Columbia River System Operation Review

Final Environmental Impact Statement

Summary

BONNEVILLE POWER ADMINISTRATION

US Army Corps of Engineers
North Pacific Division

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

DOE/EIS-0170

November 1995

This summary is an abbreviated version of the *Columbia River System Operation Review: Final Environmental Impact Statement*. The Final EIS is based on 20 technical appendices that analyze river use areas. They are:

A. River Operation Simulation
B. Air Quality
C. Anadromous Fish and 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

There are many other sources of information available about the System Operation Review. These include:

- The Columbia River: A System Under Stress
- The Columbia River System: The Inside Story
- Screening Analysis: A Summary and 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
- Streamline Newsletter, published since November 1990

To order publications, call the SOR document request line at 1-800-622-4520. Many of these documents are lengthy. The Final EIS is about 450 pages and the combined appendices are thousands of pages. Please contact the SOR Interagency Team at (503) 230-3478 in Portland, or at 1-800-622-4519 for further information.

SUMMARY OF COLUMBIA RIVER SYSTEM OPERATION REVIEW FINAL ENVIRONMENTAL IMPACT STATEMENT

U.S. Department of Energy, Bonneville Power Administration

U.S. Department of the Army, Corps of Engineers, North Pacific Division

U.S. Department of the Interior, Bureau of Reclamation, Pacific Northwest Region

Published November 1995

This document was published for the Columbia River System Operation Review, a joint project of the U.S. Bureau of Reclamation, U.S. Army Corps of Engineers, and Bonneville Power Administration.

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INTRODUCTION

The Columbia River System Operation Review (SOR) is being conducted jointly by the U.S. Army Corps of Engineers, the Bureau of Reclamation, and the Bonneville Power Administration. The Corps operates 12 and Reclamation operates two of the 14 Columbia River system hydro projects that are the focus of the SOR. BPA markets the power from these projects.

The review began in 1990. In general, the goal of the SOR is to develop a system operating strategy and a regional forum for allowing interested parties, other than these Federal agencies, a long-term role in system planning. Another goal of the SOR is to provide the environmental analysis needed for the Federal agencies to sign new agreements for coordinating power generation — PNCA — and for allocating among Federal and non-Federal parties the return of Canadian Entitlement power to Canada — CEAA.

The SOR is closing in on its last chapter. The Final Environmental Impact Statement (Final EIS), published in November, ties together years of study and a regionwide policy discussion about one of the Northwest's greatest physical assets: the Federal Columbia River hydro system.

In the final analysis, the SOR is a story about the Pacific Northwest's desire to restore prehistoric salmon runs to healthy levels and the Federal government's role in advancing that goal. And it's also the story of how Federal agencies, with discrete missions in managing and operating the Columbia River hydro system, pooled their staffs and resources to find a way to operate that puts high priority on anadromous fish recovery.

But it didn't necessarily start out that way.

The SOR began in 1990 with a focus on all river and reservoir uses. The Federal agencies responsible for river management decided after years of trying to accommodate growing demands on the system that it was time for a top-to-bottom review. The agencies began drawing up a plan. They held scoping meetings in the fall of 1990, assigned staff, and recruited outside experts to help with the comprehensive study they had outlined.

The Endangered Species Act (ESA) began to overtake the review in November 1991, when the Snake River sockeye was declared endangered. In the spring of the following year, several stocks of Snake River chinook were listed as threatened. With the National Marine Fisheries Service

(NMFS) responsible under the ESA for determining the biological consequences of river operations, the SOR took on a different character. The SOR began to focus on the role system operations could play in salmon recovery, and NMFS became a key player.

This summary of the SOR story begins where the Draft EIS summary left off. It is divided into seven parts, each of which reports some aspect of the study's outcome: Part 1 is a history. The SOR was not a simple study on any level, and to understand the EIS alternatives, some background is necessary. Part 2 reports the major findings of the technical analysis of alternative system operating strategies, and presents the agencies' Preferred Alternative.

the key concept for operation is adaptive management

Part 3 explains actions the agencies may take with respect to the Columbia River Regional Forum, the Pacific Northwest Coordination Agreement, and the Canadian Entitlement Allocation Agreements. Part 4 presents the Purpose and Need, elements at the core of any Federal EIS. It includes a map showing the Columbia River Basin and information on the affected Federal projects. Part 5 describes the substantial public participation and outreach that occurred during the SOR, and Part 6 summarizes efforts to incorporate the Tribal perspective into the study. Part 7 describes other activities that will be taking place in the next few years, which are related to and build upon the SOR.

The river system and its operation are dynamic. As explained in Part 2, the key concept for operation under the Preferred Alternative for a System Operating Strategy (SOS) is adaptive management; operations can be modified to meet changes in the natural environment, as well as in other arenas.

The SOR agencies know that the outcomes described in this EIS are a snapshot in time. A year from now, there will be changes in operations built on the experience gained during the 1995 season. The same will be true in 1997, 1998, and beyond.

What has really happened is that in preparing all 22 SOR EIS volumes, the SOR lead agencies have strengthened their commitment to fish and wildlife, and determined to persevere together with other Federal agencies, Indian Tribes, state agencies, and local and regional interests to realize common goals.

Part 1:

Deciding on a System Operating Strategy

The story of the SOR takes many twists and turns. They are legal and political, as well as analytical.

As stated earlier, the SOR became intertwined with activities taking place in the basin with regard to salmon recovery. It is impossible to separate the Final SOR EIS from NMFS' Biological Opinions on operations to recover salmon, the U.S. Fish and Wildlife Service's (USFWS) listing of white sturgeon under the ESA and subsequent Biological Opinion, and the rulings in several court cases on salmon-related issues.

> the SOR story is legal and political, as well as analytical

Here's a brief recap of recent events.

While the SOR agencies were winding up the Draft EIS in spring 1994, a U.S. District court ruled in a case called Idaho Department of Fish and Game (IDFG) v. NMFS that the 1993 Biological Opinion, under which the system was being operated, had failed to meet certain legal standards. The judge ordered the parties to the lawsuit, which included the Federal operating agencies, back into consultations to prepare a new Biological Opinion that would pass legal muster.

A key issue in the lawsuit was whether enough water in the Columbia River system had been dedicated to salmon recovery. The judge said it had not, indicating that a new Biological Opinion must incorporate more water for fish into operations.

Shortly after the IDFG v. NMFS ruling, the Ninth Circuit Court of Appeals issued a ruling in another case, which said the Northwest Power Planning Council had not given proper deference to the recommendations of state resource agencies and Tribes in preparing its Fish and Wildlife Program. Many people read this decision to mean that agency and Tribal proposals should be given more weight in operating decisions.

It became clear to the Federal operating agencies that the system operating strategy that came out of the SOR would need to take these legal decisions into account. Throughout the fall and winter of 1994, the agencies consulted with NMFS on the Biological Opinion for Snake River salmon.

The agencies were presenting the Draft SOR analysis to the public, holding community meetings and taking comments, when the Kootenai River white sturgeon joined Snake River salmon on the ESA list in October 1994. Consultations with USFWS on operations to recover sturgeon began shortly thereafter.

In March 1995, NMFS and USFWS issued Biological Opinions on hydro system operations and whether they jeopardized the recovery of endangered fish. These opinions were used to guide operations through the spring and summer of 1995.

The gavels came down again in June 1995 on two lawsuits pertaining to fish operations, putting an end to several outstanding legal questions. These actions essentially anointed the 1995 Biological Opinions as the guidelines for operating the hydro system in light of the ESA.

From these events and activities, the alternatives for the Final EIS evolved.

The SOR Interagency Team selected 13 alternatives to be analyzed for the Final EIS, including the Preferred Alternative. Part 2 explains the differences between the strategies examined in the Draft EIS and those studied in the Final EIS.

The Preferred Alternative represents the SOR agencies' preference for system operation, and it replicates the operational recommendations of the two ESA-related Biological Opinions released in March 1995: NMFS' on Snake River salmon and USFWS' on the Kootenai River white sturgeon.

Policy Choices in the Preferred Alternative

The Preferred Alternative proposes several means to assist anadromous fish recovery: in-river migration, barge transportation, fish passage objectives, spill at projects, flow augmentation, flow targets, reservoir drawdowns, and further study of the feasibility of deep drawdowns. These measures represent key operating decisions.

In the Draft EIS summary, these decisions were presented in a series of decision diagrams to illustrate possible paths that could lead to a Preferred Alternative. The SOR agencies chose not to

identify a Preferred Alternative in the Draft EIS to encourage a broad public review, rather than focusing review on a specific proposal. In this Final EIS Summary, the path to a Preferred Alternative is shown by the shaded portions of the decision diagrams. The first decision involved juvenile salmon passage through the Federal Columbia and Snake River hydro system.

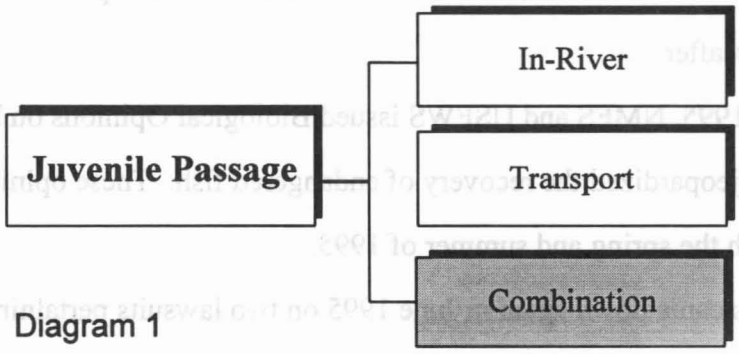


Diagram 1

The SOR Preferred Alternative charts a combination course that involves both in-river migration and barge transportation of smolts. The 1995 NMFS Biological Opinion establishes an 80 percent fish passage efficiency target at each mainstem project. This means 80 percent of the smolts would pass the projects through non-turbine routes. The 80 percent fish passage efficiency target is adopted in the Preferred Alternative, and both spill and transportation would be used to achieve this goal.

During the 1995 migration season, over 25 million smolts entered collection systems at the dams; about 75 percent of these fish continued their trip in a barge, and 25 percent were bypassed back into the river. Millions went over the spillways.

Spill has been part of seasonal salmon operations since the 1980s. The Preferred Alternative incorporates spill as one of the measures to be used to move migrating salmon and steelhead safely past the dams. If water is put over the spillways instead of through the generating turbines, a portion of the smolts will go with it, avoiding a potentially hazardous trip via the turbine blades.

As mentioned above, spill helps to accomplish the 80 percent fish passage efficiency goal. But it is not a cure-all.

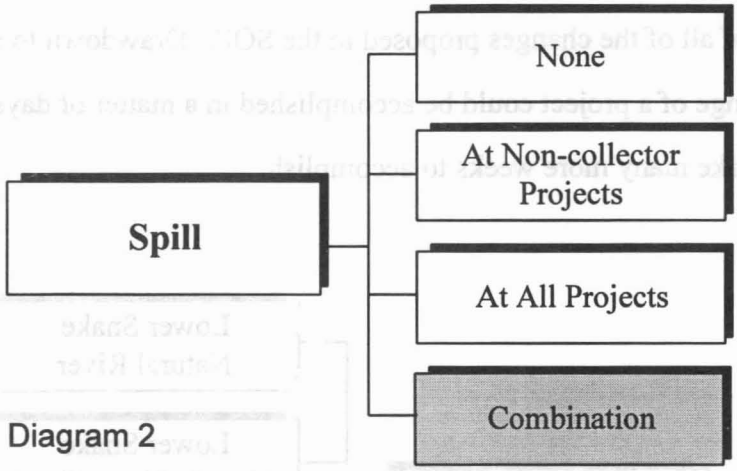


Diagram 2

Spill can create a condition in the water known as gas supersaturation. Large amounts of air are trapped as water plunges over the spillway, and the water becomes supersaturated with dissolved gases, principally nitrogen. This condition can cause gas bubbles to form within the fish, which could lead to death. Because of the potential for harm to aquatic life, all four Northwest states have legal limits for gas supersaturation. Gas levels must be monitored and, where necessary and possible, controlled when spill is occurring.

Spill also diverts fish away from the barge collection areas at the dams. If spill is taking place at a project where fish are amassed for transport, fewer fish will enter the collection system.

NMFS recognized that transportation is necessary, particularly when in-river conditions are poor, such as low flow or high gas saturation. Like the Biological Opinion, the Preferred Alternative aims to maximize fish survival by providing for a range of spill operations based on flow conditions. Specific spill percentages are established at run-of-river projects to achieve an 80 percent fish passage efficiency. Spill is capped at a certain percentage of outflow to prevent excessive levels of dissolved gas. The gas level is measured at the forebay of each project.

In addition, the Preferred Alternative allows for spill at all projects when flows are good to capture the benefits of in-river migration for a larger number of smolts. There is, however, no spill at the collector projects when flow conditions are poor, in order to put more fish into barges, safe from predators and other adversities. This combination of spill and transport operations is seen as a "share the risk" strategy.

Drawdown is included as an operating measure in the Preferred Alternative. It is perhaps the most controversial of all of the changes proposed in the SOR. Drawdown to an elevation within the normal operating range of a project could be accomplished in a matter of days or weeks. Deeper drawdowns would take many more weeks to accomplish.

