure:
very low to very high (37 to 365 days per year)

Inundation:
very low to very high (0 to 329 days per year)

80 percent shoreline erosion:
0 to 1 site

80 percent site exposure:
1 to 10 sites

4.5.9 Ice Harbor

Ice Harbor's rates of impact would be almost identical to those at Lower Granite, Little Goose, and Lower Monumental. See further discussion under Lower Granite.

Shoreline erosion:
very low (0 to 68 days per year)

Drawdown zone exposure:
very low to very high (44 to 350 days per year)

Inundation:
very low to very high (15 to 321 days per year)

80 percent shoreline erosion:
0 to 3 sites

80 percent site exposure:
3 to 24 sites

4.5.10 Chief Joseph

Since Chief Joseph would be operated at a steady reservoir level, with up to 5 feet (1.5 meters) of fluctuation for fine–tuning operations, the 95 sites located on its shoreline would experience both shoreline erosion and site exposure all of the time. The remaining 76 sites in its pool would be inundated all of the time.

4.5.11 McNary

Since McNary would be operated at a steady reservoir level, with up to 5 feet of fluctuation for fine–tuning operations, the 24 sites located on its shoreline would experience both shoreline erosion and site exposure all of the time. The remaining 81 sites in its pool would be inundated all of the time. However, the survey status of McNary is poorly understood and survey coverage has been minimal. There should be many unrecorded sites on the shoreline.

4.5.12 John Day

John Day would experience low rates of shoreline impact (very low for SOS PA), and moderate rates of drawdown zone exposure, according to the simulation. Rates of inundation would be moderate (low for SOS PA).

Shoreline erosion:
very low to low (70 to 140 days per year)

Drawdown zone exposure:
moderate to high (194 to 239 days per year)

Inundation:
low to moderate (126 to 171 days per year)

Very high shoreline rate:
7 to 32 sites

4.5.13 The Dalles

Since The Dalles would be operated at a steady reservoir level, with up to 5 feet (1.5 meters) of fluctuation for fine–tuning operations, the 11 known sites located on its shoreline would experience both shoreline erosion and site exposure all of the time. The remaining 10 sites in its pool would be inundated all of the time. The survey status of The Dalles is poorly understood, and survey coverage has been minimal. There are probably many more unrecorded sites on the shoreline.

4.5.14 Bonneville

Since Bonneville would be operated at a steady reservoir level, with up to 5 feet (1.5 meters) of fluctuation for fine–tuning operations, the 13 known sites located on its shoreline would experience both shoreline erosion and site exposure all of the time. The remaining site in its pool would be inundated all of the time. The survey status of Bonneville is poorly understood, and survey coverage has been minimal. There are probably many more unrecorded sites on the shoreline.

4.5.15 Discussion

The simulation study of the individual reservoirs helps to highlight patterns or relationships that might not otherwise be apparent. Understanding these patterns, in turn, may be useful in managing the resources as the system changes operation.

Low Rates of Impact

One surprising pattern is that the simulated rate of shoreline erosion, generally speaking, is lower than expected at all the reservoirs. It is moderately high to high only at Albeni Falls and Dworshak. For many reservoirs, including Libby, Hungry Horse, and the lower Snake River projects, the overall rate is very low, below 20 percent for all alternatives. The real rates may be underestimated somewhat in the model due to a lack of precise elevation data for relatively flat sites whose recorders gave them only a single elevation rating. However, the figures also reflect the realities of system operation. When shorelines move, they move away from, as well as onto, archeological and historic sites.

This does not mean, however, that the reservoir operation impact on the sites is low. It only means that the impact is slower than might otherwise have been expected. Shoreline erosion is devastating to archeological deposits, but many sites are favorably located or are resilient and resistant to some of these effects. The relatively slow rate of simulated impact simply provides hope that there may be some significant deposits remaining at some of these sites that experienced shoreline erosion for the many years since the reservoirs filled. This is essentially what was shown in Draper's (1992a) study of a sample of sites along the shorelines of Lower Granite and Little Goose Reservoirs during a special drawdown. Many of these sites still have intact deposits of value.

Low reservoir impact ratings also do not mean that particular sites are not suffering sustained and rapid damage. For example, despite the low rate of shoreline erosion at the sites of the lower Snake River reservoirs combined under the preferred alternative (12 percent or less), 17 sites in these reservoirs would suffer shoreline erosion rates of more than 95 percent.

Differences Among Reservoirs

A second surprising or unexpected pattern is that there are large differences in simulated rates of impact among reservoirs. The rates of shoreline erosion and site exposure are both high or very high at Albeni Falls, for example, and low or very low at all four lower Snake River reservoirs (except for SOSs 5b and 5c). As explained above, this is in both cases the result of a particular site distribution pattern coupled with a narrow reservoir operating range. At Albeni Falls, most of the sites are high in the pool, where the reservoir fluctuates. This is because Pend Oreille Lake was a natural lake with many shoreline sites before the Albeni Falls dam was built. At the lower Snake projects, most of the sites are low in the pool, where the reservoir does not fluctuate. The few sites that are high in the pools at the lower Snake projects are deteriorating rapidly.

These patterns have implications for cultural resources management. An appropriate strategy at the lower Snake projects would be to focus on the sites that are being rapidly impacted, field–verify the simulation results, and allocate resources to those sites in particular. For Albeni Falls, on the other hand, there is an indication that a large number of sites may be in poor condition and may continue to deteriorate. It would be appropriate, under these circumstances, to revisit most of the sites in the high pool, identify examples of particular site types that for some reason are relatively well preserved, and focus efforts especially on those sites.

Patterns suggesting particular management strategies are not as clear for reservoirs that are less completely surveyed, such as Grand Coulee, Hungry Horse, Dworshak, and the lower Columbia reservoirs. Inventory completion should be the first goal at these reservoirs.

Fixed Shoreline Reservoirs

The simulation is not particularly useful for drawing conclusions about effects at the fixed– shoreline reservoirs (Chief Joseph, McNary, The Dalles, and Bonneville). The known sites in these reservoirs are either underwater or on the shoreline. If they are on the shoreline, they are obviously experiencing shoreline erosion and site exposure almost constantly.

It should also be kept in mind that, except for Chief Joseph, there has been little archeological survey below the operating pools at these reservoirs. Bonneville had no survey prior to dam construction. Surveys at The Dalles and McNary recorded only the largest sites. Salvage efforts during the 1940s and 1950s were cursory by today's standards. Since The Dalles–Deschutes locality had a very high seasonal population density throughout the ages because of the excellent fishing opportunities afforded by Celilo Falls and the Long Narrows, this loss of archeological resources lends significance to those that remain. Because inundation of the Columbia River is continuous from Bonneville Dam to the Hanford Reach, there is a major cumulative loss of resources. Though this loss also applies to the lower Snake projects, their later construction allowed for a more thorough program of investigation prior to inundation.

As Draper's (1992b) options analysis study showed at McNary, many of the shoreline sites at these reservoirs are badly damaged. Furthermore, since the shoreline does not move very far, there is little or no opportunity to access them to recover materials that would otherwise be lost. Mitigation efforts at these sites should focus on preventing further bank slumpage or on recovering materials adjacent to the bank that may soon be lost.

Site Exposure

Site exposure is particularly a problem at the storage reservoirs. Exposure rates at Albeni Falls, Hungry Horse, and Dworshak are all high to very high. Rates at Grand Coulee and Libby are more moderate. It is easy to picture the large drawdown zone of a storage reservoir, exposing sites on slopes and mid–slope benches. As described above for Dworshak, these slopes often have thin soils that deflate quickly, and artifact deposits move downslope. The slopes easily develop erosional rills, and rapid fluctuation and drawdown can cause piping and slumping. Depending on the local soil and slope conditions and the intensity of recreational use, sites on these slopes are especially vulnerable. Site exposure impacts are likely to be highly dependent on these local conditions, and attempts to identify well–preserved examples of sites might be worthwhile.

4.6 TRADITIONAL CULTURAL RESOURCES

The SOR agencies did not conduct a comprehensive assessment of impacts to traditional cultural resources for the EIS. The CRWP head testimony regarding impacts from Tribal representatives and received letters or reports on cultural resource impacts form some of the Tribes. Most of the reports submitted by Tribes are printed in the exhibits section at the end of this Appendix. Other written statements from affected Tribes may be found in exhibits to the EIS Main Report, and in Appendix T, Comments and Responses. Shown below are just a few excerpts from Tribal sources as examples of the effects of the power system on traditional cultural resources. Also included below is a portion of one Tribe's analysis of some of the proposed alternatives.

From Colville Conferated Tribes

"The Columbia River had provided material resources, as well as living resources that are seldom included as an impact. Change in flow of the main river, changed living habitat for fresh water clams, eel, shrimp and other salt water food resources that used to make their way up the Columbia River before Dams were constructed on the river. Plant communities that lived by free flowing rivers in a wet environment were never studied or inventoried. There is no specific information of these resources except for oral information of medicines, matting, and bag making materials, that at one time were found right next to the free flowing river environment. Indian people had river crossing to resource areas on the opposite side of the river. Communities and family homes became inaccessible because they became inundated or were separated because of the reservoirs behind the new Dams.

Tribe have a spiritual connection with their resources which resulted from their traditional teachings and their up bringing. They grew up understanding their spiritual connection with their environment and Mother Earth. Their parents and grandparents were role models to how they would carry out their sacred trust responsibility to the resources and the environment.

After thousands of years, the Indian way of life became changed in one single generation of time. There was no time to the Indian people to accept or adjust their sacred responsibliity to the resources and the environment that was important to their resources. The ceremonial grounds and sacred sites were inundated or became effected by project operations. The United States government condemned ancestral lands to construct Dam's without consideration of the effects of their projects to our Indian way of life. Because of their efforts to produce power the government destroyed the very fabric of Indian religions, ceremonies and sacret trust responsibility for resources within a free flowing river and watershed setting. Even though the Tribes have selected new sites for their ceremonies, the ceremonial ritual that allowed Tribes to "put–away" the old ceremonial sites, has never been supported by the United States government. The United States government has never provided for or seen any responsibility to religious rights of Tribes effected by their undertaking.

The same is true for the traditional and cultural trust responsibility for resources and the environment that was located within watershed areas supported free flowing river. Roots, berries, medicines and other plants and life forms that were effected by federal undertaking were never properly managed by the United State Government. These resources were displaced or inundated to total destruction. Because these resources are no longer there, a portion of the Tribes' traditional way of life is no longer there. The United States government's efforts to produce power had also destroyed whole ecosystem's that at one time *provided the necessary environment for Tribal resources and their Inidan way of life.*

There has never been any assessment of how the Tribes' were affected by federal projects on the Columbia River. There are measurable impacts to our Indian way of life that can be identified to the United States. If there exists a possibility that this assessment is important to management procedures and policies, then the United States government must provide assessments for the concerns identified here."[1]

From the Spokane Tribe

"These rivers [the Columbia River, the Spokane River, and the Snake River] are traditional culturally significant properties, playing an essential and irreplaceable role in Native Americans' historically rooted beliefs, customs, and practices. These rivers are a critical part of cultural practices and beliefs of living Native Americans, including the Spokane Tribe of Indians among many others, that (a) are rooted in our community's history, and (b) are important in maintaining the continuing cultural identity of the community. Native American elders of this region gave testimonies identifying the significance of these rivers to their people many times during meetings of the SOR EIS Cultural Resource Work Group staff and full work group meetings. We have included a sample of these testimonies given at one such meeting in our exhibit to this Appendix.

Systems operations have negative impacts on other Spokane traditional cultural properties that include but are not limited to vision quest sites, plant gathering areas, social/political gathering areas, sites associated with traditional oral stories (such as the story of creation) and traditions. Types of sites that are traditional cultural properties because of their sacred and central nature to Spokane culture, but that also may be eligible under other National Register categories include but are not limited to pictographs and petroglyphs, camp sites, battle sites, churches, fisheries and procurement sites.

Most of the vision quest sites used traditionally by the Spokane peoples are inaccessible because of inundation, or they have lost their traditional context and feeling because of inundation of the surrounding landscape. Many of these vision quest sites could be restored if the land were no longer inundated, if elders remain to identify their location.

The reservoir has inundated social and political gathering areas which were often located at river fords; though some of these sites are seasonally accessible within the zone of fluctuation. Again, inundation removes traditional context and feeling for many of these sites. Some of these areas were the sites of important battles, or landmark peace agreements between warring tribes. Some of these sites were the locations of sacred and religious ceremonies. Others are important because of their association with famous or outstanding individuals.

Sites associated with traditional oral stories often include particular and sometimes spectacular landforms. Today those sites that are affected by reservoir operations include those that are inundated and those which are not inundated but eroding or threatened with erosion from reservoir action. The ecological landscape is often key to understanding these sites; changes in the surrounding landscape has negative effect on the context, feeling, and interpretation of the landform even if the landform itself is not destroyed. Because of their often unusual appearance, shape or composition, these sites often attract recreational use which further contributes to their deterioration.

Another type of Spokane cultural resource is the natural environment. Both physically and spiritually, natural resources are an essential and inseparable part of Spokane culture. The salmon, eels, and other riverine resources are more important cultural resources to archeological and historical sites, and play an essential role in Spokane cultural identity.

The land itself is another cultural resource. One's homeland is inseparable from the individual. One cannot be laid to rest in a strange land, yet Spokane ancestors must be moved from their original resting place because of erosion and looting, and Spokane

[1]Review of SOR Draft EIS Appendix D. Cultural Resources, memo dated May 26, 1995.

tribal elders cannot be laid to rest in their place of birth.

Procurement sites that should be assessed in reviewing systems operations strategies include but are not limited to plant gathering and processing areas, mammal hunting and processing areas, and riverine resource gathering, fishing, and processing areas. Those plants traditionally gathered by the Spokanes and that are still in use today include many different species in and near Lake Roosevelt. Some examples include blackberries, blueberries; wild raspberries; pinenuts; and many camas roots species, to name just a few. Spokanes gather other plants for making baskets, hats, matting, etc. Most of the remaining gathering areas are barely being maintained, as the environment they developed in has been so drastically changed with the creation of Lake Roosevelt. Furthermore, they were part of an annual round which through destruction of the riverine environment by the reservoir, has also been destroyed. These plants and the gathering areas from which they have come are significant not only economically, but are essential to the cultural, linguistic, and religious life of the Spokanes.

Fishing areas, as with plant gathering area, are important to the Spokanes not only as archeological sites with crucial information on paleo–environment, social processes, technological change, and diet, but are critical to the cultural, linguistic, and religious life of the Spokanes. Fishing areas included not only the sites of net and spear fishing, but for the gathering of eels, crawfish, mussels, and other riverine resources. The fate of individual men, families, tribes, and regions were made at these fishing sites. Fishing techniques and technology were an integral part of Spokane culture: fishing jargon and analogies were woven in daily dialogue, in personal and tribal identity, in placing humankind in nature, and especially in the teaching of children. Sacred landscapes or landforms often surround fishing sites. They were often focal points for camps and social gatherings areas. Spokanes grew up with fishing areas being not only part of the annual cycle, but part of the individual and family as well. Burial grounds often overlook these areas, emphasizing the sacred nature of fishing areas.

Spokanes often hunted game on higher ground, but the use of hunting blinds located in natural avenues down to the rivers were key. Since the creation of the reservoir, game more seldom use these avenues so that the economic and spiritual use of these traditional hunting blinds are strongly impacted. The negative impacts on Spokane hunting are many. For example, the wolf, buffalo, and antelope were primary religious and economic sources before whites came, but no longer live here. Elk, golden and bald eagles, and beaver were nearly eliminated from our area, though through positive actions they are attempting to come back. The presence of the reservoir has removed the salmon, the eels, some snakes, and riverine mammals such as otter of important economic and religious status to the Spokane people."[2]

From the Confederated Tribes of the Umatilla Indian Reservation (CTUIR)

"Just as remaining Tribal land is now checker-boarded, so the salmon resource upon which the Tribes of the CTUIR have relied for centuries has also become checkerboarded and disconnected – swimming to those stretches of river the dams don't preclude, spawning in the few areas where habitat remains or being stripped for next years hatchery production, surviving in those reaches and at those times where flow is adequate and water temperature tolerable, avoiding, to a small extent the perilous gauntlet of dams in their passage to the sea.

Game, roots, berries, plants, and all the other things the Tribes relied on have also almost been destroyed. In addition to the loss of lands discussed in previous report sections – and by the way of example – wildlife habitat loss assessments prepared by BPA, State and Federal agencies and the Tribes, identify 20,749 acres of habitat lost within the Bonneville Project Area, 27,455 acres in the John Day Project Area, 9,138 acres in The Dalles Project Area, and 15,502 acres in the McNary Project Area[82].

[2]Review of SOR Draft EIS Appendix D. Cultural Resources, letter dated September 26, 1995.

In this manner, the capital stock of wealth in land, water, fish, game and other resources that the Tribes of the CTUIR have relied on to provide annual subsistence, income and cultural and religious satisfaction has been almost entirely destroyed – and despite the fact that at least the core of these "survival assets" were supposed to be protected by Treaty.

