Section 1.C.2. Hydropower Structure and Operation Strategies

General Comments and Justification

The presence, configuration and operation of the FCRPS and mainstem FERC licensed hydroprojects is primarily responsible for the decline of migrating, rearing and spawning salmon, steelhead and Pacific Lamprey and sturgeon. For example, NMFS has documented juvenile fall chinook mortality as high as 62-99% and adult fall chinook mortalities as high as 39% through the FCRPS (NMFS 1995). The CRITFC mainstem amendment biological objectives and strategies are designed to substantially reduce the direct mortality rate to salmon and other fish stocks in the mainstem Columbia and Snake River basins. The these objectives and strategies are also intended to reduce the substantial indirect mortality suffered by juvenile and adult salmon from the hydrosystem and the hydrosystem's impact on critical mainstem habitat in a effort to increase overall stock production and diversity.

The scientific foundation for the biological objectives and strategies are found in the mainstem ecological conceptual foundation described in the *Wy-Kan-Ush-Mi Wa-Kish-Wit (Spirit of the Salmon;* Nez Perce et al. 1995) the ISG's *Return to the River* (Williams et al. 1996), and the NWPPC and Independent Scientific Advisory Board's *Report and Recommendations of the Northwest Power Planning Council upon Review of the Corps of Engineers' Columbia River Fish Mitigation Program* (Report 99-5).

The CRITFC objectives and strategies establish actions to shape of available storage volumes and runoff toward normative hydrographs and create dam passage configurations that simulate the natural migration behaviors of anadromous fish. The objectives and strategies specified actions to meet physical (i.e water quality) conditions, essential life history and other biological requirements, for Snake River, upper Columbia, and lower Columbia adult and juvenile steelhead, sockeye, coho, fall chinook, chum, sturgeon and Pacific Lamprey.

The federal hydrosystem operators,[1] should remain cognizant that they have other responsibilities to protect, mitigate and enhance salmon and other anadromous fish other than under the Endangered Species Act. The Fish and Wildlife Coordination Act, the Northwest Power Act, the Clean Water Act, the *US-Canada Salmon Treaty* and treaties with the CRITFC tribes all require that the operators pursue and address tribal recommendations for river operations and hydrosystem configuration. Neither the operators' biological assessments nor their Records of Decisions on the federal fisheries agencies'biological opinions nor the NMFS' Adaptive Management Process can substitute or mitigate for these responsibilities. The tribes recommend that the federal operators to carefully consider implementing the tribal biological objectives and strategies to fully protect and restore tribal treaty resources. Implementation of these objectives and strategies is vital to the treaty tribes as part of the federal government's trust responsibility and the NWPPC's charge under the Northwest Power Act to shift the

[11] The operators include the Corps of Engineers, BPA, Reclamation and FERC in its authority to license and condition non-federal hydro projects under the Federal Power Act.

inequitable conservation burden away from tribal harvest and to assist tribal members in beginning to increase their standard of living and health to levels enjoyed by non-tribal peoples. These inequities were clearly identified and defined in the NWPPC's *Multi-Species Framework* process.[2]

The CRITFC biological objectives and strategies are based on the best available peer reviewed science. The objectives and strategies are consistent with the recommendations of the Independent Science Advisory Board in *Return to the River*, the findings of the Process for Analyzing and Testing Hypotheses (PATH) and The Independent Scientific Advisory Board's (ISAB) reviews of the Corps of Engineers' capital construction program and estuarine limiting factors. The CRITFC strategies and actions have the greatest certainty of meeting the NWPPC's legal and statutory obligations under Treaties, the Clean Water Act, the Endangered Species Act, and the Fish and Wildlife Coordination Act.

Redline Version of Framework Language

(b) Biological Objectives and Standards for mainstem passage

1. **Restore normative river conditions to provide spawning, resting, and rearing habitat for salmon and steelhead in the mainstem of the Columbia and Snake Rivers by 2006.**

[2] Most of the salmon wealth has been taken away from the tribes and redistributed to non-tribal people in the form of flood control, navigation, irrigation and municipal development. This redistribution of wealth from tribal people that originated in the Columbia Basin has resulted in elevated poverty and death rates within tribal populations well in excess of the general population (Ch2 M Hill 1999). In particular, the loss of salmon from construction and operation of the federal and FERC licensed hydrosystem has transferred the sustainable wealth created by the river away from tribal peoples and has redistributed this wealth to non-tribal peoples (CH2 M Hill 1999). For example, the Yakama Nation tribal members have access to and take less than 10% of their traditional salmon harvest.

Loss of tribal wealth and the diminishment of opportunities to exercise treaty fishing rights from the depletion of salmon stocks has resulted in disproportionate rates of poverty, disease, mental illness and death in tribal communities compared to non-tribal communities (CH2 M Hill 1999). For example, the per capital income of a Yakama Nation tribal member is only 43% of the State of Washington per capita income, and the poverty rate of a Yakama Nation tribal member is 42.8% compared to the average citizen of Washington State at 10.9 % (CH 2 M Hill 1999).

Further, salmon are the mainstay of tribal religious and cultural practices. Every juvenile salmon that survives hydrosystem passage brings back as an adult some of the river's wealth to the tribal economy and culture. The NWPPC's mainstem amendment must recognize the hydrosystems effects on tribal culture and economies. The amendment must adopt objectives and strategies that create the ability to redistribute the river wealth back to tribal peoples.

1.1 **Provide 9,000 acres of spawning habitat for Snake River fall chinook by 2006.**

1.2 **Provide 40 miles of fluvial spawning habitat for mid-Columbia fall chinook core populations identified by the Independent Science Advisory Board in *Return to the River* by 2008.**

1.3 **Provide a mainstem hydrograph that resembles the shape of the normative hydrograph.**

2. **Ensure 80 percent Fish Passage Efficiency between 2001 and 2004, and 90 percent Fish Passage Efficiency after 2004. Fish Passage efficiency is defined as passage through a hydroelectric project by non-power house routes.**

3. **Meet the gas supersaturation and temperature standards under the Clean Water Act.**

4. **Eliminate stranding and other problems associated with fluctuation of the hydroelectric system.**

5 Reduce the travel time for migrating salmon and steelhead while protecting resident fish.

Two biological principles in particular should ~~become the dominant focus of~~**guide** decisions about how to ~~improve~~ **meet these standards for** fish passage through the hydrosystem:

- ***protect biodiversity*** -- passage solutions must be designed to benefit the range of species, stocks and life-history types in the river, which may require multiple passage solutions at a project, and

- ***favor passage solutions that best fit natural behavior patterns and river processes*** -- the best passage solutions are those that take into account and work with the behavior and ecology of the species and life-history types using the river system, that mimic the natural situations and processes that emigrating salmonids encountered in their evolutionary history.

The two principles are linked. Technologies that most closely approximate the natural physical,chemical and biological conditions of migration would seem most likely to accommodate diverse species/stocks.

The Corps of Engineers and other federal agencies in the region that participate in decisions on mainstem passage modifications must take into account these **standards and** principles to the fullest extent practicable at every stage of considering and deciding upon passage improvements. The Council recommends that these agencies ensure that their decision-making processes and criteria are consistent with the principles stated here. This means developing project ranking criteria and budget decision explanations that are responsive to all of the principles, especially the two core themes of protecting

biodiversity and designing passage solutions that favor natural behavior patterns and river processes. Most important, passage standards, objectives, designs and evaluations should all focus on protecting the wide array of species and life history types in the river, not just the weighted average or most abundant species, and must ultimately be related to increases in adults back to the spawning grounds, not just the survival of juveniles (or adults) through the federal Columbia River hydropower system.

For these reasons, the Council requests that the Corps of Engineers, working within the regional prioritization process, report to the Council and the region on how the prioritization criteria and other decision-making standards for passage improvements are being revised to be consistent with the principles here. To further the implementation of these principles, the Council:

- Expects that the Independent Scientific Review Panel (ISRP) **and Independent Scientific Advisory Board** will apply the **standards and** principles during the Panel's **and Board's** review of the reimbursable portion of the Bonneville fish and wildlife budget, which includes the Corps' **capital construction and** passage program;
- Will itself apply these standards in its review of any ISRP report and resulting recommendations to Congress on these passage budget items; and
- Will recommend to Congress, in its reimbursable budget recommendations, that budget requests from the Corps of Engineers be evaluated for consistency with these principles.

(c) Standards for water and hydrosystem management (including flow augmentation, spill, dissolved gas management, system configuration and optimizing power and non-power objectives)

~~[To be developed following further consultation. Where practicable, the program will include specific performance standards.]~~

Hydrosystem Overview

The presence, configuration and operation of the FCRPS is primarily responsible for the decline of migrating, rearing and spawning salmon, steelhead and Pacific Lamprey. For example, NMFS has documented juvenile fall chinook mortality as high as 62-99% and adult fall chinook mortalities as high as 39% through the FCRPS (NMFS 1995). The following actions are directed to substantially reduce the direct mortality rate to salmon in the mainstem Columbia and Snake River basins. These actions are also intended to reduce the substantial indirect mortality suffered by juvenile and adult salmon from the hydrosystem and the hydrosystem's impact on critical mainstem habitat in an effort to increase overall stock production and diversity.

The federal operators should remain cognizant that they have other responsibilities to protect salmon and other anadromous fish other than under the Endangered Species Act. The Fish and Wildlife Coordination Act, the Northwest Power Act, the *US-Canada Salmon Treaty* and treaties with the CRITFC tribes all require that the operators pursue and address these actions for river operations. Neither the opinion of the federal fisheries agencies nor the NMFS Adaptive Management Process (i.e. "Regional Forum") can substitute for these responsibilities. The tribes ask the federal operators to implement the following actions to fully protect, mitigate and enhance tribal treaty resources. Implementation of the actions is vital to the treaty tribes as part of the federal government's trust responsibility to shift the inequitable conservation burden away from tribal harvest and to assist tribal members in beginning to increase their standard of living and health to levels enjoyed by non-tribal peoples.

The hydrosystem should be operated and configured to:

1. **Maximize in-river juvenile anadromous fish survival and health consistent with flows and dam and reservoir operations established in the CRITFC 2000 and 2002 River Operations Plans (Attachments 1 and 2~~ppendix __~~);**
2. **Maximize adult anadromous fish health, survival and spawning capacity;**
3. **Maintain, protect and enhance currently healthy natural riverine conditions and habitat; and**
4. **Restore, rebuild and reclaim such conditions and habitat where they have been altered or destroyed**

To satisfy the above criteria, incorporate the following measures in hydrosystem operations and management:

Mainstem Flows- Normative River Hydrograph Concept

Runoff and storage volumes should be managed to more closely approximate the natural, historic river hydrograph (Williams et al. 1996). A normative river hydrograph promotes physical and chemical parameters necessary for anadromous fish production. For example, turbidity regimes set by a peaking hydrograph have been shown to enhance anadromous fish production in the mainstem (Junge and Oakley 1966) and estuary (Bottom and Jones 1990; Maser et al. 1988). A peaking hydrograph also transports large woody debris and inorganic and organic sediment creating habitat diversity and a base for primary and secondary invertebrate production (Lisle 1986; McMahon and Holby 1992; Johnson et al. 1995). Biodiversity is best protected in rivers with natural flow regimes (Power et al. 1996).

The normative river hydrograph concept includes meeting flow objectives at each of the main river points- Lower Granite, Priest Rapids and The Dalles, [3] while retaining water in storage reservoirs to meet integrated rule curves and other biological criteria. The concept relies on flexibility in flood control, flow augmentation from Non-Treaty storage and purchase of flood control space, and appropriate contributions from irrigation withdrawals.

The flat, target flow concept currently employed by the federal government does not adequately protect migrating anadromous fish through the mainstem, nor does it promote ecological diversity or establishment and enhancement of critical habitat functions and values. RPA 1 (1995-1998 FCRPS Opinion as modified by the 1998 FCRPS Supplemental Opinion and the 2000 FCRPS Opinion) spring seasonal targets were not met for one of two years at Priest Rapids Dam (135 kcfs) (FPC 1996, FPC 1997; FPC 1998). NMFS (1995g FCRPS Biological Opinion) noted that these flow targets were the minimum necessary to avoid juvenile mortality. Additional mortality to non-listed juvenile salmon is associated with these flow conditions.

For example, in 1998, federal operators failed to meet the 135 thousand feet per second (kcfs) target flow at Priest Rapids. This resulted from the loss and non-replacement of about 0.8 million acre feet (MAF) of storage at Grand Coulee and caused significant fluctuation in flows. While to date, only one unconfirmed steelhead redd in the Hanford Reach may have been desiccated, these fluctuations likely caused the mortality of millions of juvenile fall chinook by stranding and entrapment in the Hanford Reach (P.Wagner WDFW personal communication 1999). Consultations were not reinitiated to address these circumstances. The opinions target flows of 220-260 kcfs at McNary Dam, 100 kcfs at Lower Granite Dam and 135 kcfs at Priest Rapids Dam are based upon the spring migration season as defined by the biological opinions. This is April 10-June 20 of each year[4]. If the averaged flows over the course of the season have met, then the target flow requirement in the opinions has been met.

Thus, flows during the season can remain significantly below the target for a substantial period of time. There is a strong relationship between flows and salmon

[3] The Dalles is appropriately the index point because it has been *the* lower Columbia point where flows have been measured since the 1800s. The use of McNary Dam as a downstream index point is not appropriate because storage and power operations in the John Day pool perturb flows below John Day. These perturbations that are counter to a normative hydrograph in the lower Columbia and estuary are not evident if McNary is used as the lower river index point.

[4] These dates are defined in the opinion as "planning dates". However, decisions to implement flows are made by the NMFS and federal operators in the Technical Management Team. The record indicates that since the 1995-1998 FCRPS opinion, despite the strong recommendations of the tribes and state agencies to implement flows outside the planning periods, flows to meet the opinion targets have never been made available for listed salmon outside of the planning periods. This has occurred even when substantial numbers of listed spring chinook were found migrating in the river (FPC 1995-1998).

productivity. Higher flows and attendant spill have been demonstrated to reduce juvenile mortality and increase smolt-to-adult returns (Petrosky 1991; Petrosky 1992; Petrosky and Schaller 1998). This was the case in the lower Snake River in 1999 as flows at Lower Granite dropped to nearly 80 kcfs in May during the peak of the spring and summer chinook migrations (DART 1999).

In 1999 and most other years, the onset of the spring migration occurs well before April 10. For example, in 1999, thousands of listed and unlisted juvenile spring chinook migrants began to appear at Lower Granite Dam starting the last week in March (WDFW 1999). Flows at Lower Granite during this period until April 12 remained below 80 kcfs. In 1999, subyearling spring chinook salmon were found in purse seine sampling in the Lower Columbia the third week in March (Backman 1999 preliminary data).

For the years 1995-1998 under the RPA, average flows from McNary Dam have been reduced by about 30% from the last ten days in August to the first ten days in September (DART 1999). This compares unfavorably with a 4.3% reduction in flows from the last ten days in August to the first ten days in September for the period 1989-1993, which is prior to the opinions when the water budget was available (DART 1999). Based on the runoff forecast, technical experts of the tribes advised the NMFS to adopt a sliding scale normative hydrograph using the same flow volumes identified in the RPA (CRITFC 1998 Recommendations to the NMFS 1998 Supplemental Opinion). These flow recommendations would result in substantially increased flows during late summer critical periods for the listed species' juvenile and adult migrations. This recommendation was rejected by NMFS. In doing so, NMFS stated that the Technical Management Team, has the "capability and flexibility to make water management decisions" (p.III-7 1998 Opinion).[5]

Nor are the flows assured at all under the 2000 FCRPS Biological Opinion. BPA has defined "power emergency" as that which causes insufficiency for FCRPS system reliability and/or BPA financial solvency. However, as noted by Blumm and Rohlf (2001), it is not appropriate for BPA to attempt to use the emergency clause in the 2001 Opinion as a shield to protect BPA's financial sufficiency. [6] Further, as

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[5] The Technical Management Team (TMT) final decisions are ultimately made by the federal power operators. Since the onset of the FCRPS opinions, the TMT has never agreed to any additional flow or spill beyond the seasonal flow and spill RPAs.

[6] Blumm and Rolf (2001) note that " [i]t is possible that BPA may have believed there was a potential for an insufficiency. Such an interpretation would, however, give BPA virtually unfettered discretion to exempt itself from operational limits imposed by NMFS under the ESA, based solely on its determination of power system costs. That is precisely what a set of proposed principles for 2001 hydrosystem operations aimed to codify. But those principles were not in effect when BPA declared the emergencies in January and February. Moreover, the legal authority on which they rest is hardly clear, since they seem to conflict with the NMFS' most recent biological opinion on hydrosystem operations, approved in December 2000, does authorize deviations from prescribed water management operations "due to unforeseen power system, flood control, or other emergencies. . . . as

noted in the energy portion of these comments (Power Supply Considerations and Long Term Objectives and Strategies for the Mainstem), other financial options are available to the federal operators to assure that CRITFC recommended flows and spill are fully implemented.

In November 1999 and November 2000, concern for listed Lower Columbia chum salmon prompted NMFS to support higher flows of 150 kcfs from time of spawning to emergence of fry in March for chum that spawn below Bonneville Dam in November (Brown 1999). CRITFC analyses indicate that these flows will require 5-6 maf over CRITFC's recommended flows for chum of 125 kcfs. The water required to maintain winter flows at 150 kcfs has reduced the probability of refill of upper basin storage reservoirs for the 2000 and 2001 spring and summer salmon migrations. In conversations with CRITFC staff and in a letter to the federal operators (Brown 1999), NMFS has stated priority for Vernita Bar flows and refill of upper reservoirs for the 2000 migrations. Yet, operations for chum salmon and flood control have drained storage reservoirs again placing emerging Hanford fry and refill of storage reservoirs to the spring and summer targets at risk, as well as achieving spring target flows. In the 2001 spring period, Priest Rapids flows were less than one third of the Opinion's 135 kcfs target.

Williams et al. (1996) and Dodge et al. (1989) note that anadromous fish production in the Columbia Basin and in rivers worldwide were founded and sustained upon the spatial and temporal cues and trophic systems created by the physical and chemical environment characterized by a normative hydrograph. Cada et al.

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a last resort and should not be used in place of the long-term investments necessary to allow full, uninterrupted implementation of the required reservoir operations." The opinion allows water being stored for spring and summer flow augmentation to be drafted "[d]uring winter power system emergencies," subject to the promise that it "should be replaced as soon as possible, to the maximum extent. However, the opinion does not define what constitutes a "winter power system emergency." More details on operations under extraordinary circumstances are set forth in an interim protocol on emergency operations developed in September 2000 by the technical management team, the interagency body responsible for making management recommendations for hydrosystem operations. NMFS ' biological opinion subsequently endorsed this protocol, which distinguishes "emergencies" from "planned risks," cautioning that even an "extreme circumstance . . . is not necessarily an emergency even though it was sudden and urgent, and caused an immediate action to be taken." The protocol does recognize three categories of emergencies: "generation" emergencies, "transmission" emergencies, and "other" emergencies, but none of those categories fits easily within what might be termed BPA's declared "financial" emergency. The emergency clearly wasn't a "transmission" emergency caused by a transmission line failure. It might have been an "other" emergency, but the protocol defines such an emergency as "extenuating circumstances" outside the range of normal operations and threatening "catastrophic impact, physical damage, or failure to part of the physical power system." The examples the protocol gives to illustrate an "other" emergency/earthquakes, floods, barge or ship strandings, facility failures, chemical spills, train derailments, and terrorists acts,seem to describe a physical, not a financial, threat to the power system. Perhaps the BPA declaration satisfies the definition of a "generation" emergency, since that is "the *potential for* or actual insufficiency of electrical generations to satisfy electrical demand." Despite the lack of actual power,the Supreme Court's conclusion that federal agencies may not ignore ESA requirements because of economic cost concerns. The ESA does include a process for exempting agency actions, but BPA did not attempt to invoke these procedures."