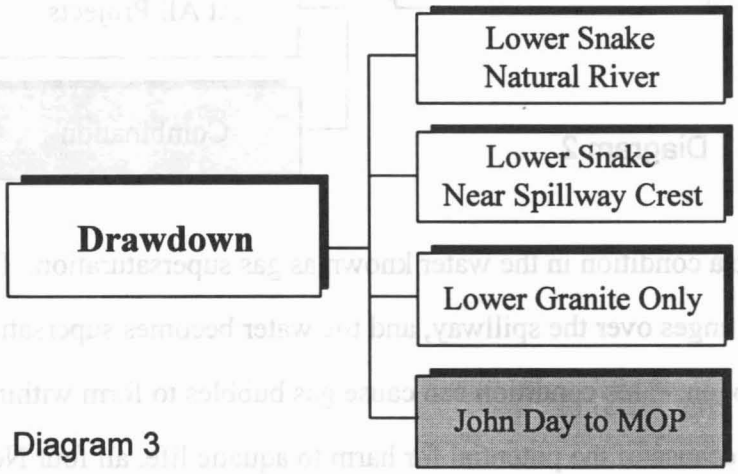


Diagram 3

In most cases, deep drawdowns would require massive modifications to dams before they could be implemented. The multimillion dollar expense of the engineering and construction that would be needed is but one aspect of the drawdown controversy. Authorization and funding by Congress would be a necessary first step.

Several drawdown options were analyzed in the Final EIS system operating strategies. They ranged from a permanent riverbed-level drawdown of all four lower Snake River projects to a four and one-half month drawdown of Lower Granite Reservoir.

Under the Preferred Alternative, John Day Dam would be operated at minimum operating pool throughout the year. Minimum operating pool is the lowest elevation within the established normal operating range of a reservoir. There would be three feet of operating flexibility from March through October, meaning the project could go to three feet above minimum operating pool for power peaking purposes. There would be five feet of flexibility from November through February.

The Preferred Alternative also calls for the lower Snake River projects to be operated at minimum operating pool during the spring and summer. The feasibility of drawing the four lower

Snake pools even lower would be the subject of further study under the Preferred Alternative. In addition, more study would take place to determine whether drawdown options at other projects should be pursued.

The role of flow augmentation in operations was another key variable in the fish recovery equation. There were several choices studied in the Final EIS alternatives.

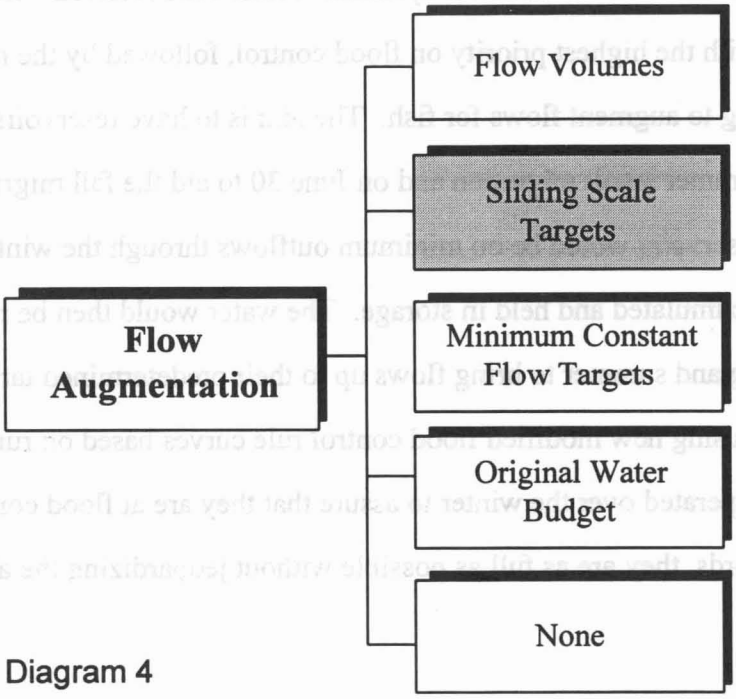


Diagram 4

The agencies' Preferred Alternative uses sliding scale flow targets. On the Columbia River, targets are based on the January to July runoff forecast at The Dalles Dam. Snowmelt is generally later in the season on the Snake River, and therefore targets are based on the April to July runoff forecast at Lower Granite Dam.

The NMFS Biological Opinion specifies that flow targets be set within the following ranges:

	Spring Target	Summer Target
Lower Granite Dam	April 10 to June 20	June 21 to August 31
Flow Target Range	85,000 to 100,000 cfs	50,000 to 55,000 cfs
McNary Dam	April 20 to June 30	July 1 to August 31
Flow Target Range	220,000 to 260,000 cfs	200,000 cfs

Water would be drafted from storage if natural runoff is insufficient to meet the flow targets. The storage reservoirs are therefore operated conservatively through the winter — less water is drafted to generate electricity, and elevations are held at maximum flood control levels — to ensure there is enough water to augment flows if needed in the spring.

The flow augmentation goals in the Preferred Alternative largely dictate operations at storage reservoirs in the Columbia and Snake River systems. Under the Preferred Alternative, reservoirs would be operated with the highest priority on flood control, followed by the need to have water available in the spring to augment flows for fish. The aim is to have reservoirs ready on April 15 to aid the spring and summer smolt migration and on June 30 to aid the fall migrants.

In general, reservoirs would be on minimum outflows through the winter so as much water as possible could be accumulated and held in storage. The water would then be released as needed throughout the spring and summer to bring flows up to their predetermined targets. The Preferred Alternative calls for using new modified flood control rule curves based on runoff forecasts. The reservoirs are to be operated over the winter to assure that they are at flood control elevations by April 15; in other words, they are as full as possible without jeopardizing the ability to control floods.

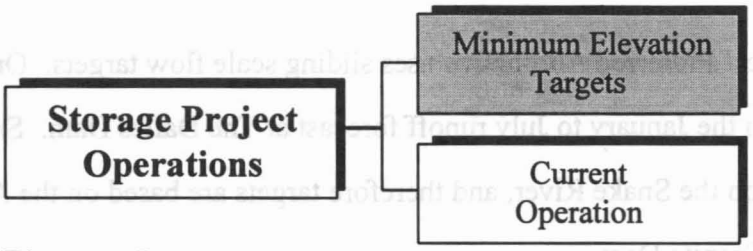


Diagram 5

The Preferred Alternative sets a specific target for flood control at each reservoir. At Libby and Hungry Horse, operations would be calculated to achieve the flood control elevations in at least 75 percent of the years included in the historical streamflow record upon which planning is based. At Grand Coulee, the elevations are to be achieved in 85 percent of the years and at Albeni Falls, in 90 percent. The Preferred Alternative limits the elevation to which the reservoirs are drafted from April 15 through August 31.

One of the biggest issues in the SOR with regard to storage reservoirs was whether to operate them according to Integrated Rule Curves, which combine all of the demands into a single operating curve. Integrated Rule Curves operation emphasizes the biological needs of resident fish that inhabit the reservoirs.

The 1995 Biological Opinions did not incorporate the Integrated Rule Curves into operations. Therefore, neither does the SOR Preferred Alternative; however, this question is receiving further study under the adaptive management approach that has been selected for operations.

The bottom line in all of these decisions is anadromous fish recovery. In its 1995 Biological Opinion, NMFS said, except for flood control, other river uses must take a back seat to salmon recovery at the 14 Federal projects that are the subject of the SOR. Because of this, the ESA has become the real driver of the SOR EIS System Operating Strategy.

The decisions highlighted above obviously have significant impacts on other river uses and users. For example, the John Day reservoir drawdown to minimum operating pool would mean irrigation pumps or their intakes must be lowered, extended, or moved. Drafts from storage reservoirs during the spring and summer mean recreation and sport fishing opportunities may be diminished. Part 2 summarizes these impacts and the many others identified during the SOR analysis.

To conclude that the story is completely told in this Final EIS would be a mistake. One of the greatest challenges of the SOR has been that it is and will be a work in progress. The pressures on the Columbia River hydro system — economic, environmental, social, and political — that brought about the SOR in 1990 did not abate while the review took place. These forces continue today and will shape the operations of tomorrow.

Part 2:

Impacts of the System Operating Strategies

The System Operating Strategies (SOS) represented the range of river management actions the Federal agencies could take — from reverting to past practices, to continuing current practices, to making dramatic changes. A number of actions suggested early in the SOR fell outside the scope of the study, which was limited to the operation of the Federal Columbia River Power System. Some alternatives were discarded because they were being studied elsewhere. Some were eliminated when early study showed they were not workable; others were beyond the jurisdiction of the Federal agencies and the purpose of the SOR, such as recommendations to ban or limit commercial fishing.

The Draft EIS examined seven strategies, with options representing 21 alternative approaches to operating the 14 Federal projects in the Columbia River Basin. Using the public comments received on those alternatives, as well as recommendations for river operations contained in the 1995 Biological Opinions from NMFS and USFWS, the SOR Interagency Team formulated seven strategies, with options representing 13 alternative ways to operate the projects, for study in the Final EIS.

Changes In Alternatives From the Draft to the Final EIS

The Final EIS uses the numbering conventions for the strategies and options used in the Draft EIS. Because some alternatives in the Draft EIS were dropped, the numbering of the options in the Final EIS is not consecutive.

Six of the options examined in the Final EIS are identical to options considered in the Draft EIS (see box). One alternative (SOS 4c) is a revision of an option in the Draft EIS. SOSs 9a through 9c replace the Federal resource agency operations (SOSs 7a through 7c) in the Draft EIS.

The SOR team added three alternatives in response to public comments and the 1994 Biological Opinion discussions. SOS 2d is new, represent-

Draft EIS Alternatives (July 1994)	Final EIS Alternatives (February 1995)
1 Pre-ESA Operation	1a Pre-Salmon Summit Operation 1b Optimum Load-Following Operation
2 Current Operations	2c Current Operations/No Action 2d 1994-98 Biological Opinion (New)
3 Flow Augmentation	3 **(Deleted)**
4 Stable Storage Project Operation	4c Stable Storage Project Operation **(Revised)**
5 Natural River Operation	5b Natural River Operation 5c Permanent Natural River Operation (New)
6 Fixed Drawdown	6b Fixed Drawdown Operation 6d Lower Granite Drawdown Operation
7 Federal Resource Agency Operations	7 **(Replaced with new alternatives)** 9a Detailed Fishery Operating Plan 9b Adaptive Management 9c Balanced Impacts Operation PA Preferred Alternative (New)

ing operations recommended in the 1994 Biological Opinion. New alternative SOS 5c responds to public comments that suggested the permanent drawdown of lower Snake projects might be less costly than annual drawdowns. The Preferred Alternative was also added; it represents operations in the 1995 Biological Opinions.

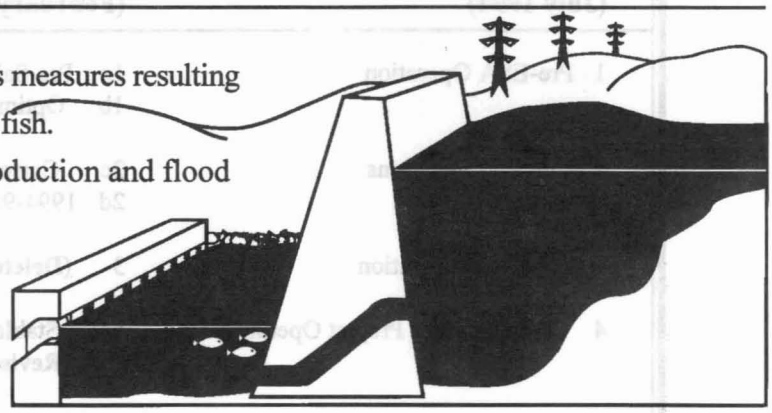
The SOR team eliminated some alternatives from study in the Final EIS due to lack of public support, or because they duplicated other options or were not viable or practical. The flow augmentation options in the Draft EIS (SOSs 3a and 3b) were dropped because this type of operation was incorporated in SOSs 9a and 9b. Public comments on the Draft EIS questioned the practicality of two-month drawdowns. As a result, options 5a, 6a, and 6c were dropped, but a two-month spillway crest drawdown at all four lower Snake projects was retained as an element in SOS 9c.

Here is a strategy-by-strategy summary of the findings of the analysis in the Final EIS.

SOS 1 - PRE-ESA OPERATION

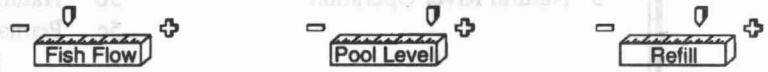
Features:

- Base case strategy without various measures resulting from ESA listings of anadromous fish.
- Operations directed at power production and flood control.
- Satisfies traditional nonpower requirements at projects.



Options:

- **SOS 1a Pre-Salmon Summit Operation** represents operations as they existed from 1983 to 1991 and includes the original Water Budget.



- **SOS 1b Optimum Load-Following Operation** represents operations as they existed prior to changes resulting from the Northwest Power Act.