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[82]Bonneville Power Administration, 1989. ***Wildlife Impact Assessment: Bonneville, McNary, The Dalles and John Day Projects.*** *Annual Reports. Division of Fish and Wildlife.*

We have identified that all Tribal trust resources have important cultural linkages for the CTUIR. In this analysis, the alternative options for Columbia/Snake systems management have particularly differing effects on CTUIR culture through their effect on fish resources and through their effects on lands of particular cultural significance. Effects on fish stocks have been outlined previously.

Almost 1,500 known sites of particular cultural significance to the CTUIR have been inundated by Bonneville, The Dalles, John Day, McNary, Ice Harbor, Lower Monumental, Little Goose and Lower Granite reservoirs[107] (Table 10). These sites represent only a portion of the number that potentially exist.

Table 10

Known Sites of Particular Cultural Importance to the CTUIR – Inundated by Selected Columbia/Snake River Reservoirs –

Reservoirs	Number of Cultural Sites
Bonneville	21
The Dalles	99
John Day	509
McNary	168
Ice Harbor	73
Lower Monumental	77
Little Goose	199
Lower Granite	314
Total Known Sites	1,460

Source: CTUIR Cultural Resources staff.

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[107] *Some of these sites are shared with other tribes.*

Only with sufficient cultural resources, sites and opportunities can CTUIR members "grow their culture" – fishing where their ancestors did – fishing for the salmon, their historic survival resource – standing where their ancestors stood, in their villages and campsites, at their fishing places, in their burial and ceremonial places – communicating in their own language, about the knowledge learned from the past, and about its application to the contemporary circumstances of their life – and understanding that all these actions give them self–esteem, power and a healthy capability to deal with the challenges of contemporary society as CTUIR Indians.

Today, the people of the CTUIR are threatened, if not endangered. Their survival resource – the salmon – is threatened and endangered. Most of the key sites where they lived, fished and buried their ancestors are drowned. Access to other ceded lands, and to the diminished trust resources on them is severely impeded. And, as the opportunities to "practice their culture" diminish – own language capability, a key indicator of cultural wellbeing, has declined – until only 10 percent of CTUIR members can presently speak their own language.

Taking these circumstances together, the general effect of each SOS alternative on CTUIR cultural wellbeing is identified in Table 11.

Table 11

Impact on CTUIR Cultural Trust Resources and Wellbeing –Alternative SOS Options on the Columbia and Snake Rivers–

System Option	Impact on Cultural Wellbeing
No Action [SOS 2c]	•Continues to destroy fishing opportunity. •Continues to flood CTUIR traditional villages, camps, fishing sites, burial and ceremonial sites. •Marginal remaining opportunity to practice CTUIR culture. •Threatens and endangers CTUIR culture.
Biological Opinion	•Significant, but limited improvement in fishing opportunity. •No improvement in flooding of CTUIR traditional villages, camps, fishing sites, burial and ceremonial areas. •Survival of CTUIR culture remains very difficult.

DFOP2 [SOS 9a]	*•Significant increase in CTUIR fishing opportunity.* *•Substantial recovery of cultural sites and opportunities flooded by four lower Snake River reservoirs.* *•Continued flooding of 509 cultural sites under John Day Pool continues to denigh cultural opportunities associated with this key area to CTUIR peoples.*
CTUIR [SOS 9d]	*•Significant increase in CTUIR fishing opportunity.* *•Substantial cultural recovery through access to key village, camp, fishing, burial and ceremonial areas presently flooded by John Day Reservoir.* *•Substantial cultural recovery through similar access to traditional areas presently flooded by the four lower Snake reservoirs.*

*Considering all effects, we conclude that the No **Action** alternative represents a policy of continued destruction of CTUIR Trust Resources, and of the ingredients necessary for the material and cultural survival of the CTUIR as a people.*

*Action under the **Biological Opinion** offer a measurable improvement for fisheries stocks. But this improvement, if obtained, would be insufficient to return Columbia/Snake stocks to levels of the historic past – and are also insufficient to significantly close the poverty gap between CTUIR members and non–Indians resident in the State of Oregon. The Biological Opinion also fails to restore any of the critically important traditional villages, camps, fishing sites, burial areas and ceremonial sites inundated by the reservoirs. We therefore conclude that the Biological Opinion does not sufficiently address responsibilities to CTUIR Trust Resources or CTUIR material or cultural wellbeing.*

*The **DFOP2 Option** does substantially improve CTUIR fisheries, and would restore access to important cultural areas presently flooded by Ice Harbor, Lower Monumental, Little Goose and Lower Granite reservoirs. It does not restore access to cultural areas inundated by John Day Pool. It represents a significant effort to meet tribal Trust Resource responsibilities associated with fishing – and would also significantly improve cultural access for some tribes along the lower Snake River.*

*The **CTUIR Option** equals and slightly exceeds the DFOP2 alternative with respect to restoration of spring chinook. Further, by restoring key cultural areas close to the CTUIR reservation currently flooded by John Day reservoir, as well as restoring access along the lower Snake River, it comes the closest of all options considered to meeting Trust Responsibilities to CTUIR – and in improving CTUIR material and cultural wellbeing. In fact, cultural areas presently inundated by John Day reservoir may be of such significance to CTUIR, that restoration of access to these areas may, by itself, be required before actions in fulfillment of responsibilities to CTUIR Trust Resources can be judged sufficient."*[3]

4.7 IMPACTS TO NATIONAL REGISTER SITES AND DISTRICTS

All of the sites and districts currently listed on the National Register of Historic Places at the Federal projects (Table 2–2) are adversely affected in some way by system operation. Many of these sites and districts include resources that are located within reservoir pool drawdown zones. Others are located in or near recreation areas along reservoir shores and are subject to vandalism and artifact theft.

These sites have been nominated to and listed on the National Register either because they are located at projects constructed since the National Historic Preservation Act became law in 1966, or because they are sites of obvious national significance; such as Bonneville Dam or prehistoric archeological sites at The Dalles.

Many of the other cultural resources at the projects are eligible or potentially eligible for National Register nomination due to national, regional, or local significance. Most cultural resources at the Federal reservoirs have not yet been evaluated for their National Register eligibility. The list of af-

[3]Report titled Assessment of the Effort on Trust Resources of the Confederated Tribe of the Umatilla Indian Reservation from Alternative System Operating Strategies (SOS) for Columbia/Snake River Flows, September 1995.

fected National Register sites in Table 2–2 represents a small fraction of sites that could ultimately be nominated and listed on the National Register.

4.8 EFFECTS AT OTHER REACHES OF THE COLUMBIA SYSTEM

The alternatives would have impacts at reaches of the Columbia River system other than those covered by the system reservoir pools. Although lack of funding has prevented an exhaustive study of such effects, certain kinds of effects are apparent and deserve mention.

Releases from storage reservoirs can affect downstream river reaches, and resulting water fluctuations can erode cultural resources. System locations where this is a major problem include Chief Joseph below Grand Coulee, the lower Clearwater below Dworshak, the Kootenai River reach below Libby Dam, the Hells Canyon reach below Brownlee Dam, and to a lesser extent, the Pend Oreille River below Albeni Falls Dam.

Downstream effects at run–of–river reservoirs tend to take the form of accelerated streambank erosion when pools are maintained at high streamflows. This problem is potentially acute on the mid–Columbia dams owned by public utility districts. This problem also occurs on the lower Snake and lower Columbia reservoirs.

The periodic massive discharge of the Columbia River through its estuary mouth downstream from Bonneville Dam has at different times stripped away known cultural and historic sites from the stream banks and buried others in huge deposits of flood sediments. In spite of this, a number of historic shipwrecks and cultural resources sites have been identified in the estuary mouth. By reducing the severity of floods, system operation has lowered the amount of damage that would otherwise have taken place at these sites.

Table 4–4. Simulated Days per Year of Shoreline Erosion at Known Archeological and Historic Sites

a. Storage projects.

Project	Hungry Horse		Libby		Albeni Falls		Grand Coulee		Dworshak	
No. Sites	24		231		361		180		183	
SOS	days/yr	percent	days/yr	percent	days/yr	percent	days/yr	percent	days/yr	percent
1a	32	8.7	28	7.8	214	58.7	75	20.5	142	38.9
1b	33	9.0	28	7.6	215	58.8	75	20.4	138	37.7
2c	32	8.8	29	8.0	212	58.1	80	22.1	160	43.8
2d	32	8.8	28	7.8	212	58.1	86	23.7	139	38.1
4c	60	16.3	36	9.8	262	71.8	90	24.6	163	44.6
5b	32	8.7	28	7.5	214	58.7	80	22.0	137	37.5
5c	32	8.7	28	7.5	214	58.7	80	22.0	139	38.1
6b	32	8.7	28	7.5	214	58.7	80	22.0	139	38.1
6d	32	8.7	28	7.5	214	58.7	80	22.0	139	38.1
9a	25	6.9	29	7.8	262	71.8	65	17.8	140	38.3
9b	49	13.3	34	9.2	268	73.5	79	21.7	120	33.0
9c	60	16.3	36	9.8	261	71.6	85	23.2	153	42.0
PA	44	12.2	34	9.4	225	61.7	85	23.4	148	40.5

b. Snake River run–of–river projects.

Project	Lower Granite		Little Goose		Lower Mon		Ice Harbor	
No. Sites	114		75		10		25	
SOS	days/yr	percent	days/yr	percent	days/yr	percent	days/yr	percent
1a	26	7.2	29	8.0	37	10.0	44	12.0
1b	26	7.0	29	8.0	37	10.0	44	12.0
2c	33	8.9	47	13.0	37	10.0	44	12.0
2d	33	8.9	47	13.0	37	10.0	44	12.0
4c	33	8.9	47	13.0	37	10.0	44	12.0
5b	19	5.1	20	5.6	20	5.6	26	7.2
5c	0	0.1	0	0.0	0	0.0	0	0.0
6b	21	5.7	28	7.6	50	13.8	67	18.5
6d	21	5.7	47	13.0	37	10.0	44	12.0
9a	26	7.2	51	13.9	50	13.7	68	18.5
9b	35	9.5	53	14.6	37	10.0	44	12.0
9c	35	9.5	32	8.7	41	11.1	56	15.4
PA	38	10.4	53	14.6	37	10.0	44	12.0

c. Columbia River run–of–river projects.

Project	Chief Joseph		McNary		John Day		The Dalles		Bonneville	
No. Sites	171		105		130		20		14	
SOS	days/yr	percent	days/yr	percent	days/yr	percent	days/yr	percent	days/yr	percent
1a	196	53.8	83	22.9	140	38.4	164	45.0	339	92.9
1b	196	53.8	83	22.9	140	38.4	164	45.0	339	92.9
2c	196	53.8	83	22.9	128	35.0	164	45.0	339	92.9
2d	196	53.8	83	22.9	128	35.0	164	45.0	339	92.9
4c	196	53.8	83	22.9	138	37.7	164	45.0	339	92.9
5b	196	53.8	83	22.9	111	30.5	164	45.0	339	92.9
5c	196	53.8	83	22.9	111	30.5	164	45.0	339	92.9
6b	196	53.8	83	22.9	111	30.5	164	45.0	339	92.9
6d	196	53.8	83	22.9	111	30.5	164	45.0	339	92.9
9a	196	53.8	83	22.9	135	37.0	164	45.0	339	92.9
9b	196	53.8	83	22.9	128	35.0	164	45.0	339	92.9
9c	196	53.8	83	22.9	107	29.2	164	45.0	339	92.9
PA	196	53.8	83	22.9	70	19.2	164	45.0	339	92.9

Table 4–5. Simulated Drawdown Zone Exposure Days per Year at Known Archeological and Historic Sites

a. Storage projects.

Project	Hungry Horse		Libby		Albeni Falls		Grand Coulee		Dworshak	
No. sites	24		231		361		180		183	
SOS	days/yr	percent	days/yr	percent	days/yr	percent	days/yr	percent	days/yr	percent
1a	276	75.6	175	47.9	312	85.5	167	45.7	230	63.0
1b	277	75.8	185	50.6	312	85.4	167	45.8	227	62.3
2c	280	76.7	171	46.8	311	85.3	158	43.3	235	64.4
2d	280	76.7	179	49.1	311	85.3	149	40.9	254	69.7
4c	198	54.2	123	33.7	293	80.3	154	42.2	219	59.9
5b	279	76.4	179	48.9	312	85.4	158	43.3	215	58.8
5c	279	76.4	179	48.9	312	85.4	158	43.3	204	56.0
6b	279	76.4	179	48.9	312	85.4	158	43.3	206	56.5
6d	279	76.4	179	48.9	312	85.4	158	43.3	206	56.5
9a	308	84.4	240	65.7	299	82.1	186	51.0	235	64.5
9b	224	61.3	152	41.7	284	77.9	159	43.6	271	74.3
9c	198	54.2	123	33.7	280	76.6	160	43.7	237	65.0
PA	226	61.9	169	46.2	306	83.8	153	41.9	262	71.9

b. Snake River run–of–river projects.

Project	Lower Granite		Little Goose		Lower Mon		Ice Harbor	
No. sites	114		75		10		25	
SOS	days/yr	percent	days/yr	percent	days/yr	percent	days/yr	percent
1a	34	9.2	29	8.0	37	10.0	44	12.0
1b	29	7.9	29	8.0	37	10.0	44	12.0
2c	37	10.1	47	13.0	37	10.0	44	12.0
2d	37	10.1	47	13.0	37	10.0	44	12.0
4c	37	10.1	47	13.0	37	10.0	44	12.0
5b	215	58.9	215	58.8	213	58.4	206	56.4
5c	365	100.0	365	100.0	365	100.0	350	96.0
6b	91	24.9	107	29.3	114	31.2	114	31.1
6d	91	24.9	47	13.0	37	10.0	44	12.0
9a	108	29.6	139	38.0	114	31.3	114	31.2
9b	40	10.8	53	14.6	37	10.0	44	12.0
9c	80	22.0	83	22.9	89	24.5	84	23.0
PA	43	11.9	53	14.6	37	10.0	44	12.0

c. Columbia River run–of–river projects.

Project	Chief Joseph		McNary		John Day		The Dalles		Bonneville	
No. sites	171		105		130		21		14	
SOS	days/yr	percent	days/yr	percent	days/yr	percent	days/yr	percent	days/yr	percent
1a	203	55.6	97	26.7	194	53.0	164	45.0	365	100.0
1b	203	55.6	97	26.7	194	53.0	164	45.0	365	100.0
2c	203	55.6	97	26.7	197	54.0	164	45.0	365	100.0
2d	203	55.6	97	26.7	197	54.0	164	45.0	365	100.0
4c	203	55.6	97	26.7	194	53.3	164	45.0	365	100.0
5b	203	55.6	97	26.7	210	57.6	164	45.0	365	100.0
5c	203	55.6	97	26.7	210	57.6	164	45.0	365	100.0
6b	203	55.6	97	26.7	210	57.6	164	45.0	365	100.0
6d	203	55.6	97	26.7	210	57.6	164	45.0	365	100.0
9a	203	55.6	97	26.7	203	55.6	164	45.0	365	100.0
9b	203	55.6	97	26.7	197	54.0	164	45.0	365	100.0
9c	203	55.6	97	26.7	214	58.7	164	45.0	365	100.0
PA	203	55.6	97	26.7	239	65.4	164	45.0	365	100.0

Table 4–6. Simulated Days per Year of Reservoir Inundation at Known Archeological and Historic Sites

a. Storage Projects.

Project	Hungry Horse		Libby		Albeni Falls		Grand Coulee		Dworshak	
No. Sites	24		231		361		180		183	
SOS	days/yr	percent	days/yr	percent	days/yr	percent	days/yr	percent	days/yr	percent
1a	89	24.4	190	52.1	53	14.5	198	54.3	135	37.0
1b	88	24.2	180	49.5	53	14.6	198	54.3	138	37.7
2c	85	23.3	194	53.2	54	14.7	207	56.7	130	35.6
2d	85	23.3	186	50.9	54	14.7	216	59.1	111	30.3
4c	167	45.9	231	63.3	72	19.8	211	57.8	146	40.1
5b	86	23.6	186	51.1	53	14.6	207	56.7	150	41.2
5c	86	23.6	186	51.1	53	14.6	207	56.7	161	44.0
6b	86	23.6	186	51.1	53	14.6	207	56.7	159	43.5
6d	86	23.6	186	51.1	53	14.6	207	56.7	159	43.5
9a	57	15.6	125	34.3	66	18.0	179	49.0	130	35.5
9b	141	38.7	213	58.3	81	22.1	206	56.4	94	25.7
9c	167	45.9	242	66.3	85	23.4	205	56.3	128	35.0
PA	139	38.1	196	53.8	59	16.2	212	58.1	103	28.1

b. Snake River run–of–river projects.