(1994). These studies provide evidence of the linkage between flow, habitat accessibility and survival. Over 80% of the adults migrate through the mainstem after August 31. Since the implementation of flow regimes under the NMFS 1995 Biological Opinion, flows during this period have been significantly reduced from flow that occurred under the NWPPC water budget (CRITFC 1999).

***Performance Standardss*:**

The federal operators [7] shall :

- **Shape runoff and storage to create a normative hydrograph, with a peak that is timed to that of predevelopment runoff at each one of the three major river points: Lower Granite, Priest Rapids and The Dalles. The existing federal operating strategy of seasonal, flat target flows fails to protect salmon in the early portions of the emergence and migration periods before April 10 and after the planning date of August 31. Figure 1 illustrates the difference between the existing operations strategy of seasonal flat flows and the same volumes of water shaped to meet a normative hydrograph for an average runoff year of 100 MAF at The Dalles. Appendix 1; Figures 2-14 illustrate how existing storage can be shaped with runoff at specific points in the river to accomplish this recommendation.**

- **Achieve a peak hydrograph of at least 420 kcfs at The Dalles in average water years, and a sliding scale based on the January-July runoff at The Dalles in other water years. Achieve peak hydrographs at Lower Granite and Priest Rapids.**

- **Limit chum spawning, incubation and early emergence flows below Bonneville Dam to 125 kcfs.**

- **Maintain flows at the Hanford Reach at no more than 70 kcfs during daylight hours and nighttime moonlight hours of the adult bright fall chinook spawning period (approximately October 20- November 22).**

- **Assure, with the assistance of the Mid-Columbia PUDs, that Hanford fall chinook fry are provided with an increasing hydrograph from March 15- June 20 as measured on a daily basis.**

- **Modify flood control to provide for fish flows and reservoir refills and energy production.**

- **Pursue and secure financial options to assure that normative flows are implemented, even in low runoff and high energy cost cycles.**

[7] The federal operators include BPA, the Corps of Engineers and the Bureau of Reclamation

- Make available, on a real-time basis, runoff, reservoir storage, hydrological and system operating model results to tribes, and federal and state fish and wildlife agencies to enable timely and informed fish migration operational decisions.

The region must substantially modify its current flow management strategy that is based upon seasonal targets that are not met on a seasonal, weekly, and daily basis. The federal operators should reshape river runoff to a normative hydrograph as recommended by the ISG (1996) and CRITFC (1998; 2000), using state-of-the-art forecasting tools and a sliding scale appropriate for the runoff year. Table 1 below specifies peak flow levels at the three major index sites for low, medium and high flow years.

Table 1. Sliding Scale Normative Hydrograph Peak Flows

	Water Year (TDA Jan-July)		
Index Site	Low (52-84 MAF)	Medium (85-105 MAF)	High(>106 MAF)
The Dalles	336	420	504
Priest Rapids	249	300	360
Lower Granite	90	120	156

- Use a sliding scale flow augmentation target at The Dalles based on The Dalles April 1st, January through July volume runoff. For volume forecasts between 85 and 105 Maf, use Normative Flow values (see below). For volume forecasts above 105 Maf, use the 120% of the Normative Flows. For volume forecasts below 85 Maf, use 80% of the Normative Flows. The priority for releasing water from upstream reservoirs for flow augmentation is Grand Coulee, Libby and Hungry Horse.
- Use a sliding scale flow augmentation target at Priest Rapids based on the Rock Island April 1st, April through September volume runoff. For volume forecasts between 55 and 70 Maf, use the Normative Flow values. For volume forecasts above 70 Maf, use the 120% of the Normative Flows. For volume forecasts below 55 Maf, use 83% of the Normative Flows. The priority for releasing water from upstream reservoirs for flow augmentation is Grand Coulee, Libby & Hungry Horse.
- Use a sliding scale flow augmentation target at Lower Granite based on the Lower Granite April 1st, April through July volume runoff. For volume forecasts between 16 and 22 Maf, use the Normative Flow values. For volume forecasts above 22 Maf, use the 130% of the Normative Flows. For volume forecasts below 16 Maf, use 75% of the Normative Flows.

The planning date for the salmon migration period should be modified to begin on March 20, and end on September 30 as important life history components of listed

stocks (ie: subyearling and early yearling spring chinook; adult spring chinook migrating in the Snake and Mid and Lower Columbia River) are migrating at this time and need protection (Lichatowich *in* Williams et al. 1996). The federal operators should provide flows for these salmon based on Table 1.

Once the normative hydrograph is established for any particular year, the federal operators should meet recommended flow regimes on at least a weekly basis to fully protect the salmon resource.

Normative River Index Points

Table 1 describes CRITFC recommended flows for Priest Rapids and The Dalles for an average water year.[8]

Table 2. CRITFC Recommended Flows (in kcfs) for an Average Water Year to Create a Normative Hydrograph.

Flow (kcfs)	Lower Granite	Priest Rapids	The Dalles
January	30	70	125
February	40	70	125
March 1-15	40	70	130
March 16-31	50	90	150
April 1-15	70	140	220
April 16-30	80	170	270
May 1-15	100	240	370
May 16-31	120	260	390
June 1-15	110	300	420
June 16-30	90	275	380
July 1-15	50	240	300
July 16-31	45	195	250
August 1-15	40	175	220
August 16-31	40	150	195

[8] During July 16th through September 30th, CRITFC recommends that 1.75 MAF of Non-Treaty Storage be drafted from Mica. The inflow projections utilize Water Supply Forecast (WSF) volumes, subject to monthly updates, and 1-5 month climate forecasts provided by NOAA/National Weather Service. A weekly MRF analysis will be conducted once in-season management begins. This bi-monthly analysis should give the managers a sense of how this runoff season will unfold. This early analysis also points to trouble spots that the federal operators should take action to avoid water shortages later during summer. Specifically, flows at MCDB, ARDB, GCL, HGH, LIB, and DWR need to go to minimum immediately and hold through February.

Sept.1-15	35	130	170
Sept.16-30	30	95	130
October	20	80	110
November	30	70	125
December	30	70	125

Flood Control Flexibility

The Corps should relax and seek flexibility in rigid, overly conservative, flood control rule curves to recreate normative hydrographs, reclaim mainstem and estuarine floodplain habitat and assure that storage reservoirs meet biological criteria. Flood control flexibility will aid in establishing a normative hydrograph by allowing more reservoir storage and create additional critical habitat for anadromous fish production.

Flood peaks and floodplain habitat are the key factors regulating the existence and productivity of fish populations worldwide (Junk et al. 1989; Welcomme 1985; Ward and Stanford 1979; Ligon et al. 1995). Recent examination of the value of flood peaks and floodplain habitat have lead to breaching of dikes in the Mississippi River and the Florida Everglades. The ISAB recently noted the importance of modifying flood control to increase fish estuarine habitat in *Columbia River Estuary and Columbia River Fish and Wildlife Program (Report 200-5).*

RPA #1 (1995-1998 NMFS FCRPS Opinion) calls for the COE and Reclamation to evaluate flood control operations, including the utility of John Day drawdown, to gain flexibility in flows and other river operations for listed salmon. The COE's preliminary report, Variable Q (COE 1997), failed to address John Day drawdown (RPA #5, 1995-1998 Opinion) flood control and adjustments to system flood control that would result in significantly increased flows for listed salmon. The FCRPS 1998 Supplemental Opinion calls for a status report on these flood control actions by summer of 1998. To date, no status report has been completed.

The Variable Q report states that the Corps was authorized by Congress in 1950 and 1962 to provide protection to damage centers in the lower Columbia and Willamette rivers from flows up to 800 kcfs as measured at The Dalles, Oregon (Corps 1997). This authorization was based upon protection of the Congress authorized levee system that allows floods up to 800 kcfs to cover riparian areas (Corps 1997). The Corps, however, attempts to operate the Columbia River to a regulated flow of 450 kcfs at The Dalles (a control point of 330-350 kcfs) and protect developed floodplain areas that are not protected by federally authorized levees (Corps 1997). Thus, the Corps has no Congressional authorization to be operating the river to 450 kcfs at The Dalles. The Corps decision to eliminate tens of thousands of acres of critical steelhead and salmon habitat by this operation has

never been subject to environmental review or consultation with the tribes. Further, it has not been considered in either of the FCRPS Biological Opinions. Reduction and removal of floodplains from the river environment is perhaps the leading cause of the significant reduction or even elimination of fish populations in large river system worldwide (Dodge 1989).

In 1999, the Corps of Engineers extremely conservative flood control operations, that were not based upon state-of-the-art forecasting methods, caused a premature draft of the federal reservoirs from January through April (DeHart 1999). Cool weather in March and April caused a significant drop in runoff, and at the end of March, Hungry Horse was drafted *below* flood control elevation. Libby was drafted this period for flood control and power operations. Flood control operations at Dworshak Reservoir reduced reservoir volumes by 300-400 kaf that could have been used to meet opinion flow targets at Lower Granite in April and May (DeHart 1999).

The Corps has flood control authority over joint Reclamation reservoirs for 3.4 maf of active water storage and the Corps has and has similar authority for flood control in Dworshak reservoir for 2 maf of storage (Corps 1991; NMFS 1999). The Corps, in coordination with British Columbia Hydro has about 20.5 maf of flood storage in Canadian reservoirs under the *Columbia River Treaty* (Corps 1991). Further, the Corps has authority for about 13.3 maf of flood control in Hungry Horse, Libby and Grand Coulee reservoirs. Flexibility in flood control operations by using state-of-the-art forecasting tools provided by the National Weather Service would allow additional water to be stored in the winter months to make additional flows possible for spring and summer chinook.

According to CRITFC recent analyses using the NWPPC's state-of-the-art GENSYS hydro regulation model, in an average water year, between 1-3.5 million acre feet of water could be made available for spring and summer salmon migrations basin wide, by incorporating more flexible flood control management. The analyses show that the flexibility in flood control required to obtain the additional flows would not increase the probability of flooding downstream areas in all but the highest runoff years.

The CRITFC February 13, 2001 Regional Flood Control Workshop revealed a number of different state-of –the-art tools including advanced weather predictive forecasting tools, and ESP models capable of on-line demand forecasting that will soon be available. Better local control to restrict floodplain development is also necessary. Modification of flood control could have positive impacts on fish flows and energy generation, striking a more appropriate balance between competing river uses. The current flood control management policy by the Corps sends thousands of acre feet of water seaward at times when there is little fish or power benefit. The Council recommends that the Corps of Engineers expedite a review of flood control, in full coordination with the region's tribes and fishery agencies to be completed by December 2003.

Redline Version of Existing Program Language

Section 5

JUVENILE SALMON MIGRATION

Salmon and steelhead begin and end life in many diverse streams and tributaries throughout the Columbia River Basin, but they all eventually share one route. They must make their way down and ultimately back up the mainstems of the Columbia and Snake rivers as they go to and from their spawning beds. Between passages, they spend most of their adult lives in the Pacific Ocean.

Given that their unusual life cycle depends on a long river journey that can stretch hundreds of miles, it is clear that safe passage is paramount to their survival. Downstream passage is especially dangerous for juveniles because of the effects of dams and slow-moving reservoirs, such as turbine, bypass and spill-related mortalities, predation, migration delays and high water temperatures. The fish are on a biological time clock. To reach the ocean safely, the spring migrants must complete their downstream journey quickly. **The *Return to the River* also describes the important resting, rearing, and spawning functions in the mainstem. As juveniles migrate, they need nourishment, a place to rest and rear, and protection from predators. These functions are essential to the survival of migrating salmon and steelhead.**

Development of the dams has greatly altered the natural flows and cross-sectional areas of rivers in the basin. The spring runoff is stored in reservoirs so it can be used to produce electricity, as well as to provide for irrigation, transportation, recreation and flood control throughout the year. However, this practice and others also reduce river flows, particularly during the spring when juvenile salmon and steelhead are migrating downstream to the ocean.

The combination of reduced flows and the greater cross-sectional area of the river due to reservoir storage slows the juvenile fish as they migrate to the ocean. An increase in travel time in the river affects the migratory behavior of juvenile fish and increases their exposure to predatory fish and birds. Reduced flows also endanger juvenile salmon by raising water temperatures, altering water chemistry and increasing susceptibility to disease.

The reservoirs have also eliminated much of the mainstem riparian habitat that is critical to survival of migrating salmon and steelhead. In addition, the operation of the hydroelectric system causes daily fluctuations of the reservoirs and river segments. These fluctuations cause stranding and reduce the ability of the ecosystem to produce nutrients for the food web.

The physical problems faced by salmon and steelhead have been compounded by the diversity of the parties involved in the river basin's management. Even with major efforts to increase the amount of water for salmon and steelhead, matching water supplies with the needs of spring and summer migrating fish poses a substantial problem of analysis and coordination.

From the start in 1982, the Council's program recognized and focused on the importance of improving mainstem survival for both smolts and returning adult salmon. However, in recent years, the problem has been exacerbated by a series of low water years, caused primarily by drought conditions in the southern and eastern parts of the basin. The Snake River Basin has been particularly dry. It is believed that this drought contributed significantly to a reversal in the increases in run sizes observed in the early 1980s.

To increase salmon survival in the mainstem, the approach must be multifaceted. Flows and reduced water temperatures alone are not sufficient. Control of predation, improved ~~and/or new fish transportation methods and completion of programs to install and upgrade screens at both~~**passge at** the dams and **installation of proper screens at** all unscreened water diversions are all vital to successful mainstem passage.

When it first addressed these problems in 1982, the Council developed a "water budget" to be used between April 15 and June 15. The water budget is a block of water set aside for fish and released during the spring runs to create an artificial freshet that speeds juvenile fish to the ocean. Separate water budgets were established for measurement at Priest Rapids Dam on the Columbia River and Lower Granite Dam on the Snake River, both in Washington. **Under the water budget, all anadromous fish stocks under the Council Program were afforded flow augmentation.**

Through the use of the water budget, the fish and wildlife agencies and tribes could increase spring flows to aid the downstream migration of juveniles. The Council established a schedule of firm power flows for the April 15 to June 15 period to provide a base from which to measure water budget use. (Firm power is the electricity that the hydropower system guarantees it can produce. That guarantee was premised on the assumption that this amount of hydropower is available even in historic low, or "critical," water conditions.) The water budget may be used to implement any flow schedule that would ensure juvenile salmon survival, provided the flows allow existing firm non-power commitments, such as flood control, to be met.

The Columbia River Inter-Tribal Fish Commission contributed an important element to the development of the water budget by pointing out that optimum flows for downstream migration are only needed when the fish are present. Recognition of this factor led to the concept of "shaping" fish flows, which in turn led to the concept of a specified volume of water rather than specified flow levels. This volume of water, to be shaped by the fish and wildlife agencies and tribes, became the water budget. **Unfortunately, in low flow years the water budget was not met.**

To improve coordination between fish and power interests, the Council called for two coordinators known as "fish passage managers" (originally called water budget managers).One was appointed by the basin's fish and wildlife agencies and one selected by a majority of Columbia River Basin tribes. The agencies and tribes are now operating with a single fish passage manager. The Council provides a fish passage advisor on its staff to review the operation of the water budget, advise the Council on all matters related to the water budget and assist the Council in resolving water budget disputes.

The Council called for a study of the water budget's biological effects, including reductions in smolt travel time, improvements in smolt survival and impacts on the power system. In 1987, the fish and wildlife program was modified to encourage experimentation with and evaluation of alternatives for implementing the water budget.

In 1991 and 1992, with new data showing continuing declines in wild stocks, the Council adopted two kinds of measures to supplement the earlier water budget volumes. The first was a set of immediate measures that could be implemented in time for the 1992 fish migration. Second, recognizing that these immediate measures are inadequate to rebuild some weak populations, the Council identified a set of intermediate-term measures.

In 1994 the Council adopted additional measures to improve mainstem survival. These measures included drawdowns at the Snake River and John Day dams, and significant additional water from Idaho and Canada to increase travel time. Unfortunately, these measures have not been implemented.

In this rulemaking, the Council has concluded that **significant** additional actions to improve mainstem survival of migrating salmon must be taken. Analyses conducted by the **fishe ry managers through the peer-reviewed PATH process showed that the status quo has a very low probability of meeting the survival and recovery measures established by the National Marine Fisheries Service. The status quo has no chance of fulfilling Treaty obligations to Columbia Basin tribes. The PATH analysis also shows that the modification of Snake River Dams to natural river conditions and drawdown of John Day Dam have a very high likelihood of meeting survival and recovery standards and making progress toward tribal Treaty rights. These measures will also provide significant progress toward meeting the Clean Water Act standards for gas supersaturation and temperature. Other modeling by the National Marine Fisheries Service through CRI indicates a high likelihood of extinction for a number of Columbia and Snake Basin stocks unless there are significant improvements in migration survival and the creation of additional mainstem spawning habitat.** ~~Council indicate that, absent additional action and a substantial change in ocean conditions, salmon populations in the Snake Basin will not rebuild and will, in all likelihood, go extinct. This conclusion is consistent with that reached by the Council in developing its 1992~~

~~salmon strategy. In that rulemaking, the Council put in place a number of immediate survival improvements, while acknowledging that the measures would be insufficient to protect all weak populations or rebuild salmon populations to levels specified in the Council's goals.~~

The urgency of action has only been heightened by the exceedingly poor returns of the ~~past two~~**ten** years~~ and the even worse projections for the coming several years~~. These constitute historical low numbers in the population and raise the specter of extinction. While it appears clear that a portion -- perhaps a substantial portion -- of the most recent declines can be attributed to poor ocean survival conditions and the effects of a persistent drought in the region, the Council is persuaded that a sound salmon rebuilding program must be able to withstand periodically adverse natural circumstances. The salmon runs were able to survive poor natural conditions in the past and would be able to survive in today's conditions but for a wide variety of human-caused sources of mortality. These mortalities must be reduced. Doing so will require additional action directed toward restoring the ecological health of the Columbia River ecosystem.

These additional actions are detailed below and are tied to an explicit adaptive management approach that will ensure careful monitoring and evaluation of impacts so mid-course corrections can be made. The Council believes, on the basis of the best available scientific information, that these actions are likely to improve the survival of anadromous fish and that immediate survival improvements are needed or important components of the salmon runs will likely be lost to extinction. Flow and velocity improvements are called for on the basis of agency, tribal and other scientific information on the reasonableness of the relationship between flow, migration speed and salmon survival. **Increases in mainstem spawning, resting, and rearing habitat are based on the work of the Independent Science Advisory Committee in *Return to the River*.** While the relationship is not precisely known, and is attended by much debate, the Council concurs with the Oak Ridge National Laboratory **and the National Marine Fisheries Service** review**s** and believes that a positive characterization of this relationship is reasonable, and merits pursuit through a variety of actions contained in this program.