This strategy resembles river operations before they were modified by numerous measures aimed at providing more water to assist anadromous fish or resulting from ESA consultation. SOS 1 has two options — the first, SOS 1a, represents operations as they existed from 1983 to 1991, prior to the listing of three species of salmon as endangered or threatened. The second option, SOS 1b, represents operations prior to the 1980 Northwest Power Act. It was designed to show how much power could be produced if most flow-related operations to benefit anadromous fish were eliminated, and it assumes maximum fish transportation to aid juvenile fish migration.

Because SOS 1 represents a time when system operation focused on the uses Congress authorized for the projects, such as power generation, flood control, navigation, and irrigation, it was no surprise that these uses fared well under this operation. Of all the alternatives, SOS 1b would be the least costly way to satisfy the region's power needs, reducing power generation costs by an annual average of $72 million and retail rates by 1.1 percent. Annual average hydropower generation would increase by 309 average megawatts or 1.8 percent. SOS 1a would be the next most economical means of operating the hydroelectric system, reducing generating costs by $38 million annually and retail rates by 0.6 percent.

In fact, all of the strategies other than SOS 1 would reduce hydropower production and increase the cost of the power system for Northwest ratepayers. System flexibility for power

SOS 1 Effects	
Anad. Fish	Moderate passage survival and adult escapement; slight differences from existing conditions
Resident Fish	Variable conditions among reservoirs and species; pool fluctuations and failure to refill impact productivity
Wildlife	Resources largely unchanged from current conditions; continuation of downward trends
Power	Energy production and load shaping maximized; 0.6-1.1% rate decrease
Flood Control	Flooding risk unchanged from current conditions
Navigation	Normal conditions for shallow draft navigation and reduced costs for Dworshak log transport; net decrease $0.1 million compared to SOS 2c
Irrigation, Municipal & Industrial Water Supply	Minor increase in pumping costs at Grand Coulee of $9,000 over SOS 2c
Cultural Resources	Ongoing shoreline erosion and exposure at same rate as current conditions
Recreation	Annual benefits could increase up to $7.9 million under SOS lb
Water Quality	Slight decrease in water temperature but increase in total dissolved gas in lower Snake River
Change In Total Annual System Costs	-$42 to -$80 million

production would be enhanced under SOS 1 and reduced under all other strategies.

Recreation did well under SOS 1 because recreational facilities were designed and developed around traditional project operations. The hydro system essentially created today's recreation patterns along the river. The analysis showed SOS 1b would provide more recreation benefits than any other option; it was estimated to increase recreation visitation by 1.5 percent and provide average annual benefits of $7.9 million.

One authorized use of Dworshak Reservoir consists of rafting logs across the pool to a transfer area near the dam. Timber operations can continue during normal drawdowns, but the pool becomes unusable for log rafting during periods of significant drawdown. SOS 1 is one of several alternatives that would reduce costs of the log operations compared to the No Action Alternative.

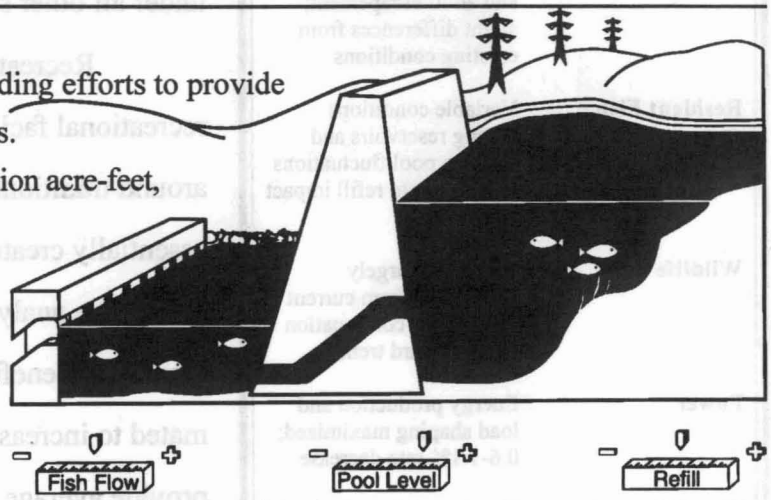
Assuming no juvenile fish transportation occurred, SOS 1 produced some of the lowest rates of survival for salmon and steelhead juvenile passage and numbers of adult fish returning to spawn, although differences from existing conditions would be slight. The operations at the reservoirs, such as normal drafting for power generation, would continue, with the same effects on resident fish (fish that live in fresh water all their lives), wildlife, erosion, Indian trust assets, and cultural resources.

All of the SOSs studied would cause adverse effects to cultural resources, and some would be more dramatic than others. All of the strategies would continue the existing pattern of soil erosion and exposure of cultural resources to damage, looting, and vandalism.

SOS 2 - CURRENT OPERATIONS

Features:

- Current system operations, including efforts to provide additional anadromous fish flows.
- Flow augmentation of up to 3 million acre-feet, in addition to the Water Budget.
- Supplemental drafts from Dworshak Reservoir.
- Flood control space shifted from the Snake River Basin to Grand Coulee Dam.
- Lower Snake projects near minimum operating pool levels.
- John Day at minimum irrigation pool level.



Options:

- **SOS 2c Final Supplemental EIS Operation - <u>No Action Alternative</u>** represents an operation consistent with the Corps' 1993 Supplemental EIS. It includes up to 427 thousand acre-feet of additional water from above Brownlee Dam to improve fish flows.
- **SOS 2d 1994-98 Biological Opinion** matches the hydro operations contained in the 1994-98 Biological Opinion issued by NMFS in mid-1994.

This strategy represents operations that resulted after three species of salmon were listed under the ESA; it also reflects the 1993 and 1994 ESA consultations. The strategy has two options. SOS 2c is the No Action Alternative; it models operations consistent with the Corps' 1993 Supplemental EIS, including the addition of water from the Snake River above Brownlee to the Columbia River system to improve fish flows. SOS 2d matches the hydro operations contained in the 1994-98 Biological Opinion issued by NMFS in mid-1994.

Both SOS 2 options would have higher costs for power generation than SOS 1 because flow augmentation in the spring and summer requires that water be stored in the winter, a time when it would ordinarily be used to generate electricity. Under SOS 2c, there would be no change in electricity rates or demand from existing conditions. Under SOS 2d, annual hydropower generation would drop by 34 average megawatts; power costs would rise by $24 million annually and retail rates could go up 0.4 percent.

The SOR computer models evaluated travel time and survival rates for juvenile anadromous fish and adult anadromous fish returning from the ocean to the river to spawn (adult

SOS	2 Effects
Anad. Fish	Survival rates in the middle range of all alternatives; with transport, juvenile survival is high
Resident Fish	Variable conditions among reservoirs and species; pool fluctuations and failure to refill impact productivity
Wildlife	Long-term downward trends to resources; slight impacts at John Day due to lower reservoir levels
Power	Annual generation costs the lowest of all SOSs except SOS 1; up to 0.4% rate increase
Flood Control	Flooding risk unchanged from current conditions; expected annual average flood damage costs are $3.3 million
Navigation	Shorter Dworshak log transport operating season; total annual cost for navigation is $414.4 million
Irrigation, Municipal & Industrial Water Supply	All irrigation needs served
Cultural Resources	Ongoing shoreline erosion and exposure at same rate as current conditions
Recreation	Annual average recreation benefit is $315 million
Water Quality	Similar to SOS 1 but slight increase in water temperature; decrease in total dissolved gas
Change In Total Annual System Costs	$29 million, but SOS 2c equals 0 (no action alt.)

returns). Juvenile survival rates were studied for fish traveling in-river to the ocean and for fish that are taken out of the river and transported.

The conclusions from the models varied depending on assumptions about the effectiveness of fish transportation in improving fish survival rates. The models that considered transportation highly beneficial showed much higher survival predictions for those options that included a large amount of transportation.

The region's fish transportation program, operated by the Corps, collects juvenile fish at Lower Granite, Little Goose, Lower Monumental, and McNary Dams and transports them by barge or truck to be released below Bonneville Dam. In the SOR studies, transportation emerged as the most important factor for juvenile fish survival in the next five to 10 years.

Under SOS 2, the survival rates for juvenile passage and adult returns fell in the middle range of all the alternatives. There were no great differences between the options for most stocks.

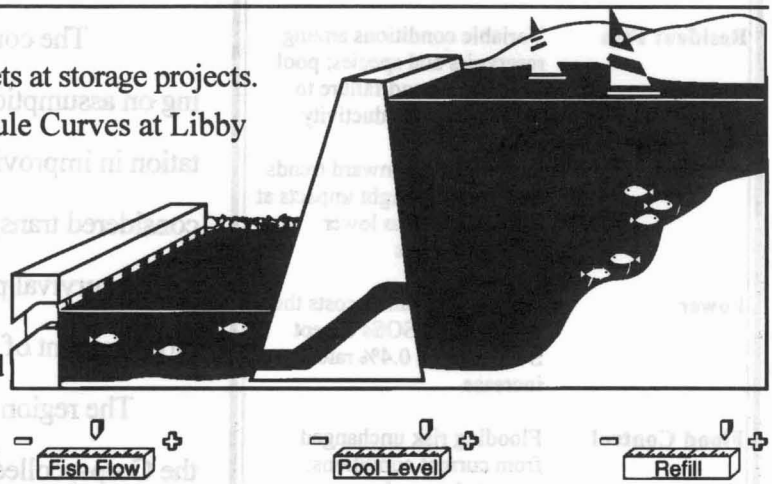
Water levels at the storage projects would be lowered more often under SOS 2 than under SOS 1. This would decrease the chance of refill, which worsens conditions for resident fish and could diminish the attractiveness of the reservoirs for recreational use. Because SOS 2d calls for additional water releases at Libby Dam to benefit Kootenai River white sturgeon, this option would improve conditions for this ESA-listed species.

Effects on erosion, air quality, and irrigation and other water supply would be similar to those under SOS 1a. Indian treaty rights and trust assets would benefit from improved salmon survival.

SOS 4 - STABLE STORAGE PROJECT OPERATION

Features:

- Year-round monthly elevation targets at storage projects.
- Operations based on Integrated Rule Curves at Libby and Hungry Horse Dams.



Options:

- **SOS 4c Stable Storage Project Operation with Modified Grand Coulee Flood Control** applies Integrated Rule Curves developed by Montana at Libby and Hungry Horse year-round. Dworshak and Albeni Falls are operated to specific elevations. Grand Coulee is also operated to specific elevations to provide acceptable water retention times. Grand Coulee flood control rule curves are applied only when the January-July forecast is greater than 68 million acre-feet.

This strategy focuses on managing water levels at the upstream storage projects to keep the reservoirs as full as possible for as long as possible. The idea is to have the reservoirs fill on a more "guaranteed" basis, which would improve conditions for resident fish and wildlife. Projects would fill early in the spring and remain full throughout the summer and into the fall. This strategy was also designed to benefit recreation by providing stable reservoirs that encourage leisure-time activities such as boating, fishing, and sightseeing.

SOS 4c, the only stable storage project option evaluated in the Final EIS, would apply specific minimum elevation levels year-round to improve conditions for resident fish, wildlife, and recreation. Integrated Rule Curves, developed by the state of Montana, would be used at Libby and Hungry Horse year-round. Dworshak, Albeni Falls, and Grand Coulee would be operated to specific elevations, and flood control rule curves would be applied at Grand Coulee only when runoff is forecast to be high (over 68 million acre-feet).

The analysis showed that this strategy would in fact fulfill its goal of improving conditions for resident fish and wildlife. Overall, SOS 4 is the best strategy for resident fish; conditions at Lake Pend Oreille, Libby, Hungry Horse, and Dworshak would improve. It would benefit the Kootenai

SOS 4 Effects	
Anad. Fish	Survival about the same as SOS 2
Resident Fish	Best SOS for resident fish; improved productivity at storage projects
Wildlife	Moderate to significant increases in wildlife habitat at Lake Pend Oreille, Libby, Hungry Horse, and Grand Coulee
Power	Flows and generation needs mismatched; 1.3% rate increase
Flood Control	Increased risk at Bonners Ferry, the upper Columbia, and Clearwater reaches; average annual flood damage costs increase $0.4 million over SOS 2c
Navigation	Longer Dworshak log transport operating season; net decrease $0.2 million compared to SOS 2c
Irrigation, Municipal & Industrial Water Supply	Minor decrease in pumping costs at Grand Coulee of $18,400 over SOS 2c
Cultural Resources	High rates of shoreline erosion at storage projects; decrease in exposure due to high pools
Recreation	Annual benefits could increase $4.2 million
Water Quality	Similar to SOS 2 with slightly lower dissolved gas in lower Columbia
Change In Total Annual System Costs	$81 million

River white sturgeon by providing more water during this ESA-listed species' spawning period.

SOS 4 is the only strategy that would markedly improve conditions for wildlife, i.e., an increase in the abundance of water-dependent habitat. Significant increases in wildlife habitat at Lake Pend Oreille could be expected, with smaller increases occurring at Lake Koocanusa (Libby), Hungry Horse, and Lake Roosevelt. Canada geese and other nesting birds would benefit from higher pools at Brownlee Reservoir. There would be some wildlife benefits at Lake Umatilla behind John Day Dam and along the Hanford Reach. SOS 4c was the best strategy for air quality and maintaining the visual attractiveness of the reservoirs. It would also generally reduce shoreline erosion and sedimentation at the storage projects. Some known archeological sites located in the high pool shoreline areas would, however, experience accelerated erosion, particularly at Albeni Falls.