Project	Lower Granite		Little Goose		Lower Mon		Ice Harbor	
No. Sites	114		75		10		25	
SOS/n	days/yr	percent	days/yr	percent	days/yr	percent	days/yr	percent
1a	331	90.8	336	92.0	329	90.0	321	88.0
1b	336	92.1	336	92.0	329	90.0	321	88.0
2c	328	89.9	318	87.0	329	90.0	321	88.0
2d	328	89.9	318	87.0	329	90.0	321	88.0
4c	328	89.9	318	87.0	329	90.0	321	88.0
5b	150	41.2	150	41.2	152	41.6	159	43.6
5c	0	0.0	0	0.1	0	0.0	15	4.0
6b	274	75.1	258	70.7	251	68.8	251	68.9
6d	274	75.1	318	87.0	329	90.0	321	88.0
9a	257	70.4	226	62.0	251	68.7	251	68.8
9b	325	89.2	312	85.4	329	90.0	321	88.0
9c	285	78.0	282	77.2	276	75.6	281	77.0
PA	322	88.1	312	85.4	329	90.0	321	88.0

c. Columbia River run–of–river projects.

Project	Chief Joseph		McNary		John Day		The Dalles		Bonneville	
No. Sites	171		105		130		20		14	
SOS/n	days/yr	percent	days/yr	percent	days/yr	percent	days/yr	percent	days/yr	percent
1a	162	44.4	268	73.3	171	47.0	201	55.0	26	7.1
1b	162	44.4	268	73.3	171	47.0	201	55.0	26	7.1
2c	162	44.4	268	73.3	168	46.0	201	55.0	26	7.1
2d	162	44.4	268	73.3	168	46.0	201	55.0	26	7.1
4c	162	44.4	268	73.3	171	46.7	201	55.0	26	7.1
5b	162	44.4	268	73.3	155	42.4	201	55.0	26	7.1
5c	162	44.4	268	73.3	155	42.4	201	55.0	26	7.1
6b	162	44.4	268	73.3	155	42.4	201	55.0	26	7.1
6d	162	44.4	268	73.3	155	42.4	201	55.0	26	7.1
9a	162	44.4	268	73.3	162	44.4	201	55.0	26	7.1
9b	162	44.4	268	73.3	168	46.0	201	55.0	26	7.1
9c	162	44.4	268	73.3	151	41.4	201	55.0	26	7.1
PA	162	44.4	268	73.3	126	34.6	201	55.0	26	7.1

Table 4–7. Summary of Simulated Reservoir Operation Effects

a. Shoreline erosion.

Project	Storage Projects		Snake River RoR		Columbia RoR		All Combined	
No. sites	979		224		440		1643	
SOS	days/yr	percent	days/yr	percent	days/yr	percent	days/yr	percent
1a	127	34.7	30	8.1	145	39.7	122	33.3
1b	126	34.5	29	8.0	145	39.7	121	33.2
2c	130	35.7	39	10.7	141	38.7	124	34.0
2d	127	34.9	39	10.7	141	38.7	122	33.5
4c	153	42.0	39	10.7	144	39.5	139	38.0
5b	127	34.7	20	5.5	137	37.4	118	32.3
5c	127	34.8	0	0.0	137	37.4	115	31.6
6b	127	34.8	30	8.1	137	37.4	119	32.7
6d	127	34.8	33	9.0	137	37.4	120	32.9
9a	142	38.9	40	11.0	143	39.3	131	36.0
9b	145	39.7	42	11.5	141	38.7	133	36.5
9c	150	41.2	36	9.9	135	37.0	134	36.7
PA	135	37.1	44	12.0	124	34.1	123	33.7

b. Site exposure in a drawdown zone.

Project	Storage Projects		Snake River RoR		Columbia RoR		All Combined	
SOS	days/yr	percent	days/yr	percent	days/yr	percent	days/yr	percent
1a	237	64.8	33	9.1	167	45.6	193	53.0
1b	238	65.3	31	8.5	167	45.6	194	53.2
2c	235	64.3	41	11.3	168	45.9	194	53.1
2d	239	65.4	41	11.3	168	45.9	196	53.7
4c	211	57.8	41	11.3	167	45.7	179	49.1
5b	233	63.8	214	58.5	172	47.0	217	59.5
5c	231	63.3	363	99.5	172	47.0	236	64.7
6b	231	63.4	100	27.3	172	47.0	201	55.0
6d	231	63.4	69	18.8	172	47.0	196	53.8
9a	253	69.2	119	32.7	169	46.4	215	59.0
9b	226	61.9	44	12.2	168	45.9	189	51.8
9c	211	57.7	82	22.5	173	47.3	186	51.0
PA	235	64.4	46	12.7	180	49.3	198	54.2

c. Inundation in a reservoir pool.

Project	Storage Projects		Snake River RoR		Columbia RoR		All Combined	
SOS	days/yr	percent	days/yr	percent	days/yr	percent	days/yr	percent
1a	128	35.1	331	90.8	187	51.1	172	47.0
1b	126	34.6	334	91.5	187	51.1	171	46.8
2c	130	35.6	324	88.7	186	50.8	171	47.0
2d	126	34.5	324	88.7	186	50.8	169	46.3
4c	151	41.4	324	88.7	186	51.0	186	50.9
5b	132	36.1	151	41.4	182	49.8	148	40.5
5c	134	36.6	2	0.5	182	49.8	129	35.2
6b	133	36.5	265	72.6	182	49.8	164	45.0
6d	133	36.5	296	81.1	182	49.8	169	46.2
9a	112	30.7	246	67.3	184	50.3	150	41.0
9b	139	38.0	320	87.8	186	50.8	176	48.3
9c	154	42.2	283	77.4	181	49.5	179	49.0
PA	130	35.5	318	87.2	173	47.5	167	45.8

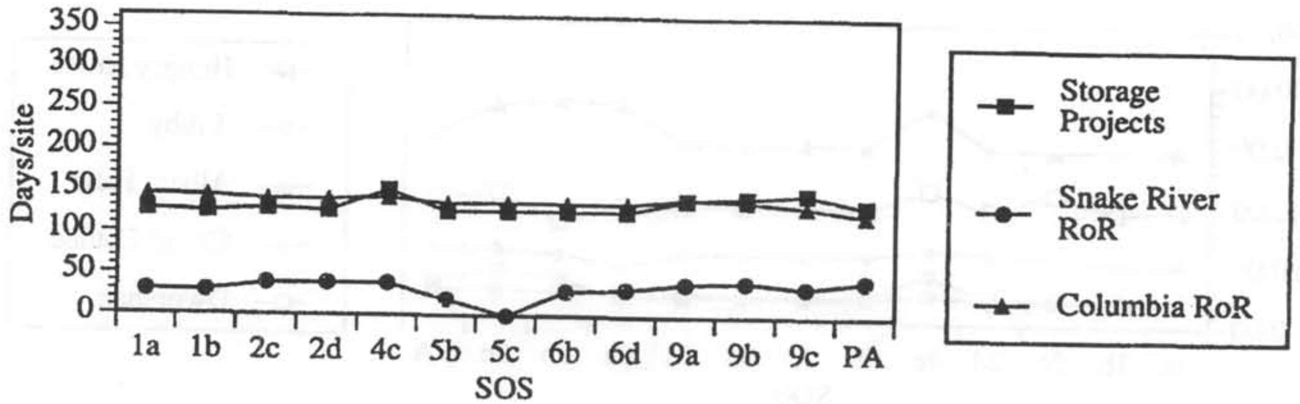

Figure 4–2. Average Days per Year when the Shoreline would be within Sites

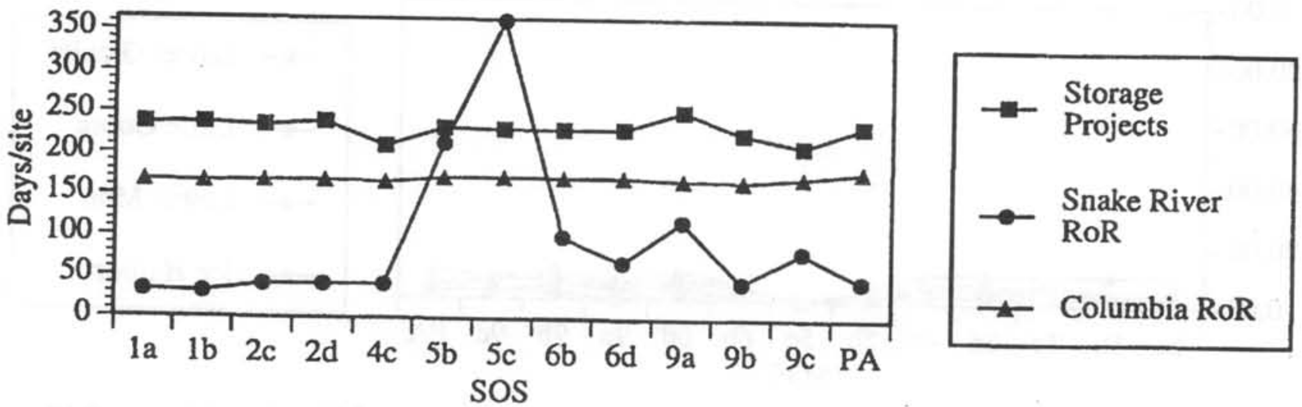

Figure 4–3. Average Days per Year when Sites would be Exposed in a Drawdown Zone

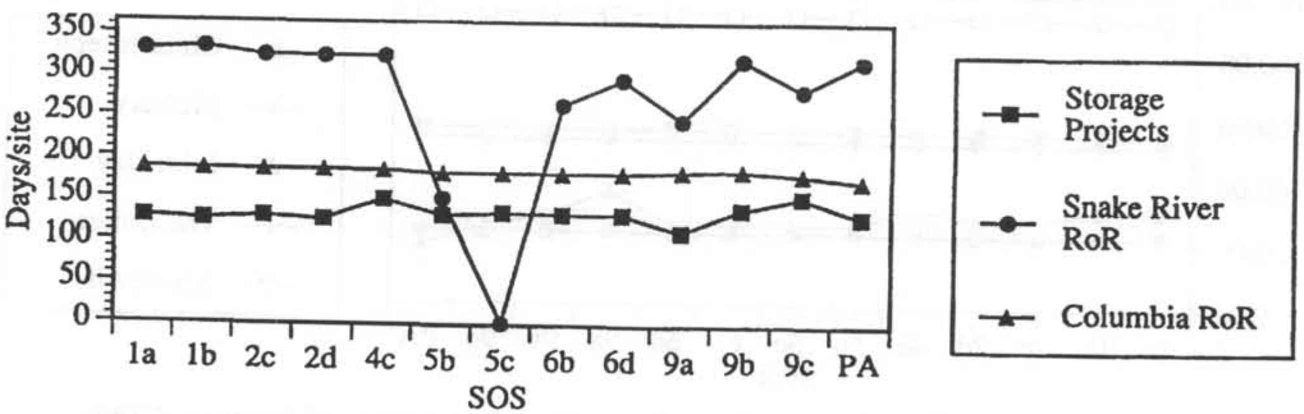

Figure 4–4. Average Days per Year when Sites would be Inundated

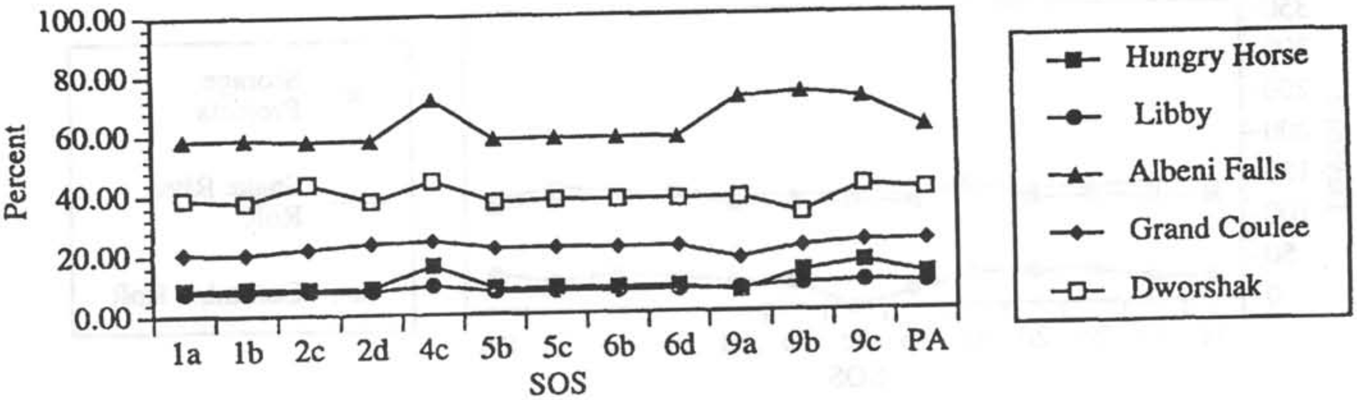

Figure 4–5. Storage Reservoirs, Percentage of Simulated Time when Known Sites would Experience Shoreline Erosion

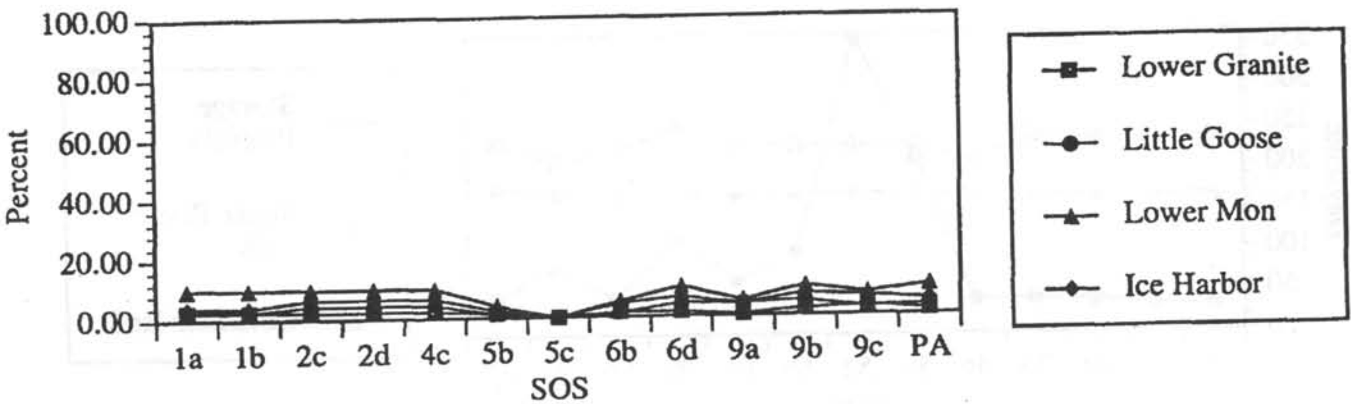

Figure 4–6. Snake River Run–of–River Reservoirs, Percentage of Simulated Time when Known Sites would Experience Shoreline Erosion

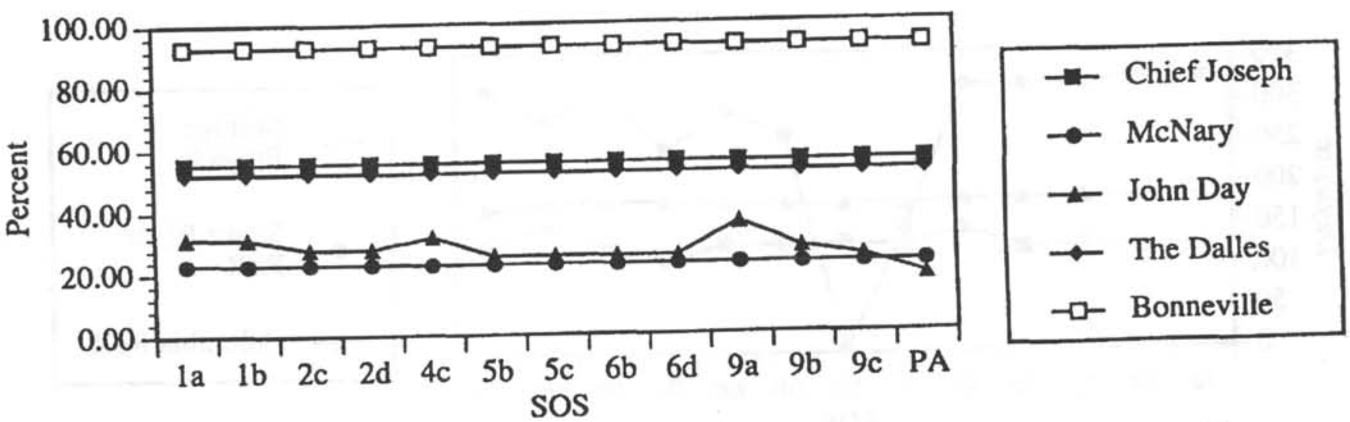

Figure 4–7. Columbia River Run–of–River Reservoirs, Percentage of Simulated Time when Known Sites would Experience Shoreline Erosion