At the same time, the Council explicitly acknowledges the biological uncertainties associated with the complex ecosystem needs of the salmon and is vitally interested in seeing the level of understanding and the quality of scientific information improved expeditiously. Accordingly, the Council has established a means whereby the region can proceed with actions that appear reasonably likely to improve survival in a significant way while providing the opportunity to learn more about the biological needs of the salmon.

Further, the Council has included a number of measures to protect resident fish populations from excessive power operations or anadromous fish operations of the hydroelectric system that could undermine resident fish.

~~In the 1991-93 amendment process and the 1994 amendment process, the fish and wildlife agencies and tribes recommended several objectives related to hydroelectric project operations. Specifically:~~

- ~~The fish managers' recommendations reflect a fairly broad consensus that flows (or equivalent velocities) of 140,000 cubic feet per second in the Snake River and 300,000 cubic feet per second in the Columbia River would improve salmon survival rates, but concerns were raised about impacts on resident fish.~~

- ~~There were strong recommendations for an 80 percent fish passage efficiency objective for measures to reduce fish mortalities at the projects.~~

- ~~There were recommendations to control summer and early fall temperatures in the rivers to improve the survival of returning fall adult chinook salmon.~~

- The Columbia River Inter-Tribal Fish Commission recommended that the hydropower facilities be managed to achieve 120,000 cubic feet per second in the Columbia River in September.

- The Montana Department of Fish, Wildlife and Parks and the Salish-Kootenai Tribe recommended "integrated rule curves" to protect environmental conditions for resident fish and wildlife at storage reservoirs in Montana. Reservoir constraints were also proposed for Lake Pend Oreille and Grand Coulee.

Commentors expressed a variety of concerns about these objectives. For example, the Upper Columbia United Tribes and the Colville Tribe opposed flow augmentation on the order of 140,000/300,000 cubic feet per second, because of the effects it could have on resident fish in Grand Coulee. At the same time, Montana's integrated rule curves show that operating the hydropower system to protect resident fish and other reservoir values may mean more water for flow augmentation downstream. Idaho Department of Fish and Game also urged caution in augmenting flows for salmon, potentially at the expense of riverine resident fish and wildlife. To take another example, if stored water must be released to control summer temperatures when they are above 62 degrees, spring flow augmentation may have to be reduced to ensure that sufficient cold water is available later for temperature control. There are other examples -- river analysis shows that in some water years summer flow objectives may conflict with spring flow objectives -- but the point is obvious. It is not clear when and how these objectives can be achieved, particularly in low water years, and particularly when the basin experiences a succession of low water years, as the last six or seven have been.

The recommendations described above are for operational objectives. Each operational objective must have a biological objective. Some commentors were skeptical that these operational objectives would produce the survival benefits suggested by the objectives' proponents. Giving due weight to the authorities, expertise and rights of the fish and wildlife agencies and Indian tribes, and considering the independent review conducted by the Council's consultant, Dr. G.F. Cada,[19] the Council accepts the agencies' and tribes' judgment on the expected biological value of these operational objectives. This is not to say that the Council accepts these judgments conclusively. The scientific data are not clear, and there are genuine disagreements among capable scientists on these matters.

One of the issues raised in connection with these objectives is whether the region will be assured of an "adequate, efficient, economical and reliable power" supply if the hydropower system is managed to meet fish and wildlife objectives. The Council has made findings on this issue in Section 1 of the program. However, these questions require further exploration for the longer term.

With this in mind, four general observations are important here:

First, for the near term, it is not clear when and how mainstem fish and wildlife objectives can be achieved along with the other authorized purposes of the hydropower system. The measures below make it considerably more likely that the region can achieve these objectives, or their velocity equivalents, recognizing that they may not be achievable in some years, especially in the near term. Inevitably, determining to what extent these objectives can be met in any given year will require careful annual planning and in-season management.

Second, beyond the near term, the Council and the region must continue to make changes in the hydroelectric system to make fish and wildlife objectives more achievable and to minimize

[9] Cada, G.F., et al., 1994. Review of information pertaining to the effect of water velocity on the survival of juvenile salmon and steelhead in the Columbia River basin. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

the need for or impacts of tradeoffs among objectives, while carrying out the purposes of the Northwest Power Act.

Third, the region must evaluate the biological assumptions that underlie these operational objectives to see if changed river operations are achieving the expected biological benefits. The questions detailed in the Council's mainstem hypotheses, for example, must be investigated expeditiously through an adaptive management strategy. As new information emerges, the region must be prepared to adjust these operational objectives.

Fourth, the Council will work with Bonneville, the fishery managers, utilities and others to assure the continuing adequacy, efficiency, affordability and reliability of the region's power supply. ~~In 1995-96, the Council will conduct a revision of the power plan that will address these issues more thoroughly.~~

The measures outlined below are the Council's prescription for carrying out these courses of action. Each measure or group of measures, including operational objectives, is accompanied by a statement of the measure's biological objective, which was explicit or clearly implicit in the original recommendations and in the Council's proposed amendments.

Performance Standards for Mainstem Passage and Habitat

5. **Restore normative river conditions to provide spawning, resting, and rearing habitat for salmon and steelhead in the mainstem of the Columbia and Snake Rivers by 2006.**

5.1 **Provide 9,000 acres of spawning habitat for Snake River fall chinook by 2006.**

5.2 **Provide 40 miles of fluvial spawning habitat for mid-Columbia fall chinook core populations identified by the Independent Science Advisory Board in *Return to the River* by 2008.**

5.3 **Provide a mainstem hydrograph that resembles the shape of the normative hydrograph.**

6. **Ensure 80 percent Fish Passage Efficiency between 2001 and 2004, and 90 percent Fish Passage Efficiency after 2004. Fish Passage efficiency is defined as passage through a hydroelectric project by non-power house routes.**

7. **Meet the gas supersaturation and temperature standards under the Clean Water Act.**

8. **Eliminate stranding and other problems associated with fluctuation of the hydroelectric system.**

9. **Reduce the travel time for migrating salmon and steelhead while protecting resident fish.**

Biological Objectives for Mainstem Passage and Habitat

1. **Increase Smolt to Adult Return rates to 4-6 percent for Snake River and Upper Columbia salmon and steelhead by 2008.**

2. **Reduce pre-spawning mortality by 50 percent by 2006.**

Implementation of these performance standards and biological objectives should favor passage solutions that best fit natural behavior patterns and river processes--the best passage solutions are those that take into account and work with the behavior and ecology of the species and life-history types using the river system. The life history types that now use the river system are not necessarily all of those that would be desirable in a restored system. To the extent that significant life-history types have been lost through watershed degradation and alteration of the mainstem passage conditions, future mainstem passage conditions should not simply be attuned to matching the needs of those life history characteristics that have managed to adapt to adverse conditions.

The following strategies are designed to achieve the Performance Standards and Biological Objectives. They are necessary to meet survival rates for anadromous fish at each different life stage as expressed in *Wy-Kan-Ush-Mi Wa-Kish-Wit.* The key to accomplishing the tribal vision for basin-wide anadromous fish restoration is achieving survival rates for each life history stage that are expressed by tribal strategies in *Wy-Kan-Ush-Mi Wa-Kish-Wit.* Adaptive management of different strategies and actions with increased scientific knowledge are also important elements to realize the tribal vision.

Mainstem Passage and Habitat Strategies

- **Emphasize healthy rivers and watersheds with abundant and diverse species assemblages and their management, maintenance and restoration, with particular attention to ecosystem diversity, productivity and stability**

- **Emphasize natural production provided by such rivers and watersheds**

- **Reintroduce and restore anadromous fish to the rivers and streams that historically supported them, in numbers sufficient to provide for the needs of the ecosystem and people, in perpetuity.**

Actions

Hydrosystem Overview

The presence, configuration and operation of the FCRPS is primarily responsible for the decline of migrating, rearing and spawning salmon, steelhead and Pacific Lamprey. For example, NMFS has documented juvenile fall chinook mortality as high as 62-99% and adult fall chinook mortalities as high as 39% through the FCRPS (NMFS 1995). The following actions are directed to substantially reduce the

direct mortality rate to salmon in the mainstem Columbia and Snake River basins. These actions are also intended to reduce the substantial indirect mortality suffered by juvenile and adult salmon from the hydrosystem and the hydrosystem's impact on critical mainstem habitat in a effort to increase overall stock production and diversity.

The federal operators should remain cognizant that they have other responsibilities to protect salmon and other anadromous fish other than under the Endangered Species Act. The Fish and Wildlife Coordination Act, the Northwest Power Act, the *US-Canada Salmon Treaty* and treaties with the CRITFC tribes all require that the operators pursue and address these actions for river operations. Neither the opinion of the federal fisheries agencies nor the NMFS Adaptive Management Process can substitute for these responsibilities. The tribes ask the federal operators to implement the following actions to fully protect tribal treaty resources. Implementation of the actions is vital to the treaty tribes as part of the federal government's trust responsibility to shift the inequitable conservation burden away from tribal harvest and to assist tribal members in beginning to increase their standard of living and health to levels enjoyed by non-tribal peoples.

The hydrosystem should be operated and configured to:

5. **Maximize in-river juvenile anadromous fish survival and health consistent with flows and dam and reservoir operations established in the CRITFC 2000 River Operations Plan (Appendix __);**
6. **Maximize adult anadromous fish health, survival and spawning capacity;**
7. **Maintain, protect and enhance currently healthy natural riverine conditions and habitat; and**
8. **Restore, rebuild and reclaim such conditions and habitat where they have been altered or destroyed**

To satisfy the above criteria, incorporate the following measures in hydrosystem operations and management:

Mainstem Flows- Normative River Hydrograph Concept

Runoff and storage volumes should be managed to more closely approximate the natural, historic river hydrograph (Williams et al. 1996). A normative river hydrograph promotes physical and chemical parameters necessary for anadromous fish production. For example, turbidity regimes set by a peaking hydrograph have been shown to enhance anadromous fish production in the mainstem (Junge and Oakley 1966) and estuary (Bottom and Jones 1990; Maser et al. 1988). A peaking

hydrograph also transports large woody debris and inorganic and organic sediment creating habitat diversity and a base for primary and secondary invertebrate production (Lisle 1986; McMahon and Holby 1992; Johnson et al. 1995). Biodiversity is best protected in rivers with natural flow regimes (Power et al. 1996).

The normative river hydrograph concept includes meeting flow objectives at each of the main river points- Lower Granite, Priest Rapids and The Dalles, [10] while retaining water in storage reservoirs to meet integrated rule curves and other biological criteria. The concept relies on flexibility in flood control, flow augmentation from Non-Treaty storage and purchase of flood control space, and appropriate contributions from irrigation withdrawals.

The flat, target flow concept currently employed by the federal government does not adequately protect migrating anadromous fish through the mainstem, nor does it promote ecological diversity or establishment and enhancement of critical habitat functions and values. RPA 1 (1995-1998 FCRPS Opinion as modified by the 1998 FCRPS Supplemental Opinion) spring seasonal targets were not met for one of two years at Priest Rapids Dam (135 kcfs) (FPC 1996, FPC 1997; FPC 1998). NMFS (1995g) noted that these flow targets were the minimum necessary to avoid juvenile mortality. Additional mortality to non-listed juvenile salmon is associated with these flow conditions.

For example, in 1998, federal operators failed to meet the 135 thousand feet per second (kcfs) target flow at Priest Rapids. This resulted from the loss and non-replacement of about 0.8 million acre feet (MAF) of storage at Grand Coulee and caused significant fluctuation in flows. While to date, only one unconfirmed steelhead redd in the Hanford Reach may have been desiccated, these fluctuations caused the mortality of millions of juvenile fall chinook by stranding and entrapment in the Hanford Reach (WDFW 1999). Consultations were not reinitiated to address these circumstances. The opinions target flows of 220-260 kcfs at McNary Dam, 100 kcfs at Lower Granite Dam and 135 kcfs at Priest Rapids Dam are based upon the spring migration season as defined by the biological opinions. This is April 10-June 20 of each year[11]. If the averaged flows over the course of the season have met, then the target flow requirement in the opinions has been met.

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[10] The Dalles is appropriately the index point because it has been *the* lower Columbia point where flows have been measured since the 1800s. The use of McNary Dam as a downstream index point is not appropriate because storage and power operations in the John Day pool perturb flows below John Day. These perturbations that are counter to a normative hydrograph in the lower Columbia and estuary are not evident if McNary is used as the lower river index point.

[11] These dates are defined in the opinion as "planning dates". However, decisions to implement flows are made by the NMFS and federal operators in the Technical Management Team. The record indicates that since the 1995-1998 FCRPS opinion, despite the strong recommendations of the tribes and state agencies to implement flows outside the planning periods, flows to meet the opinion targets have never been made available for listed salmon outside of the planning periods. This has occurred even when substantial numbers of listed spring chinook were found migrating in the river (FPC 1995-1998).

Thus, flows during the season can remain significantly below the target for a substantial period of time. There is a strong relationship between flows and salmon productivity. Higher flows and attendant spill have been demonstrated to reduce juvenile mortality and increase smolt-to-adult returns (Petrosky 1991; Petrosky 1992; Petrosky and Schaller 1998). This was the case in the lower Snake River in 1999 as flows at Lower Granite dropped to nearly 80 kcfs in May during the peak of the spring and summer chinook migrations (DART 1999).

In 1999 and most other years, the onset of the spring migration occurs well before April 10. For example, in 1999, thousands of listed and unlisted juvenile spring chinook migrants began to appear at Lower Granite Dam starting the last week in March (WDFW 1999). Flows at Lower Granite during this period until April 12 remained below 80 kcfs. In 1999, subyearling spring chinook salmon were found in purse seine sampling in the Lower Columbia the third week in March (Backman 1999).

For the years 1995-1998 under the RPA, average flows from McNary Dam have been reduced by about 30% from the last ten days in August to the first ten days in September (DART 1999). This compares unfavorably with a 4.3% reduction in flows from the last ten days in August to the first ten days in September for the period 1989-1993, which is prior to the opinions when the water budget was available (DART 1999). Based on the runoff forecast, technical experts of the tribes advised the NMFS to adopt a sliding scale normative hydrograph using the same flow volumes identified in the RPA (CRITFC 1998 Recommendations to the NMFS 1998 Supplemental Opinion). These flow recommendations would result in substantially increased flows during late summer critical periods for the listed species' juvenile and adult migrations. This recommendation was rejected by NMFS. In doing so, NMFS stated that the Technical Management Team, has the "capability and flexibility to make water management decisions" (p.III-7 1998 Opinion).[12]

In November 1999, concern for newly listed Lower Columbia chum salmon prompted NMFS to support higher flows of 150 kcfs from time of spawning to emergence of fry in March for chum that spawn below Bonneville Dam in November (Brown 1999). CRITFC analyses indicate that these flows will require 5-6 maf over CRITFC's recommended flows for chum of 125 kcfs. The water required to maintain winter flows at 150 kcfs could reduce the probability of refill of upper basin storage reservoirs for the 2000 spring and summer salmon migrations. In conversations with CRITFC staff and in a letter to the federal operators (Brown 1999), NMFS has stated priority for Vernita Bar flows and refill of upper reservoirs for the 2000 migrations. Yet, operations for chum salmon and flood control have

[12] The Technical Management Team (TMT) final decisions are ultimately made by the federal power operators. Since the onset of the FCRPS opinions, the TMT has never agreed to any additional flow or spill beyond the seasonal flow and spill RPAs.

drained storage reservoirs again placing emerging Hanford fry and refill of storage reservoirs to the summer target at risk.

Williams et al. (1996) and Dodge et al. (1989) note that anadromous fish production in the Columbia Basin and in rivers worldwide were founded and sustained upon the spatial and temporal cues and trophic systems created by the physical and chemical environment characterized by a normative hydrograph. Cada et al. (1994). These studies provide evidence of the linkage between flow, habitat accessibility and survival. Over 80% of the adults migrate through the mainstem after August 31. Since the implementation of flow regimes under the NMFS 1995 Biological Opinion, flows during this period have been significantly reduced from flow that occurred under the NWPPC water budget (CRITFC 1999).

***Measures*:**

The federal operators [13] shall :

- **Shape runoff and storage to create a normative hydrograph, with a peak that is timed to that of predevelopment runoff at each one of the three major river points: Lower Granite, Priest Rapids and The Dalles. The existing federal operating strategy of seasonal, flat target flows fails to protect salmon in the early portions of the emergence and migration periods before April 10 and after the planning date of August 31. Figure 1 illustrates the difference between the existing operations strategy of seasonal flat flows and the same volumes of water shaped to meet a normative hydrograph for an average runoff year of 100 MAF at The Dalles. Appendix 1; Figures 2-14 illustrate how existing storage can be shaped with runoff at specific points in the river to accomplish this recommendation.**

- **Achieve a peak hydrograph of at least 420 kcfs at The Dalles in average water years.**

- **Limit chum spawning, incubation and early emergence flows below Bonneville Dam to 125 kcfs.**

- **Maintain flows at the Hanford Reach at no more than 70 kcfs during daylight hours and nighttime moonlight hours of the adult bright fall chinook spawning period (approximately October 20- November 22).**

    - **Assure, with the assistance of the Mid-Columbia PUDs, that Hanford fall chinook fry are provided with an increasing hydrograph from March 15-June 20 as measured on a daily basis.**

[13] The federal operators include BPA, the Corps of Engineers and the Bureau of Reclamation

The region must substantially modify its current flow management strategy based upon seasonal targets that are not met on a weekly and daily basis. The federal operators should reshape river runoff to a normative hydrograph as recommended by the ISG (1996) and CRITFC (1998; 2000), using state-of-the-art forecasting tools and a sliding scale appropriate for the runoff year. The sliding scale (Table 1) was previously presented in the preceeding section.

The planning date for the salmon migration period should be modified to begin on March 20, and end on September 30 as important life history components of listed stocks (ie: subyearling and early yearling spring chinook; adult spring chinook migrating in the Snake and Mid and Lower Columbia River) are migrating at this time and need protection (Lichatowich *in* Williams et al. 1996). The federal operators should provide flows for these salmon based on Table 1.

Once the normative hydrograph is established for any particular year, the federal operators should meet recommended flow regimes on at least a weekly basis to fully protect the salmon resource.

Normative River Index Points

Tables 1 and 2 describe CRITFC recommended flows and normative river index points for Priest Rapids and The Dalles for an average water year.[14]

Flood Control Flexibility

The Corps should relax and seek flexibility in rigid, overly conservative, flood control rule curves to recreate normative hydrographs, reclaim mainstem and

[14] During July 16th through September 30th, CRITFC recommends that 1.75 MAF of Non-Treaty Storage be drafted from Mica. The inflow projections utilize Water Supply Forecast (WSF) volumes, subject to monthly updates, and 1-5 month climate forecasts provided by NOAA/National Weather Service. A weekly MRF analysis will be conducted once in-season management begins. This bi-monthly analysis should give the managers a sense of how this runoff season will unfold. This early analysis also points to trouble spots that the federal operators should take action to avoid water shortages later during summer. Specifically, flows at MCDB, ARDB, GCL, HGH, LIB, and DWR need to go to minimum immediately and hold through February.

estuarine floodplain habitat and assure that storage reservoirs meet biological criteria. Flood control flexibility will aid in establishing a normative hydrograph by allowing more reservoir storage and create additional critical habitat for anadromous fish production.