Despite the fact the strategy was designed to enhance recreation, SOS 4 would increase visitation systemwide by just under 1 percent. SOS 4 did not turn out to have the highest benefits for recreation because it focused on elevation levels at the upstream storage projects (Libby, Hungry Horse, and Dworshak). Currently, more people visit downstream sites, many of which would be adversely affected by SOS 4, and these results offset the benefits at the upstream reservoirs. Annual recreation benefits were predicted to increase up to $4.2 million as a result of this strategy.

The number of recreational visitors systemwide would not change dramatically under any strategy, suggesting that changes in system operations may have a limited ability to increase or decrease recreation systemwide. But there are important localized impacts on recreation at such places as Lake Pend Oreille, Dworshak, and on the Kootenai River. In addition, operations that would benefit certain projects or areas of the system, in some cases, would worsen conditions for recreation in other areas.

None of the SOS options would have a dramatic impact on flood control, partly because none would affect operations at the Canadian storage projects. SOS 4c has the greatest potential for flood damage because it would base some storage reservoir operations on the Integrated Rule Curves rather than flood control rule curves. In this case, reservoir capacity to store upstream runoff in the spring would be reduced to maintain higher reservoir elevations to benefit resident fish.

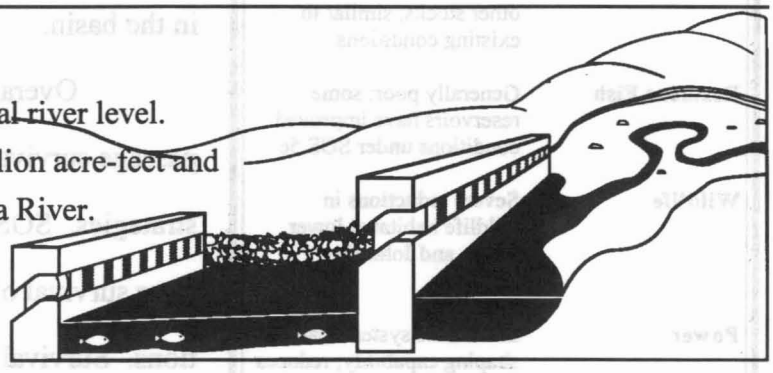
Within the upper Columbia region, Columbia Falls would experience the greatest amount of flood damage under any SOS option; estimates under SOS 4c range from 21 to 73 percent higher than existing conditions. Residential and commercial properties near Kalispell would account for approximately 60 percent of the flood damage. Along Flathead Lake, flood damage would consist mostly of waterfront erosion and dock damage. In other upper Columbia areas, damage would primarily be to agricultural lands.

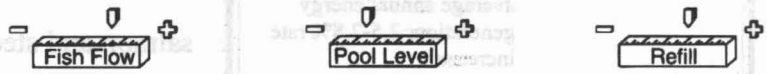
The survival rates for anadromous fish juvenile passage and adult returns would be about the same as existing conditions for most stocks. Under this option, water stored in reservoirs would not be as available for power generation, and in certain months of low-runoff years, particularly August and September, more purchases of energy would be needed to make up for energy deficits. Average annual power generation would decrease, and the costs of operating the hydro system could increase by $85 million. Retail power rates could go up 1.3 percent.

SOS 5 - NATURAL RIVER OPERATION

Features:

- Lower Snake drawdowns to natural river level.
- Flow augmentation of up to 3 million acre-feet and Water Budget from mid-Columbia River.
- John Day at minimum operating pool during spring and summer.
- Dworshak at flood control levels.





Options:

- **SOS 5b Four and One-Half Month Natural River Operation** draws down the lower Snake River projects from April 16 through August 31 each year.
- **SOS 5c Permanent Natural River Operation** assumes the drawdown occurs year-round with no refill of the projects to normal operating ranges.

This strategy would draw down the reservoirs at the four projects on the lower Snake River (Lower Granite, Little Goose, Lower Monumental, and Ice Harbor) to near "natural river" elevations. John Day Dam would be drawn down to its minimum operating pool from May through August. The idea is to increase the water velocity through the reservoirs, so conditions for downstream fish migration would be more like they were before these dams were built.

This operation would require the installation of new low-level outlets to allow water to bypass the dam, powerhouse, and spillway. Reservoirs would be drafted at the rate of 2 feet a day, beginning in mid-February until the specified elevations are reached. The resulting drawdowns, in excess of 100 feet, essentially would remove the impoundments behind the dams.

The strategy has two options. SOS 5b would draw the projects down for four and one-half months. SOS 5c contemplates year-round drawdown, with no refill of the projects to normal operating ranges. Collection and transportation of fish would occur only at McNary Dam under both options.

SOS 5 is the only strategy that has the potential for providing in-river survival rates for juvenile salmon that approach those now being obtained through fish transportation programs. The exception is fall chinook, which must be transported to maintain its already low numbers. The SOR

SOS 5 Effects	
Anad. Fish	Highest in-river survival for Snake River stocks; for other stocks, similar to existing conditions
Resident Fish	Generally poor; some reservoirs have improved conditions under SOS 5c
Wildlife	Severe reductions in wildlife habitat at lower Snake and John Day projects
Power	Eliminates system load shaping capability; reduces average annual energy generation; 2.5-2.8% rate increase
Flood Control	Flooding risk in all areas similar to SOS 2
Navigation	No shallow draft navigation on the lower Snake River for 7 months or permanently; net increase $14 to $38 million compared to SOS 2c
Irrigation, Municipal & Industrial Water Supply	Drawdowns at John Day and Ice Harbor require pump modifications and increases pumping cost by about $3.3-4.5 million
Cultural Resources	Dramatic increase in exposure at lower Snake River projects; less shoreline erosion at these projects
Recreation	Annual benefits could decrease between $66 and $90 million
Water Quality	Maximum silt concentrations; nearly all excessive dissolved gas eliminated in lower Snake
Change In Total Annual System Costs	$266 to $336 million

models showed that transportation would provide greater survival benefits for fall chinook than for any other stock in the basin.

Overall, SOS 5 achieved the highest in-river passage survival for Snake River stocks of any of the strategies. SOS 5 is estimated to almost double the in-river survival of Snake River stocks over existing conditions. Survival rates under SOS 5 for non-Snake River salmon and steelhead stocks would be similar to those of today since they would be unaffected by the drawdown of the lower Snake projects.

While none of the strategies was uniformly good for water quality, SOS 5 would provide the best long-term results. In the first five to 10 years, when the four Snake River projects are initially drawn down, large amounts of sediment would be moved from these reservoirs. High flows would create maximum silt concentrations in the lower Snake River during the initial drawdowns. The longer drawdown (SOS 5c) would transport more silt than the four and one-half month drawdown (SOS 5b).

The sediment in the water would create a problem for fish, especially rearing fall chinook. But the sediment would eventually dissipate, and SOS 5 would provide flows from upstream projects to keep water temperatures cooler. The lack of spill in SOSs 5b and 5c resulted in the lowest dissolved gas saturation levels of all the strategies studied.

The physical modifications at the dams necessary to put SOS 5b into effect would cost as much as $4.1 billion and take as long as 15 years. For SOS 5c, the cost is estimated at $570 million and five years. These estimates come from the Corps' System Configuration Study.

While it could provide long-term benefits to anadromous fish, this strategy would have severe consequences for the other uses and users of the river. Lower Snake drawdowns could damage resident fish habitat in these reservoirs. Most of the drawdowns in SOSs 5 and 6 would create two different environments for resident fish — lake-like conditions for part of the year and river-like conditions for the rest — neither reservoir nor river-dwelling species of resident fish would benefit from this abrupt switch in habitat conditions. SOS 5b is one of the two worst strategies for resident fish, and SOS 5c would have varied effects depending on the location. While the impacts would vary from reservoir to reservoir and species to species, in general, drawdowns would substantially disrupt resident fish habitat, spawning, and food supply.

Both SOS 5 and SOS 6 would decrease wildlife habitat in the lower Columbia (Lake Umatilla) and lower to middle Snake reaches that has developed around the original projects. More than half the wildlife — waterfowl, shorebirds, aquatic furbearers, and others — near Lake Umatilla and in the lower Snake reaches could be lost because emergent marsh and riparian habitat would dry up. The longer drawdowns in these areas (through August under SOSs 5b and 6b) would be even worse for wildlife.

The short-term impacts of SOS 5c would be similar to those of SOS 5b; riparian habitat might disappear more quickly without a return to near full pool during non-growing season months. Over many years, however, natural river operation under SOS 5c would allow riparian and some wetland habitats to re-establish. The rebound in habitat and wildlife would depend on the suitability of sediments for plant growth and topography of the shoreline.

This strategy would eliminate hydroelectric generation at several projects; turbines would be taken out of service or hydraulic head would be severely reduced. SOS 5b could reduce average annual generation by 828 average megawatts, costing an additional $85 million in annual system power costs; SOS 5c could reduce generation by 945 average megawatts, with a $167 million cost hike. Retail power rates could go up between 2.5 and 2.8 percent.

Under SOSs 5 and 6, substantial capital outlays would be necessary before the reservoirs could be safely drawn down. These additional costs were included in the analysis as part of the cost of operating the power system.

This strategy would lower water levels at Ice Harbor and/or John Day pools during the irrigation season. SOS 5c would have the greatest impact on irrigators; it would increase their annual operating costs by $4.5 million while SOS 5b would increase irrigation pumping costs by $3.3 million. The lower Snake and John Day drawdowns would require municipal and industrial water users to modify their pumps and facilities, causing costs to rise between $3.3 million (SOS 5b) and $4.5 million (SOS 5c) annually.

Erosion would increase dramatically at the four lower Snake River dams under either option, as large areas of reservoir shoreline would be exposed each year or permanently. Water tables near the lower Snake reservoirs would decrease dramatically under SOS 5c and approach pre-project levels within the first years. Some wells would go dry, and the yield would decrease in others.

Cultural resource sites at the lower Snake projects would suffer major damage. SOS 5c is nonetheless considered the most beneficial for cultural resources because the drawdown to natural river level would be permanent. Access to more than 200 archeological sites in the reservoirs would be restored, and the drawdown zones would revegetate, affording some additional protection from erosion.

Under SOSs 5 and 6, Dworshak would be operated for local flood control. The four lower Snake projects would take over the system flood control duties shifted from Brownlee and Dworshak. The space made available by drawing down the lower Snake projects would not have a significant effect on mainstem flood control.

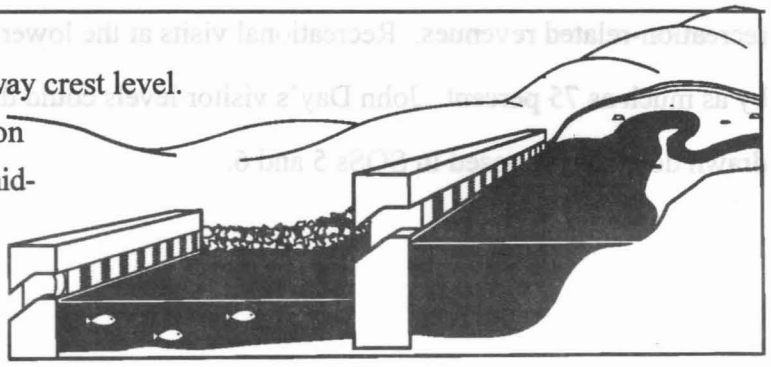
SOSs 5 and 6 would render the navigation system in the lower Snake River unusable at certain times of the year. Drawdowns would interrupt navigation year-round under SOS 5c; seven months, beginning in February, under SOS 5b; and four and one-half months between April and August or September (SOSs 6b and 6d). Shippers would have to reschedule shipments, store commodities, and/or use trucks or rail to deliver their products. Activities at lower Snake River ports would shift to other locations. Under SOS 5c, annual shallow-draft navigation costs would increase $38 million from today's levels; SOS 5b would mean a $14 million increase.

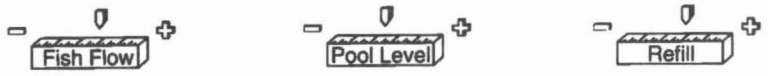
SOS 5c presents the worst scenario for recreation, an 11.5 percent drop in recreational visitors systemwide. This would translate into a loss of $90 million for communities that depend on recreation-related revenues. Recreational visits at the lower Snake projects could plummet, maybe by as much as 75 percent. John Day's visitor levels could drop over 20 percent if the project is drawn down as proposed in SOSs 5 and 6.

SOS 6 - FIXED DRAWDOWN

Features:

- Lower Snake drawdowns to spillway crest level.
- Flow augmentation of up to 3 million acre-feet and Water Budget from mid-Columbia River.
- John Day at minimum operating pool during spring and summer.
- Dworshak at flood control levels.





Options:

- **SOS 6b Four and One-Half Month Fixed Drawdown** draws down all four lower Snake River projects for four and one-half months.
- **SOS 6d Four and One-Half Month Lower Granite Drawdown** draws down only Lower Granite project for four and one-half months.