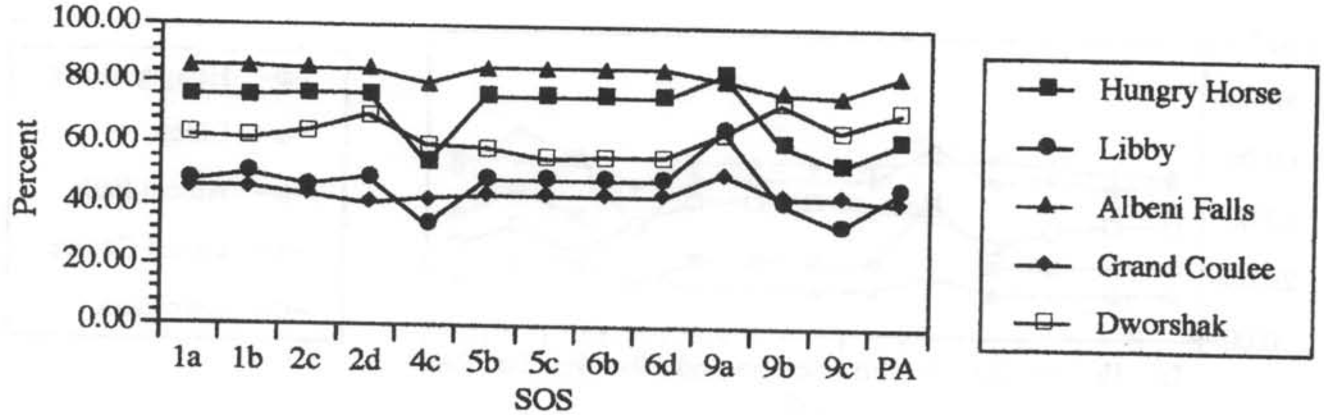

Figure 4–8. Storage Reservoirs, Percentage of Simulated Time when Known Sites would Experience Exposure in a Drawdown Zone

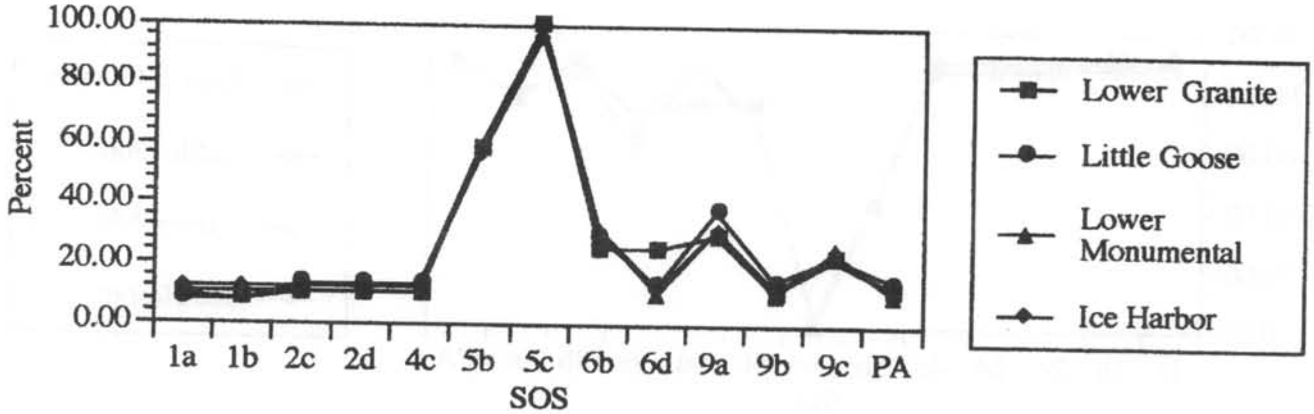

Figure 4–9. Snake River Run–of–River Reservoirs, Percentage of Simulated Time when Known Sites would Experience Exposure in a Drawdown Zone

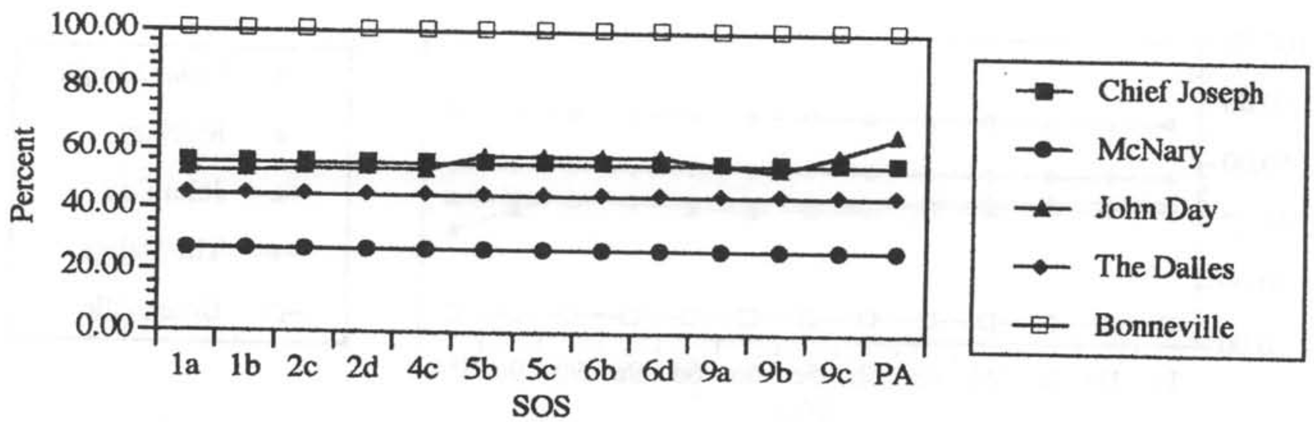

Figure 4–10. Columbia River Run–of–River Reservoirs, Percentage of Simulated Time when Known Sites would Experience Exposure in a Drawdown Zone

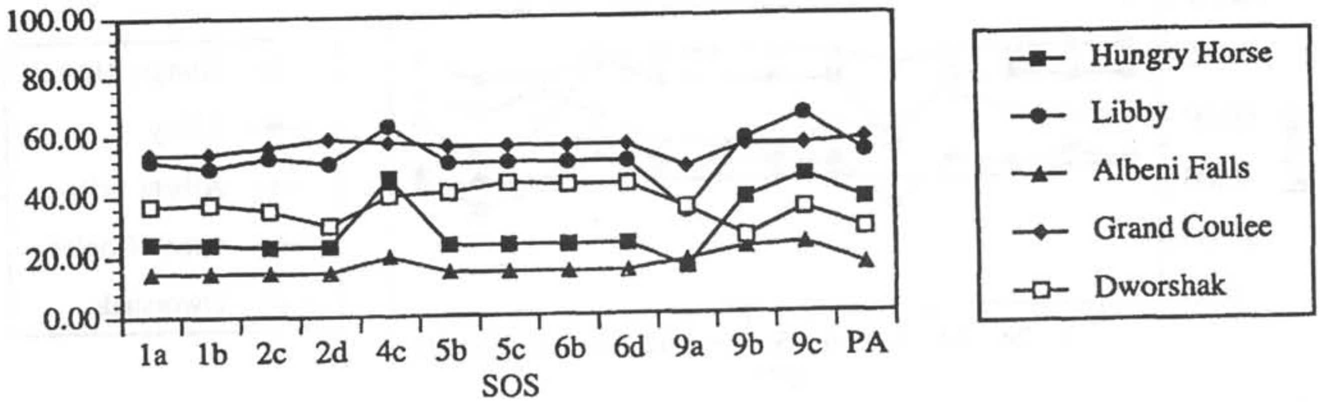

Figure 4–11. Storage Reservoirs, Percentage of Simulated Time when Known Sites would be Inundated

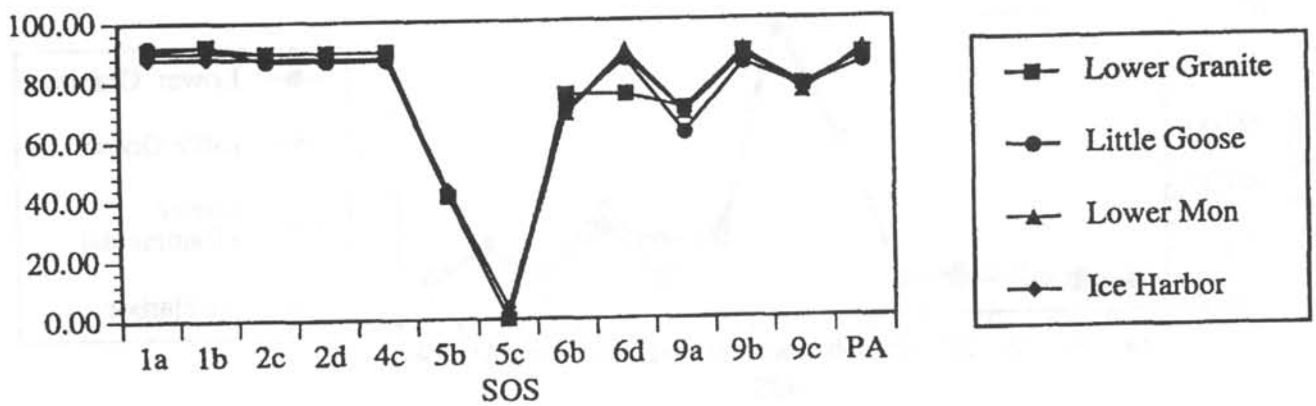

Figure 4–12. Snake River Run–of–River Reservoirs, Percentage of Simulated Time when Known Sites would be Inundated

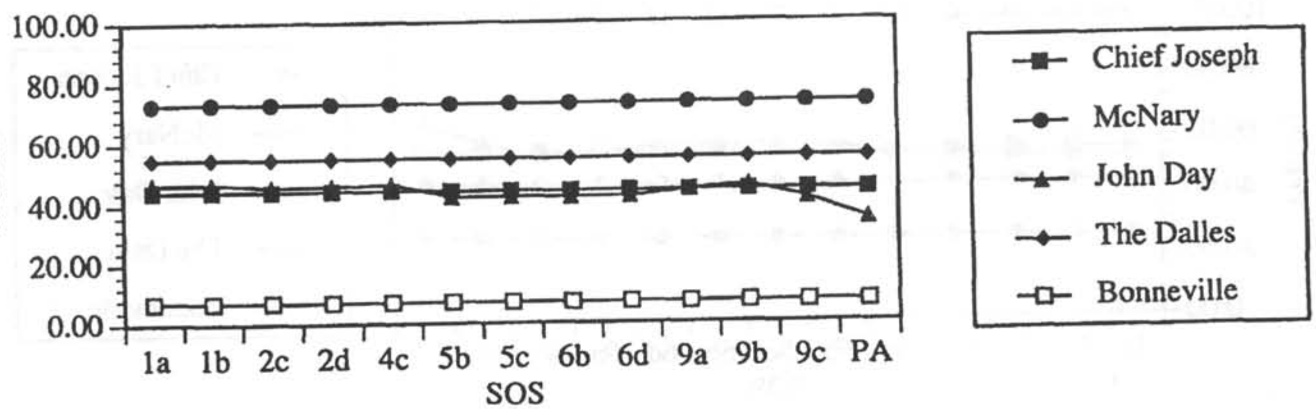

Figure 4–13. Columbia River Run–of–River Reservoirs, Percentage of Simulated Time when Known Sites would be Inundated

CHAPTER 5

COMPARISON OF ALTERNATIVES

This chapter focuses on comparisons among the operating strategies, rather than impacts at specific reservoirs or within individual SOSs. The central point of reference for the comparisons is SOS 2c, the existing condition and No–Action Alternative in the EIS.

5.1 GEOMORPHIC ANALYSIS

The alternatives are compared in terms of their potential to change erosion and sedimentation regimes, thereby adversely affecting cultural resources. Comparison shows that the most significant increases in sedimentation and erosion would occur with SOS 5, natural river operation strategy, and SOSs 6 and 9, deep drawdown strategies (except 9b). Grand Coulee and Dworshak, when operated under strategies that feature hydropower flows combined with flow augmentation having target spill levels such as SOSs 2d, 4 or 9b, would exhibit slope failures in silty, unconsolidated soils on steep slopes. This operational strategy results in short–term (usually daily) cyclic drawdown and refill over a range of a few feet. Wave wash, ice gouging, or high internal water pressure within the soil mass causes bank sloughing and failure of slopes above the pool level. Where pools impinge on loose, unconsolidated soils—such as the glacial tills in the storage reservoirs in the upper reaches of the basin—the resulting erosion and mass wasting has a profound, adverse effect on cultural resources.

Alternatives representing the lowest increase in adverse effects on cultural resources would be SOSs 1a and 2c since these strategies have been in effect for some time. Alternative 2c, the current operation, has caused the least adverse effect throughout the system. Exceptions are the Dworshak and Grand Coulee projects, which operate with rapid drawdown and rapid fluctuation. Both have historic properties that are undergoing serious damage. Ongoing adverse effects such as inundation would continue, but choosing either the SOS 2c or 1a alternative provides needed time for implementing programs of continued inventory and site evaluation. Where appropriate, mitigation and protection actions should be undertaken in an attempt to halt further deterioration and damage to historically significant sites.

Compared with SOS 2c, the present strategy, new reservoir levels cause a significant increase in erosion of reservoir shoreline soils, particularly when this level is maintained for 4 or more months as proposed under alternatives SOS 2c, 2d, 6, and 9. The effect is variable since the new shoreline, if located at a level held previously by the pool, has already removed finer soil and armored the bankline. The bankline would then have developed a near–equilibrium condition and the adverse effect would be minimal. However, if the new level lies at some location previously uneroded during 2c operation, the erosion process would have a severe effect on silty or otherwise sensitive soils as a new beachline is established. Portions of John Day and all of the lower Snake projects would undergo severe erosion and severe adverse effects to historic properties under SOS 2d, Lower Granite under 6d, lower Snake projects under SOS 5 and 9, and John Day under SOS 9a, should any of these strategies be selected for implementation.

Rapid drawdown, which caused bank sloughing and other severe adverse effects to historic properties during drawdown testing of the current strategy SOS 2c, would be a feature of SOS 4c, but the effect would only occur at Dworshak and Grand Coulee. Carefully planned and executed mitigation and protection could counter these effects.

Rapid fluctuation is a feature of past and present SOS 2c and 1a operations. It would cause severe adverse effects to historic properties at Dworshak with alternatives 4 through 9, and at Grand Coulee with alternatives 5 through 9, if any of these strategies are implemented. The effect would be similar at Brownlee under SOS 9b. The Bonneville Pool has operated in this manner since the 1970s. However, since shorelines in the Bonneville Pool are rock and stable soil, the effect of rapid fluctuation has been, and would continue to be, minimal under any of the alternatives.

Drawdown to existing minimum pool is featured in SOSs 5, 6, 9b, and the preferred alternative for John Day, and in SOS 9 and the preferred alternative at the lower Snake projects. The adverse effect on historic properties from operating at or near minimum pool under these strategies would generally be severe. Although these levels have beaches that have been at least partially stabilized by the current baseline operating strategy, exposed slopes would be subjected to wind and sheetwash erosion as well as erosion from augmented flows. The erosion conditions resulting from implementing this alternative would be more severe than those of the baseline operating alternative 2c. Consequently, the effect of the preferred alternative on historic properties would be negative and would worsen current, ongoing, adverse effects.

Drawdown to natural river levels under SOS 5 would produce severe adverse effects, but the effects would be felt only at the lower Snake projects. This alternative represents the greatest departure from SOS 2c in terms of the new erosion conditions it would impose on the lower Snake reservoirs.

5.2 SIMULATION STUDY

The baseline condition for comparing the alternatives is SOS 2c, which represents the current mode of reservoir and river operation. Other alternatives contain operational features that considerably change the ways in which the reservoirs affect archeological and historic sites. For example, some alternatives, notably 5b and 5c, involve major drawdowns at the lower Snake River reservoirs, which currently operate within a narrow range of elevations. Other alternatives, such as 4c, maintain high pools at the storage reservoirs for a longer period of time in the summer. Most of the alternatives involve combinations of operational features that affect flood control, juvenile fish passage, recreation, navigation, and other goals, and differ from the baseline in various ways.

The simulation program compares the alternatives by combining all of the shoreline erosion, site exposure, and inundation days for each site at each reservoir over the 50–year model period. It then compares their percentage of difference from SOS 2c and calculates the average number of site–days per year that the effect would occur for each alternative. These figures are shown in Table 5–1 and illustrated in Figures 5–1 and 5–2. Note that these are aggregate figures, and that individual sites would experience the impacts in a variety of ways.

Since shoreline erosion and site exposure in a drawdown zone both cause serious impacts to archeological and historic sites, the program combines them by adding the numbers of site–days that each contributed for a given alternative. Though inundation is an adverse impact, it does not cause ongoing and incremental effects at the same rate or in the same ways as do shoreline erosion and drawdown zone exposure. Therefore, inundation is not included in the comparison directly. If it were included, it would appear to counteract drawdown zone exposure (inundation and exposure vary inversely), which is a much more serious impact. Sites may survive years of inundation with relatively few effects, for example, while exposure in a drawdown zone will continue to cause deterioration. Though inundation is not to be ignored, since it does affect sites and does remove them from access to investigation, sites are usually not managed for inundation.