Flood peaks and floodplain habitat are the key factors regulating the existence and productivity of fish populations worldwide (Junk et al. 1989; Welcomme 1985; Ward and Stanford 1979; Ligon et al. 1995). Recent examination of the value of flood peaks and floodplain habitat have lead to breaching of dikes in the Mississippi River and the Florida Everglades.

RPA #1 (1995-1998 NMFS FCRPS Opinion) calls for the COE and Reclamation to evaluate flood control operations, including the utility of John Day drawdown, to gain flexibility in flows and other river operations for listed salmon. The COE's preliminary report, Variable Q (COE 1997), failed to address John Day drawdown (RPA #5, 1995-1998 Opinion) flood control and adjustments to system flood control that would result in significantly increased flows for listed salmon. The FCRPS 1998 Supplemental Opinion calls for a status report on these flood control actions by summer of 1998. To date, no status report has been completed.

The Variable Q report states that the Corps was authorized by Congress in 1950 and 1962 to provide protection to damage centers in the lower Columbia and Willamette rivers from flows up to 800 kcfs as measured at The Dalles, Oregon (Corps 1997). This authorization was based upon protection of the Congress authorized levee system that allows floods up to 800 kcfs to cover riparian areas (Corps 1997). The Corps, however, attempts to operate the Columbia River to a regulated flow of 450 kcfs at The Dalles (a control point of 330-350 kcfs) and protect developed floodplain areas that are not protected by federally authorized levees (Corps 1997). Thus, the Corps has no Congressional authorization to be operating the river to 450 kcfs at The Dalles. The Corps decision to eliminate tens of thousands of acres of critical steelhead and salmon habitat by this operation has never been subject to environmental review or consultation with the tribes. Further, it has not been considered in either of the FCRPS Biological Opinions. Reduction and removal of floodplains from the river environment is perhaps the leading cause of the significant reduction or even elimination of fish populations in large river system worldwide (Dodge 1989).

In 1999, the Corps of Engineers extremely conservative flood control operations, that were not based upon state-of-the-art forecasting methods, caused a premature draft of the federal reservoirs from January through April (DeHart 1999). Cool weather in March and April caused a significant drop in runoff, and at the end of March, Hungry Horse was drafted *below* flood control elevation. Libby was drafted this period for flood control and power operations. Flood control operations at Dworshak Reservoir reduced reservoir volumes by 300-400 kaf that could have been used to meet opinion flow targets at Lower Granite in April and May (DeHart 1999).

The Corps has flood control authority over joint Reclamation reservoirs for 3.4 maf of active water storage and the Corps has and has similar authority for flood control in Dworshak reservoir for 2 maf of storage (Corps 1991; NMFS 1999). The Corps, in coordination with British Columbia Hydro has about 20.5 maf of flood storage in Canadian reservoirs under the *Columbia River Treaty* (Corps 1991). Further, the Corps has authority for about 13.3 maf of flood control in Hungry Horse, Libby and Grand Coulee reservoirs. Flexibility in flood control operations by using state-of-the-art forecasting tools provided by the National Weather Service would allow additional water to be stored in the winter months to make additional flows possible for spring and summer chinook.

According to CRITFC recent analyses using the NWPPC's state-of-the-art GENSYS hydro regulation model, in an average water year, between 1-3.5 million acre feet of water could be made available for spring and summer salmon migrations basin wide, by incorporating more flexible flood control management. The analyses show that the flexibility in flood control required to obtain the additional flows would not increase the probability of flooding downstream areas in all but the highest runoff years.

Measures
Short term recommendations (2001-2004).

- **Using state-of-the-art forecasting tools reviewed at the February 2001 Flood Control Workshop, the Corps shall implement necessary flood control flexibility to meet reservoir elevation objectives described in the next section and normative hydrograph index points described above to meet at least a 420 kcfs peak at The Dalles in early June for all runoff years. [15] The Corps shall seek flexibility in flood control in storage reservoirs basinwide, including the Hells Canyon Complex. Manage late fall and winter flood control releases of Bureau of Reclamation storage in upper Snake reservoirs during late August and September to augment flows for adult fall chinook and steelhead. Data from Reclamation indicates that many upper Snake Reservoir storage are near full during the late summer and fall months and must be excavated for flood control in the winter.**

- **BPA shall purchase of at least 0.5-1 MAF of flood control storage space from Canadian entities. This space will be used to store water to create the normative**

[15] In 1999 and in past years, summer salmon flows could have been much better if the Corps had implemented flexible flood control management in storage reservoirs. While CRITFC and state fishery agencies supported keeping storage reservoirs at higher elevations during the spring because weather forecasts indicated that the late spring runoff would be protracted, the Corps emptied storage reservoirs and they were never refilled. For example, Dworshak Reservoir remained about ten feet below full going into the summer migration period. Currently, the Corps manages flood control to extremely conservative levels without Congressional authorization. In an average water year with January-July runoff of 102 MAF, the Corps manages for control points (peak hydrograph) at The Dalles between 330-350 kcfs when they have authorization to manage for a flood control point of 550 kcfs at The Dalles (Corps 1997). The Corps should expedite a basin wide flood control review in a NEPA process.

hydrograph and to assure that storage reservoirs meet IRC and other biological criteria.

Long term recommendations (2004-2006)

- **The Corps shall implement a basin wide review of flood control focusing on additional flood control flexibility. This review shall be completed by the end of 2003.**

Reservoir Storage and Flow Augmentation

Reservoir storage should be managed to meet normative hydrograph objectives, IRCs and other biological criteria. Flood control flexibility and augmentation of flow from irrigation sources and flood control storage space are necessary to meet normative hydrograph and reservoir elevation objectives.

The normative river concept calls for stabilizing upper storage reservoirs by utilizing integrated rule curves and other biological curves established for Libby, Hungry Horse, Dworshak and Lake Roosevelt consistent with the findings of the ISAB in *Ecological impacts of the flow provisions of the Biological Opinion for endangered Snake River salmon on resident fishes in the Hungry Horse, and Libby system in Montana, Idaho and British Columbia* (Report 97-3; ISAB 1997).

Under current storage reservoir management by the federal operators, storage reservoir and flow objectives are not being met. For example, in 1998, the Grand Coulee storage elevation of 1280 mean sea level (msl) by April 10 was not met, as called for by RPA #1 (1995-1998 Opinion as modified by the FCRPS 1998 supplemental opinion). Flows during the spring chinook and summer chinook and steelhead migration were short nearly 1 million acre feet (maf) of storage because of this action.

The 1995-1998 FCRPS biological opinion also calls for Reclamation to take all reasonable steps to secure additional volumes of water in the upper Snake River beyond the 427 thousand acre feet (kaf) after 1998 (p. 100 Opinion). In 1997, operation of the Hells Canyon Complex prevented passing the full 427 kaf through the Complex to provide salmon flows. Further, NMFS was to conduct a study with the FERC licensee of the Complex to consider adjustments to project operations to assure that the 427 kaf would be passed through for salmon (p. 101 Opinion). NMFS consultation with FERC on this issue was to occur. To date, the study with the Hells Canyon Complex licensee has not been conducted, nor has consultation with FERC been concluded. To CRITFC's knowledge, NMFS has not issued a final biological opinion on Reclamation's 1998 biological assessment on the availability of

acquiring additional upper Snake River water for listed juvenile and adult migrants.

RPA #1 (1995-1998 Opinion) that calls for consultation of the federal agencies to secure an additional 3.5 maf of Canadian storage (p. 101 Opinion) through flood control reallocations and summer drafting of Arrow Reservoir for average and below average runoff years. The Opinion states that if the Corps and BPA fail to make "significant progress' on obtaining these volumes, then consultation will take place. To CRITFC's knowledge this consultation has not occurred. Additionally, NMFS has not consulted with Reclamation to secure 0.5-1 maf of storage from the Columbia Basin Irrigation Project as recommended by CRITFC for the 1998 Supplemental Opinion for listed steelhead (CRITFC 1998).

CRITFC recommends operating Libby and Hungry Horse to integrated rule curves and if possible, stabilizing Lake Roosevelt to elevation 1283 during August and particularly September. In order to assure these criteria for Lake Roosevelt elevation, at least 500 kaf of water intended for Banks Lake should remain in Lake Roosevelt.

***Measures*:**

Short term (2001-2004)

- **The Bureau of Reclamation shall secure additional amounts of water to enhance flows and reservoir storage requirements including an additional 0.5 MAF from the upper Snake where irrigation currently appropriates about 7 MAF from the Snake River.**

- **The Bureau of Reclamation shall secure additional amounts of water to enhance flows and reservoir storage requirements including an additional 0.5 MAF from the Banks Lake and/or the Columbia Basin Irrigation Project which current appropriates 2.7 MAF from the Columbia River. Maintain Lake Roosevelt at elevation of at least 1283 during August and do not fill Lake Roosevelt above elevation 1283 during September, but pass all inflows thorough the storage reservoirs to the Lower Columbia**

- **The BPA shall purchase an additional 1 MAF from Canadian storage**

- **The Bureau of Reclamation and the Corps of Engineers shall operate Libby and Hungry Horse to integrated rule curves, stabilize Dworshak to elevation 1600 by August 1 and stabilize Lake Roosevelt to elevation 1283 during August and September.**

- **FERC should require Idaho Power Company to use the Upper Snake water to keep the Brownlee pool near elevation 2058 and pass all additional flow.**

Brownlee should remain near full pool, until storage is needed to augment fish flows.

- **Dworshak Reservoir management. The federal operators shall follow the Nez Perce Tribe and State of Idaho Management Plan. Flexibility is needed in the timing of Dworshak flood control excavations. There should be water for a spring and August peak of 14 kcfs. During spring keep the reservoir near full in order to sustain the 14 kcfs flows. Then the pool should be filled to elevation 1600 by early June. Keep Dworshak full until August 1 unless water quality concerns force earlier excavation.[16] Flows for the first half of September should be 12 kcfs to support adult passage in the Clearwater and flush remaining juveniles. Studies indicate that increased flow with temperature control promotes better spawner distribution, and facilitates adult passage (Bjornn 1999 unpublished data; Heinith 1992 unpublished data; Cramer et al. 1985; McGie 1992; Mundy et al. 1998).[17] The Independent Scientific Advisory Board (1999) estimates that one adult fall chinook escaping to the spawning grounds represents 1500 fall chinook smolts successfully passing eight mainstem dams. Bjornn (1999, unpublished data) has demonstrated that adult steelhead passage is substantially benefited from cool water augmentation. Lichatowich and Cramer (1979) found that the low coefficient of variation (high sensitivity) for measurements of spawner distribution to upper river areas was an influential parameter for salmonid productivity. Geist et al. (1997) suggest that adult fall chinook that are delayed more that five days by dams may have insufficient energy reserves to complete spawning.**

……..

- **Implement Seasonal Drawdowns. Implement an experimental drawdown of Lower Granite Reservoir to elevation 723 by June 20 to augment the declining Snake hydrograph and to improve critical rearing habitat and passage for subyearling fall chinook. Do not fill the reservoir until October 31, after adult migrants have passed upstream of the reservoir. Drawdown and maintain John Day and McNary reservoirs to plus or minus 1.5 feet of minimum operating pool from March 20-October 31. Operate the remaining Lower Snake reservoirs at Minimum Operating Pool until November 1.**

Biological rationale: **Drawing down these reservoirs will improve critical rearing habitat and expedite water particle travel time and passage survival. Operating pools at MOP will reduce water particle travel time, facilitating juvenile and adult passage. Heat transfer analyses indicate that Lower Granite drawdown will make limited cool water releases from Dworshak more effective, and better meet temperature water quality standards. Radio telemetry studies indicate that Lower**

[16] The decision to implement an earlier excavation will be made in-season consistent with the Nez Perce Tribe and State of Idaho's 2000 Dworshak operations plan.

[17] In a comprehensive study of factors that influence salmon production, Lichatowich and Cramer (1979) found that timing of spawning and spawner distribution had low coefficients of var

Snake River adult passage does not appear to be impacted when fishway entrances are at MOP (Bjornn, 1997,unpublished data).

Power Peaking and Ramp Flows. To prevent stranding of juvenile migrants and to maintain riparian community integrity, Dworshak releases should be ramped at a rate of 6 inches per hour as measured at the Clearwater gage below Dworshak Dam. Adjust Dworshak release temperatures to meet the 68 degree water quality standard as measured in the scrollcase at Lower Granite Dam. At the Hells Canyon Complex, limit all flow reductions by ramping rates of no more than 6 inches per hour as measured at Lime Point. Such impacts have caused fishery managers to invoke ramping rate criteria to limit power peaking activities in tributaries to less than a two inch per hour change to shoreline areas (Hunter 1992). In the Hanford Reach, reduce power peaking from federal projects upstream to ramp flows a rate of no more than 2 inches per hour during the early emergence of Hanford fry (March 20- April 20).

***Biological Rationale:* The NMFS' 1995 FCRPS biological opinion does not call for any provisions that restrict daily flow fluctuations. Extreme flow fluctuations that routinely occur in a 24 hour period from power peaking makes it difficult, if not impossible, for adult fishways and juvenile bypass systems to consistently remain in hydraulic criteria. These criteria are essential to meet fish facility performance standards established by the state and federal fisheries agencies and tribes (DFOP 1993). Studies have shown that adult passage is significantly delayed by power peaking activities (DFOP 1993).**

Power peaking can impact critical riparian habitat by limiting invertebrate production and diversity (Gislasen 1985) and is contrary to the normative river concept (ISG 1996). Dramatic flow fluctuations from power peaking can strand juvenile salmon in shallow littoral areas causing direct mortality of many fish (Hunter 1992; Wagner et al. 1998).

Spill Operations: the following spill operations should be implemented at all federal and FERC licensed mainstem hydro projects. Spill has been consistently shown to provide the best route of juvenile and adult passage through mainstem dams.

Spill levels can be modified based upon real-time monitoring of physical and biological parameters at the discretion of the tribes and fish and wildlife management agencies.

> ***Measure*: Spill to the total dissolved gas waiver level at each mainstem dam for 24 hours a day from April 10 – September 30. [18] Limited spill (about 3-5 kcfs per**

[18] The initiation of spill should be determined by the tribes and fishery management agencies by the presence of migrating juvenile and adult salmonids using passage systems, hydroacoustic methods and in-river sampling. The dates provided are general planning dates. Spill at Bonneville Dam for the passage of Spring Creek Hatchery migrants should be provided for at least 10 days in March at the levels and times recommended for the general anadromous fish populations.

dam) for adult downstream passage should continue until adult salmon and steelhead cease to pass the dams.

Other Spill actions:

1. **Relax and seek flexibility in rigid flood control rule curves to recreate normative hydrographs and reclaim floodplain habitat;**
2. **Spill and/or surface bypass to achieve 80% Fish Passage Efficiency (FPE) or better through non-powerhouse routes;**
3. **Turbine operation within 1% of peak efficiency;**
4. **Reduced water level fluctuations from power peaking operations;**
5. **New and/or improved turbine technology and efficiency;**
6. **Predator reduction and abatement;**
7. **Water temperature and total dissolved gas reduction and abatement to comply with the federal Clean Water Act;**
8. **Additional adult fish ladders, new designs and structural improvements to existing ladders and improved maintenance of existing ladders;**
9. **Restrict new dredging and improve existing dredging management practices and;**
10. **24-hour video fish counting**

Modify Snake River Dams to Natural River Conditions: Restore natural river levels, conditions and habitat in the Lower Snake River by removing the earthen embankments at Ice Harbor, Lower Monumental, Little Goose and Lower Granite dams, and mitigate for the economic and other short-term impacts that will occur; draw down Lower Granite reservoir to 710 feet (spillway crest) until embankment removal is accomplished. Complete removal by 2006. This action will restore approximately 9,000 acres of spawning habitat for Snake River fall chinook. It will also improve migration survival for juvenile and adult salmon and steelhead and lower water temperatures.

John Day Drawdown: Draw down the reservoir behind John Day Dam to Minimum Operating Pool (MOP) immediately, and to spillway crest or natural river level, on a year-round basis, in the near-term. Complete the drawdown by 2008. This action will restore approximately 40 miles of spawning habitat for Columbia River fall chinook. It will also improve migration survival for juvenile and adult salmon and steelhead and reduce water temperatures.

Water Management: Manage water resources to more closely mimic the natural, historic river hydrograph (for example, through improved utilization of water from Canadian storage, Banks Lake and various irrigation projects) but maintain, to the maximum extent practicable, full, stable water levels in Lake Roosevelt and in Libby, Dworshak and Hungry Horse reservoirs according to their Integrated Rule Curves and consistent with the Northwest Power Planning Council's Fish and Wildlife Program

Improve Passage: Develop juvenile and adult anadromous fish passage capabilities, employing any and all possible biological, engineering/technological, legal, political and societal means, to circumvent the current artificial barriers to anadromous fish migration at Chief Joseph and Grand Coulee dams, Dworshak Dam and the Hells Canyon Complex (Hells Canyon, Oxbow and Brownlee dams)

Protect and restore estuary habitat: Protect critical estuary habitat and restore former estuary habitat

Improve Water Quality: Improve water quality in the mainstem Columbia and Snake Rivers by reducing or eliminating toxic pollution sources and other contaminant discharges in compliance with applicable water quality criteria (at a minimum)

Protect the Hanford Reach: Designate the Hanford Reach of the Columbia River under the federal Wild and Scenic Rivers Act, and re-establish normative river conditions there as otherwise described in this section.

~~This section provides for immediate mainstem survival actions in the following areas:~~

- ~~An expedited program to improve fish bypass at mainstem dams through use of surface bypass systems and, until these and other bypass improvements are in place, additional spill to levels that do not exceed state-defined levels of nitrogen gas supersaturation.~~
- ~~Improvements in spill efficiency and actions to reduce dissolved gas levels.~~
- ~~Improved flows in the Snake River through acquisition of 1 million acre feet of additional water from willing sellers and additional water from Brownlee.~~
- ~~Improved flows in the Columbia River through modified operation of Grand Coulee and Albeni Falls dams and negotiations for additional water from Canadian storage reservoirs.~~
- ~~Enhanced velocity in the Snake and Columbia rivers through drawdown of Lower Granite and Little Goose reservoirs to near spillway crest and operation of John Day reservoir at near minimum operating pool.~~
- ~~An emphasis on inriver juvenile migration in all but the worst water conditions, along with improved fish transportation and an accelerated National Marine Fisheries Service directed comprehensive scientific evaluation of transport and inriver migrant survival~~
- ~~An intensified effort to control predators and reduce competition with depressed salmon stocks.~~

~~This section also provides for expeditious evaluation of the following additional mainstem survival actions and schedules future Council decisions on them:~~

- ~~Additional upstream storage reservoirs to hold water in good flow years and make it available in dry years.~~
- ~~Additional velocity improvements, including additional drawdowns to spillway or natural river levels.~~

~~It also puts in place and reinforces a comprehensive monitoring and evaluation effort designed to help the region make wiser choices in the future. This monitoring and evaluation program builds on the prior Council rulemaking which developed a set of hypotheses for additional action and evaluation of mainstem survival. It will require a much stronger regional~~

commitment than has been evidenced to date to conduct careful evaluations of the contentious flow/velocity/survival relationship -- a relationship on which the Council has consistently called for more rigorous analysis. The failure of the region to develop better information in this area has been due in part to the unavailability of new techniques and technologies, such as the PIT tags and necessary detectors at hydroelectric facilities. However, it has also been the result of unnecessarily prolonged debates about the need for the research, the best methods for conducting it and the desirability of taking additional action pending the development of additional information. The Council hopes that its call for immediate action and immediate improvement in the knowledge base will help resolve this long-standing impasse.