This strategy, aimed at aiding anadromous fish migration, would draw down the four projects on the lower Snake River to below minimum operating pool. The drawdown would not be as extensive as under SOS 5 (about 33 feet compared to 100 feet or more), but substantial physical modifications to the projects would still be required. John Day Dam would be drawn down to minimum operating pool from May through August.

There are two options. SOS 6b would draw down reservoirs at all four projects for four and one-half months. SOS 6d would draw down only the reservoir at Lower Granite Dam for four and one-half months.

The Anadromous Fish Work Group studied this strategy using optimistic and pessimistic scenarios for fish survival. The wide range of uncertainty between the optimistic and pessimistic assumptions in SOS 6 indicates how little is known about how drawdowns would affect juvenile passage survival. Under SOS 6, the most optimistic assumptions yielded in-river juvenile survival rates that exceeded other non-drawdown alternatives. Some of the in-river passage results for SOS 6 were comparatively high. Under the most pessimistic assumptions, survival rates were worse than other non-drawdown strategies. Like SOS 5, it would be years before SOS 6 could be accomplished.

SOS 6	Effects
Anad. Fish	In-river survival for Snake River stocks varies greatly depending on assumptions
Resident Fish	Impacts generally the same as SOS 5, but not as severe; conditions worse at Lower Granite and John Day
Wildlife	Wildlife habitat impacts similar to SOS 5; 6d limits impacts to Lower Granite
Power	Generation effects similar to SOS 5; generation costs slightly more than SOS 2c; 0.3-0.9% rate increase
Flood Control	Flooding risk in all areas similar to SOS 2
Navigation	No shallow draft navigation on the lower Snake River or Lower Granite for 6 months; net increase $2 to $12 million compared to SOS 2c
Irrigation, Municipal & Industrial Water Supply	Drawdowns at John Day and Ice Harbor require pump modifications and increases pumping cost by about $1.4-2.6 million
Cultural Resources	Similar to SOS 5 but less dramatic
Recreation	Annual benefits could decrease up to $40 million
Water Quality	Major sediment transport similar to SOS 5; dissolved gas and water temperature similar to SOS 2
Change In Total Annual System Costs	$78 to $145 million

SOSs 6b and 6d (as well as SOSs 9a and 9c) could impede or prevent adult fish passage, particularly for Snake River spring and summer chinook. The fish ladders at the four dams would not function at the proposed drawdown levels (except the Lower Granite exit), and project modifications would be required to enable passage. With drawdown to near spillway crest, reduced tailwater depth would require deepening and lengthening the ladder entrances to accommodate fish passage at all flow levels. The SOR analysis of adult returns assumed that this redesign had been done and would provide adult survival rates similar to juvenile downstream passage rates. Under these scenarios, adult returns decreased because of the overall decrease in juvenile downstream survival.

Any survival improvements for anadromous fish would be offset by problems for other uses. These would not be as severe as under SOS 5.

Under SOS 6b, resident fish and wildlife would suffer the effects of drawdowns described above under SOS 5, but not to as great an extent as under SOS 5b. The effects of SOS 6d would be identical to SOS 6b, except they would be restricted to the Lower Granite Reservoir.

Cultural resources would not be affected as much as under SOS 5 because the drawdowns would not be as low, and less area would be exposed each year. Damage at the lower Snake projects would, however, still be extensive. Erosion at the projects would increase, about one-third as much as under SOS 5.

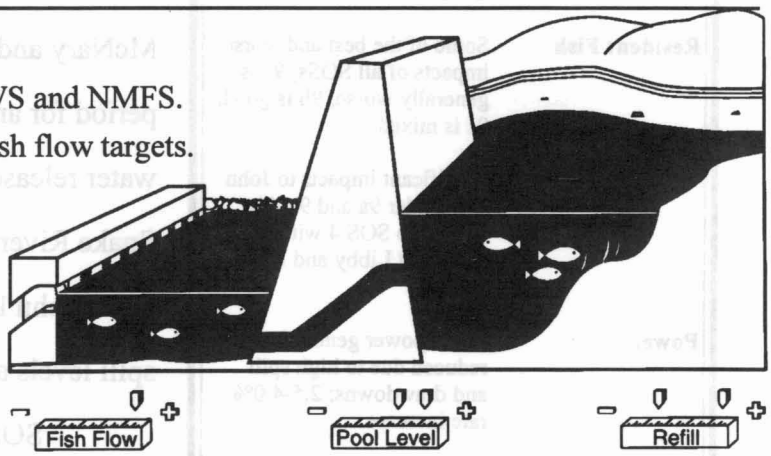
Like SOS 5, SOS 6 would eliminate some power generation. It would have less effect on load shaping (the ability to adjust reservoir releases to balance generation and load) than several of the other alternatives, so its effects on both energy and capacity would be fairly moderate. In fact, SOS 6 would be the third least-cost way to operate the hydroelectric system, following SOSs 1 and 2. Total system generation costs would increase by $35 million under SOS 6b and $17 million under SOS 6d. Retail power rate increases would be in the 0.3 to 0.9 percent range.

Under this strategy, irrigators' annual costs would rise substantially, increasing $2.6 million under SOS 6b and $1.4 million under SOS 6d. Most of this would fall on irrigators who depend on water from the Ice Harbor and John Day pools. The drawdowns would increase municipal and industrial water pumping costs; these costs would go up $3.6 million under SOS 6b and $4.1 million under SOS 6d.

SOS 9 - SETTLEMENT DISCUSSION ALTERNATIVES

Features:

- Recommendations from the USFWS and NMFS.
- Spring and summer anadromous fish flow targets.
- Elimination of fish transportation.



Options:

- **SOS 9a Detailed Fishery Operating Plan** establishes flow targets at The Dalles, based on the previous year's end-of-year storage content. Specific volumes of water are released from Dworshak and Brownlee, and lower Snake River projects are drawn down to near spillway crest level for four and one-half months. Specific spill percentages are established at run-of-river projects; spill caps are used to prevent excessive total dissolved gas. Fish transportation is assumed to be eliminated.
- **SOS 9b Adaptive Management** establishes fixed flow targets at McNary and Lower Granite Dams from April through July.
- **SOS 9c Balanced Impacts Operation** establishes higher fixed flow targets, compared to SOS 9b, at McNary and Lower Granite Dams.

This strategy is designed to provide increased flows for anadromous fish by establishing flow targets during the migration period and carrying out other actions that benefit ESA-listed salmon. The SOR incorporated the three options included in this strategy at the request of USFWS and NMFS, cooperating agencies in the SOR; state fisheries agencies and Tribes; and as a result of settlement discussions that took place in response to a court ruling in the lawsuit, IDFG v. NMFS. The specific options were developed by a group of technical staff representing parties in the lawsuit.

The strategy has three options. SOS 9a, the Detailed Fishery Operating Plan, is the state fisheries agencies' and Tribes' recommended operation; it was suggested by USFWS. It would establish flow targets at Lower Granite and The Dalles, draw down lower Snake River projects to near spillway crest for four and one-half months, specify spill levels at run-of-river projects, and eliminate fish transportation.

SOS 9	Effects
Anad. Fish	Some of the highest and lowest in-river survival depending on SOS option and stock
Resident Fish	Some of the best and worst impacts of all SOSs; 9a is generally worse, 9b is good, 9c is mixed
Wildlife	Significant impacts to John Day under 9a and 9c; 9b similar to SOS 4 with no benefit at Libby and Hungry Horse
Power	Hydropower generation reduced due to high spill and drawdowns; 2.5-4.0% rate increase
Flood Control	Highest flood risk primarily in upper Columbia; average annual flood damage ranges from $0.03 to $0.5 million more than SOS 2c
Navigation	No shallow draft navigation on the lower Snake for 3 or 6 months; net increase up to $12 million compared to SOS 2c
Irrigation, Municipal & Industrial Water Supply	Similar impacts to SOS 6 at Ice Harbor and John Day; increase in pumping costs at Grand Coulee up to $34,900
Cultural Resources	Increased shoreline erosion and exposure due to drawdown; increased bank sloughing due to flow augmentation
Recreation	Annual benefits could decrease $35 to $97 million depending on option
Water Quality	Highest impacts due to water temperature and total dissolved gas supersaturation
Change In Total Annual System Costs	$233 to $400 million

NMFS suggested options 9b and 9c. SOS 9b, adaptive management, is a modification of SOS 9a, with reduced flow levels. It would establish flow targets at McNary and Lower Granite Dams during the migration period for anadromous fish. It would specify maximum water releases from upstream projects, draw down lower Snake River projects to minimum operating pool, draw down John Day to minimum irrigation pool, and specify spill levels at run-of-river projects.

SOS 9c, originally recommended by the State of Idaho, would establish higher fixed flow targets than SOS 9b at McNary and Lower Granite. It would draw down the four lower Snake River projects to near spillway crest for two and one-half months during the spring salmon migration period. It includes flow augmentation at 1994 Biological Opinion levels, Integrated Rule Curves at Libby and Hungry Horse, and a higher winter operating elevation at Albeni Falls.

The three options are quite different, and so are their impacts on the resources and projects covered in the SOR study. Since SOSs 9a and 9c include fixed drawdown of the four lower Snake River projects and operation of John Day at minimum operating pool, their impacts are similar to those of SOS 6b.

Assuming optimistic passage conditions at the drawn down lower Snake projects, SOSs 9a and 9c would provide relatively high in-river survival for juvenile anadromous fish, and SOS 9b would also result in some improvements over current conditions. In-river survival of mid-Columbia stocks

improved slightly under SOSs 9a and 9b, which rely primarily on spill for fish passage. This is especially true in combination with a lower John Day pool level (SOS 9a). Lower Columbia River stocks showed some slight survival improvement under SOSs 9a, 9b, and 9c.

The analysis for returning adults on the Snake River, which used hypotheses with favorable transport survivals, showed SOS 9b had some of the higher adult production numbers, especially for steelhead. Neither of the spillway crest drawdown options, SOSs 9a or 9c, even with optimistic dam passage assumptions, looked good for adult production. With pessimistic passage assumptions, they were particularly bad, driving some stocks to extinction within 30 to 40 years.

On the mid-Columbia, SOSs 9b and 9c would provide adult production that amounts to about two-thirds of that predicted under existing conditions for Methow summer chinook and Hanford Reach fall chinook. Under SOS 9a, Methow summer chinook production would be extremely low and Hanford Reach fall chinook production would be the lowest of the three alternatives.

The SOS 9 options, particularly SOS 9a, would provide the worst conditions of all the strategies for several resources. Water temperatures would be the highest in every major reach of the system, and the SOS 9a and 9c drawdowns would create sediment transport impacts similar to those of SOS 6b.

SOS 9a is one of the two worst strategies for resident fish production; conditions would deteriorate at Libby, Hungry Horse, Grand Coulee, and John Day. It would, however, provide improvements in spawning conditions for the Kootenai River white sturgeon, and hence the probability of survival of that ESA-listed species. SOSs 9b and 9c would also provide these benefits; otherwise their effects on resident fish in the region are mixed, with SOS 9b providing more overall benefits than SOS 9c.

Drawdown to near spillway crest at the lower Snake River projects would cause erosion and sedimentation problems similar to, although not as extensive as, the other drawdown alternatives. McNary Reservoir would receive large amounts of sediment from the eroding shorelines and reservoir bottoms of the lower Snake River projects.

Effects of the three options on wildlife would vary widely. SOS 9a would eliminate wetland and riparian wildlife habitat at Lake Umatilla and at the lower Snake River projects, as described under SOS 5. There would be decreases in the populations of birds and aquatic furbearers at Lake

Koocanusa, Brownlee, and the Hells Canyon Reach of the Snake River. Wildlife would, however, likely increase at Lake Pend Oreille under SOS 9a, due to higher winter lake levels.

Like SOS 4, SOS 9b would increase waterfowl and other wildlife by 6 to 30 percent at Lake Pend Oreille. But SOS 9b would not improve conditions at Lake Koocanusa or Hungry Horse as SOS 4 does; it would essentially mean no change from today. Habitat and wildlife populations at Brownlee and John Day would be reduced.

SOS 9c would reduce habitat at the lower to mid-Snake River projects, but not as much as under SOS 9a. Reductions in habitat at John Day would be the same as under SOS 9a. Using the Integrated Rule Curves at Libby and Hungry would generally improve wetland habitat.

SOSs 9a and 9c would affect shallow-draft navigation. Navigation on the lower Snake River would be interrupted four and one-half months between April and August or September under SOS 9a, and two and one-half months between April and June under SOS 9c. Annual shipping costs would increase as a result. SOSs 9b and 9c would result in some interruptions of the Gifford ferry service on Lake Roosevelt.

The drawdowns and/or large amounts of spill under SOS 9 would reduce hydropower generation. Sizable amounts of replacement energy would be needed. SOS 9a would have the greatest impact on the power system of any of the strategies, increasing costs by an annual average of $236 million and retail power rates by 4 percent. SOSs 9b and 9c would raise annual costs by $213 million, and $138 million, with rate increases of 3.2 and 2.5 percent respectively.