Table 5-1. Comparison of Reservoir Operation Effects by Alternative

SOS	a. Shoreline erosion			b. Site exposure		
	Site-days per 50-year model period	Site-days per year	Percent difference from SOS2c	Site-days per 50-year model period	Average site-days per year	Percent difference from SOS2c
1a	9,995,358	150	-2.0	15,892,549	238	-0.1
1b	9,949,051	149	-2.4	15,954,048	239	0.2
2c	10,195,966	153	0.0	15,916,362	239	0.0
2d	10,051,816	151	-1.4	16,113,565	242	1.2
4c	11,389,874	171	11.7	14,731,722	221	-7.4
5b	9,693,683	145	-4.9	17,846,256	268	12.1
5c	9,489,138	142	-6.9	19,430,007	292	22.1
6b	9,819,781	147	-3.7	16,493,818	247	3.6
6d	9,858,071	148	-3.3	16,144,321	242	1.4
9a	10,825,025	162	6.2	17,706,861	266	11.2
9b	10,948,532	164	7.4	15,528,805	233	-2.4
9c	11,006,151	165	7.9	15,300,437	230	-3.9
PA	10,121,952	152	-0.7	16,264,098	244	2.2

SOS	c. Inundation			d. Shoreline and exposure combined		
	Site-days per 50-year model period	Average site-days per year	Percent difference from SOS2c	Site-days per 50-year model period	Average site-days per year	Percent difference from SOS2c
1a	14,111,917	212	0.2	25,887,907	388	-0.9
1b	14,050,418	211	-0.3	25,903,099	389	-0.8
2c	14,088,104	211	0.0	26,112,328	392	0.0
2d	13,890,901	208	-1.4	26,165,380	393	0.2
4c	15,272,744	229	8.4	26,121,596	392	0.0
5b	12,157,210	182	-13.7	27,539,940	413	5.5
5c	10,574,460	159	-24.9	28,919,144	434	10.7
6b	13,510,648	203	-4.1	26,313,600	395	0.8
6d	13,860,145	208	-1.6	26,002,392	390	-0.4
9a	12,297,605	185	-12.7	28,531,885	428	9.3
9b	14,475,661	217	2.8	26,477,338	397	1.4
9c	14,704,029	221	4.4	26,306,589	395	0.7
PA	13,740,368	206	-2.5	26,386,049	396	1.0

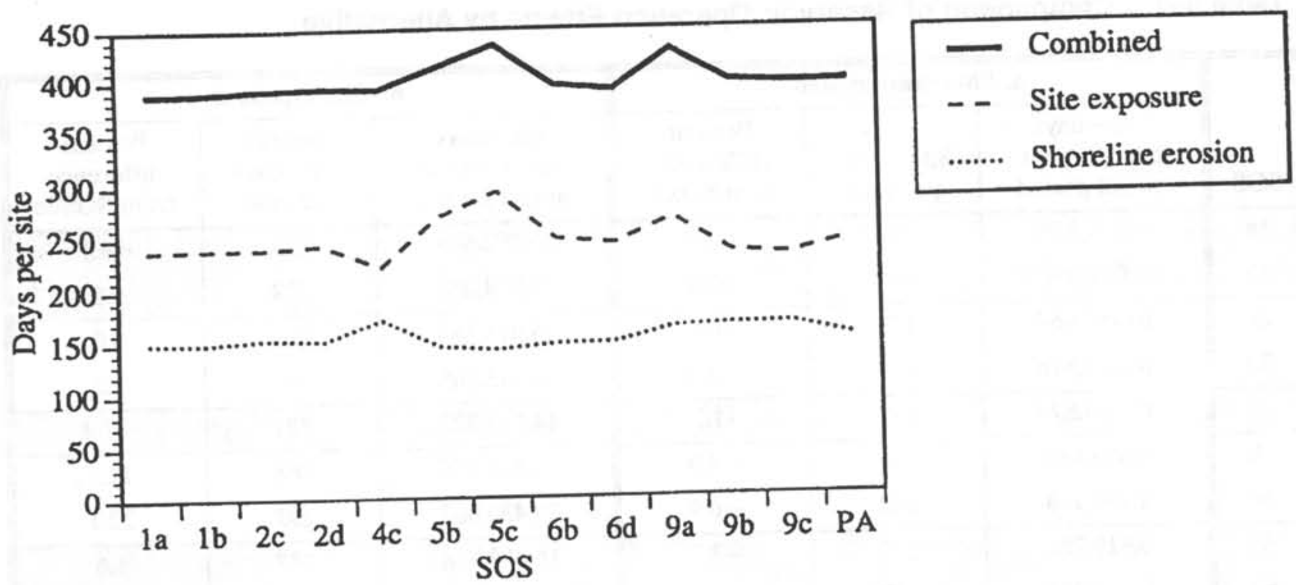

Figure 5–1. Simulated Average Days per Year that Sites would Experience Shoreline Erosion, Exposure in a Drawdown Zone, and Both Effects Combined, for Each Alternative

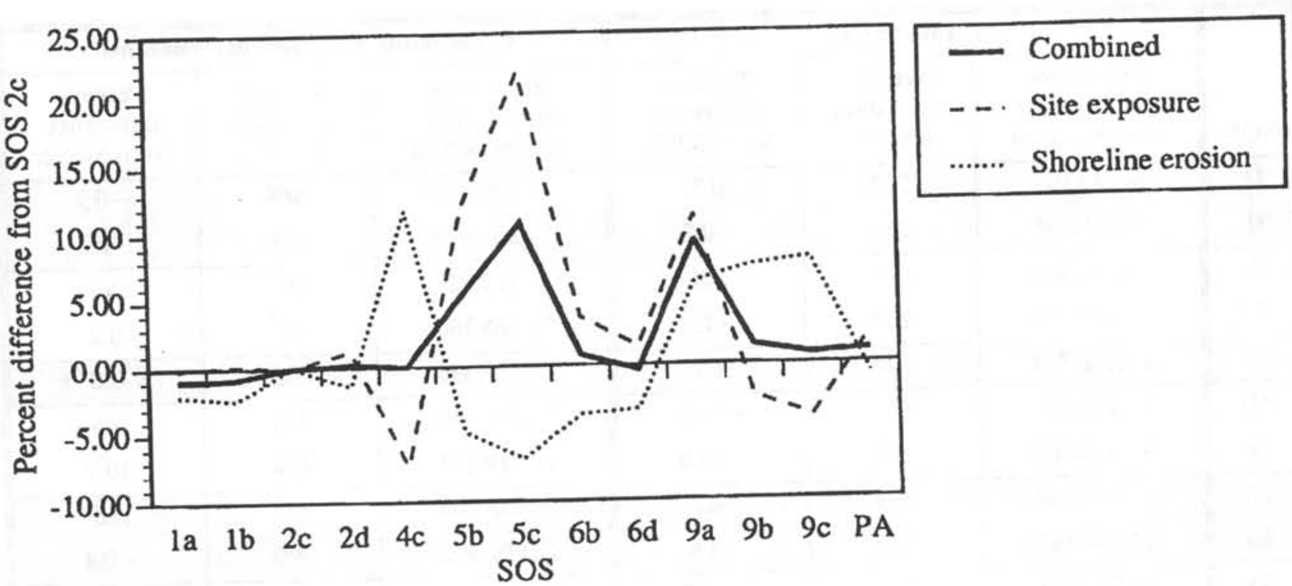

Figure 5–2. Simulated Percentage of Difference from the Baseline (SOS 2c) Alternative in Terms of Shoreline Erosion, Exposure in a Drawdown Zone, and Both Effects Combined

SOS 1 and SOS 2d

Alternatives 1a, 1b, and 2d would be most similar to the baseline condition in their simulated rates of effect. Alternative 1a would have a 0.9 percent lower combined effect than the baseline. This makes it appear that SOS 1a would be the best alternative for the protection of archeological and historic sites, since it would represent a slight decrease in both shoreline erosion and site exposure rates. The improvement would be small, however, and there might be some advantage to maintaining an existing operation mode.

This would be because any operations that are different from those under SOS 2c might begin new erosion cycles at those reservoirs with soils or operating conditions that have produced stable banks under SOS 2c. Assuming that SOS 2c will have operated consistently for several years by the time the SOR is implemented, it may have cut deep shoreline benches at certain elevations where reservoir levels have consistently stayed. Cultural resources at these levels may have been badly damaged, and new operations would begin to create new wave–cut terraces and new damage at the new reservoir levels.

It should also be noted that SOS 1a was the operational mode for a considerably longer period than SOS 2c will have been when the SOR is implemented. Returning to SOS 1a's mode of operation might therefore slow down, to some extent, the rate of damage at sites that are relatively intact. This is simply because it would shift impacts back to places where much damage has already been done and where the percentage of badly damaged sites is highest.

SOS 4

SOS 4 shows little or no difference from baseline in the rates of the two simulated impacts combined. However, this hides the fact that, for this alternative, large differences from the baseline in both shoreline erosion and site exposure cancel each other out when combined. In fact, this SOS offers both the most improvement compared with the baseline in terms of site exposure, and the largest aggregate increase in shoreline erosion.

This dramatically points out the fact that, for most alternatives, site exposure is high when shoreline erosion is low, and vice–versa. They vary inversely (the correlation coefficient, Pearson's r, is −0.60). Only for Alternative 9a is this pattern not apparent. It applies particularly to SOS 4, which would increase the overall rate of shoreline erosion by 11.7 percent, and would decrease the overall rate of site exposure by 7.4 percent.

This pattern may be due to the fact that archeologists recorded many of the sites after construction, when only the shoreline zones and higher drawdown shore have been accessible. It may also be due partly to the higher density of archeological and historic sites near the natural river level. Each reservoir would have a cluster of sites in the upper pool's drawdown zone at its upstream end, and these sites have been accessible for recording since the projects were built.

Shoreline erosion is a very serious impact and high pool levels increase recreational traffic. This leads to an increase of waves from boat wakes, which can be very damaging. An increase in recreationists at high pool also leads to more pedestrian traffic along the shore and an intensification of unauthorized collecting and vandalism at sites near the high pool shore. SOS 4 would probably cause deterioration of sites in the high pool to accelerate rapidly.

SOS 5

SOS 5 involves deep drawdowns at the lower Snake projects. It would therefore cause much higher rates of site exposure than any other SOS. SOS 5c would apparently represent the greatest increase in the rate of impacts at sites in the reservoirs overall, because it would be markedly worse (22.1 percent) for site exposure than the baseline.

If implemented, however, SOS 5c would not cause nearly as great an increase in effects from exposure as it appears, based on the simulation results. A large part of the reason for the high site exposure rates with SOS 5c is that the four lower Snake River projects would be permanently drawndown to natural river level. This would expose archeological sites in an unvegetated drawdown zone for a time. After that, the former reservoirs would be revegetated, protecting the sites somewhat and providing access for archeological research and traditional cultural practice. The drawdowns would remove the previously constant effects of shoreline erosion at these four reservoirs. The net effect at the lower Snake reservoirs, therefore, would be positive. For these projects, this alternative would be better than any other because it offers these improvements.

The effects of SOS 5b would be very different than for 5c, however. Under 5b, natural river drawdown would take place only for several months of each year, after which the system operators would again raise the pool. This alternative would relieve a few sites in the high pool of some shoreline erosion, but would expose sites in the deeper pool to a much greater extent than before.

SOS 6

Alternative 6b would enlarge the drawdown zone at the four lower Snake River projects. The rates of simulated shoreline erosion and site exposure would not change appreciably from the baseline for all other reservoirs in the system. At the lower Snake projects, the broader drawdowns would actually cause a slight decrease in shoreline erosion, because the shoreline would spend more time away from sites high in the pool. Rates of shoreline erosion would remain very low, however. The rates of site exposure, on the other hand, would triple. This increase would be less dramatic than it might at first seem, however, since at these projects, rates would move from very low (10–13 percent) to low rates of impact (24 to 31 percent).

SOS 9

The alternatives of SOS 9 offer a mix of operating features that includes deeper drawdowns at the lower Snake projects, and changes in storage reservoir operations to provide flow augmentations. Of the three SOS 9 alternatives, 9a would clearly cause the greatest increase in simulated overall rates of impact. Unlike the other alternatives, it would not improve shoreline erosion as it worsens site exposure, or vice–versa. This alternative would cause a 6.2 percent higher rate of shoreline erosion than Alternative 2c, and a 11.2 percent higher rate of site exposure. SOSs 9b and 9c, by contrast, would cause higher rates (7.4 and 7.9 percent, respectively) of shoreline erosion than the baseline, but this would be offset somewhat by small improvements in the rates of site exposure.

SOS PA

The preferred alternative differs very little from the baseline in its overall rates of impact. It would cause slightly higher simulated rates of drawdown zone exposure (by 2.2 percent), offset by slightly lower shoreline erosion (by 0.7 percent).

Discussion

The alternatives that would not cause significant change compared to Alternative 2c appear to be best for cultural resources. These are the SOS 1 and 2 alternatives. Although alternatives 4c, 6b, 6d, 9b, 9c, and the preferred alternative show very little difference from the baseline when shoreline erosion and site exposure are added together, they would cause changes in the individual rates of impact for shoreline erosion and site exposure. This means that the system equilibrium would be disrupted and that impacts would accelerate at certain places where they now occur at a slower rate.

The SOSs causing the greatest change, such as SOSs 4, 5, and 9, appear to be the worst for cultural resources. This interpretation assumes that shoreline erosion and site exposure are roughly equal in their impact, or that their effects are variable enough that it is difficult to choose which may be the worst. Under this interpretation, the least desirable alternatives for cultural resources would be those showing the greatest difference from baseline of shoreline erosion and site exposure combined. These are SOSs 5b, 5c, and 9a.

Other interpretations are possible by examining the simulation results more closely, however, and by choosing shoreline erosion as generally more damaging than site exposure. The severity of the effects of site exposure are highly variable, depending on local circumstances. In some places, surface erosion due to wind and runoff will be very serious; in others, it will not. Similarly, some sites are very accessible to the public and experience vandalism when exposed, and others are less accessible or more difficult to detect. In addition, site exposure has the beneficial impact of making sites accessible to scientific study and traditional cultural practice. By contrast, shoreline erosion constantly eats away at sites where it occurs. It may be the most serious of the two impacts.

If we take this assumption, that shoreline erosion is most often worse than site exposure, then a new picture of comparative effects emerges. Alternatives that increase site exposure might be the best for cultural resources, since these would allow access to the sites for testing and eventual data recovery at significant sites. These alternatives would have the added benefit of improving shoreline erosion rates, compared with the baseline, since shoreline erosion and site exposure vary inversely in most of these alternatives. These benefits only accrue, however, if programs of testing and mitigation are undertaken.

When seen in this way, SOS 5c, surprisingly, has several positive features, even though it would cause the greatest overall departure from baseline. This alternative would drawdown all lower Snake reservoirs to natural river level. Afterwards, the drawdown zone would revegetate, providing both protection for and access to sites. At the same time, it would decrease shoreline erosion, mostly at the lower Snake River projects. Since the lower Snake projects contain 224 sites in their operating pools, for which ongoing impacts from reservoir operation would all stop, it is difficult to avoid the conclusion that this is the best alternative for cultural resources, all other things being equal. In contrast, SOS 5b involves repeated exposure and inundation of sites, and would therefore accelerate impacts.

Seen in this light, SOS 4 also emerges as one of the worst for cultural resources. It would decrease rates of site exposure by covering up sites, but at the expense of causing a much higher (11.7 percent) rate of shoreline erosion, which is a constant and very serious impact. This increase would occur at the storage reservoirs, especially Albeni Falls and John Day.

Another alternative that would accelerate impacts to cultural resources would be SOS 9a, since it would cause higher rates of both shoreline erosion (6.2 percent) and site exposure (11.2 percent).

5.3 TRADITIONAL CULTURAL RESOURCES

Some of the affected Tribes submitted comments concerning the analysis, comparison of alternatives, and results. Following are brief excerpts from reports by two of the Tribes. The full reports are printed in the exhibits section at the end of this Appendix.

From the Spokane Tribe of Indians

> *"The Spokane Tribe was not part of the screening, scoping, or analyses included in the Cultural Resources appendix. The Cultural Resource Work Group presented the models and analyses to the tribes after the models and analyses were largely completed, and then only for the tribes to provide comment. The federal agencies have not acknowledged nor used tribal staff technical expertise, data, or experience, or traditional tribal knowledge in the development of alternatives, modeling, analyses, or interpretation of results. It is not possible, after you have completed most of the analysis, for the tribes to begin and be included in a meaningful or significant way in the SOR process. By excluding the tribes from the screening, scoping, and analysis, they did not use all available knowledge, nor could this knowledge be considered in the decision–making process. Knowledge and data held by tribes was excluded from meaningful use and consideration in the SOR EIS process.*
>
> *Strong objection must be again made to the descriptions of effects of Natural River Operations. The exposure, erosion, and damage to cultural resources which here is described as "maximum" of any operations option, is (1) exaggerated, as re–vegetation of exposed surfaces would be required, and would greatly modify all of these effects; and (2) is a short–term perspective, describing only the temporary effects of return to natural conditions. Only*

in long–term natural river conditions can stability, preservation, protection, and access to cultural resources be reached.