Finally, in the resident fish section of the program, the Council adopts the following measures to protect resident fish populations:

- Integrated rule curves to improve operation of Hungry Horse and Libby dams for resident fish.
- A call for no significant degradation of the existing nutrient retention time[19] and drafting limits for the reservoir behind Grand Coulee Dam.
- A limit on the depth to which the reservoir behind Dworshak Dam is drafted.

5.0 MAINSTEM PASSAGE EXPERIMENTAL PROGRAM

5.0A Adaptive Management Approach

Clear answers regarding improvements in survival in the mainstem lie in extensive ecological research, and long-term monitoring and evaluation. At the same time, Congress recognized that these issues would rarely be crystal clear, and directed the Council to make decisions on the basis of the best *available* scientific information. Most importantly, the condition of many fish populations makes immediate action imperative.

In 1984, the Council endorsed the concept of adaptive management -- using management initiatives as experimental probes to clarify uncertainties about the effectiveness of mitigation measures. The Council proposes to utilize this management technique explicitly to deal with the mainstem dilemma. Below, we call for significant actions to improve both inriver and transported survival. These actions are coupled with an experimental program intended to maximize our ability to learn and to assist the region in making crucial decisions about mainstem passage.

The mainstem experiment focuses on an approach to dealing with uncertainty termed "spread the risk." A version of this strategy was advanced by the region's fishery managers. It calls for both transportation and inriver passage to be used within each migration season -- basically, dividing the population into two more or less equal groups, one of which is transported while the other group migrates downstream. Thus the survival of the entire migrating population is not totally dependent on the benefits of either strategy. At the same time, through careful experimental design, monitoring and evaluation, the region should be able to learn which mode of passage is best and how survival under each mode is affected by the prevailing environmental conditions.

This approach is premised on the region's willingness to make within-year evaluation of the two modes of passage an explicit and integral component of the mainstem strategy. Spreading the risk makes sense only as an interim strategy to deal with critical uncertainties that are impeding the

[19] The amount of time microscopic food organisms, and nutrients on which they depend, spend in a reseroir. It is these organisms on which fish and the entire food chain depend. Nutrient retention time is measured by the amount of time it takes water to flow through a reservoir.

region's efforts to craft a fish recovery plan. Clearly, we must ultimately develop an approach that resolves how to use either or both modes of mainstem passage. For this to be possible, the region must be willing to adhere to an experimental program for several years and over a range of conditions.

The experimental approach has five essential features:

- A statement of hypotheses regarding the effects of transportation, flow and velocity augmentation on survival of salmon and steelhead from smolt to adult return.
- Development of the technical aspects of the experiment under the aegis of the Independent Scientific Group.
- A series of actions to improve passage survival in the river during the experiment.
- An accelerated research effort to clarify the relationships between variation in natural survival conditions, overall fish survival and the impact of human-caused actions on the production of salmon and steelhead in the basin.
- A partnership between the Council and the National Marine Fisheries Service, state fishery agencies, Indian tribes, river operators and others to plan and implement this experiment and to review the results.

5.0B Purpose of the Experiment

The experimental program has the following goals: 1) To understand the relative within-year differences in survival to adult return of fish that were transported versus those that migrated in the river over a range of environmental conditions; 2) to refine the hypotheses described below; and 3) to increase our understanding of natural survival processes in the ocean and freshwater, and how these relate to human actions and the success of this program. For each outmigration year, the experiment should compare survival to adult return between fish that were transported and those that migrated in the river under the enhanced survival conditions described below.

The technical aspects of the design of this experiment are to be developed under the direction of the Independent Scientific Group. The experimental design should describe evaluations needed to address the above questions in terms of impacts to juvenile and adult survival. The design should also describe how smolt transportation should be managed to spread risk as described above and fulfill the needs of the experiment. The experiment will likely require a reduction in the number of smolt collection points, perhaps to a single upriver site. Further, in order to compare the two modes of passage over a range of environmental conditions, the Council expects that the relative proportion of fish in either mode of passage should remain relatively constant. As a result, compared to the situation that has prevailed through much of the 1980s and 90s, fewer fish will be transported in years of low runoff, and more fish will be transported in years of high runoff. Overall, however, the Council expects that this strategy will result in a reduction in the proportion of the migration being transported.

5.0C Oversight of the Experimental Program

An experiment of this magnitude must include input from a range of interested parties in the region. The Council will use the Fish Operations Executive Committee to provide regional review of the experimental information as it becomes available and to develop strategies to facilitate implementation of the experiment. Because of their respective roles under the Northwest Power

Act and the Endangered Species Act, it is also imperative that the Council and the National Marine Fisheries Service work closely together to ensure that this experiment is successful.

Fish Operations Executive Committee

5.0C.1 Approximately every six months and well in advance of the spring/summer migration periods, convene a special meeting to review the existing results of the experiment and problems associated with its implementation.

Council and National Marine Fisheries Service

5.0C.2 Ensure that procedures are in place to provide coordination at policy and technical levels on matters that affect the success of this experiment.

Independent Scientific Group

5.0C.3 Convene and oversee a technical committee to provide technical coordination and experimental design.

5.0D Timeline for the Experiment

This experiment attempts to balance two important aspects: 1) the need to take meaningful action to address the needs of declining fish populations, and 2) the need to answer critical scientific questions. Accordingly, the region will proceed with a number of measures aimed at enhancing survival on the basis of the knowledge on hand. At the same time, a considerable expenditure of effort will be focused on the evaluation program to compare the relative benefits of the two modes of fish passage.

5.0E Mainstem Passage

Hypotheses

In this section, the Council states its working hypotheses regarding two key sets of relationships. One relationship is the effect of flow, water velocity and fish travel time on fish survival. The second is the efficacy of smolt transportation for improving salmon survival. These hypotheses underlie many of the actions included in later parts of this section, and are the starting point for the adaptive experiment described above. The Council's reasons for including these working hypotheses are twofold: first, to explicitly state the rationale behind many important measures in the program, and second, given the uncertainties in our knowledge of these relationships, to emphasize the experimental nature of these actions and facilitate their scientific evaluation. In scientific investigation, hypotheses are used to describe phenomena on the basis of existing knowledge and judgment. They are essential starting points for experimentation and an adaptive approach.

While these hypotheses do not authorize changes in river operations, they do emphasize the need to learn from actions the Council authorizes elsewhere in this program.

By stating a hypothesis, the Council does not imply that scientific evaluation should supplant action in the mainstem. Indeed, the Council has consistently emphasized the need to take action, but within an adaptive approach that promotes learning and reduces scientific uncertainty. The

region is taking a number of actions to improve mainstem salmon survival, and the Council will continue to consider the need for further actions. Many of these actions are controversial and are based on uncertain science. It is necessary, however, to take immediate actions to address the needs of declining fish populations. In stating a hypothesis, the Council's purpose is to ensure that the region *learns* from taking these actions. The Council is concerned that if the region fails to take aggressive steps to learn now, we will be faced with the same difficult questions 10 years from now, with little better information on which to base choices.

Much of the controversy surrounding these issues results from conflicting beliefs based on limited and inadequate information. By stating its working hypotheses on how these actions relate to overall fish survival, the Council is providing direction for an adaptive program to address the overarching issue of how to increase the survival of salmon and steelhead in the Columbia Basin. The Council sees the experimental program acting in concert with measures to increase survival based on the best information available at this time. These working hypotheses provide the rationale for actions in the Council's program and, given the uncertainties in our knowledge of these relationships, are intended to guide research and evaluation as part of the Council's adaptive experiment.

The relationship between actions taken in the river and overall fish survival is not simple. Survival from the smolt stage to adult spawner is the result of a host of factors, only a few of which are under human control. Important relationships can be obscured because improved survival at one life stage can be negated by changes in survival at other life stages. Some survival conditions in the ocean, for example, can vary independently of survival conditions in the river or estuary. Other changes in ocean and other natural survival conditions can also compound human-caused survival bottlenecks.

In addition, the positive and negative effects of actions taken in the river to improve survival, such as flow augmentation, drawdown and transportation, may be delayed until later life stages. The amount of change in survival that occurs in the river as a result of augmenting water velocity may not tell the whole story. Changes in survival could occur later in the life cycle, particularly in the estuary. The bottom line is how actions affect the return of adult fish to spawn in the Columbia River Basin.

The Council's hypotheses must be general enough to embrace all of these aspects, while providing enough specificity to guide research and evaluation. In addition to the hypotheses themselves, the Council is providing a list of experimental considerations that expand on the hypotheses and are intended to highlight aspects of the relationship that should be examined in the experimental program. The Council expects the implementing agencies to make all possible efforts to implement quickly an experimental program to address both the hypotheses and the supporting elements.

For each hypothesis, observations regarding flows, survival and transportation are suggested by the existing scientific information. The Council therefore believes that research to test and refine the hypotheses should include investigation of these elements. Like the hypotheses, these elements are adopted by the Council as guides for further research. The supporting elements are not conclusions or findings, and do not change other substantive measures in the Council's fish and wildlife program.

As new data are generated and reviewed, the Council expects to refine and improve both working hypotheses. The Council will gear future amendment processes to information generated from the adaptive management process identified in Section 5.0A, and will determine whether further steps are warranted.

Hypothesis I: Flow, Water Velocity, Fish Migration Rate and Survival

Hypothesis: The Council accepts that there is a relationship between flow, water velocity, fish travel time and survival such that increasing water velocity increases the survival of salmon and steelhead from the onset of active downstream migration to adult spawner. Improvement in the level and frequency of favorable mainstem migration conditions for juvenile salmonids will improve fish conditions, increase migration rates, reduce vulnerability to predators, and improve timing and fitness at entry into the ocean. As a result, survival to adult recruitment will improve to levels that, together with full implementation of other measures in this program, will sustain recovery and rebuilding of salmonid populations.

Background: Major changes in the timing, magnitude and frequency of flows in the Columbia River have occurred as a result of development of the hydroelectric system. Based on evolutionary considerations and the information now available, these changes in the river have likely had a detrimental effect on fish survival.

Existing Information: Like all organisms, the behavior, physical characteristics, and life history of salmon and steelhead are influenced by their environment. Alteration of a fundamental feature of the environment, such as significant changes in flow, water velocity and water temperature, can be expected to affect fish survival and abundance. At the same time, natural survival conditions can change due to drought or changes in the ocean environment. This can compound the effects of human-induced changes in the environment.

Various attempts have been made over the past decades to evaluate the effects of changes in mainstem flow and water velocity on salmon and steelhead. Most studies have focused on the effect of water velocity on survival during the downstream migration. Examples include the National Marine Fisheries Service's flow-survival studies of the 1970s, predator studies, and correlations between water particle travel time and fish travel time.

During the 1980s, little new information on the effect of flows on juvenile fish survival was developed. However, recent research using PIT-tagged fish shows promise as a way to evaluate survival of juvenile fish in the mainstem and possibly to the adult return stage as well. Results of some of the recent work may be interpreted to show that survival in some reservoirs could be much higher than estimated from the earlier National Marine Fisheries Service data. However, this research is too preliminary to justify conclusions regarding flows, velocity and fish survival.

A lesser number of studies have focused on the bottom line -- the relationship between actions taken in the river to augment water velocity and the subsequent return of adult spawners. These include the Marsh Creek (Idaho) study of the survival of spring chinook, other studies of Snake River chinook populations in Oregon and Idaho, and a draft report on summer migrating fall chinook salmon in the Columbia River. The latter report, by investigators at the University of Washington, evaluated the survival rate of mid-Columbia River fall chinook salmon and preliminarily reported a relatively strong relationship between survival and flow during the summer outmigration.

Many of these studies have been criticized on technical and procedural grounds, and none of them gives crystal clear answers. As part of the process of developing its working hypotheses, the Council funded an independent scientific review of the available data. (The Dr. Cada review referenced earlier.) The reviewers found that the studies were often dated, suffered from inadequate experimental designs, or provided imprecise results. Nonetheless, the reviewers concluded, "Despite these problems with the existing data sets, the general relationship of increasing survival with increasing flow in the Columbia River Basin still appears to be reasonable." As a result, the Council believes that these studies provide enough information to support the flow/velocity-survival hypothesis and realizes that further, focused scientific research is warranted.

Uncertainties: The amount of change in survival for a given change in flow or water velocity is uncertain, as is the relative importance of different mechanisms that relate to flow from the juvenile outmigration to the survival of returning adult fish.

Supporting Elements:

a. The question of interest is how flow and water velocity and transportation affect the survival of fish to their return as adult spawners and the productivity of the populations measured as the ratio between the number of fish returning and their parental spawners.[20]

b. The biologically important component of the relationship is water velocity. Water velocity can affect fish survival through its effect on other environmental parameters and on fish behavior and condition. Water velocity is affected by flow, reservoir operations and other factors. The rate of downstream movement of actively migrating juvenile salmon and steelhead is positively influenced by the prevailing water velocity. The propensity of juvenile salmon and steelhead to migrate is a function of environmental cues and several factors relating to age and physiological state.

c. The effect of flow/water velocity could occur at one or more life stages after the onset of active downstream migration (beginning of migration in the natal stream to below Bonneville Dam), estuarine/early ocean (Bonneville Dam to the first
year in the ocean), ocean adult (subsequent years in the ocean) and adult passage (estuary to spawning ground). The experimental program should address the effect of water velocity during the juvenile outmigration on cumulative survival to adult return, including specific impacts at each life stage.

d. At the estuarine stage, flow/water velocity could influence survival through its effect on migration speed and fish condition. This in turn can affect the date of entry into the estuary to

coincide with food availability or predator concentrations and/or by influencing the arrival to the estuary within a physiological window enhances the likelihood of a successful salt water transition.

e. The preponderance of information indicates that during the downstream migration, the lowest survival occurs at the lowest flow. At higher water velocities, survival continues to increase but at a decreasing rate. The relationship between flow/water velocity and survival during the downstream migration is defined by a parameter describing the rate of change in survival as flow/water velocity increases (the slope), and a parameter relating to the range of survival
expected over a reasonable range of flow or velocity (the intercept).[21] The value of these parameters is uncertain, as is the relationship between inriver survival, as affected by water velocity, and overall survival to adult spawner.[22]

f. The relationship between water velocity and survival may differ between species or races and could differ between hatchery and wild populations. In particular, the shape of the relationships is likely to be different for yearling (spring migrating) and sub-yearling (summer migrating) chinook

g. Most of the information on the relationship between flow/velocity and downstream migrant survival relates to chinook salmon and steelhead. However, because sockeye migrate at the same time and at about the same rate as yearling (spring migrating) chinook, hypotheses for the flow/velocity survival relationships for yearling chinook are a reasonable surrogate for sockeye salmon until more specific information can be developed.

[21] In Figure 2, and in most representations of this relationship, these parameters are incorporated within an exponential equation. This implies that the rate of increase in survival will decrease as flow or water velocity increase .

[22] For example, the National Marine Fisheries Service studies during the 1970s suggest the hypothesis shown below as Line A in Figure 2. It has been used in modeling analysis by the fishery managers and the Council. Expansion of estimated predation rates in John Day pool suggest the alternative relationship depicted as Line B, used in analysis by the Bonneville Power Administration. Other hypotheses can be suggested from more recent preliminary information. These hypotheses relate only to the downstream migration portion of the life cycle. It remains unclear how survival during this portion of the life cycle relates to the subsequent return of adults, such as that shown in the Figure 1, above. This information, too, should be considered illustrative and not necessarily conclusive.

h. Variation in ocean productivity and other natural survival conditions can confound the effects of inriver measures such as flow, velocity and transportation while, at the same time, compounding the effects of human-induced survival bottlenecks. Techniques must be developed to consider and, if possible, correct for these considerations. For example, insight into the effect of ocean conditions might be gained by comparing returns of upriver populations to similar downriver populations and to populations in other river systems on the Pacific Coast with similar life histories.

Hypothesis II: Smolt Transportation

Hypothesis: The Council accepts that under some passage conditions, transportation can increase the survivalof salmon and steelhead from the onset of active downstream migration to their return as adult spawners relative to survival experienced by fish migrating in the river. Fish migrating in the river include those fish that pass dams through the collection system and are bypassed to the river, as well as fish that pass dams via turbines or spill without entering the collection system.

Background: One tool used to address the survival changes resulting from development of the hydroelectric system is to collect juvenile fish (smolts) at several Columbia River dams and transport them below Bonneville Dam. Limited information indicates that this can improve survival under some circumstances, especially when river conditions are poor.

Existing Information: Most studies of the efficacy of smolt transportation were conducted by the National Marine Fisheries Service during the 1970s. Evaluations also occurred in 1986 and 1989 under more modern conditions. In contrast to much of the work on flow and survival, smolt transportation has been evaluated in terms of its effect on adult returns. Benefits have been measured as the ratio of adult survival rate of transported fish to the survival of fish in the collection system that were not transported.[23] These studies have shown variable results, especially for spring chinook. In general, however, most of the evaluations have indicated a positive relationship under some conditions. Again, none of these studies is conclusive and all have been criticized on technical grounds. For example, a recent Columbia Basin Fish and Wildlife Authority report[24] suggested that transportation may be contributing to declines in wild salmon populations. Conversely, the National Marine Fisheries Service Recovery Team's draft recovery plan argues that the data show relatively clear benefits from transportation.

The U.S. Fish and Wildlife Service recently funded an independent review of the available transportation data.[25] This review has contributed to the formulation of the Council's hypothesis. While finding fault with the current state of knowledge regarding transportation effects, the review team concluded that the preponderance of evidence indicates that transportation can improve survival of fish to adult return under some adverse inriver conditions. They felt, however, that there was insufficient evidence to indicate that transportation alone could rebuild

[23] There are four ways that fish can pass a hydroelectric project. They can enter the collection system and be transported, they can enter the collection system and be put back into the river, or they can pass through the turbines or over the spillway without entering the collection system. Transportation has been evaluated relative to the survival of fish entering the collection system and put back into the river. It has not been evaluated relative to the third mode of passage.

[24] Ad Hoc Transportation Review Group, *Review of Salmon and Steelhead Transportation Studies in the Columbia and Snake Rivers, 1984-89* (December 31, 1992).