While most of the strategies would have a very minor effect on irrigators at Grand Coulee in most years, SOS 9a could have a more serious impact. Pumping costs for Grand Coulee irrigators would increase by $34,900. SOS 9a could reduce the delivery of water to irrigators during certain months in low-water years. This would occur because the unusually low lake level would reduce the efficiency of the pumps, and they could not keep up with the demand for water.

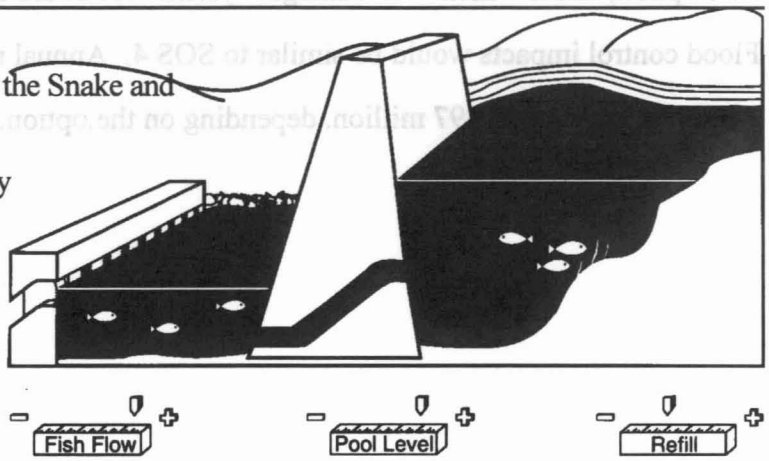
SOSs 9a and 9c would increase annual pumping costs to irrigators at Ice Harbor and John Day pools. Annual costs would go up $2.3 million under SOS 9a, and about $2.6 million under 9c. Average annual municipal and industrial pumping costs would go up about $3.6 million under SOSs 9a and 9c; they would not change from current levels under SOS 9b.

Flood damage costs would significantly increase under SOS 9a or 9c. SOS 9c is the worst-case option, under which total damages systemwide could be over $0.5 million higher than SOS 2c. Flood control impacts would be similar to SOS 4. Annual recreation benefits could decrease under SOS 9 by as much as $97 million, depending on the option.

SOS PA - PREFERRED ALTERNATIVE

Features:

- Spring and summer flow targets for the Snake and Columbia Rivers.
- Refill to flood control levels by early spring.
- Summer draft limits at storage reservoirs.
- Kootenai River white sturgeon operation.
- Drawdown to minimum operating pool levels.
- Increased spill levels limited by dissolved gas.



Options:

- **SOS PA Preferred Alternative** operates the system according to the recommendations of the 1995 Biological Opinions issued by NMFS and USFWS. Only one option was considered.

This strategy represents operations recommended in the Biological Opinions issued in March of 1995. Its intent is to support the recovery of ESA-listed fish by storing water in reservoirs during the fall and winter to meet spring and summer flow targets and by using maximum summer draft limits to minimize detrimental effects on other natural resources, while still providing flood protection and a "reasonable" level of power generation.

The strategy includes flow augmentation and additional spill. Drawdowns would not exceed minimum operating pool on the lower Snake River. In high flow years, projects would spill water and fewer fish would be transported; in low flow years, there would be less spill and more transport. SOS PA pushes for progress on juvenile fish surface collection bypass technology and additional study of drawdown.

During fall and winter, the system would be operated to achieve a high confidence of refill to flood control elevations by April of each year, and this stored water would be used for flow augmentation. There would be spring flow targets at McNary and Lower Granite, a sliding scale flow target at Lower Granite during the summer, and a fixed summer flow target at McNary. Summer draft

SOS PA Effects	
Anad. Fish	In-river survival for Snake River stocks similar to SOS 2; in-river survival for other stocks in the mid to upper range
Resident Fish	Conditions better at Lake Roosevelt, Hungry Horse, Lower Granite, and John Day; worse at Dworshak, sturgeon improved
Wildlife	Impacts at John Day similar to SOS 5b; stable levels allow some restoration of habitat; some impacts at Grand Coulee
Power	Increased water storage in fall and winter and increased spill mismatches flow and generation needs; 2.0% rate increase
Flood Control	Upper Columbia flood damages increase $0.2 million over SOS 2c
Navigation	Normal operations for navigation; shorter Dworshak log transport season; net increase $0.1 million compared to SOS 2c
Irrigation, Municipal & Industrial Water Supply	Minor savings in pumping costs at Grand Coulee;$1.5 million increase at John Day, $4.3 million for M&I
Cultural Resources	Little overall change from current conditions; site exposure increases at Dworshak and John Day
Recreation	Annual benefits decrease by $26 million
Water Quality	Similar to SOS 2 except high total dissolved gas in the lower Columbia
Change In Total Annual System Costs	$164 million

limits would be established at Hungry Horse, Libby, Grand Coulee, and Dworshak.

Lower Snake River projects would be drawn down to minimum operating pool during spring and summer; John Day would be at minimum operating pool year-round. Libby would be operated to enhance conditions for Kootenai River white sturgeon, and spill levels would be established at run-of-river projects, with spill caps to prevent excessive dissolved gas.

This strategy is comparable to the other non-drawdown strategies in terms of juvenile salmon survival (with transportation). The analysis showed that SOS PA would result in returns of Snake River stocks, either for harvest or spawning, comparable to those predicted under the No Action Alternative. This strategy had the highest adult production estimates for Methow summer chinook, Hanford Reach fall chinook, and Snake River fall chinook compared to all other alternatives analyzed.

SOS PA would also represent an improvement for Indian treaty fishing rights and trust assets.

This strategy would provide substantial improvements in conditions for Kootenai River white sturgeon. Otherwise, its effects on resident fish would be mixed. It would provide benefits for resident fish in the reservoirs at John Day and Grand Coulee, as well as Lower Granite and other Snake River reservoirs.

The most significant consequence for wildlife would be the loss of large areas of wetland, riparian, backwater, and pond habitats at John Day as a result of year-round operation at

minimum operating pool. Lowering Lake Umatilla would cause severe wildlife habitat losses similar to those described for SOSs 5, 6, and 9. Initially, waterfowl populations would decline by over half. Duck populations could drop 50 to 80 percent. Bald eagle numbers in the vicinity could decrease by 6 percent.

The permanent nature of this operation would, however, provide the opportunity for restoring lost habitat over the long term. About one to five years after the strategy goes into effect, riparian habitat would likely re-establish along the new shoreline of Lake Umatilla, and goose and duck production would increase. This process could take 20 to 40 years.

The extent to which habitat rebounds would determine the future numbers of waterfowl at Lake Umatilla. The analysis showed that factors such as soils and nuisance fish might make replacement of waterfowl and other wildlife habitat at John Day costly and not entirely successful.

As ponds dry up, there would likely be a significant reduction in western painted turtles at Lake Umatilla. Beavers and otters would have their dens exposed and habitat lost. Beaver recovery could take 15 to 25 years; otters might recover more quickly if plants rebound after the new pool level is established.

While the study did not predict SOS PA would cause much in the way of changes for wildlife at other projects, the rapidity of spring and summer drawdowns at Lake Roosevelt could lead to reduced populations of waterfowl, birds, and amphibians.

This strategy creates high levels of gas supersaturation in the lower Columbia, and is only slightly better in this regard than the worst alternative, SOS 9a. In the mid-Columbia and lower Snake reaches, SOS PA was in the medium to low range for dissolved gas of all the strategies.

Fall and winter water storage and spring and summer flow releases would both increase under SOS PA, shifting when power generation occurs. This shift increases costs due to the need for power purchases during fall and winter, and reduced prices for spring and summer sales. The 307 average megawatt reduction in average annual power generation is due mainly to large amounts of spill for anadromous fish. In the SOR analysis, annual power system costs would rise by $126 million. Retail power rates could go up 2 percent.

The year-round drawdown of John Day would increase irrigation pumping costs. Costs to irrigators drawing from John Day would rise $1.5 million. Average annual pumping costs for municipal and industrial water suppliers would jump the highest of any of the strategies: an increase of over $4.3 million annually.

Recreation visitation would drop slightly (about 6 percent) from current levels, with a decrease in annual benefits of about $26 million. SOS PA would have minor effects on navigation, flood control, air quality, and aesthetics.

How the Strategies Would Affect River Uses

	SOS 1	SOS 2	SOS 4	SOS 5	SOS 6	SOS 9	PA
Anadadromous Fish	Moderate passage survival and adult escapement; slight differences from existing conditions	Survival rates in the middle range of all alternatives; with transport, juvenile survival is high	Survival about the same as SOS 2	Highest in-river survival for Snake River stocks; for other stocks, similar to existing conditions	In-river survival for Snake River stocks varies greatly depending on assumptions	Some of the highest and lowest in-river survival depending on SOS option and stock	In-river survival for Snake River stocks similar to SOS 2; in-river survival for other stocks in the mid to upper range
Resident Fish	Variable conditions among reservoirs and species; pool fluctuations and failure to refill impact productivity	Variable conditions among reservoirs and species; pool fluctuations and failure to refill impact productivity	Best SOS for resident fish; improved productivity at storage projects	Generally poor ; some reservoirs have improved conditions under SOS 5c	Impacts generally the same as SOS 5, but not as severe; conditions worse at Lower Granite and John Day	Some of the best and worst impacts of all SOSs; 9a is generally worse, 9b is good, 9c is mixed	Conditions better at Lake Roosevelt, Hungry Horse, Lower Granite, and John Day; worse at Dworshak, sturgeon improved
Wildlife	Resources largely unchanged from current conditions; continuation of downward trends	Long-term downward trends to resources; slight impacts at John Day due to lower reservoir levels	Moderate to significant increases in wildlife habitat at Lake Pend Oreille, Libby, Hungry Horse, and Grand Coulee	Severe reductions in wildlife habitat at lower Snake and John Day projects	Wildlife habitat impacts similar to SOS 5; 6d limits impacts to Lower Granite	Significant impacts to John Day under 9a and 9c; 9b similar to SOS 4 with no benefit at Libby and Hungry Horse	Impacts at John Day similar to SOS 5b; stable levels allow some restoration of habitat; some impacts at Grand Coulee
Power	Energy production and load shaping maximized; 0.6-1.1% rate decrease	Annual generation costs the lowest of all SOSs except SOS 1; up to 0.4% rate increase	Flows and generation needs mismatched; 1.3% rate increase	Eliminates system load shaping capability; reduces average annual energy generation; 2.5-2.8% rate increase	Generation effects similar to SOS 5; generation costs slightly more than SOS 2c; 0.3-0.9% rate increase	Hydropower generation reduced due to high spill and drawdowns; 2.5-4.0% rate increase	Increased water storage in fall and winter and increased spill mismatches flow and generation needs; 2.0% rate increase
Flood Control	Flooding risk unchanged from current conditions	Flooding risk unchanged from current conditions; expected annual average flood damage costs are $3.3 million	Increased risk at Bonners Ferry, the upper Columbia, and Clearwater reaches; average annual flood damage costs increase $0.4 million over SOS 2c	Flood risk in all areas similar to SOS 2	Flood risk in all areas similar to SOS 2	Highest flood risk primarily in upper Columbia; average annual flood damage ranges from $0.03 to $0.5 million more than SOS 2c	Upper Columbia flood damages increase $0.2 million over SOS 2c
Navigation	Normal conditions for shallow draft navigation and reduced costs for Dworshak log transport; net decrease $0.1 million compared to SOS 2c	Shorter Dworshak log transport operating season; total annual cost for navigation is $414.4 million	Longer Dworshak log transport operating season; net decrease $0.2 million compared to SOS 2c	No shallow draft navigation on the lower Snake River for 7 months or permanently; net increase $14 to $38 million compared to SOS 2c	No shallow draft navigation on the lower Snake River or Lower Granite for 6 months; net increase $2 to $12 million compared to SOS 2c	No shallow draft navigation on the lower Snake for 3 or 6 months; net increase up to $12 million compared to SOS 2c	Normal operations for navigation; shorter Dworshak log transport season; net increase $0.1 million compared to SOS 2c
Irrigation, Municipal and Industrial Water Supply	Minor increase in pumping costs at Grand Coulee of $9,000 over SOS 2c	All irrigation needs served	Minor decrease in pump-ing costs at Grand Coulee of $18,400 over SOS 2c	Drawdowns at John Day and Ice Harbor require pump modifications and increase pumping costs by about $3.3-4.5 million	Drawdowns at John Day and Ice Harbor require pump modifications and increase pumping costs by about $1.4-2.6 million	Similar impacts to SOS 6 at Ice Harbor and John Day; minor increase in pumping costs at Grand Coulee up to $34,900	Minor savings in pumping costs at Grand Coulee;$1.5 million increase at John Day, $4.3 million increase for M&I
Cultural Resources	Ongoing shoreline erosion and exposure at same rate as current conditions	Ongoing shoreline erosion and exposure at same rate as current conditions	High rates of shoreline erosion at storage projects; decrease in exposure due to high pools	Dramatic increase in exposure at lower Snake River projects; less shoreline erosion at these projects	Similar to SOS 5 but less dramatic	Increased shoreline erosion and exposure due to drawdown; increased bank sloughing due to flow augmentation	Little overall change from current conditions; site exposure increases at Dworshak and John Day
Recreation	Annual benefits could increase up to $7.9 million under SOS lb	Annual average recreation benefit is $315 million	Annual benefits could increase $4.2 million	Annual benefits could decrease between $66 and $90 million	Annual benefits could decrease up to $40 million	Annual benefits could decrease $35 to $97 million depending on option	Annual benefits decrease by $26 million
Water Quality	Slight decrease in water temperature but increase in total dissolved gas in lower Snake River	Similar to SOS 1 but slight increase in water temperature; decrease in total dissolved gas	Similar to SOS 2 with slightly lower dissolved gas in lower Columbia	Maximum silt concentra-tions; nearly all excessive dissolved gas eliminated in lower Snake	Major sediment transport similar to SOS 5; dissolved gas and water temperature similar to SOS 2	Highest impacts due to water temperature and total dissolved gas supersatura-tion	Similar to SOS 2 except high total dissolved gas in the lower Columbia
Change In Total Annual System Costs*	-$42 to -$80 million	$29 million, but SOS 2c equals 0 (no action alt.)	$81 million	$266 to $336 million	$78 to $145 million	$233 to $400 million	$164 million

*Includes capital expenditures to modify existing dams.