The assumptions throughout Chapter 5 that current operations constitute stable conditions and that a sustained operation strategy creates stability are false. Damage and destruction not only occur, but escalate under most operation strategies, even if the operations themselves remain the same. Continuation of current operations has not created stable conditions at Lake Roosevelt; continuation of any operation cannot be automatically assumed to create a stable environment for cultural resources. This chapter is flawed by acceptance of false assumptions, inadequate data, over–generalizations, the stating of opinions as if they were fact, and lack of meaningful analysis. These flaws do not constitute real consideration of impacts on cultural resources, do not make best use of available data, and do not allow decision–makers to consider the impacts of different alternatives on cultural resources.

Draft EIS, Appendix D, Pg 5–2 through 5–6, Site–Specific Analysis. The title of this section (as in Chapter 4) is misleading, because the authors do no analysis for any specific site, but rather run previously recorded numbers through a computer to spit out raw number that reflect how many (raw count) previously recorded sites, for previously recorded elevations, are exposed according to monthly averages for reservoirs. All previous comments concerning the lack of adequate and/or accurate data, lack of consideration of site size or type, lack of consideration for unsurveyed areas and resource types, lack of consideration of real–time fluctuations (as opposed to monthly averages for reservoir levels) apply here. This type of description and analysis is not acceptable either in scientific or tribal terms, and does not meet federal responsibilities to manage and consider effects to cultural resources in these reservoirs.

It is a critical mistake throughout this section (as in Chapter 4) that "shoreline erosion" is equated with percentage of previously recorded sites (with all the problems listed above) located in the monthly averages' fluctuation zone. This is not only false, it is ridiculous. Shoreline erosion is never addressed in this analysis.

The exposure of archeological resources to wave impact, furthermore, is most definitely no equatable to "shoreline erosion," though this false equation is repeated over and over again in this document. Exposure in the fluctuation zone and to wave impact are very important impacts to cultural resources and require serious consideration, but they are not equatable to shoreline erosion. The analyses on "shoreline erosion" were produced by plugging the raw number (count) of previously recorded sites, by previously recorded elevations, and comparing it to the fluctuation zone for monthly average reservoir levels. All previous comments concerning the lack of adequate and/or accurate data, lack of consideration of site size or type, lack of consideration for unsurveyed areas and resource types, lack of consideration of real–time fluctuations (as opposed to monthly averages for reservoir levels) apply here. The researches acknowledge that surveys are extremely biased to particular elevations (especially those involved in the fluctuation zone), but continue without correction or compensation or correction of this problem, is a particularly critical flaw in these analyses. The numbers produced, and the interpretation of these numbers, in these analyses are meaningless, and in no way reflect shoreline erosion or impact of waves to cultural resources. This type of description and analysis is not acceptable either in scientific or tribal terms, and does not meet federal responsibilities to manage and consider effects to cultural resources in these reservoirs.

It would have been most interesting and productive to see an analysis developed to determine the impact of true fluctuation of the reservoirs, based on realized fluctuation, not monthly averages. Use of monthly averages does not reflect the greatest amount of fluctuations that affect cultural resources. As long as the Cultural Resource Work Group was "plugging in" numbers into the computer, they could have used real–time fluctuations as opposed to monthly averages. The fluctuations that occur on hourly and daily basis are completely ignored in this document, and in consideration of effects on cultural resources, *even though it is these hourly and daily fluctuations that actually impact these resources.*

The effects on cultural resources above high pool are never considered in this document, though these sites are directly and indirectly effected by reservoir operations. A direct analysis of shoreline erosion and view–/audio–sheds would help to address the effects operations on "higher" resources. There is no way at this point for decision–makers to take the effects of systems operation or the different alternatives on these cultural resources.

Another repeated example is the false assumption that inundation is a benign impact on cultural resources. The authors and researchers explicitly accept that this assumption is false, yet continue to work and analyze data (which appear to be the "hard facts") without any attempt at correction or compensation for the falsehood. Accepting the false assumption that inundation is a benign impact to cultural resources will result in incredible devastation of resources, without their preservation or destruction even being considered. Lack of accessibility to sites, most permanently, is also never even considered as a negative impact. This is not giving consideration to the effects of system operations on these cultural resources as required by law."[1]

From the Confederated Tribes of the Umatilla Indian Reservation

"Cultural Resource information in the SOR DEIS is misrepresented, implying that stable storage alternatives represent the best–cause scenario for Cultural Resource management. In actuality there is not enough quality data to make this determination. Further, all the SOS alternatives will have an adverse effect on Cultural Resources and the agencies must act accordingly. The Cultural Resource modeling is an academic exercise and is use full to a degree, but these models need to be adequately tested before such broad statements can be made.

The graphs and discussions of drawdown alternatives are presented such that the drawdown alternatives provide the worst–case scenarios regarding the protection of Cultural Resources. Information from the same analysis could be presented to suggest otherwise, further illustrating the subjective character of the analysis. The analysis actually suggests that there are weaknesses and strengths of both stable storage and drawdown alternatives, however, the analysis does little to discuss the full spectrum. The authors of the document simply assume that stable storage is the best selection. After reviewing the analysis in the Main Report and the Cultural Resources appendix it is apparent that there is insufficient baseline data to make such broad generalizations about the management of Cultural Resources.

It is suggested that the drawdown scenarios may lead to increased access to cultural properties encouraging traffic, looting and vandalism, as well as making the site susceptible to wind erosion. The analysis implies that the adverse effects increase proportionally to the increase in exposure during drawdowns. Further, the analysis suggests that Cultural Resource properties will suffer increasing natural erosion due to greater exposure.

The reality is, the very same natural erosion factors will be present in all SOS alternatives and occur daily along pools where reservoir levels are stable. Wave erosion characteristics have actually buried Cultural Resource properties, preventing them from being exposed during drawdown. The analysis fails to recognize that vandalism and wind erosion occur on stable storage reservoirs as well as on drawn–down pools, and that the shorelines in stable storage pools fluctuate as much as six feet a day, causing impacts to cultural properties including vandalism and erosion.

The Cultural Resource values portrayed in the SOR DEIS emphasize scientific/archaeological values. This emphasis does not reflect the importance of tribal members continuing to use those resources to enhance and restore aspects of living cultures. Drawdowns, for instance, may provide access to areas that are currently inundated and may allow tribal members to

[1]Review of SOR Draft EIS Appendix D. Cultural Resources, letter dated September 26, 1995.

utilize these areas for traditional, cultural, religious or other uses even during brief drawdowns.

There are several variables described in the Main Report and Appendix D which illustrate the complexity of Cultural Resource management issues. The Columbia River Plateau is one of the most significant archaeological regions in the country, perhaps the world. Cultural Resources are irreplaceable, non–renewable resources that are essentially priceless; such considerations are not incorporated in any meaningful way.

Almost nothing is discussed about the Columbia River as a traditional Cultural Property as described in Bulletin 38 prepared by the National Park Service. This deference to science is troubling to the CTUIR given the abundant comment we provided on the significance of the Columbia Rive to our way of life. The Cultural Resource analysis justifies the need for future Historic Preservation Plans and Programmatic Agreements (PAs). These plans and agreements will ostensibly address all concerns not addressed in detail in the study and bring the SOR agencies into compliance with historic preservation laws.[2]

Very few sites have been nominated to the National Register, almost none nominated by the SOR agencies themselves. There is a desperate need to rerecord many of the documented sites and new properties using new methods and technologies such as completed site forms, computer data bases, geographical information systems, global positioning satellites, cameras, and video recorders.

How many previously unknown and unrecorded sites are currently being impacted or will be discovered during the implementation selected alternatives? This is a concern because the agencies have failed in the past to develop and implement adequate cultural resources inventory strategies as required under Section 110 of the NHPA. Agencies have typically allocated all financial resources to Section 106 undertakings and have not maintained programs that assess the effects of their actions on properties under their jurisdiction and control. Some of the SOR agencies have consistently planned and implemented Section 106 historic preservation activities without consultation with the Tribes and there is concern about the consistency of such consultation and resource management because there are three lead agencies and myriads of other parties involved in the SOR.

There is a tremendous need to conduct oral histories with knowledgeable tribal members to salvage much of the information that has been lost by the inundation and destruction of important resources and resource gathering areas. The alteration of the Columbia River System has damaged Native American culture and life. There has been the loss of many opportunities to continue practicing integral parts of Columbia Plateau life. There is the immediate need to begin documenting place names, and histories from elders and other tribal members who are knowledgeable of such things. It is critical that Tribes be allowed to gather information in their own languages and in their own ways for the purpose of managing cultural resources consistent with traditional life. Many areas where language was practiced have been lost due to inundation.

The agencies lack of support for their cultural resources programs to address Section 110 concerns such as ongoing historic preservation programs has left the agencies in a situation where they need to make recommendations about resources without the necessary baseline to accurately portray the results. This is not untypical of most federal agencies, however, now that land management projects are being developed on such large scales such as SOR, Section 110 data will be crucial.[3]

The agencies failure to fully support programs to address ongoing historic and Cultural Resource preservation has left the agencies in a situation where they need to make recommendations about resources

[2]CTUIR's Draft Supplemental Comments on the SOR Draft EIS Appendix I. Federal Indian Law and other Applicable Constraints on the SOR and the FCRPS, dated September 1995.

[3]Review of Cultural Resources, Concerns of the Systems Operation Review EIS Cultural Resources Appendix dated October 12, 1995.

without the necessary baseline data to sufficiently portray the effects of the SOS alternatives. This past failure to properly invest in the management of Cultural Resources during facility operations is tantamount to outright neglect and malfeasance. There is no indication from the agencies that they will begin to implement their historic and cultural preservation responsibilities.

The SOR agencies must begin to identify how Cultural Resource management will be funded, and also demonstrate to the CTUIR and the public that such funding will be used to implement historic and Cultural Resources planning."[4]

5.4 SUMMARY OF EFFECTS

The computer simulation and geomorphic approaches to assessing the system's effects on cultural resourcees agree very generally that SOSs 1a and 2c would be the best alternatives for cultural resources because they would cause the least amount of change from the current operating regime. In addition, the geomorphic analysis predicts additional adverse effects from SOSs 2c and 2d that the simulation does not predict. These are slope failures in silty soils on steep slopes resulting from flow augmentations with target spills, and new long–term shoreline stands that would cut deeper shoreline benches.

The two approaches also agree that SOSs 5 and 9 would cause the most dramatic increases in adverse effects to cultural resources. The simulation model shows SOS 5 increasing the rate of site exposure much more than it decreases the rate of shoreline erosion. Under the geomorphic analysis, the drawdowns to natural river level at the lower Snake projects would dramatically increase erosion and sedimentation at these reservoirs because of the large drawdowns that SOS 5 would involve.

The outcome of SOS 4 is less certain in either analysis. According to the simulation model, SOS 4 would decrease the rate of site exposure, but increase the rate of shoreline erosion dramatically. This is because many of the known sites are located in high pool areas and because SOS 4 features high reservoir pools in the summer. According to the geomorphic analysis, SOS 4 would be beneficial to cultural resources most of the time because it would involve a more stable reservoir with a narrower range of fluctuation. The negative feature of SOS 4, under this analysis, is its rapid drawdown at Dworshak and John Day in the fall. This could cause slope failures in silty soils and on steep slopes.

The approaches also disagree regarding SOS 6. According to the geomorphic analysis, SOS 6 would be particularly bad for cultural resources. This alternative would involve the establishment of relatively long–term new stable shoreline stands that would cut deeper benches at new locations at the lower Snake projects. The simulation results do not show a large change from the baseline in potential effects at all known sites. They predict that, while the rate exposure of known sites would increase under this alternative, shoreline erosion rates would decrease slightly.

Both approaches agree that the preferred alternative would not cause dramatically increased rates of ongoing impact, compared to the other alternatives. The simulation shows only small changes in the rates of shoreline erosion and site exposure, compared with the baseline. The geomorphic analysis notes that the supply of flow augmentation water under this alternative would be shared by several reservoirs, which would lessen the impacts from drawdowns and fluctuations that would otherwise occur, though it also notes that the preferred alternative would create wave–cut benches at new reservoir levels. Table 5–2 at the end of this chapter is a general summary of the potential effects of the alternatives.

5.5 CUMULATIVE IMPACTS

Cumulative effects are the combined impacts of many separate actions and may take many different forms. For example, repeated drawdown and refill at a single reservoir causes the erosion of cultural resources in a way that is both incremental and cumulative. Other

[4]CTUIR's Draft Supplemental Comments on the SOR Draft EIS Appendix I. Federal Indian Law and other Applicable Constraints on the SOR and the FCRPS, dated September 1995.

features associated with reservoir construction and operation may each have a small effect in isolation. However, when taken together, they may cause damage or destruction to a large proportion of the significant cultural resources along the mainstem of a particular river or river system. Contributing factors can include the cumulative impoundment of a river segment, repeated effects of flushing flows, levee construction, and the addition of recreational facilities, housing developments, and bridge crossings.

Incremental river impoundment has caused or will eventually cause some of the most serious cumulative effects in the Columbia Basin. Federal and non–Federal projects constructed on the Columbia and Snake rivers and their tributaries have impounded an increasingly large proportion of the river system. There are thus fewer stretches of uncontrolled river where cultural resources are not subject to reservoir impacts. Certain stretches of the river basin—such as the lower Columbia from Bonneville to McNary, and the lower Snake from the Columbia confluence to Lower Granite—are entirely inundated. The lower Columbia, for example, is continuously inundated above Bonneville for 207 miles (270 kilometers) (Corps of Engineers, 1977).

The cumulative effects of system operation also pertain to the repeated incremental impacts of erosion and exposure within and between the reservoirs. The reservoirs can act as giant sluices, slowly stripping away the protective covering that most archeological sites have prior to inundation. These effects are especially pronounced at the heads of reservoirs and at inundated tributary mouths. The longer a reservoir has been in operation, the greater the effect.

The cumulative effects of reservoir erosion are dramatically illustrated by the rate of discovery of new archeological sites following the construction of Libby Dam. Archaeologists identified about 25 archeological sites in the uncleared reservoir pool area before reservoir construction. In the first 5 years following reservoir filling, a sampling study identified 100 additional archeological sites and estimated that a total of 3300 sites might be present. After 10 years, inventory surveys in the drawdown area actually disclosed more than 300 archeological sites. The same erosive processes that revealed these formerly hidden sites will continue to erode the site deposits destructively. At older reservoirs, preservation efforts may be too late—many sites in their pools may have been destroyed.

The effect of the system reservoirs on downstream river reaches and non–Federal impoundments is also cumulative. Rapid fluctuations in these river reaches can cause river bank slumping that destroys cultural resources. When combined with the erosion of cultural resources at the reservoirs themselves, the cumulative effect is significant, placing a relatively high percentage of the region's significant riverine cultural resources in jeopardy.

Another kind of cumulative effect upon cultural resources has resulted from the expanded development of reservoir shorelines for industrial facilities, commercial shipping, navigation, public recreation, and residential use. These developments indirectly cause cumulative impacts to cultural resources at and near the Federal projects.

The cumulative effects at SOR storage projects include, most importantly, the cyclic hydraulic effects of drawdown, discharge, and refill. The cumulative effects at run–of–river projects are more likely to be related to streambank erosion and stabilization efforts and the development of housing, recreation, irrigation, and transportation facilities.

As system operation eventually destroys a large percentage of the cultural resources at these reservoirs, the cumulative effect will be the loss of heritage sites and scientific resources from the river mainstem in an entire region. This is important because the cultural resources along the mainstem are not duplicated or replaced at other locations. Because most cultural resources are nonrenewable, this would be a significant cumulative impact. Under SOSs 5b and 6, as noted earlier, the lower Snake River reservoirs would sustain a large acceleration in impacts. This would constitute a significant cumulative impact, because these reservoirs, plus McNary, cover all of the Snake mainstem downstream of the Clearwater confluence.

Table 5–2. Summary of Effects of the Alternatives in Terms of Geomorphic Change, and Change in Rate of Site Destruction as Compared with SOS2c [1]

SOS	Upper Columbia [3]	Grand Coulee	Dworshak	Lower Snake [3]	Lower Columbia [3]
1a: Pre-Salmon Summit Operation	Pool fluctuations for power increase sloughing and erosion Ongoing impact from exposure, erosion, vandalism, ice gouging	Pool fluctuations for power increase sloughing and erosion Additional sloughing due to hydropower operations	Ongoing impact from exposure erosion, vandalism	Ongoing impact from exposure, erosion, vandalism	Ongoing impact from exposure, erosion, vandalism
1b: Optimum Load-Following			Additional sloughing due to hydropower operations	Much slower [2] site destruction at Little Goose Moderately (1b) or slightly slower site destruction at Lower Granite	
2c: No-Action Alternative	Ongoing impacts from exposure, erosion, vandalism, ice gouging	Ongoing impacts from exposure, erosion, vandalism	Ongoing impact from exposure, erosion, vandalism	New stable shorelines and wave–cut benches, April-August	Ongoing impact from exposure, erosion, vandalism
2d: Final SEIS–1994-98 Biological Opinion	Flow augmentation increases sloughing at Libby	Flow augmentation increases sloughing	Flow augmentation increases sloughing		
4c: Stable Storage Operation	Much slower site destruction at Libby and Hungry Horse, with small increase in shoreline erosion offset by larger decrease in site exposure Slightly faster site destruction at Albeni with decrease in site exposure offset by larger increase in shoreline erosion.	Ongoing impacts from exposure, erosion, vandalism	Rapid fluctuation causes slope failure	Ongoing impact from exposure, erosion, vandalism	Ongoing impact from exposure, erosion, vandalism

1 The change in rate of site destruction combines effects of shoreline erosion and site exposure. These sometimes offset (see Sections 4.5 and 5.2).