[25] Mundy, P.R. et al. 1994. Transportation of Juvenile Salmonids From Hydroelectric Projects in the Columbia River Basin; An independent peer review. U.S. Fish and Wildlife Service, Portland, OR.

~~upriver runs. For this reason, they emphasized that transportation should be considered an experimental program.~~

~~**Uncertainties:** The amount of benefit and the circumstances under which a benefit is achieved are uncertain. In addition, evaluation efforts to date have not addressed the effect of transportation on adult returns to the spawning ground nor have they examined effects relative to all modes of inriver passage.~~

~~**Supporting Elements:**~~
~~a. The value of transportation should be assessed relative to the alternative of inriver passage over a wide array of conditions using the ratio between adult return rates of transported and non-transported fish. Ultimately, the statistic of interest is the ratio back to the spawning ground.~~

~~b. The benefit of transportation is expected to be inversely proportional to the survival of non-transported fish. Thus, benefits should decrease within a year as the collection point moves downstream and between years as flow and other passage conditions improve.~~

~~c. Survival of transported fish to adult return may be decreased by adverse conditions encountered prior to the collection of juvenile fish due to environmental factors or hatchery rearing conditions, for example.~~

~~d. Transportation benefits are likely to differ among species and populations of fish. In addition, benefits for hatchery fish may differ from those of naturally spawning fish.~~

5.0F Research and Monitoring

~~During the 1980s, the region made unsatisfactory progress in evaluating the relationship between spring and summer flow, velocity and fish survival, notwithstanding concerted efforts by several parties. At the same time, the scientific basis for transportation remains hotly disputed. A lack of direction on these issues has hindered recovery efforts. The importance of these issues is such that continued stalemate is not acceptable. The Council joins with the National Marine Fisheries Service and other regional interests in insisting that these relationships immediately receive the highest priority in the region's research efforts.~~

~~Because of the simultaneous need for action and better scientific information, these relationships can best be clarified through an adaptive management approach. This would involve the use of inriver passage and transportation as management experiments to address the Council's hypotheses. The experimental actions could include a combination of management actions, research, evaluation and monitoring implemented as part of an adaptive management framework. This framework would describe the overall experimental design and link the Council's hypotheses to management and research actions.~~

The region needs a process to ensure that the adaptive management framework is developed in an independent, scientifically credible and open manner. This will have to proceed in close cooperation with the National Marine Fisheries Service and federal river operating agencies. The region should work with the existing research process and make sure that it is coordinated with all interested parties. The primary means for coordination should be through a technical group organized under the auspices of the Independent Scientific Group. This technical group will work with the National Marine Fisheries Service and other agencies to design an adaptive framework. The role of the Independent Scientific Group will be to ensure that the adaptive framework and

flow/velocity-survival research is scientifically credible and to keep decision-makers abreast of important developments.

Independent Scientific Group

5.0F.1 ~~As soon as possible, appoint a technical group to work with the National Marine Fisheries Service and other researchers on the design of an adaptive experiment as described in Section 5.0A. The technical group should report to the Independent Scientific Group on a regular basis. The Independent Scientific Group should provide for scientific review of the adaptive framework and ensure that the activities of the technical group are conducted in a scientifically credible manner. The Independent Scientific Group should also ensure that the Council and the National Marine Fisheries Service are kept apprised of the group's progress and communicate the draft adaptive framework to the Council. A draft adaptive framework should be completed and submitted to the Council and the National Marine Fisheries Service by February 15, 1995.~~ **The Independent Science Advisory Board will provide scientific advice to the Council, the National Marine Fisheries Service, and the Columbia Basin Indian Tribes. The ISAB will be overseen by a three member board composed of the Chairman of the Northwest Power Planning Council, the Regional Director of the National Marine Fisheries Service, and a policy representative of the 13 Columbia Basin Indian Tribes. The policy board will review the workplan of the ISAB and provide recommendations for the priorities of the ISAB.**

5.0F.2 ~~The Council recognizes that the hypotheses described above are a subset of a larger set of hypotheses, assumptions and facts that underlie the entire fish and wildlife program and link program goals and measures. Collectively, these form the conceptual foundation called for by Bonneville's Scientific Review Group.[26] The Council calls on the Independent Scientific Group to oversee the development of this foundation. The foundation should not be a reinvention of the Council's program, but should seek to define and review the scientific basis for the program. Like the hypotheses described above, the foundation should define the rationale for the program and describe scientific uncertainties that should be addressed. The hypotheses described above are examples of how the foundation might appear. They should be incorporated into the overall foundation. The Independent Scientific Group should prepare a proposal including a detailed description of the foundation concept and a work plan and budget for its development. The workplan should describe how the foundation could be drafted within six months of its approval by the Council. The proposal should be submitted to the Council by January 1, 1995.~~

~~**Council and National Marine Fisheries Service**~~

~~5.0F.3 Review the draft adaptive framework to ensure that it addresses the Council's hypotheses and supporting elements, the needs of the National Marine Fisheries Service recovery plan and this program. Evaluate the feasibility of implement ation. Within six months of receipt of the draft plan provide review and direction for regional efforts to address these issues. However, the intent of the Council is that concrete action to evaluate the hypotheses and supporting elements should begin during the 1995 smolt migration season.~~

[26] Scientific Review Group, 1992. Critical uncertainties in the Fish and Wildlife Program. Submitted to the Bonneville Power Administration.

Bonneville

5.0F.4 After approval of the adaptive framework by the Council and National Marine Fisheries Service, fund actions necessary to implement the adaptive framework.

~~5.0F.5 Continue to fund, on an expedited basis, ongoing evaluations in this research area.~~

~~5.0F.6 After Council approval of the proposal from the Independent Scientific Group described in measure 5.0F.2, provide funding and resources necessary for the preparation of a conceptual foundation for the entire fish and wildlife program.~~

~~Fishery Managers~~

~~5.0F.7 Make available from hatcheries or other appropriate sources the required numbers of juvenile salmon necessary to conduct the flow, travel time and survival studies called for in this fish and wildlife program.~~

~~5.0F.8 By December 1, 1995, the fishery managers should provide to the Council for review a conceptual plan for experimental use of pulsing flows to improve salmon migration conditions. Upon Council approval, implement the pulsing experiment.~~

~~Bonneville~~

~~5.0F.9 On an expedited basis, fund the continued development of PIT tag technology, and other salmon marking techniques for evaluations.~~

~~5.0F.10 Fund the installation of juvenile salmon PIT tag detection facilities at John Day and Bonneville dams, to facilitate assessments of naturally producing stocks and improve the quality of monitoring the effects of juvenile and adult fish passage. Installation should be in coordination with the Corps of Engineers, the fishery managers, and the Independent Scientific Group's technical group, according to the following schedule:~~

~~Project~~	~~Installation date~~
~~John Day~~	~~1996~~
~~Bonneville~~	~~1996~~

~~5.0F.11 Provide funds and resources necessary to enable the Pacific States Marine Fisheries Commission to fulfill measures 5.0F.14 and 5.0F.15, described below.~~

5.0F.12 Working with the Mid-Columbia Coordinating Committee and the Independent Scientific Group's technical group, determine the steps necessary to install PIT tag detectors on projects in the mid-Columbia River.

5.0F.13 Working with the Independent Scientific Group's technical group, evaluate the merits of installing adult salmon PIT tag detection facilities at selected projects to facilitate evaluation of smolt-to-adult survival. Report to the Council by January 1, 1995, and, on Council approval, install these facilities.

Pacific States Marine Fisheries

Commission

5.0F.14 By January 1, 1995, prepare a five-year action plan for development of PIT tag technology and other mark placement and collection practices throughout the Columbia Basin in consultation with the fishery managers and interested parties. Include the steps necessary for installation of PIT tag detectors at projects in the mid-Columbia River, and assess the merits of installing PIT tag detection facilities for adult fish at selected projects. The plan should also assess how to incorporate changing marking and detection technology into the system over time. Report to the Council for review of the plan in January 1995.

5.0F.15 As part of the Coordinated Information System, provide data management capabilities to ensure open and timely access to all mark recovery data.

5.1 COORDINATE RIVER OPERATIONS

The Columbia River and its tributaries and the hydroelectric system they fuel make up an extremely complex operating system. The Council recognizes that the flow, velocity and temperature improvement measures contained in this program will have a substantial impact on the operations of this system.

Given more time and experience, it is likely that the following measures can be refined, resulting in greater operational efficiency and better coordination between the needs of fish and other uses of the river.

The Council welcomes proposals from river operators, especially those proposals that emerge from the river operations process described below, for better ways of providing equivalent amounts of water for salmon and steelhead within time frames specified in this program. Any such proposals should be submitted to the Council and, on approval, implemented.

The Council expects that river operation changes for fish will be in accordance with the following measures as they are now written. The Council will carefully monitor these operations and will welcome suggestions from all interested persons on how they can be improved. Each year, until further notice, the Council will review the operations. At that time, it will determine whether these measures should be revised to provide the intended benefits to fish in the most practical and efficient manner.

5.1A Fish Operations Executive Committee

Fish Operations Executive Committee

Council

5.1A.1 Initiate an annual policy and technical process to address flow and temperature regimes and reconcile measures described below to protect salmon and steelhead. The process will be managed by the Fish Operations Executive Committee, which will be appointed by the Council **and affected tribes** and made up of senior management representatives of the Council, as well as power and fishery interests. **This group is necessary because the NMFS' Technical Management Team is unable to foster regional participation, does not provide policy level input and the TMT's authority is only for listed stocks.**

5.1A.2 The Committee should produce a detailed, annual implementation plan for carrying out its work. The committee should produce the operating plan by March 31 of each year and will need to begin in the preceding year to complete its work. ~~Insofar as practical,~~ **T**~~t~~he committee should consider matters such as spill, transportation, the Corps' Fish Passage Plan, **mainstem water quality issues, system configuration issues,** the fishery agencies and tribes' Detailed Fishery Operating Plan, recommendations from the Ad Hoc Committee of the Columbia Basin Fish and Wildlife Authority, the coordinated plan of operation for flow augmentation (Section 5.1C), annual operating plans for the Non-Treaty Storage Fish and Wildlife Agreement, planning for coordinated system operations, Idaho Power Company's proposed operations under its weak stock plan, water identified by the Snake River Anadromous Fish Water Management Office, spring and fall trade-offs, research and monitoring results and other mainstem passage matters.

In its meetings, the committee should identify all water available in a particular year and plan for its use consistent with Council specified reservoir constraints and anadromous fish measures. During low flow conditions when the monthly average flow equivalent[27] of 85,000 cubic feet per second in the Snake River cannot be provided for the full migration period, flows should be distributed to protect a portion of all known naturally reproducing stocks. The plan will have the flexibility to move flows between May and June, if such shaping is more likely to achieve the intent of this

[27] "Flow equivalent" means the flow level required to achieve the same water particle travel time as 85,000 cubic feet per second at average normal pool elevations at all projects. For example, 81,000 cubic feet per second at minimum operating pool elevations is the flow equivalent of 85,000 cubic feet per second at average normal pool levels.

program. If there are conflicting water demands among anadromous species, conflicts should be resolved by the Fish Operations Executive Committee ~~in consultation with the National Marine Fisheries Service~~. In resolving conflicts, the committee should carefully consider the value of retaining cold water in the Dworshak project to help control temperatures for Snake River fall chinook returning adults.

All alterations in river operations undertaken pursuant to these amendments should consider impacts on resident fish and other species, especially threatened, endangered or native species, and should seek to avoid adverse effects on them.

5.1A.3 Develop a procedure to address fish flow operations throughout the migration season, if necessary.

5.1A.4 Develop accounting procedures for the use of this water. These procedures will be provided to the Council and other interested parties. Pending development and Council approval of new accounting rules, the provisions set out below (Section 5.1D) will continue to apply. All water supplies acquired under the measures below will be applied to the fish migration.

5.1A.5 Manage water supplies for fish in accordance with the annual implementation plan. To assist the full range of stocks migrating in the Snake and Columbia rivers, every effort must be made to shape water stored for fish flow augmentation to the fullest extent practicable. Any proposed deviations from the implementation plan must be approved by the Fish Operations Executive Committee.

5.1A.6 In developing the annual implementation plan, the committee shall specifically evaluate tradeoffs between flows needed for anadromous fish and reservoir operations needed to protect resident fish and wildlife in Columbia Basin storage reservoirs that are federally operated, licensed or regulated.

5.1B Fish Passage Center

Bonneville

5.1B.1 Fund the establishment and operation of a Fish Passage Center, including funds for a fish passage manager position, technical and clerical support and the services of consultants when necessary, as jointly agreed by Bonneville and the fish and wildlife agencies and tribes. This support will assist the fish passage manager in:

1) ensuring that anadromous fish, resident fish and wildlife are protected, mitigated and enhanced;
2) planning and implementing the annual smolt monitoring program;
3) developing and implementing flow and spill requests as related to the water budget volumes, spill criteria and flow targets in the Council's fish and wildlife program;
4) coordinating storage reservoir and river operations and evaluating potential conflicts between anadromous and resident fish to ensure that Council-adopted operating criteria for storage reservoirs are met when considering system operational requests;
5) identifying when conditions allow for operations in excess of minimum objectives and criteria, so that this situation can be brought to the attention of relevant decision-makers to allocate the operational flexibility to maximize benefits for anadromous fish, resident fish and wildlife;

6) monitoring and analyzing research results to assist in implementing the water budget and spill planning and in preparing reports; and
7) monitoring and analyzing monitoring and research data to assist in implementing storage reservoir operating criteria and to better provide for the needs of anadromous and resident fish and wildlife.

5.1B.2 Provide funds to establish **two** ~~a~~ "fish passage manager" ~~position~~ **positions, one** designated by the federal and state fish and wildlife agencies and **one designated by** the Columbia River Basin Indian tribes. The fish passage manager**s** will provide expert assistance to the designated entities in working with the power project operators and regulators to ensure that the Council's program requirements for fish are made a part of all river system planning and operations. The fish passage manager**s** will be selected for knowledge of the multiple purposes of the regional hydropower system and of the water needs of fish and wildlife, as well as the ability to communicate and work with the fish and wildlife agencies, tribes, project operators, regulators and other interested parties, including members of the public. The fish passage manager**s** will be selected by members of the Columbia Basin Fish and Wildlife Authority and report to the Authority's executive director. The fish passage manager**s** and the executive director will report as needed and at least annually to the Council on any issues that are raised regarding the Center's operations, including communications with the fish and wildlife agencies, tribes, project operators, regulators and members of the public. The Council will provide a fish passage advisor on its staff to review the operation of the water budget, to advise the Council on all matters related to fish passage and to assist in resolving fish passage disputes.

Fish Passage Center

5.1B.3 House the fish passage manager**s** and staff and function as the primary program center for housing data and information about juvenile fish passage. All data collected and stored at the Fish Passage Center will be available upon request to all interested parties.

Fish Passage Center and Bonneville

5.1B.4 The Council expects Bonneville and the fish and wildlife agencies and tribes to cooperate fully in developing the contractual agreements necessary to carry out tasks described in this section. Pursuant to this expectation, the Council or its staff will review all contracts related to the Fish Passage Center and the fish passage managers.

5.1B.5 The fish passage manager**s** will be the primary point of contact between the power system and the fish and wildlife agencies and tribes on matters concerning all flow and velocity augmentation, temperature control and spill operations affecting juvenile fish migrating downstream at hydroelectric projects operated by the Corps of Engineers and the Bureau of Reclamation on the mainstem of the Columbia and Snake rivers. The fish passage manager**s** will be responsible for informing the Corps of Engineers when and to what extent the manager wishes to draw on the water budget. In making requests, the fish passage manager should: 1) give the Corps three days advance written notice of changes in the planned flow schedule, unless otherwise agreed by the manager**s** and the Corps; and 2) take into account flow and reservoir level fluctuation requirements for resident fish and reflect these considerations in writing in system operational requests. The Corps will inform the other project operators and regulators of water budget requests and spill communications to the extent necessary, manage and implement annual water budget and

juvenile fish passage plans and make in-season spill decisions in consultation with the fish passage managers and the Fish Operations Executive Committee.

5.1C Coordinated Plan of Operation for Flow Augmentation

Federal Project Operators and Regulators

5.1C.1 By January 15 of each year, meet with a committee composed of the fish passage managers, the Council's fish passage advisor and representatives of the power system operators to: 1) review the official January water supply forecast, 2) coordinate the system's flow operation for the current year with the Fish Operations Executive Committee, and 3) report to the Fish Operations Executive Committee on development of the annual coordinated plan of operation for flows for the juvenile fish migration. Conduct a similar meeting in mid-February and mid-March of each year. This committee also shall evaluate alternative water budget and other flow measure implementation procedures and report to the Council.

Corps of Engineers

5.1C.2 By March 20 of each year, provide to the Fish Operations Executive Committee and the Council a coordinated plan of operation for flow augmentation for the periods April 15 through June 30 and July 1 through September 30. During these periods, submit to the Fish Operations Executive Committee, the Council and the fish passage managers a daily flow report and make available a copy of the National Weather Service weekly flow forecast. During the remainder of the year, submit a monthly flow report to the Council.

Fish Passage Center

5.1C.3 By November 1 of each year, submit to the Fish Operations Executive Committee and the Council a single report that explains the scheduling of flow augmentation and supporting rationale for that calendar year. This report will include:

- the actual flows achieved for that calendar year;
- a record of the estimated number of smolts that passed Lower Granite and Priest Rapids dams, and the period of time over which the migration occurred;
- a description of the flow shaping used for that calendar year to achieve improved smolt survival; and
- further assessments of tradeoffs between anadromous and resident fish.

Bonneville

5.1C.4 Pay the travel costs and related travel expenses for one or two representatives from each Columbia River Basin Indian tribe to attend up to three meetings per

year for the purpose of coordinating tribal flow augmentation activities.

5.1D Operating Rules for Flow Augmentation

Fish Passage Center and Corps of Engineers

5.1D.1 To provide a base from which to measure use of water for flow augmentation, the Council has established the "firm power flows" listed in Table 5-1. For the Columbia River, the fish passage manager**s** will request flows for Priest Rapids and/or The Dalles dams and dates on which these flows are desired. The flow requests must be greater than the firm power flows. For the Snake River, the fish passage manager will request flows from Dworshak and/or Brownlee reservoirs to provide flow augmentation at Lower Granite Dam. The fish passage manager must give the Corps of Engineers three days' written notice of changes in the planned flow schedule from the water budget volumes, unless otherwise agreed to by the manager and the Corps. For the Columbia River, water budget use will be measured as the difference between the actual average weekly flows or the fish passage manager**s** '~~s~~ flow request at Priest Rapids Dam, whichever is less, and the firm power flows, or as agreed to by the project operators and the fish passage **managers** ~~manager~~.

Relevant Parties

5.1D.2 The Council recognizes that the description of the water budget lacks many of the operating details that will be addressed as the water budget is implemented and operating problems occur. Recognizing that operating decisions could influence the effectiveness of the water budget, the Council recommends priorities for competing uses of the hydropower system. Relevant parties should rely on these priorities in their decisions about the hydropower system.

First: Firm power to meet firm loads.
Second: Water budget and other flow measures and reservoir constraints.
Third: Reservoir refill.
Fourth: Secondary energy generation (beyond that provided in connection with use of the water budget).