Part 3:

The Other SOR Decisions

Choosing a system operating strategy has been a major focus in the SOR because of the potential for environmental impacts from changes in operations. But there are three other important decisions that are a part of the SOR. The following material describes the proposed actions with regard to the Columbia River Regional Forum (The Forum); the Pacific Northwest Coordination Agreement (PNCA); and the Canadian Entitlement Allocation Agreements (CEAA).

The upcoming expiration of the PNCA and CEAA was part of the impetus for the SOR. The SOR provides the environmental analysis of alternatives that the Federal agencies need before they sign renewed or updated versions of these major Columbia River pacts.

The PNCA and CEAA involve multi-party contracts, and negotiations have gone on simultaneously with the SOR. The discussions are still in progress as this Final EIS is completed.

Columbia River Regional Forum: Proposed Interim Action

The lead SOR agencies originally saw a need to develop a process to keep the SOS constantly tuned to changes in the river system and to reflect new information on the tradeoffs among river resources. They were looking for a way to provide governments, such as Tribes; organized interests, such as environmental and citizen groups; and state and Federal fish and wildlife agencies, an ongoing role in helping shape decisions on system operations.

The SOR agencies found no regional consensus on the Forum options. This, combined with changes that have taken place with ESA consultation and fish recovery since the SOR began, led the agencies to decide not to select a Preferred Alternative for the Forum or to pursue the creation of a Forum.

As an interim step, the SOR agencies propose to continue with the current decisionmaking process, which resembles Forum 1: decisionmaking by the SOR lead agencies with a public involvement program conducted by those agencies.

This alternative indicates that decisions are made by the SOR agencies. But because of the ESA, these decisions are made only after extensive consultations with NMFS and USFWS. There must also be a consultation with the Northwest Power Planning Council. At a minimum, all five of the Federal agencies are at the decision table.

What Happened to the Other Forum Alternatives?

In many ways, the events described in Part 1 also overtook the discussion of the need for a Forum. When the SOR began, the agencies heard frequent comments based on the perception that the PNCA was the place where "real" operating decisions were made. Fisheries and environmental interests were not parties to the PNCA and did not have a role in PNCA-related decisions. They argued that they were not represented at the table where the "real" action took place.

Power users, on the other hand, argued that a joint power and nonpower decision process would be cumbersome. They felt it could delay the annual planning mechanism set out in the PNCA and was not sufficiently predictable for long-term resource planning.

NMFS' actions to list sockeye and chinook salmon under the ESA and USFWS' decision to list Kootenai River white sturgeon have considerably altered the system planning process since the SOR began. The ESA requires extensive consultation between the SOR agencies and NMFS and USFWS. In addition, the court rulings in several fish and wildlife-related cases have opened up the planning process to representatives of state and Federal resource agencies, and to Indian Tribes.

The world of power generation has changed as well. BPA has informed the region it is changing to meet the demands of a competitive environment and has begun shaping its rates, contracts, and other business functions accordingly.

In the Draft EIS, the SOR agencies considered seven alternative ways to structure and conduct the Forum. These alternatives involved various options for how recommendations for change would be solicited and processed; the extent of the public review and involvement that would occur; where the decisionmaking authority would reside; and how decisions would be communicated and implemented.

Few Comments, No Consensus

The agencies received just over a dozen comments on the Forum. This is a relatively small number compared with comments on other aspects of the SOR. There was no consensus in the comments, and they offered contradictory views on the need for the Forum, as well as how it should be organized and operated. It was clear to the agencies that there is no single alternative that enjoys the support of the region.

In addition, the ESA listings have changed the perception that the "real" decisions are made by the PNCA. The ESA consultations, however, have not simplified the process, nor made it more predictable, open, and visible to all interested parties in the region. The consultations fail to meet some of the criteria the SOR agencies established for creating a Forum.

NMFS is currently seeking ways to involve many of the same constituencies that were the focus of this SOR action in a Forum-type process. Some version of a Columbia River Regional Forum may well be the upshot of NMFS' efforts.

The SOR agencies would have preferred a more immediate solution that simplifies the decisionmaking process, encourages all interests to meet at the same table, and consolidates the number of points at which people try to influence operating decisions. Once the region has absorbed the impact of the ESA listings, it may wish to consider new arrangements. NMFS' efforts may prove to be a good alternative to the SOR-proposed Forum.

For a list of all of the Forum alternatives considered, the reader should consult the Final EIS Main Report or Appendix Q, Columbia River Regional Forum.

Pacific Northwest Coordination Agreement (PNCA)

The PNCA is a complex agreement that coordinates the generating resources of 17 agencies and utilities in the Columbia River Basin. The PNCA optimizes the power benefits of major generating resources by planning and operating them as a coordinated, single-owner system. A cornerstone of the agreement is Section 15, which provides that nonpower uses of a PNCA-coordinated reservoir have priority over power production. The current agreement took effect in 1964 as part of the Columbia River Treaty process. The current PNCA expires in 2003.

The SOR agencies have selected PNCA 4 as the Preferred Alternative. PNCA 4 is a modified contract supplemented with operating procedures.

Under this alternative, some changes would be made to the existing PNCA, and a combination of short and long-term operating procedures would be used to implement the contract. The region would continue to have a highly reliable and efficient power system, within the limits and flexibility allowed by the system operating strategy to be selected by the SOR agencies. In addition, some PNCA parties believe this alternative would resolve some long-standing issues in the current contract. PNCA 4 is considered superior to having no agreement when the current contract expires in 2003.

The analysis concluded there would be no significant impacts from any of the PNCA alternatives since multiple-use operating decisions would be accommodated prior to power coordination. It is the operating decisions that have environmental impacts, and those impacts were evaluated under the system operating strategy portion of the analysis.

It is not clear how much operating flexibility would remain for PNCA operations under the system operating strategy Preferred Alternative. But it is clear that power production is incidental to nonpower requirements under the 1995 Biological Opinions, which are the basis for the system operating strategy Preferred Alternative.

A number of organizations, agencies, and Tribes directed comments to the PNCA alternatives. Several comments were aimed at specific provisions of the current contract that would be revised in the Preferred Alternative, PNCA 4. In particular, such mechanisms as shifting and flexibility adjustments, would be more restricted under PNCA 4 than they would be under the current contract. Some of the checks and balances incorporated into PNCA 4 were urged upon the agencies in public comments.

A Closer Look at the PNCA Preferred Alternative

Under PNCA 4, the current PNCA parties would be signatories to the agreement, but nothing would preclude other entities from seeking to become a party. PNCA 4 would continue to allow reservoir owners to incorporate nonpower requirements into the PNCA planning process, and it retains critical water planning as a tool to estimate firm hydro capability.

Most of the mechanisms in the current agreement that estimate firm hydro resource capability are part of the Preferred Alternative. Some of these have been modified to respond to concerns of various environmental groups.

A party's ability to shift firm resource capability between years in the planning studies would be more limited than it is under the current contract. Additional limits would restrict flexibility adjustments. Interchange energy, a mechanism to enable power coordination, would continue, but the distinction between hydro and nonhydro interchange energy would be eliminated. The Preferred Alternative would clarify this treatment of unplanned nonpower requirements and provide a mechanism that uses hydro system flexibility to distribute the costs of implementing those unplanned nonpower operations.

Aside from PNCA 4, there were four alternatives considered:

PNCA 1: Expiration of the existing contract, no replacement

PNCA 2: Contract to maximize regional power benefits

PNCA 3: Extension of the existing contract

PNCA 5: Power coordination agreement to enhance nonpower considerations.

Canadian Entitlement Allocation Agreements (CEAA)

The CEAA, which distribute the downstream power benefits of the Columbia River Treaty among six Federal and five non-Federal hydro projects, begin to expire in 1998. The Canadian share of the downstream benefits (50 percent) is to be returned to Canada in increments as the agreements expire.

The downstream power benefits that accrued from the storage built under the treaty are divided into an energy component and a capacity component. Energy is the actual generation over time (measured here in average megawatts), and capacity refers to the maximum sustainable amount of power a generator can produce at any instant (measured in megawatts). The total Canadian Entitlement is estimated to be close to 600 average megawatts of energy and 1,400 megawatts of capacity. New agreements will distribute the responsibility for generating this power among the 11 dams. Four alternatives for that distribution were analyzed in the SOR.

The CEAA Preferred Alternative

The SOR agencies have selected CEAA Alternative 3 as the Preferred Alternative. With this alternative, the Entitlement allocation would be 70 percent Federal and 30 percent non-Federal. The

return obligation would be split according to this formula between the Federal and non-Federal projects. This alternative most closely represents the expected outcome of negotiations between the U.S. Entity and non-Federal utilities for allocation of the Entitlement.

Since the determination of the Canadian Entitlement and the resulting allocation are dependent on a number of factors, the exact numbers for the Federal and non-Federal percentages will vary during the proposed contract period, 1998 through 2024. The expected range of the Federal and non-Federal percentage allocation over the life of the contract will probably be 70 to 75 percent Federal and 25 to 30 percent non-Federal. In round numbers, CEAA 3 means the Federal obligation would be about 420 average megawatts of energy and about 980 megawatts of capacity; the non-Federal obligation would be about 180 average megawatts of energy and 420 megawatts of capacity.

The renewed CEAA are not expected to greatly influence hydro system operations. Changes in river flows would be minor, perhaps nonexistent, since both the Federal and non-Federal projects would be used to generate power to deliver to Canada. At any rate, the Canadian Entitlement deliveries would occur within the hydro system operating bounds ultimately defined by the system operating strategy selected by the SOR agencies.

The most likely scenarios for satisfying the Canadian Entitlement obligation are to acquire new resources or purchase power. For this reason, the greatest effect of the CEAA decision may be on resource acquisitions by the Federal and non-Federal parties.

The other CEAA alternatives considered in the SOR were:

CEAA 1: 100 Federal, 0 Percent Non-Federal (No Action). The agreements would expire without replacement

CEAA 2: 55 Percent Federal, 45 Percent Non-Federal. The obligation would be allocated according to this formula

CEAA 4: No Agreement. The Federal system would be responsible for delivering all of the Entitlement.

Part 4:

Purpose and Need

In recent years, the Northwest's growing population has intensified the demands on the waters of the Columbia River system. The river has been labeled "a system under stress." Human activities, such as industry, agriculture, power, and recreation depend on Columbia River water, as do fish and wildlife. It is difficult to decide when to help one at the expense of the others.