2 Rates of site destruction are: slightly faster/slower, 5–15 percentage point change; moderately faster, 15–25 points; much faster, >25 points.

3 Upper Columbia projects are: Libby, Albeni Falls, and Hungry Horse.
Lower Snake Projects are: Lower Granite, Little Goose, Lower Monumental, and Ice Harbor.
Lower Columbia Projects are: McNary, John Day, The Dalles, and Bonneville.

Table 5–2. Summary of Effects of the Alternatives in Terms of Geomorphic Change, and Change in Rate of Site Destruction as Compared with SOS2c [1] – CONT

SOS	Upper Columbia [3]	Grand Coulee	Dworshak	Lower Snake [3]	Lower Columbia [3]
5b: Natural River- 4.5-month drawdown	Pool fluctuations for power increase sloughing and erosion	Pool fluctuations for power increase sloughing and erosion	Drafting causes increased erosion	New shorelines cause new wave-cut benches Much faster site destruction at all four projects	Ongoing impact from exposure, erosion, vandalism
5c: Permanent Natural River Operations	Ongoing impact from exposure, erosion, vandalism, ice gouging	Ongoing impact from exposure, erosion, vandalism	Moderately slower [2] site destruction	Drawdown exposes slopes, which revegetate, protecting cultural resources	
6b: Drawdown- 4.5 month, four projects	Pool fluctuations for power increase sloughing and erosion	Pool fluctuations for power increase sloughing and erosion	Moderately slower site destruction	Much faster site destruction at all projects New shorelines cause new wave-cut benches	Ongoing impact from exposure, erosion, vandalism
6d: Drawdown at Lower Granite 4.5 month	Ongoing impact from exposure, erosion, vandalism, ice gouging	Ongoing impact from exposure, erosion, vandalism		Much faster site destruction at Lower Granite, ongoing impacts at other projects New shorelines cause new wave-cut benches	

1 The change in rate of site destruction combines effects of shoreline erosion and site exposure. These sometimes offset (see Sections 4.5 and 5.2).

2 Rates of site destruction are: slightly faster/slower, 5–15 percentage point change; moderately faster, 15–25 points; much faster, >25 points.

3 Upper Columbia projects are: Libby, Albeni Falls, and Hungry Horse.
Lower Snake Projects are: Lower Granite, Little Goose, Lower Monumental, and Ice Harbor.
Lower Columbia Projects are: McNary, John Day, The Dalles, and Bonneville.

Table 5–2. Summary of Effects of the Alternatives in Terms of Geomorphic Change, and Change in Rate of Site Destruction as Compared with SOS2c.[1] – CONT

SOS	Upper Columbia [3]	Grand Coulee	Dworshak	Lower Snake [3]	Lower Columbia [3]
9a: Detailed Fishery Operating Plan	Increased sloughing and erosion due to flow augmentation Much faster site destruction at Libby Moderately slower site destruction at Hungry Horse and Albeni Falls	Increased sloughing and erosion due to flow augmentation Slightly faster site destruction	Increased sloughing and erosion due to flow augmentation Slightly slower site destruction	Much faster site destruction at all four projects	Ongoing impact from exposure, erosion, vandalism
9b: Adaptive Management	Increased sloughing and erosion due to flow augmentation Ongoing impact from exposure, erosion, vandalism, ice gouging	Increased sloughing and erosion due to flow augmentation	Increased sloughing and erosion due to flow augmentation	Moderately faster site destruction at Lower Granite and Little Goose Ongoing impact from exposure, erosion, vandalism, at other projects	Ongoing impact from exposure, erosion, vandalism
9c: Balanced Impacts	Increased sloughing and erosion due to flow augmentation Ongoing impact from exposure, erosion, vandalism, ice gouging	Slightly faster site destruction	Slightly faster site destruction	Much faster site destruction at all four projects	
PA: Preferred Alternative	Moderately slower site destruction at Hungry Horse Ongoing impact from exposure, vandalism, ice gouging at other projects	Ongoing impact from exposure, vandalism, ice gouging	Ongoing impact from exposure, vandalism, ice gouging	Moderately faster site destruction at Lower Granite Slightly faster site destruction at Little Goose	Ongoing impact from exposure, vandalism, ice gouging Increased sloughing and erosion due to flow augmentation at John Day

1 The change in rate of site destruction combines effects of shoreline erosion and site exposure. These sometimes offset (see Sections 4.5 and 5.2).

2 Rates of site destruction are: slightly faster/slower, 5–15 percentage point change; moderately faster, 15–25 points; much faster, >25 points.

3 Upper Columbia projects are: Libby, Albeni Falls, and Hungry Horse.
Lower Snake Projects are: Lower Granite, Little Goose, Lower Monumental, and Ice Harbor.
Lower Columbia Projects are: McNary, John Day, The Dalles, and Bonneville.

CHAPTER 6

MANAGEMENT RESPONSIBILITIES

6.1 OVERVIEW

The usual final step in the impact assessment process for cultural resources under the NHPA requires preparation of a MOA and PA among the Federal agencies, SHPOs, Indian Tribes, and the ACHP, which addresses adverse effects to cultural resources under the authority of Sections 106 and 110 of the NPHA. After 2 years of meetings and discussions among the parties it has become apparent that common agreement among all parties cannot be achieved in a single agreement document. Instead, documentation for the undertaking and its effects will be forwarded without an agreement to the ACHP for comment under 36 CFR Part 800.6. ACHP comments will be addressed in the RODs, if applicable, and in followon agreements for SOR implementation.

Two separate kinds of agreement documents are envisioned. One type of document will be an interagency agreement among the three SOR lead agencies based upon a statement of shared principles and commitments. The statement of principles and commitments will identify generalized goals of the SOR agencies, whereas the interagency agreement will identify specific agency roles, responsibilities, and commitments for budget allocations necessary to meet cultural resources requirements for Section 106 and 110 compliance. The other kind of document includes individual agreements, called Implementation Plans (IPs), covering specific projects of river reaches. (These are called various names including Cultural Resources Management Plans, Historic Property Management Plans, Cultural Resource Action Plans). IPs will specify appropriate treatments for the effects of the SOR on historic properties, require detailed historic preservation plans (HPPs), interim measures necessary to carry out the agreed upon treatments, and identify funding actions that may be called for in the HPPs. Whereas the interagency agreement will involve only the lead SOR agencies, the IPs will involve consultation with affected Indian Tribes, other cooperating agencies, ACHP, and SHPOs.

Several important steps are involved in the preparation of IPs. These include a process for the identification and evaluation of the significance of affected cultural resources and the development of coordinated plans taking into account and mitigating the adverse effects to significant resources. Mitigation or treatment refers to actions designed to lessen or offset the loss of significant resources due to the adverse effects of an agency undertaking. The individual IPs will describe the anticipated project impacts on cultural resources and identify the approved mitigation or treatment plans, including stipulations and conditions for identification, evaluation and management, as well as recommendations for protection, monitoring, data recovery, site stabilization, and curation of recovered artifacts. In addition, the IPs will contain provisions for Native American consultation and coordination under the authorities of the AIRFA and NAGPRA and establish curation provisions.

A comparison of the alternatives described in Chapter 5 indicates that some level of adverse impacts to significant cultural properties is likely to occur at all the Federal projects as a result of system operations. These adverse effects on significant cultural properties in turn require mitigation or treatment. The present extent of cultural resource identification and evaluation at individual reservoirs, however, is highly variable; and completion of these tasks stands out as the immediate responsibility of the operating agencies. A closer look at these problems and potential responses follows:

6.2 DETERMINATIONS OF ADVERSE EFFECT

According to the "Criteria of Effect and Adverse Effect" established in 36 CFR Part 800.9, the effects of a variety of reservoir operations would be adverse effects. Therefore, the adverse effects from operations at the Federal dam reservoirs in the Columbia River system must be addressed at the individual project level in IPs by each managing agency. The adverse effects of alternatives proposed in the SOR EIS are increments beyond those occurring as a result of the current authorized operating limits at each Federal dam facility. The comparison of effects for different SOR alternatives in Chapter 5 indicates that most of the proposed alternatives fall within existing authorized limits for most Federal dams. The problem in this analysis is that the majority of inventoried cultural resources sites at the Federal dams have not been evaluated for their significance or National Register eligibility (36 CFR Part 63). Discussion of mitigation or treatment for adversely affected cultural resources at the Federal dams in the Columbia River system must be addressed in IPs by the agencies on a facility–by–facility basis, considering the extent of each facility's compliance with Sections 106 and 110 of the NHPA.

6.3 MITIGATION OR TREATMENT OF AFFECTED CULTURAL RESOURCES

The usual subjects for mitigation or treatment are National Register eligible sites threatened by adverse impacts such as construction impact, inundation, erosion, or vandalism. This study has pointed out that the majority of inventoried cultural resource sites in the Federal reservoirs of the Columbia River system have not yet been evaluated (through Determinations of Eligibility for the National Register). However, the SOR affords an opportunity to advance the site evaluation process for mitigation or treatment planning at the individual Federal reservoirs. Therefore, accelerated site evaluation studies are recommended as essential components in the development of IPs for each Federal reservoir. Mitigation or treatment planning hinges upon this site evaluation process. Actual mitigation or treatment measures may vary. Some of the common options include the following:

Avoidance or Protection

Whenever possible, Federal agencies attempt to plan projects in such a way as to avoid impacts to cultural resources. Only as a last resort, when destructive effects cannot be avoided will the agency conduct data recovery. In the case of reservoirs, it is often difficult to avoid impacts to resources. Some measure of protection can, however, be secured through bank stabilization programs or protective levees at locations where significant cultural resource sites occur and bedrock and soil characteristics permit such treatment. Covering sites or erecting barriers around them are other protective measures used in managing cultural resources. Site protection also includes intensive management efforts such as signage, public education programs, and law enforcement efforts.

Monitoring

Reservoir monitoring, with special attention to site conditions, is a key means by which the operating agencies manage cultural resources. Site evaluation is not part of monitoring. Rather, monitoring describes on–the–ground activity to document impacts or changes to cultural resource sites over time which can assist in the development of appropriate protection measures. Site observation and protection are directed specifically to areas of erosion impact, such as streambanks and the drawdown zone, and to preventing unlawful artifact collection and vandalism.

Data Recovery, Curation, and Site Stabilization

When an evaluated cultural resource from a geological deposit is threatened by loss due to erosion, vandalism, or construction activity, strictly controlled scientific data recovery may constitute the only way to document the significance and offset the loss. All scientific excavation is conducted under site–specific research plans developed in consultation with the appropriate parties. A key legal requirement of the data recovery process involves the curation of all recovered artifacts and associated documentation in a facility meeting the standards of 36 CFR part 79. This is to insure the preservation in perpetuity of such cultural resource collections for their scientific research and educational value. If the level of significance is high and geologic and soils conditions are favorable, significant sites may be protected by stabilization efforts such as site capping, slumpage control and stream–bank stabilization rather than excavation.

Consultation with Indian Tribes

Any mitigation or treatment effort undertaken by the managing agencies will require consultation with affected Indian Tribes. Such consultation must take into account the Federal agency government–to–government and tribal trust responsibilities. Discussions need to include mitigation or treatment and management measures that are sensitive to Tribal concerns yet responsive to scientific data recovery and curatorial needs and requirements. Affected Indian Tribes will participate in direct and meaningful ways in cultural resource management, including planning and implementation efforts, and Tribes may contribute to the development of IPs at specific reservoirs.

Coordination with mitigation efforts for other resources

Other SOR work groups also are developing mitigation plans to address SOR impacts on a variety of natural resources and Federal project activities. These include resident fish, wildlife, recreation, and irrigation. In some situations, cultural resources appear in the same physical context as these other resources or activities. Where such overlaps occur, planners need to coordinate mitigation activities so that actions benefiting one resource do not inadvertently harm another. IPs for the treatment of cultural resources will attempt to address issues common to mitigation for multiple resources at a project. The reader is referred to other SOR EIS technical appendices for their discussions of mitigation actions.

6.4 LEGAL COMPLIANCE

Each operating agency, or the SOR agencies collectively, must address their compliance requirements under Sections 106 and 110 of the NHPA for each Federal reservoir. Figure 6–1 identifies the generalized Section 106 Federal agency consultation process with the Advisory Council. (This process begins consultation when ACHP is notified that National Register eligible historic properties may be adversely affected by a Federal undertaking; for Federal agencies, however, consultation begins earlier in the process with efforts to identify and evaluate significant cultural resources). ACHP procedures provide several options: individual reservoir Memoranda of Agreement (MOA), a single or multiple PA(s), the use of existing MOAs and PAs, some combination of the above types of agreements, or no agreement. These options are the legal basis for SOR mitigation or treatment at the individual projects, and their acceptance or comment by the ACHP signifies legal compliance with the NHPA by the participating Federal agencies.

In addition to the Section 106 requirements, Section 110 of the NHPA mandates that Federal agencies have cultural resources management plans to provide for the protection of significant cultural resources under their jurisdiction. The SOR agencies have initiated the consultation process with the SHPOs, the ACHP and the Tribes and have determined that it is not feasible to seek concurrence in a single agreement document. Accordingly, the SOR agencies elect to secure ACHP comment without an agreement document. However, a two pronged approach is proposed to achieve SOR agency commitment through an umbrella interagency agreement, and then to secure the direct participation of Indian Tribes, cooperating agencies, and interested parties in planning and execution of management efforts for IPs at individual reservoirs or reaches.

Individual IPs will stipulate the development of treatment plans, funding actions, specific time frames for activities, any necessary interim management plans, and decisionmaking processes for accomplishing Federal agency/Tribal treatment of cultural resources affected by the SOR at specific Federal projects. In particular, the individual PCs would tailor the consulting and implementation process to the differing needs and legal rights (based on treaties, executive orders, laws, judicial decisions, and other legally binding documents) of the various Tribes. The individual Tribal MOAs will create formal, on–going partnership between the Federal agencies and individual Tribes for the decisions needed to treat the affected cultural resources.

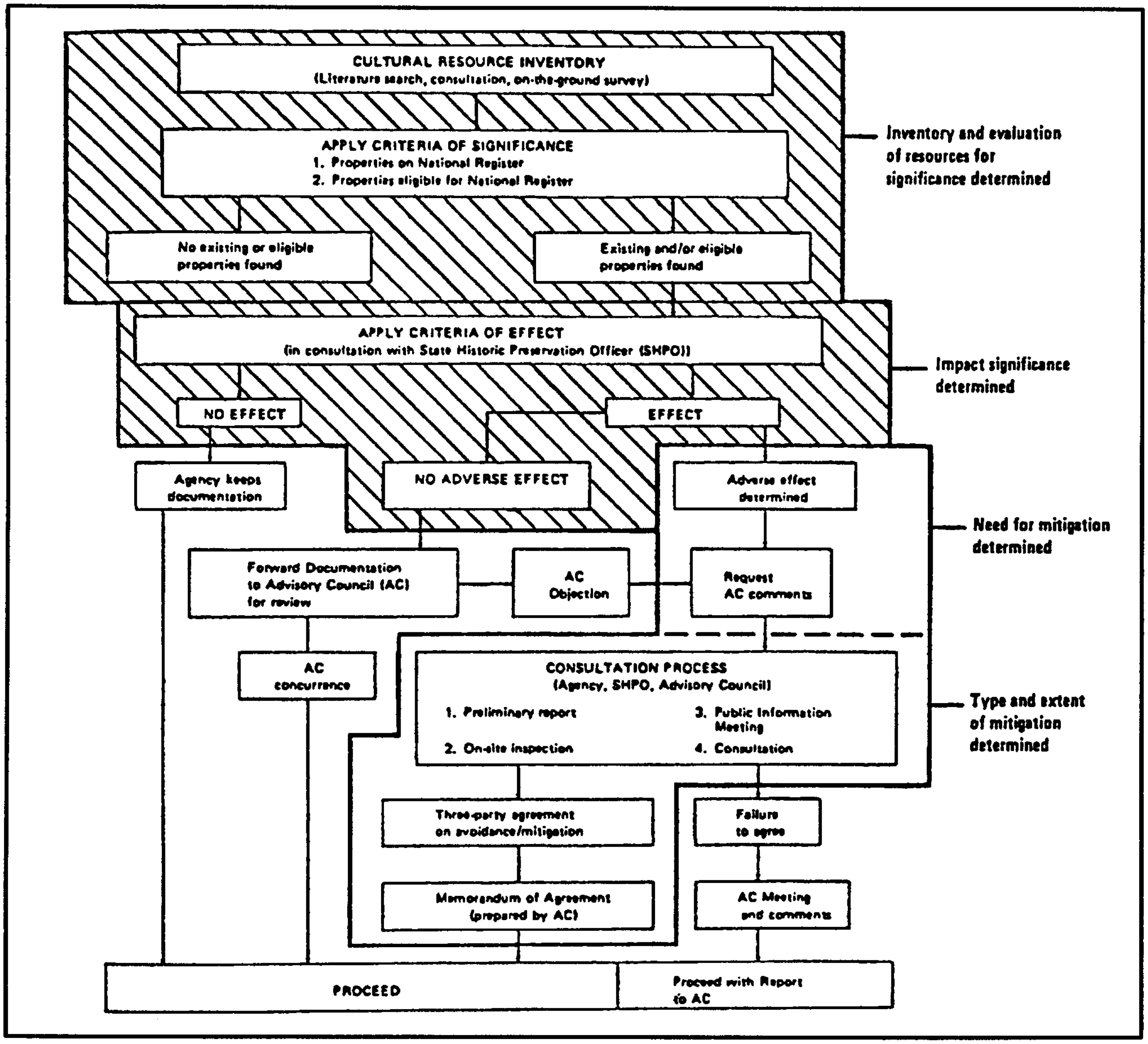

Figure 6–1. President's Advistory Council Section 106 Procedures (National Historic Preservation Act)

Figure 6–2 identifies the present status of NHPA Section 106 compliance at SOR dams. All of the storage reservoirs (Hungry Horse, Libby, Albeni Falls, Grand Coulee and Dworshak) are covered by a 1991 PA for BPAs Intertie Development and Use EIS. A 1982 Corps of Engineers PA applies to its Walla Walla District dams (Dworshak, Lower Granite, Little Goose, Lower Monumental, Ice Harbor and McNary). SOR dams lacking MOAs or a PA under Section 106 include three Corps of Engineers dams operated by the Portland District (John Day, The Dalles, and Bonneville) and one Seattle District dam (Chief Joseph).