5.1D.3 Implement flow augmentation measures within the context of laws related to federal, state and Indian water rights. (See Section 14: Disclaimers.)

5.1D.4 Beginning in 1995, evaluate alternative ramping rates for flow fluctuations at mainstem Snake and Columbia River dams to constrain reductions or increases in total flow per 24-hour period at these projects.

5.2 IMPROVE SNAKE RIVER FLOW AND VELOCITY

Biological objectives:

1) To improve conditions for salmonid production by increasing flow and water velocities, decreasing downstream migration time for anadromous fish and decreasing the quantity of habitat for predatory and competing fish species; and 2) to endeavor to provide inriver conditions to maximize adult fish survival between dams.

Operational objectives:

To endeavor to provide a minimum monthly average flow or velocity equivalent of 85,000 cubic feet per second in all water years, endeavoring to achieve a monthly average flow or velocity equivalent of 140,000 cubic feet per second at Lower Granite at full pool from April 10 through June 20 in all water years. From June 21 through July 31: the objective is to provide a monthly average flow equivalent of 50,000 cubic feet per second and to exceed this flow target in years of higher runoff.

5.2A Performance Standard: Snake River Spring Migrants

Incorporate the measures described below into firm power planning.[28] Figure 5-1 illustrates the approximate flow equivalent attained when these measures are applied to the historical water record.

Bonneville, Corps of Engineers, Bureau of Reclamation and Other Parties

5.2A.1 Operate the Dworshak Reservoir to improve salmon migration conditions consistent with the measures listed below:

- From January 1 to April 10, in years when Snake River runoff is forecast to be below average, shift system flood control storage space to other Columbia Basin projects.

- Dworshak should be as close as possible to its upper rule curve by April 10 of each year.
- Provide 1,000,000 acre-feet of water plus any water gained from the flood control shift for juvenile fish flow augmentation. This volume of water is in addition to any minimum flow release requirements at Dworshak.[29]
- Dworshak's outflow is limited to ~~25,000~~**12,000** cubic feet per second during the migration period**, unless temporary gas variances and approval have been obtained from the Nez Perce Tribe and the State of Idaho**.
- In emergency situations, for capacity and reliability needs, Dworshak may be used temporarily until arrangements can be made to continue filling toward the upper rule curve.

[28] Where the Council calls for incorporation of flow or other measures into firm planning, the Council means that the federal project operators and regulators incorporate these measures in all system planning and operations performed under the Columbia River Treaty, the Pacific Northwest Coordination Agreement, and in other applicable procedures affecting river operations, and all parties will act in good faith in implementing these measures as firm requirements.

[29] The project minimum flow release at Dworshak Dam is assumed to be 1,200 cubic feet per second.

Bureau of Reclamation,
Bonneville and the States

5.2A.2 Use uncontracted storage space to supply at least 90,000 acre-feet of water for spring migrants.

5.2A.3 By ~~1996~~**2002**, provide an additional 500,000 acre-feet of water from the Snake River Basin and by ~~1998 -~~**2003** a further 500,000 acre-feet **and by 2005 a further 500,000 acre feet** (for a total of 1,5~~0~~00,000 acre-feet over and above the 427,000 acre-feet in the Strategy for Salmon's immediate measures and the summer water provided under Section 5.2B) to augment flows in the lower Snake River in the April 10 through **the** September **30** time period. All such water should be used to benefit both Snake and Columbia river migrants, with no corresponding reduction in Columbia River flows unless the Columbia River flow/velocity objective is being met. This water may be obtained through willing seller/buyer transactions, other non-structural approaches, new storage (Section 5.2E), or a combination of such alternatives. The states should cooperate to ensure that this water will be allowed to move freely downstream, undiminished by diversion. The Fish Operations Executive Committee may recommend that some of this water be used to control water temperatures for adult salmon.

5.2A.4 To provide the water described above, review the cost-effectiveness of measures identified in the Bookman-Edmonston/ Snake River Water Committee report on irrigation efficiency improvements and other non-structural water alternatives, the Bureau of Reclamation's storage appraisal study and other sources, and implement least costly measures first.

Idaho, Oregon and Washington

5.2A.5 Facilitate water transactions to aid instream flows for salmon and steelhead by allowing water bank prices to achieve market levels, eliminating obstacles to downstream use for instream flows and developing expedited water transfer procedures.

Bonneville and Bureau of Reclamation

5.2A.6 Share equally the cost of securing the water described in measures 5.2A.3 - 5.2A.5.

Bonneville

5.2A.7 Fund an independent, third-party evaluation of the effectiveness of measures 5.2A.3 - 5.2A.5, above, to provide water for salmon and steelhead.

Council

5.2A.8 Refine the cost-effectiveness method-ology developed by the Environmental Defense Fund for use in future analysis of structural and nonstructural water measures.

Idaho Power Company, Corps of Engineers, Bureau of Reclamation and Federal Energy Regulatory Commission and Bonneville

5.2A.9 Operate Brownlee Reservoir to ensure that water described in measures 5.2A.2 and 5.2D.1 is released to assist spring migrants. Report to the Council each year during the river operations planning process on the Idaho Power Company's effort to shape this water.

5.2A.10 As needed to meet operational flow or temperature objectives, operate Brownlee dam to provide up to 110,000 acre-feet of water in the spring for flow augmentation. Pass inflow in June (do not refill). Provide up to 137,000 acre-feet in July. Pass through ~~50,000 to 140,000 acre-feet~~ **the full complement of upper Snake water provided by Reclamation** in **June, July and** August **as requested by the Fish Operations Committee**. Provide 100,000 acre-feet in September.

5.2A.11 Modify operation of the Hells Canyon Complex to provide coordinated fall and spring flows below Hells Canyon Dam to maintain fall chinook spawning, incubation and emergence. Evaluate options for providing more water for fish flows from Brownlee Reservoir, including substantially improved ability to shape water from the Snake River Basin for spring and summer migrants**, and mechanisms for selected cool water releases** and report to the Council by the end of ~~1993.~~**2003. Investigate and implement operations and configurations to reduce total dissolved gas from the Complex as necessary to meet water quality standards. Evaluate restoration of anadromy above the Complex. Assure that Sections 5.2A 9- 5.2A 12. are incorporated into an new license.**

Bureau of Reclamation, Idaho and Oregon

5.2A.12 Establish, in cooperation with fish and wildlife agencies, Indian tribes and interested parties, a Snake River Anadromous Fish Water Management Office to facilitate the use of water from the Snake River Basin. Report to the Council by May 1992.

5.2B Summer Migrants

Idaho Power Company and Federal Energy Regulators Commission

5.2B.1 During July, draft Brownlee Reservoir to a minimum elevation of 2,067 feet above sea level to provide up to 137,000 acre-feet for juvenile fall chinook migrants (Section 5.2A.10 above).

Corps of Engineers

5.2B.2 Allow Dworshak to draft to elevation 1,520 feet by the end of July, if needed to assist in meeting the summer basin flow and velocity objectives.

5.2B.3 Use remaining water identified in measure 5.2A.3 if needed to meet the summer flow objective, or for adult temperature control, as recommended by the Fish Operations Executive Committee.

5.2C Allocation of Power Losses at Brownlee Reservoir

Bonneville

5.2C.1 If Idaho Power Company experiences a power loss as a result of participating in the water budget, and it is determined that the need for water from Brownlee Reservoir is not attributable to the development and operation of Idaho Power Company's Hells Canyon Complex, Bonneville should replace the lost power. ~~To allocate non-power impacts equitably between Dworshak and Brownlee reservoirs, some spill at Dworshak may be necessary~~. It is expected that Idaho Power Company will experience power losses as a result of operating Brownlee Reservoir for the purpose of supplying the water budget. ~~Idaho Power Company maintains that, through its settlement agreement and Federal Energy Regulatory Commission license, it has compensated for all adverse effects of its projects on fish. The Council does not express an opinion on this question.~~ Nevertheless, the Council believes that Idaho Power Company's participation in providing flows on the Snake River will help significantly in providing systemwide flows for downstream migration.

5.2D Pursue Snake River Water Efficiencies and Transactions

Bureau of Reclamation, Idaho, Oregon, Bonneville and Other Parties

5.2D.1 Unless the forecasted April-through-July runoff at Lower Granite exceeds 29 million acre-feet, use water efficiency improvements, water marketing transactions, dry-year option leasing, storage buy-backs, and other measures to secure at least 100,000-**500,000** acre-feet of water from the Snake River Basin for spring migrants. Of this amount, half should be secured by the Bureau of Reclamation, and half should be secured with financial incentives provided by Bonneville (through the Idaho Water Rental Pilot Project, or such other processes as the Bureau of Reclamation, Idaho, Oregon and Bonneville choose).

Bureau of Reclamation, Idaho, Bonneville and Other Parties

5.2D.2 Use water efficiency improvements, water marketing transactions, dry-year option leasing, storage buy-backs and other measures to provide ~~up~~ **at least** ~~to~~ 137,000 acre-feet of water in August, in light of the operation described in Section 5.2B.1, above, and to provide 100,000 acre-feet of water in September to reduce water temperatures (see Section 6.1D.3). Of this amount, half should be secured by the Bureau of Reclamation and half should be secured on a matching basis using financial incentives provided by Bonneville (through the Idaho Water Rental Pilot Project or such other processes the parties choose).

Bonneville

5.2D.3 Fund an independent, third-party evaluation of the effectiveness of measures 5.2A.3 and 5.2B.5, above, to provide water for salmon and steelhead.

~~5.2E Additional Storage Projects~~

~~**Bureau of Reclamation, Corps of Engineers, Bonneville, Idaho, Oregon and Others**~~

~~5.2E.1 Proceed with all necessary planning, design and National Environmental Policy Act compliance for the Galloway, Upper Rosevear Gulch and Jacobsen Gulch storage projects, to be operated exclusively to store water for flow augmentation for salmon and steelhead. Upon completion, submit to the Council for review and decision whether to proceed with construction. The Council anticipates making a decision on construction in 2002, upon completion of the spread the risk evaluation~~ described in Section 5.0.

5.3 SNAKE RIVER RESERVOIR DRAWDOWN STRATEGY

Drawdowns to near-spillway crest elevations of the four lower Snake River projects offer an alternative for improving mainstem survival. The Council believes that a properly designed drawdown of Lower Granite pool will produce essential biological information needed before a long-term commitment to drawdown of the lower Snake projects is decided. Therefore, the Council calls on the Corps of Engineers immediately to take all steps needed to proceed with a Lower Granite drawdown.

The Corps of Engineers should not view the Lower Granite drawdown as a one-time test but rather as the first stage of an adaptive management plan. Knowledge gained from the Lower Granite drawdown regarding turbine efficiency, turbine mortality, smolt travel time and adult passage should be used in deciding about continuing the Lower Granite drawdown **in 2002** and how a **future** ~~1999~~ drawdown of Little Goose **and other Snake River** reservoir**s** could be achieved~~. if it is biologically prudent.~~ Information, gained from the **2002**~~1999~~ drawdown, including but not limited to adult passage mortality and gas supersaturation control from downstream weirs, should, in turn, be used in deciding if and how a **future** ~~2002~~ drawdown of all the Lower Snake reservoirs could be achieved. **A key**~~The~~ objective of the Snake River drawdown is endeavoring to achieve a 140,000 cubic feet per second velocity equivalent in all water years.

Using adaptive management techniques for each stage of the drawdown plan is also essential because it is possible that some of the central components of the ultimate drawdown strategy will not be fully completed in time for the Lower Granite drawdown. The Council calls on the Corps to take the steps needed to prevent or minimize any likely negative impact to salmon resulting from any element of the drawdown strategy being incomplete. However, the Corps should not fail to meet the drawdown implementation schedule merely because an element of the ultimate strategy is incomplete.

Snake River flow augmentation and transportation measures, described in Sections 5.2 and 5.8, will be pursued pending implementation of the Snake River reservoir drawdowns. The Council will review and re-evaluate transportation and flow measures as drawdowns are implemented. It is the intent of the Council that these measures will be in addition to or complement measures already initiated to achieve rebuilding targets, and that mitigation measures (including mitigation for transportation rate increases) be in place before drawdowns are implemented.

5.3A Initial Lower Granite Drawdown

Corps of Engineers

5.3A.1 In consultation with the fishery managers of the Columbia River Basin, as a recovery action/test, implement a two-month drawdown to elevation 7**23**~~10~~ feet at Lower Granite from approximately April 16 to **September 30**~~June 15~~ starting in ~~1995~~**2002**. The 1995 Lower Granite drawdown **indicated that adult passage** is **not compromised with drawdown at this level.**~~contingent on:~~

~~1. The manufacture of dipping baskets capable of handling the smolts that enter the gatewells;~~

~~2. Conditions where the number of migrating smolts will not overwhelm the dipping basket system prior to peak; and~~

~~3. Any needed modification of the adult ladder exit.~~

The Lower Granite drawdown should contain the following elements:

1. The fishery managers will develop a spill management and monitoring plan for use by the Corps of Engineers before implementing a spill program associated with the Lower Granite drawdown. The purpose of the spill program is (in order of priority) to be consistent with state water quality standards; to ensure acceptable adult passage conditions; and to provide 80 percent fish passage efficiency.

~~2. The Corps will extend auxiliary water pumps for the adult fish ladder to permit a maximum drawdown of 690 feet above mean sea level.~~

~~3. The Corps will commence refill of Lower Granite pool in mid-June. Minimize impacts on June flows by shifting a portion of the spring water budget into the June period.~~

~~If dipping baskets are not capable of adequately handling fish in gatewells or if insurmountable obstacles preclude implementation of the above described elements in time for the 1995 drawdown, immediate action must be taken to ensure that a 1996 drawdown of Lower Granite can be implemented. The 1996 drawdown should incorporate the lift tank system of salvaging fish from gatewells. The Corps should undertake actions to reduce the lead time needed to implement a Lower Granite drawdown as quickly as possible.~~

Corps and Bonneville

5.3A.2 Using Congressional appropriations, borrowing, or other authorities, whichever is more expedient, fund modifications necessary to permit drawdown of the Lower Granite pool, and mitigation, including a mitigation program in place prior to drawdown. In order to mitigate for the physical and economic impacts of the **2002**~~1995~~ drawdown of Lower Granite, and until additional mitigation procedures can be put in place, use the claims procedures that were established to mitigate the effects of the 1992 Lower Granite drawdown test. Mitigation claims should be processed more expeditiously than occurred during the 1992 drawdown test. It is the Council's expectation that mitigation funds will be made available to affected parties as soon as possible.

~~5.3B Additional Lower Snake River Drawdown~~

~~**Corps of Engineers**~~

~~5.3B.1 In consultation with the fishery managers of the Columbia River Basin, complete the following modifications to Lower Granite and Little Goose by 1998:~~

~~1. Install either lift tanks or improved dip net baskets, or a combination, at Lower Granite.~~

~~2. Construct rock weirs on the downstream side of Lower Granite dam.~~

~~5.3B.2 Upon completion of these measures, in consultation with the fishery managers of the Columbia River Basin after Council review and absent Council disapproval, implement as a recovery action/test:~~

1. By 1996, the drawdown of Lower Granite to elevation 690 feet between approximately April 16 and June 15. Commence refill of Lower Granite pool in mid-June.

2. In 1995, begin all design, engineering and environmental review activities necessary to allow construction activities to begin in January 1997 to permit drawdown of Little Goose. By January 1997, after Council review and absent Council disapproval, begin construction. In 1999, after Council review and absent Council disapproval, drawdown Little Goose to elevation 590 feet for the same time period. Commence refill of Little Goose pool in mid-June.

5.3B.3 Continue the drawdown program for the years following. The drawdowns will also be consistent with the fishery managers' spill management and monitoring plan described above. Minimize refill impacts on June flows by shifting a portion of the spring water budget into the June period.

5.3B.4 Report to the Council in March 1995 on: a workplan to meet the drawdown timelines described above; whether private engineering assistance is required to meet these schedules; and a proposal for securing such assistance. If needed, accelerate the System Configuration Study to meet this schedule, and include in the study an evaluation of spillway as well as natural river level drawdowns.

Council

5.3B.5 Using best available scientific information regarding flow and velocity contributions to life-cycle survival and experience with juvenile passage in connection with Lower Granite drawdown review and, after Council review and absent Council disapproval, proceed with 1997 construction and 1999 drawdown of Little Goose.

Corps and Bonneville

5.3B.6 Using Congressional appropriations, borrowing, or other authorities, whichever is more expedient, fund modifications necessary to permit drawdowns of the Lower Granite pool by 1996 and Little Goose pools by 1999.

5.3B.7 Using appropriations or borrowing, whichever is more expedient, fund ongoing evaluation of reservoir and life-cycle survival consequences of drawdowns.

Corps of Engineers

5.3B.8 Beginning immediately, and concluding not later than December 31, **2004**1997, complete all design, engineering and environmental review of facility and operating changes necessary to operate Lower Granite, Little Goose, Lower Monumental, and Ice Harbor **at**projects near spillway and/or natural river level: a) annually, from April 16 to June 15; or b) year-round. Include all requirements and impacts relating to power production, flood control, navigation, irrigation and other river uses. Report results to the Council by December 31, 1997**2004**.

Council

~~5.3B.9 Based upon information gained from the drawdown of Lower Granite and Little Goose pools, determine by 2002 whether to implement the drawdown of Ice Harbor and Lower Monumental pools to spillway and/or natural river levels.~~

Corps of Engineers

5.3B.10 Secure any necessary authorization and comply with all required legal processes to permit reservoir drawdowns. Implementation of the lower Snake River drawdowns will be consistent with the fishery managers' spill management and monitoring plan.

Fishery managers

5.3B.11 By ~~1996~~**2002**, develop a monitoring program before Corps implementation of drawdown to determine whether the drawdowns reduce travel time for juvenile salmon and sustain an 80-percent fish passage efficiency rate or **higher**~~lower~~ based on the maximum allowable dissolved gas level.

Corps and Bonneville

5.3B.12 Using Congressional appropriations, borrowing, or other authorities, whichever is more expedient, fund necessary project modifications and mitigation measures to permit drawdown of the Lower Snake reservoirs, including plans to protect cultural resources at the four lower Snake reservoirs during drawdown.

5.3B.13 In consultation with the fishery managers of the Columbia River Basin, starting as early as possible in **2001**~~1992~~, conduct any tests necessary to assist in the formulation of the plans called for in this section.

Council

5.3B.14 Establish a committee to coordinate analyses conducted by the federal agencies and to oversee the development of drawdown plans and structural modifications to both juvenile and adult fish passage facilities, as described in this section and in Section 6. The committee, chaired by the Council, will consist of a representative from each of the following: National Marine Fisheries Service, Corps of Engineers, Bonneville, Bureau of Reclamation, Idaho, Montana, Oregon, Washington and Indian tribes. The committee's work will facilitate regional involvement in ongoing federal processes relating to lower Snake River reservoir drawdowns and will help prevent unnecessary duplication between federal and Council-sponsored efforts. The Council will provide ongoing coordination with other interested parties in the region and will be responsible for overseeing the development, scheduling and completion of the plans called for in this section, in consultation with the National Marine Fisheries Service.