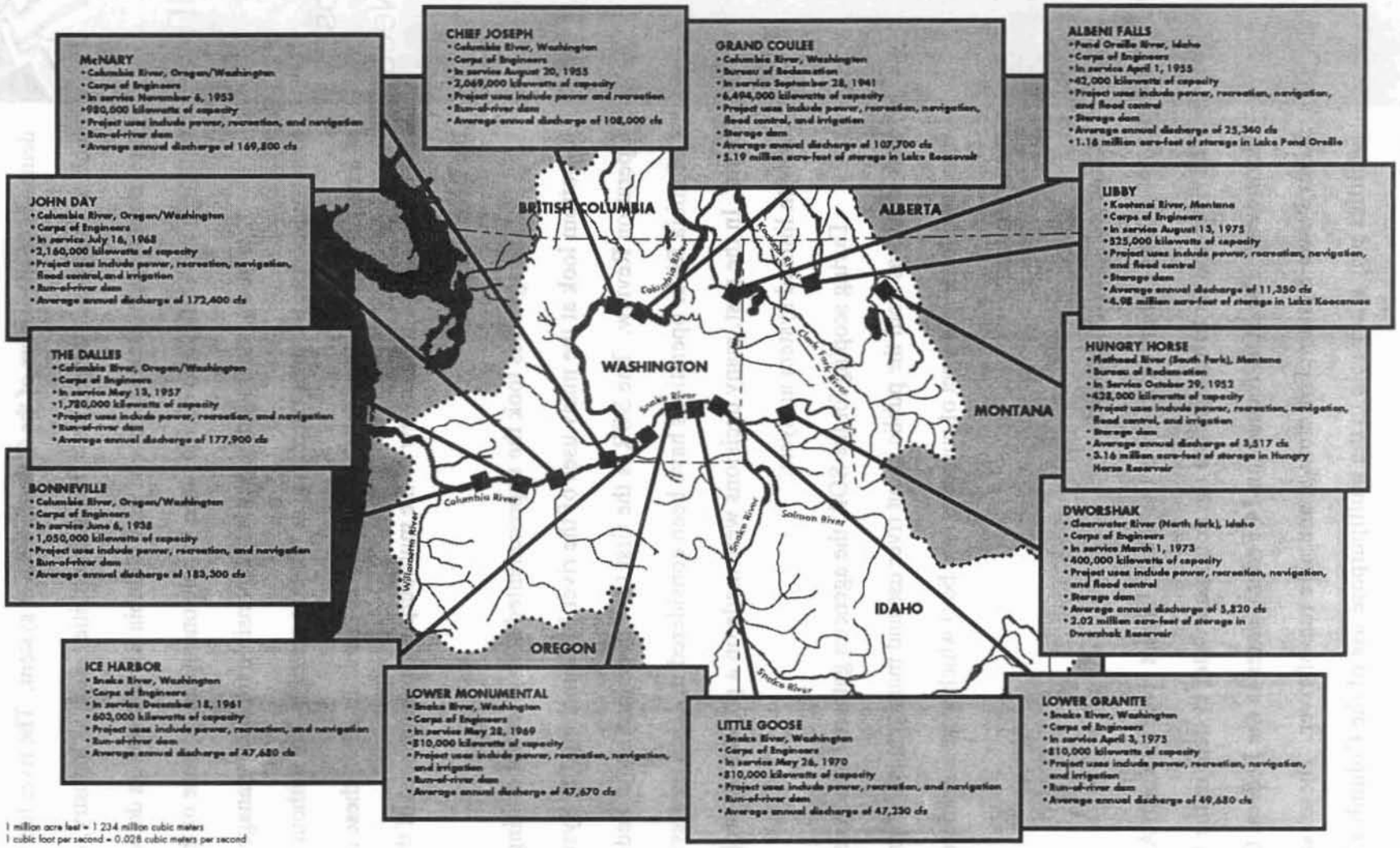
For years, the Federal agencies responsible for river management tried to accommodate the many demands as often as possible, but without the benefit of a comprehensive approach that included all users. In 1990, these agencies recognized a need for a review of the multipurpose management of the Columbia River system.

The agencies took the unprecedented step of collaborating on a top-to-bottom look at the many uses of the river by launching the System Operation Review. The SOR is the first time decisions about Federal Columbia River operations have been considered in depth on a systemwide basis. In the past, many decisions were made on a project-by-project basis, or with limited system analysis.

During scoping for the SOR, the agencies gathered hundreds of opinions and ideas from the public about river use and management. The agencies translated these into a set of purposes (see box) which were considered during the evaluation.

Affected Environment

The Columbia River is the fourth largest river in North America. The river and its tributaries are the dominant water system in the Pacific Northwest. The SOR focuses on 14 Federal dams in the Federal Columbia River Power System, five storage and nine run-of-river. These large-scale facilities play a key role in the multipurpose use of the Columbia River system.



1 million acre feet = 1 234 million cubic meters
1 cubic foot per second = 0.028 cubic meters per second

SOR Purposes

Meet Legal and Institutional Mandates:

- Act within the authorities granted to the agencies under existing statutes
- Satisfy existing contracts
- Identify areas where new statutory authority may be needed
- Provide public access to the Columbia River System Operating Strategy and future decisions associated with it
- Create a technical data base for system operating decisions
- Comply with environmental laws and regulations
- Satisfy Native American treaty rights and obligations for natural and cultural resources

Meet These Public Concerns About Resources:

Provide

- An economic, reliable, and environmentally sound power system
- An adequate supply of irrigation, municipal, and industrial water
- Public safety through an economic and dependable flood control system
- A waterborne transportation capability
- Equitable treatment of fish and wildlife
- Opportunities for recreation at lakes, reservoirs, and rivers
- Protection and preservation of threatened, endangered, and sensitive species
- Protection and preservation of cultural resources
- Protection and enhancementof socioeconomic well-being
- Protection and enhancement of environmental quality.

The Columbia River system underpins the region's economy. Industries like electric power production, shipping, agriculture, and recreation depend on the river. The SOR analysis attempted to look across the array of river uses and resources to discover which would benefit or suffer if system operations were changed. The SOR study looked at these topics: flood control, navigation, anadromous fish, resident fish, wildlife, hydroelectric power, recreation, irrigation, water quality, and cultural resources.

All of these resources and uses make up the environment affected by SOR decisions. One thing that became clear in the analysis is that on the river, for every action, there is a reaction. If you try to improve conditions for one river use, it may make things worse for others. The SOR revealed no perfect balance, but it did shed some light on key relationships and tradeoffs. And it has led to a legacy of information and cooperation that should assist in Columbia River management in the future (see Part 7).

Part 5:

Public Participation

Because the Columbia River touches the lives of almost everyone who lives in the Northwest, the SOR agencies made an extraordinary effort to involve the public in the study. They solicited opinions about what people think the system is today and what needs it should serve tomorrow.

The SOR agencies held numerous public meetings across the region at different points in the review to get people involved and hear their opinions. The technical work groups that conducted the SOR analysis included members of other Federal and state agencies, Tribes, and public and interest group representatives.

Over 500 people turned out to comment on the Draft EIS at public meetings held around the region in the fall of 1994 (see box). Meetings were held in Boise, Lewiston, and Sandpoint, Idaho; Kalispell and Libby, Montana; Grand Coulee, Pasco, and Seattle, Washington; and Portland, Oregon. The SOR agencies received 214 written comments on the Draft EIS.

Public Interest Was Strong From the Beginning

Back in 1990, about 800 people attended meetings the SOR team held around the region to explain what the SOR was and to gather comments on the scope of the study. Hundreds of written comments were sent in. The level of interest shown during scoping signaled the need for an ambitious educational and public involvement effort for the SOR. In September 1992, nearly 500 people attended 14 "mid-point" meetings where they were able to learn about and comment on the strategies being considered for full-scale analysis.

The SOR team also put together a variety of publications to educate the public about how system operations along the Columbia River actually work. One of these, the *Streamline* newsletter, was mailed to over 5,000 homes and businesses regularly over the five-year life of the SOR to inform people about new developments in the study and present information on river management issues.

WHAT DID THE PUBLIC SAY ABOUT THE DRAFT EIS?

Many commentors concentrated on system operations in their own backyard. For example, in Sandpoint, Idaho, concerns focused on how operations at Albeni Falls Dam affect the level of Lake Pend Oreille, and fishing and tourism in the area. In Kalispell, speakers worried that drafting Hungry Horse and Libby reservoirs to provide flows for salmon would jeopardize resident fish, such as bull trout and cutthroat that live in the reservoirs. The effects of changing operations at Libby Dam to improve conditions for sturgeon spawning was a main topic at the Libby meeting.

The SOR managers heard clear support for traditional system uses, such as irrigation and power production, at the Grand Coulee meeting. The impacts of salmon recovery on activities downstream were a recurring theme. At the Pasco meeting, irrigators and farmers praised the hydro system and questioned the benefits to be gained by most of the alternatives.

In Boise, a mix of opinions surfaced, with some speakers arguing for flows, drawdowns, and even breaching of certain dams. Others supported fish transportation as the best short-term option for aiding salmon, and still others suggested no options were palatable, and that the SOR should "start over."

The Lewiston meeting enabled commentors to air frustrations about the Endangered Species Act and government in general. People said no one is sure that any of the strategies will save salmon, but they are sure there would be drastic effects on their lives and livelihoods if certain strategies were implemented.

In Portland and Seattle, representatives of utilities, aluminum smelters, grain shippers, and other river users came out to tell SOR managers the Northwest economy depends on a multi-use river. Speakers criticized drawdowns and questioned how private property rights would be affected by the strategies.

There is no consensus on how the river should be operated. From the public meetings, to the myriad comments and letters mailed to the SOR — on every avenue that led to the Final SOR EIS, there was a healthy difference of opinion about what the river system's priorities should be.

The SOR may result in more public awareness of the limits government has in resolving high-profile resource conflicts. One of *Streamline*'s main goals has been to increase the public's awareness of the tradeoffs among river uses that must be considered when operating changes are contemplated.

Part 6: Tribal Perspective

There are 14 Federally recognized Tribes in the Columbia River Basin affected by SOR decisions. In recognition of the Federal government's Indian trust responsibilities, its government-to-government relationship with Tribes, and the need for government-to-government consultation, the agencies spent a great deal of time reaching out to the Tribes and incorporating the Tribal perspective into the SOR. Tribes were invited to participate early in the SOR process in 1991 and 1992.

In 1993, the SOR managers formed the Indian Coordination Group to increase opportunities for input from, and to build relationships with, the Tribes. By the year's end, the managers had met with 13 of the 14 Tribal governments in the study area (see box).

These and subsequent meetings in 1994 and 1995 sought to improve communications and cooperation between the Tribes and the agencies in general, and specifically, to find a way to reflect, as much as possible, the Tribes' holistic perspective in the SOR analysis. In addition, agency heads met with Tribal leaders on several occasions and at several locations.

The SOR meetings succeeded in opening up some new channels of communication between the Tribes and the Federal government on topics such as treaty rights, trust assets, and cultural resources. The SOR agencies also contracted with 12 Tribes to develop information for the SOR analysis. Their information is printed in the Main Report if it pertains to the SOR in general, and Appendix D, Cultural Resources, if it pertains to cultural resources specifically.

Tribes

Blackfeet Tribe	Burns Paiute Tribe
Coeur d'Alene Tribe of Idaho	Colville Confederated Tribes
Kalispel Indian Tribe	Kootenai Tribe of Idaho
Nez Perce Tribe	Spokane Tribe of Indians
Shoshone-Bannock Tribes	Shoshone-Paiute Tribes of Duck Valley

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

Part 7:

After the SOR

NEPA requires that Federal agencies wait at least 30 days after releasing a Final EIS before preparing Records of Decision (RODs) to document the actions chosen. The SOR agencies expect to issue RODs this winter.

That won't be the end of efforts to find ways to manage system operations to help fish and wildlife, while meeting the needs of other uses. Many activities that relate to and build on the SOR will be taking place in the next few years. Some notable efforts are described below.

System Configuration Study Moves Into Phase II

While the SOR comes to a close, the Corps of Engineers is beginning Phase II of its System Configuration Study (SCS). The SCS is an examination of structural modifications that could be made to Federal projects on the lower Snake and Columbia Rivers to improve juvenile salmon migration. Phase II consists of studies designed in response to recommendations made by NMFS in its 1995 Biological Opinion.

The SOR addressed the operational aspects of structural alternatives, such as drawdowns, that will be evaluated in the SCS Environmental Impact Statement. The Corps will use information developed by the SOR on Columbia River resources, uses, and economics to help assess impacts in the SCS.

The Corps' EIS will examine different drawdown scenarios for the four lower Snake River reservoirs and new juvenile bypass systems. Public meetings on the scope of the SCS EIS were held in the summer of 1995. The Corps will publish a status report on research to date in October 1996; the Draft EIS is scheduled to come out in 1998.

Snake River Resources Review Getting Under Way

In the summer of 1995, Reclamation began a review of system operations in the Snake River Basin above Brownlee Dam. Many public comments during the SOR suggested that an examination of the use of water stored in projects in the upper Snake area be conducted, but such a study was beyond the scope of the SOR.

The goal of Reclamation's review, which will take place over the next five years, is to develop a single model to guide operation of all projects in the basin to enable better management of water and related resources. The 10 Reclamation projects above Brownlee include 21 storage reservoirs and five generating plants. In addition to analyzing operations for traditional uses, such as irrigation, flood control, and power generation, the model will be able to consider water quality, recreation, cultural resources, fish and wildlife, and the Endangered Species Act.

Columbia System Flood Control Review In Progress

The Portland, Seattle, and Walla Walla District Offices of the Corps have started scoping a study to re-evaluate flood control requirements in the Columbia River Basin, at the request of NMFS in its 1995 Biological Opinion. During the SOR studies, flood control requirements were "held sacred" and not treated as a variable.

The Biological Opinion directs the Corps and Reclamation to evaluate flood control operations that could provide additional storage for fish flows. These operations could involve relaxing some existing requirements, developing and using improved streamflow forecasts, applying structural and non-structural controls, and shifting flood control operations between reservoirs. The Corps will conduct flood damage surveys in major river reaches, review river profiles, and gather the extensive data necessary to determine the impacts and implications of adopting less stringent flood control requirements. The Corps will make its first report on the effort in November 1996.

Cultural Resources Effort Builds on SOR Groundwork

The SOR Cultural Resources Work Group provided a starting point for the Federal agencies and Tribes to identify and discuss the many problems system operation causes to cultural resources and cultural properties. As a result, the agencies have committed to developing a process to ensure compliance with the requirements of the National Historic Preservation Act, the Archeological Resources Protection Act, and similar laws.

A committee has been formed, with Federal agency and Tribal representatives, that will coordinate with other agencies and state historic preservation offices to develop a regionwide cultural resources protection effort that meets the concerns and priorities of Tribes. The committee will advise on efforts to be taken regionally and at individual reservoirs.