Figure 6–2. Status of National Preservation Act Compliance at SOR Dams on the Columbia River System

6.5 TREATMENTS FOR ADVERSE EFFECTS

The precise mix of treatments for the adverse effects on cultural resources at each reservoir caused by system operations will vary, depending on the alternative operation chosen and the outcome of consultations among the parties to the individual IPs. In the case of the preferred alternative, a wide range of treatments will be appropriate because of differences between the system wide effects and the specific impacts at individual reservoirs.

On a system wide basis, the simulation study indicates that the preferred alternative does not greatly alter the overall rates of impacts from current operations. It slightly increases the rates of drawdown zone exposure but produces slightly lower shoreline erosion. However, based on the geomorphic analysis, the preferred alternative would worsen erosive conditions, system–wide, as compared to existing operations. In any case, the cumulative effects of system operations focused on drawdowns and augmented flows will be the continued loss of unique and irreplaceable cultural resources.

At a minimum, it would seem appropriate for the IPs to call for completion of surveys, inventories, and evaluations of sites and traditional cultural properties on affected reservoir lands. For identified sites and properties, periodic monitoring will be necessary until mutually acceptable treatments are agreed to, such as protection in place – – or where absolutely necessary – – data recovery. Appropriate treatments for significant cultural resources need to be worked out and priorities set among the SOR agencies, Tribes, SHPOs, and cooperating agencies for each reservoir or reach, based on available funding allocations.

CHAPTER 7

LIST OF PREPARERS

Table 7–1. List of Preparers, Contributors, and Affected Tribes

Name	Education/Years of Experience	Experience and Expertise	Role In Preparation
Michael Ary Bonneville Power Administration, Portland	B.S. Geography 14 years	NEPA Impact Analysis	Reviewer
Linda Burbach Bonneville Power Administration, Portland	NEPA Specialist 15 years	NEPA decision process, public involvement	Assist with group coordination
Maureen Corcoran US Army Corps of Engineers Waterways Experiment Station, Vicksburg MS	M.S., Geology	Geographic Information System	Analysis for erosion study
Doug Davy Foster Wheeler Environmental, Sacramento, CA	Ph.D., Anthropology 15 years	Prehistory, Cultural Resource Management (CRM)	Impact analysis and comparison based on exposure
Charles James Bureau of Indian Affairs	M.A., Anthropology 27 years	NW prehistory, ethnohistory, contemporary Indians, CRM	Reviewer
John Leier Corps of Engineers, Walla Walla	M.A. Anthropology 17 years	NW prehistory, CRM	Contributor and reviewer
Lynne B. MacDonald Bureau of Reclamation, Boise, Idaho	M.A. Anthropology 18 years	Historical archeology NW prehistory, CRM	Contributor and reviewer
Michael Martin Corps of Engineers, Portland	B.S., Anthropology 21 years	Historic land use, NW prehistory	Compiler
Gary McLean Forest Service, Flathead National Forest Kalispell, MT	M.A., Anthropology	NW prehistory, CRM	Hungry Horse cultural inventory
Robert R. Mierendorf National Park Service, North Cascades National Park, Marblemount, WA	M.A., Anthropology	CRM	Lake Roosevelt site record inventory data

Table 7–1. List of Preparers, Contributors, and Affected Tribes – CONT

Name	Education/Years of Experience	Experience and Expertise	Role In Preparation
Paul Nickens Battelle–Pacific NW Laboratory Hanford, WA	Ph.D., Anthropology	Site stabilization	Dworshak–John Day reservoir erosion analysis and modeling
Wayne Prokopetz National Park Service Seattle, WA		CRM	Reviewer
David G. Rice Corps of Engineers, Seattle	Ph.D., Anthropology 28 years	NW prehistory, ethohistory, contemporary Indians, CRM	Contributor and reviewer
Lawr Salo Corps of Engineers, Seattle	B.A. Anthropology 25 years	NW prehistory, CRM	Contributor and reviewer
Lawson Smith US Army Corps of Engineers Waterways Experiment Station, Vicksburg MS	Ph.D., Geology	Geomorphology	Analysis for erosion study of Dworshak–John Day reservoir areas
Jay Sturgill Corps of Engineers, Portland	B.A., Geology 27 years	Geomorphology, erosion sedimentology	Analysis of effects, writer
James W. Thomson National Park Service Seattle, WA	Ph.D., Anthropology NW prehistory	CRM	Reviewer
Rebecca Timmons US Forest Service Kootenai National Forest Libby, MT	M.A., Anthropology	NW prehistory	Lake Koocanusa drawdown monitoring
Ray Tracy Corps of Engineers, Walla Walla	M.A. Anthropology 7 years	NW prehistory, CRM	Reviewer
William Willingham Corps of Engineers North Pacific Division	Ph.D., History 29 years	American History, NW focus, Cultural resource management (CRM)	CRWG Leader, reviewer and editor

Affected Sovereign Indian Nations

Name
Blackfeet Tribe
Burns Paiute Tribe
Coeur d'Alene Tribe
Confederated Tribes of the Colville Reservation
Confederated Salish and Kootenai Tribes
Confederated Tribes and Bands of the Yakama Indian Nation
Confederated Tribes of the Umatilla Indian Reservation
Confederated Tribes of the Warm Springs Indian Reservation
Kalispel Indian Tribe
Kootenai Tribe of Idaho
Nez Perce Tribe
Shoshone–Bannock Tribes
Shoshone–Paiute Tribes of Duck Valley
Spokane Tribe of Indians

CHAPTER 8

GLOSSARY

Advisory Council: The Advisory Council on Historic Preservation, a body appointed by the President that advises federal agencies regarding historic preservation.

Alluvial: Unconsolidated and sorted to semi–sorted material deposited by a stream or other body of running water during relatively recent geologic time.

Anadromous fish: Fish, such as salmon or steelhead trout, that hatch in freshwater, migrate to and mature in the ocean, and return to fresh water as adults to spawn.

Anthropogenic stresses: Human–caused stresses.

Archeological context: The setting of an artifact or feature in an archeological site; or, its set of spatial, temporal, and functional relationships to other artifacts and features or the landscape.

Archeological site: A deposit, construction, or other trace of human behavior, generally greater than 50 years old.

ARPA: Archeological Resources Protection Act of 1979 (16 USC 470aa–470ll).

Augment: Increase; in this application, increase river flows above levels that would occur under normal operations by releasing water from storage reservoirs.

Biological rule curves: Reservoir water levels, represented as curved lines on graphs depicting the levels over time, that guide reservoir operation to meet the stream flow requirements of biological species such as salmon or white sturgeon.

Bioturbation: Biological disturbance of cultural resources, such as cattle trampling or rodent burrowing.

BPA: Bonneville Power Administration

Cataclysmic floods: Floods of a magnitude greater than that known during the historic times. Cataclysmic floods occurred during the glacial epoch when ice–dams impounding very large lakes broke, releasing very large volumes of water in the Columbia basin.

Catastrophic floods: See Cataclysmic Floods.

CEAA: Canadian Entitlement Allocation Agreements

Ceded lands: Lands to which Indian leaders by treaty relinquished claim of ownership to the United States Government.

Colluvial: Loose, heterogeneous, and incoherent soil and rock deposited by rainwash, sheetwash, or creep, usually at the base or sides of hills.

Coordination Agreement: Pacific Northwest Coordination Agreement

Corps: U.S. Army Corps of Engineers

CRWG: Cultural Resources Work Group (for Columbia River System Operation Review)

Cryoturbation: Disturbance of cultural resources by freezing, or alternating freezing and thawing.

Cultural resources: Archaeological and historic sites, historic architecture and engineering, and traditional cultural properties.

Cultural site: A property of archaeological, historic, or cultural significance.

Cultural site exposure: Making an archaeological, historic, or traditional cultural property vulnerable to erosion or vandalism; for example, by lowering a reservoir water level to uncover an archaeological site.

Curation: The cataloging, storage, and preservation of artifacts and other archaeological or historic materials.

Depositional processes: Processes that create and transform archaeological or geological deposits.

Digitized: Put into digital form.

Draft: To lower the elevation of a reservoir by releasing water.

Drawdown: To lower the water surface of a reservoir by releasing water at a rate faster than inflow.

EIS: Environmental Impact Statement

EPA: U.S. Environmental Protection Agency

Erosional processes: Processes such as landslide and sheetwash, that change landforms by reshaping them, wearing them away, or destroying them.

ESA: Endangered Species Act (16 USC 1531 *et seq.*)

Ethno–archeological survey: A study of ways in which traditional cultural practices might lead to the formation of sites or deposits observed archaeologically.

Ethnographic compilation: The collection of scientific information about the culture and lifeways of ethnic or cultural groups.

Extant archeological record: The information that archaeologial sites contain about prehistoric lifeways.

Extrapolation: To infer, estimate, or project from known information or conditions to unknown or hypothetical conditions.

Flow: The volume of water passing a given point per unit of time, often measured as cubic feet per second (cfs).

Fluctuation zone: The area of a reservoir pool within which the reservoir surface moves up and down.

Fluvial: Of, pertaining to, or inhabiting a river or stream.

Forum: Columbia River Regional Forum

FS: U.S. Forest Service

Full pool: The maximum level of a reservoir under its established normal operating range.

FWS: U.S. Fish and Wildlife Service

Geomorphic/geomorphological: Having to do with landforms and the forces that change them.

GIS: Geographic Information System

Historic property: An archaeological, historic, or traditional cultural property.

Historic resource: A cultural resource; or, a property belonging to a time and place for which written records are available.

Holocene salmonid: A fish belonging to the salmon and trout family (Salmonidae) and living during the Holocene epoch of geological history (within the past 10,000 years).

Housepit villages: Indian villages containing houses formed partly by excavation.

HPMP: Historic Property Management Plan

Hydraulic: Operated by water or other liquids under pressure

Hydrology: The study of water and its transformations, including the cycle of evaporation, transpiration, precipitation, and runoff

Hydroregulation model: A computerized model using numbers to represent volumes of water stored in or flowing through a water project or projects.

HYDROSIM: The hydroregulation model BPA developed to to simulate the alternatives for operating the Columbia River System (SOS alternatives).

Impoundment: A confinement or enclosure such as a reservoir.

Indian lands: Lands owned by Indian tribes.

Interstitia/interstitial pores: Air spaces between soil or rock particles.

Ionic exchange: A chemical reaction between a solid and a fluid by means of which ions may be interchanged.

Juvenile: An immature fish or animal; for example, salmon smolts during their migration downstream to the ocean.

Lacustrine: Pertaining to a lake or lakes

Lithic quarries: Places where Indians collected or mined stone suitable for toolmaking.

Locks: Chambered canals or waterways providing a means for boats or barges to bypass dams, rapids, or other obstructions to river navigation.

Low pool: The lowest water surface elevation allowed at a given reservoir.

MAF: Million acre–feet

Mammalian faunal sequence:

MAX: Maximum operating pool, the highest water surface elevation allowed at a given reservoir.

Mitigation: To moderate or compensate for an impact or effect.

MOA: Memorandum of Agreement; a legal document stipulating responsibilities and actions to which the signatories agree.

MOP: Minimum operating pool; the lowest water surface elevation allowed at a reservoir.

NAGPRA: Native American Graves Protection and Repatriation Act of 1991 (25 USC 3001 *et. seq.*)

NEPA: National Environmental Policy Act (42 USC 4321–4347)

NHPA: National Historic Preservation Act of 1966 (16 USC 470)

NMFS: National Marine Fisheries Service

Northwest Power Act: Pacific Northwest Electric Power Planning and Conservation Act

NPS: National Park Service

NRHP: The National Register of Historic Places, a list of historic properties of local, regional, and national significance.

Pacific Northwest Coordination Agreement: A binding agreement among BPA, the Corps, Reclamation and major generating utilities in the Pacific Northwest that stemmed from the Columbia River Treaty. It specifies the operating rules, criteria, and procedures for coordinating power generation at dams covered by the Agreement. It directs operation of major generating facilities as though they belonged to a single owner.

Pedoturbation: The disturbance of soil.

Permeability: The resistance to water penetration that characteriizes a soil or material.

Petroglyphs/pictographs: Carvings or paintings on rocks, especially those made by prehistoric people

PA: Programmatic Agreement, an agreement between federal agencies and other parties that stipulates procedures, such as cultural resources management procedures, the agencies will follow during the completion of a program or project.

PNCA: Pacific Northwest Coordination Agreement

Pool: Reservoir; a body of water impounded by a dam

Reconnaissance: An inspection or exploration

Repatriation: To restore or return to the place, country, or culture of origin or ownership.

Resident fish: Non–migratory fresh–water fish species

River Operation Simulation Experts: SOR work group responsible for hydroregulation modeling of the SOS alternatives.

Rock art: Carvings, drawings, and paintings in or on rock.

Rock cairns: Piles of rocks, such as prehistoric rock cairns built as commemorative landmarks or aids to astronomical observation.

Rock shelters: Natural shelters located under rock overhangs.

ROD: Record of Decision

Run–of–river projects: Hydroelectric generating plants that operate based only on available streamflow and some short–term storage (hourly, daily, or weekly)

Saturated soil: Soil, the pores of which are at or near their maximum water capacity.

Seventh approximation:

SHPO: State Historic Preservation Officer, the official responsible for administering the federal government's historic preservation program in a given state. Or, State Historic Preservation Office, the agency that houses the SHPO and SHPO staff.

Slumping: A landslide; the separation of a land or soil mass from a land surface and its movement downslope.

SNAG: SOR NEPA Action Group, the SOR work group responsible for advising on NEPA and other environmental compliance matters.

Soil dispersion:

SOR: System Operation Review

SOS: System operating strategy

Spawning: The releasing and fertilizing of eggs by fish

Storage project: A reservoir project that is operated to store water during some seasons in order to release it in others to serve power generation, flood control, fish migration, navigation, or other purposes.

Strata: A layer of rock of a given age and type.

Stratigraphic: Pertaining to rock strata.

Temporal: Pertaining to time.

Terrace: A flat, narrow stretch of ground often having a steep slope facing a river, lake, or sea

Traditional cultural properties: Cultural resources of significance because of their meaning within the traditional culture of an ethnic, religious, or cultural group.

Transgression: The spread of the sea over land along a subsiding shoreline

Transmissivity:

Usual and accustomed fishing sites: Places where Indians habitually fished prior to European American contact and to which treaties extend them continued fishing rights.

Value measure:

Velocity–transport equilibrium:

Water Budget: A part of the Northwest Power Planning Council's Fish and Wildlife Program calling for a volume of water to be reserved and released during the spring, if needed, to assist in the downstream migration of juvenile salmon and steelhead.

Watershed: A ridge of high land dividing two areas that drain to different river systems; the region draining into a river, river system, or other body of water

WES: Waterways Experiment Station, a research branch of the Corps of Engineers located in Vicksburg, Mississippi.

Wet and dry cycle exposure: The exposure of archaeological deposits or other items to repeated wetting and drying, causing physical deterioration.

Zone of vulnerability: The area extending from 15 feet below Minimum Operating Pool to 20 feet above Maximum Operating Pool. Archaeological sites are most prone to impacts from reservoir operations within this zone.

CHAPTER 9

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