Bonneville

5.3B.15 In coordination with the committee, a) fund independent technical resources, as needed, to enable the committee to review the adequacy of analyses conducted by the federal agencies and to conduct their own analyses when the committee or the chair deem appropriate. Funding will be based on a scope of work approved by the Council no later than two months

following adoption of this rule. b) Fund an independent panel of experts, preferably one that is already established, to evaluate current bypass technology relative to fish guidance efficiency, fish passage efficiency and survival at mainstem Columbia and Snake River dams. The panel of experts should compare the data to the guidance and passage efficiency standards adopted by the Council and provide recommendations to the committee regarding their evaluation. The experts should also consider the feasibility of using spill in conjunction with mechanical passage measures without violating federal or state water quality standards as appropriate for gas supersaturation.

Federal Project Operators and Regulators

5.3B.16 Implement approved plans in accordance with the schedule adopted by the Council. To ensure prompt implementation of any plans approved by the Council, federal implementing agencies should incorporate the planning process and its results into ongoing administrative processes including, but not limited to, National Environmental Policy Act and Endangered Species Act processes.

5.3B.17 Incorporate the specifications of such approved plans in all system planning and operations performed under the Columbia River Treaty, the Pacific Northwest Coordination Agreement, Congressional authorizations and appropriations, all related rule curves and other applicable procedures affecting river operations and planning. Implement approved reservoir drawdown plans as "firm" requirements.

5.3C Mitigation and Assistance for Property Owners

Corps of Engineers

Develop a mitigation plan that will assist local property owners in minimizing the impacts to buildings, facilities and roads that may result from each stage of the lower Snake River drawdown. The Corps should submit this mitigation plan to the Council no later than six months prior to the beginning of the Lower Granite drawdown and submit similar plans prior to each subsequent drawdown.

5.4 IMPROVE COLUMBIA RIVER FLOW AND VELOCITY

Biological objective:

To improve conditions for salmonid production by increasing flow and water velocity, decreasing downstream migration time for anadromous fish and decreasing the quantity of habitat for predatory and competing fish species, while endeavoring to provide inriver conditions to maximize adult fish survival between dams.

Operational objectives:

To endeavor to provide a monthly average flow or velocity equivalent at The Dalles as follows in the chart at the top of the following page.

The Council will review these objectives further based on anticipated submittals by the Columbia Basin Fish and Wildlife Authority in early 1995.

5.4A Performance Standard: Columbia River Spring Migrants

Through firm power planning, provide 58 thousand cubic feet per second per month (3.45 million acre-feet) of shapeable water. In addition, provide up to 4 million acre-feet of water, subject to conditions specified below. Add to the 4 million acre-feet any additional water from Canadian storage reservoirs that can be dedicated to anadromous fish flows as a result of negotiations and discussions with Canada.

Bonneville, Corps of Engineers, Bureau of Reclamation and Other Parties

5.4A.1 Beginning immediately, operate John Day Reservoir at minimum irrigation pool from May 1 to August 31 of each year. Minimum irrigation pool is the lowest level at which the irrigation pumps drawing from the reservoir will operate effectively. Monitor and evaluate the biological benefits of John Day Reservoir operations so that the Fish Operations Executive Committee can determine in future years how the operations can complement flow velocities and other factors to achieve rebuilding targets. The Council recognizes that, as was the experience in 1991, under certain conditions a slightly higher elevation may be required and that some daily flexibility is necessary for operation of the reservoir. Other portions of this rule contain measures that will permit irrigators and other users of the John Day pool to operate effectively at lower pool levels. The Council expects the level of the minimum irrigation pool to be lowered as these measures are implemented and that this will be accomplished by 1994. The intent of this provision is that the John Day Reservoir will be operated at the lowest practical level during the spring and summer migrations of juvenile chinook and sockeye salmon.

5.4A.2 Through firm power planning, provide **normative river flows consistent with Tables 1 and 2.** ~~58 thousand cubic feet per second per month (3.45 million acre-feet) of water at Priest Rapids Dam to be used by the Fish Passage Center consistent with the Fish Operations Executive Committee's annual plan during the period April 15 through June 15.~~

5.4A.3 When the adjusted April forecast for the January-July runoff at The Dalles Dam is less than 90 million acre-feet, have water in storage and available for juvenile fish flow augmentation by
April 30. The appropriate volume is derived from the curve in Figure 5-2 based on the official April forecast and adjusted to the National Weather Service 95-percent confidence level. This volume is in addition to the existing water budget volume. This volume of water would provide approximately the flow equivalents shown in Figure 5-3.

5.4A.4 Actions taken to store the required volume should not violate the following conditions:

- **modified** flood control limitations;
- project minimum flow requirements;

- Vernita Bar Agreement requirements, which protect fall chinook below Priest Rapids Dam.

Bonneville

5.4A.5 Beginning in January of each year, provide to the Council, the Fish Operations Executive Committee and other interested parties a monthly written report of the volume of water stored pursuant to Section 5.4A.3, above. By April 30 of each year, identify the location and total volume of water stored for juvenile fish flow augmentation.

Corps of Engineers and Bonneville

5.4A.6 Provide to the Council, the Fish Operations Executive Committee and other interested parties a monthly written report identifying where system flood control storage is being provided, including a summary of system flood control shifts.

All Parties

5.4A.7 Whenever flow augmentation measures are in effect, the weekend and holiday average flows should not be lower than 80 percent of the average of the five preceding weekdays.

5.4A.8 The 140,000 cubic feet per second flow cap in the mid-Columbia River is removed.

Bonneville

5.4A.9 Because of the uncertainty in the supply of out-of-region energy, immediately secure options for one or more resources to augment reduced hydroelectric energy during winter months. If the region is unable to store enough water for any reason other than those specified in Section 5.4A.4, above, immediately begin to acquire the optioned resources called for under Objective 2 of the 1991 Northwest Conservation and Electric Power Plan, or otherwise acquire resources that are consistent with the plan, in an amount sufficient to ensure that the full volume of required water is available in succeeding years. The Council will consult with representatives from all interested parties to determine the proper amount and timing of the acquired resource(s).

5.4B Summer Migrants

Bonneville

5.4B.1 During July and August in below-average water years, provide a volume of water from the U.S. Non-Treaty Storage
water available in that year to facilitate evaluations described below.

5.4B.2 Continue to seek energy exchanges and other energy alternatives with a potential for increasing Columbia River flows in July and August to facilitate evaluations and to improve survival of summer migrants.

5.4B.3 [deleted]

5.4C John Day Drawdown

Corps of Engineers, Bonneville, Washington, Oregon and Others

5.4C.1 Lower John Day reservoir so that it reaches near minimum operating pool by April 15, ~~1996~~ **2003**, and operate it at that level year-round, conditioned on full, prior mitigation of impacts to irrigators and other reservoir water users. If needed, and unavailable at other projects, allow load following operation outside the fish migration season. For **2002**~~1995~~, immediately explore whether immediate and/or temporary mitigation for such users (e.g., by dredging) is possible at the upper end of the reservoir to allow lowering the reservoir below the current minimum irrigation pool.

Corps of Engineers

5.4C.2 By January 1, 1995, develop a budget to finish design work, extend irrigation pumps, modify salmon passage facilities, if needed, and move boat ramps in John Day reservoir. ~~Develop a plan for wildlife mitigation measures and submit it to the Council by January 1, 1996~~.

5.4C.3 Install fliplips on spillways.

5.4C.4 Develop and implement a monitoring process to determine: the extent to which John Day drawdown reduces predation and travel time for juvenile salmon; impacts on adult salmon; effects of increased turbidity; changes in water temperature; impacts to wildlife; etc.

Corps, Bonneville, Washington, Oregon and others

5.4C.5 **Apply to for Congressional funding for implementation of Phase II of the John Day drawdown analysis by 2002. If funds are secured, implement the analysis following the recommendations and input from the state and federal fishery agencies and affected tribes by December, 2004.**

~~Beginning immediately, and concluding not later than April 30, 1996, complete all design, engineering and environmental review of facility and operating changes necessary to operate John Day Dam and its reservoir by 2002 at near spillway level: a) annually, from May 1 to August 31; or, b) year round.~~ Include all requirements and impacts and mitigation needed for power production, flood control, navigation, irrigation and other river users. In particular, evaluate: lock modification or reconstruction to facilitate continued navigation; and alternative means to provide irrigation and other water for water users in the John Day pool at the time. Report to the Council by ~~April 30, 1996~~**December 2004.**. The Council will use the report in making a decision on John Day drawdown to spillway.

5.4D River System Investigations

Bonneville, Corps of Engineers and Bureau of Reclamation in Consultation with the Council and Other Parties

5.4D.1 Evaluate seasonal exchanges, long-term nonfirm transactions, options for storing water above power rule curves, accelerated acquisition of winter peaking conservation and renewables, efficient direct application of renewable resources, wholesale and retail price structures and other changes in power system operations that could increase flows for salmon and steelhead or offset the cost of improving salmon and steelhead flows. Report annually to the Council not later than the end of each year. Among alternatives examined in the System Operations Review, include a full range of system coordination alternatives to facilitate such alternative power system operations. Take steps to include the Idaho Power Company in the coordinated system.

Council

5.4D.2 In consultation with and approval of the fishery agencies and tribes, immediately undertake a basinwide comprehensive hydrologic, hydraulic geometry and biological analysis to determine appropriate flow duration and magnitude needed to reestablish critical mainstem and estuarine floodplain habitat. As part of the analysis, explore relation of flood control rule curves, as provided in Section 5.4E, and modification of power sales contracts to move the river hydrograph back toward historical timing and duration.

Bonneville

5.4D.3 Fund the evaluation in 5.4D.2.

5.4D.4 Fund an evaluation of all Columbia River Basin water storage and hydropower facilities to determine the availability of additional velocity improvements or water for mainstem or tributary flow augmentation. The evaluation should include resident fish or other potential endangered species status and impacts. Report to the Council by January 1, 1996.

U. S. State Department

5.4D.5 Initiate discussions with Canada to attempt to secure the use of additional water for flow augmentation from Canadian storage reservoirs. Attempt to reach agreement by December 31, 1996. Report findings or progress to the Council at the end of each year.

Bonneville, Corps of Engineers and Bureau of Reclamation

5.4D.6 Use any resulting water secured through negotiations with Canada to meet the flow objectives of this program and, in addition, to provide a minimum flow of 120 thousand cubic feet per second at The Dalles Dam during September. These flows should: decrease

the migration time of the end of the juvenile subyearling fall chinook migration through the lower Columbia; reduce delay and inter-dam loss, and increase spawning success for adult fall chinook migrating through the lower Columbia; and reduce delay and inter-dam loss, and increase spawning success for adult fall chinook and steelhead.

Corps of Engineers

5.4D.7 Maintain Lake Pend Oreille at a level no lower than elevation 2,054 feet, 2,055 feet and then 2,056 feet during the next three winters, which will provide an additional amount of water for Columbia River salmon flows (see Section 10.6E). Any replacement energy for this operation must not come from Columbia River Basin storage projects.

Bureau of Reclamation, U.S.
Geological Survey, U.S.
Department of Agriculture
and Soil Conservation Service

5.4D.8 Evaluate the potential for water conservation, water efficiency or other measures in the above-listed agency programs with the most potential to benefit anadromous fish and with the least impact on third parties. Include an evaluation of the potential for using crop rotation programs to facilitate dry-year water leasing activities. Report to the Council.

Bonneville, Corps of Engineers
and Bureau of Reclamation

5.4D.9 Under the auspices of the Columbia River Water Management Group, continue with the review of, and make recommended improvements to, the urrent water supply forecasting products, including, but not limited to:

- potential for improvements in the accuracy of volume forecasts;
- potential for forecasting the shape of runoff;
- potential to incorporate the Southern Oscillation Index, other indices, and/or extended weather forecasts produced by the National Weather Service into runoff forecast procedures;
- benefits of expanding the telemetered snow monitoring system; and
- resolution of the institutional barriers for the installation of hydrologic measurement sites in existing and proposed wilderness areas.

5.4D.10 Based on the October 1993 Review of Runoff Forecasting in the Columbia River and Pacific Slope Basins related to measure 5.4D.9, continue to identify, evaluate and implement methods for improving runoff forecast accuracy. Bonneville, the Bureau, the Corps or the states should fund implementation of those methods and continuing evaluations.

5.4E Flood Control Examinations

Corps of Engineers and Others

5.4E.1 Continue to re-examine all Columbia River Basin flood control strategies and rules to identify modifications, including alternatives to impoundment that could yield more useful or shapeable flows for fish, such as alternative structural and non-structural flood protection measures. Such evaluations should include, but not be limited to: 1) the possibility of shifting flood control storage to the space provided when lower Snake River and John Day reservoirs are drawn down to minimum operating pool or lower; 2) the effects and trade-offs of reduced levels of flood protection, including decreasing the rainfall factor of safety; and 3) separating system flood control from local flood control storage requirements, favoring the latter, in upper basin storage projects. Submit a final report not later than the end of 1995.

5.5 CONDUCT ADDITIONAL RESEARCH AND MONITORING

5.5A Impact of Salmon Measures on Resident Fish and Wildlife

Idaho, Montana, Oregon and Washington, in Coordination with Appropriate Indian Tribes

5.5A.1 Continue to review, compile and submit to the Council information on the impacts of salmon and steelhead flow operations on resident fish or wildlife. In addition, identify specific research, monitoring and evaluation activities needed to determine the potential impacts of salmon and steelhead flow operations on resident fish and wildlife, particularly native species, in and around Hungry Horse, Libby, Grand Coulee, Brownlee and Dworshak reservoirs. Use this information to develop analytical methods or biological rule curves for reservoir operations, similar to those being developed by the Montana Department of Fish, Wildlife and Parks for Hungry Horse and Libby reservoirs. Include an evaluation of impacts on recreation and the recreational industry.

Bonneville

5.5A.2 Fund research, monitoring and evaluation activities needed to determine the potential impacts of salmon and steelhead flow operations on resident fish and wildlife, particularly native species, in and around Hungry Horse, Libby, Grand Coulee, Brownlee, Dworshak and other reservoirs.

~~5.6 COMPLETE INSTALLATION OF BYPASS SYSTEMS~~

~~When the first hydroelectric dams were constructed in the mainstem of the Columbia River, many people believed that providing adequate upstream passage over the dams for adult salmon returning to spawn was sufficient to sustain salmon and steelhead runs. Since that time, research has shown that juvenile salmon and steelhead heading downstream also suffer a significant mortality rate as they encounter the dams.~~

Pressure changes within each turbine are the primary cause of juvenile salmon deaths. The impact of the moving turbine blades and the shearing action of water in the turbine can cause injuries or death. In addition, juvenile salmon and steelhead may be stunned while passing through the turbines, thus increasing their vulnerability to predators, especially squawfish, which are abundant at the base of each dam. The Council recognizes the need to address all phases of mainstem salmon survival, including installation of juvenile fish screening and bypass systems.

The Council has taken a number of actions to reduce mortality rates of juvenile fish at the dams. It has called for permanent bypass facilities to be installed at mainstem dams. However, to protect juvenile fish while these installations were being built, the Council required dam operators to spill sufficient water at the dams to guarantee a specified level of fish survival. With spill, fish-laden water is diverted through a spillway, passing the dam without going through its turbines. (Spill is to be distinguished from the water budget in that spill helps juvenile fish around the dams. The water budget speeds the migrants' journey between dams.) The Council also adopted measures to transport juvenile salmon and steelhead around some dams, as determined by the fish and wildlife agencies and tribes.

In 1982, the Council called for development of mechanical bypass systems at five public utility district dams regulated by the Federal Energy Regulatory Commission in the mid-Columbia area. In 1984, operators of four of the five dams agreed to develop bypass systems as part of a settlement with fish and wildlife agencies and tribes, which had petitioned the Federal Energy Regulatory Commission to make bypass a condition of license renewals for the dams. Spill, which is to be used to protect fish until the bypass systems are operating, is to be shaped in coordination with the fish and wildlife agencies and tribes. In 1987, the Council amended the program to incorporate provisions of a settlement agreement concerning fish protection measures at Rock Island Dam. The settlement capped several years of litigation over the advisability of mechanical bypass systems for juvenile fish, whether a hatchery would be a reasonable substitute, what level of spill would be appropriate to protect juvenile fish and other issues. The settlement agreement calls for the development of juvenile bypass systems and installation of the systems, if certain criteria are satisfied. The agreement also provides for the creation of an innovative "Fisheries Conservation Account," which the joint fishery parties that have signed the agreement may use for bypass studies, bypass development or to purchase spill. The agreement specifies spill levels and provides for studies of summer spill. A hatchery and satellite facilities will be constructed promptly, and habitat and other studies will be conducted to help determine the proper use of the fish produced. Changes were also made in adult fishway operating criteria and modifications.

In 1984, the Council considered a number of proposals for improving fish passage efficiency and smolt survival at Columbia and Snake river dams with the goal of improving smolt survival systemwide. Some recommendations proposed waiting for results of studies on fish passage problems before taking action to improve bypass efficiencies. The Council, however, found that the critical status of the runs on the Columbia and Snake rivers requires prompt action instead of continued delay and study. As a result, amendments to the program called for the Corps of Engineers to develop coordinated interim juvenile fish passage plans, including spilling water over the dams, while developing permanent solutions to passage problems at John Day, The Dalles, Bonneville, Lower Monumental and Ice Harbor dams.

At the Council's request, the Corps completed a comprehensive report on smolt transportation in 1986. In addition, the Council adopted a 90-percent fish guidance efficiency standard as a design criterion for devices that deflect fish away from turbine intakes. The Council required that the level of spill be sufficient to guarantee at least 90-percent fish survival at specified projects for the middle 80-percent of the spring and summer migrations until mechanical bypass systems are installed.

In 1987, the Council adopted a "share the wealth" measure to provide increased levels of spill in years when water is above the critical level. Recognizing that many of the issues associated

~~with spill have been institutional in nature, the Council committed to aid agreement among the fish and wildlife agencies, Indian tribes and the Corps on this "sliding scale" approach to spill and on other matters.~~

~~In 1988, the Bonneville Power Administration, state and federal fish and wildlife agencies, Indian tribes and utility representatives negotiated an agreement on spills for a 10-year period beginning December 31, 1988, at Lower Monumental, Ice Harbor, John Day and The Dalles dams.~~

~~In this section, the Council establishes performance standards and sets schedules for the installation of new or improved screens and bypass systems at all Snake and Columbia river federal dams. The Council also calls for monitoring and evaluation of existing screens and new screen designs for improved effectiveness.~~

5.6A Improve Columbia and Snake River Salmon Passage

Biological objective:

To minimize delay at dams, and minimize the passage of juvenile fish through turbines by providing high survival alternative passage routes **and water quality conditions that meet state and federal standards**.

Operational objective:

To achieve 80 percent fish passage efficiency at each Snake River project from April 15 to ~~July 31~~ **September 30** and at each Columbia River project from May 1 to ~~August 31~~**September 30**, while keeping dissolved gas levels within the limits of federal and state water quality standards and ensuring a high degree of adult passage success.

Corps of Engineers

5.6A.1 Develop and implement a coordinated permanent juvenile passage plan, in consultation with the fish and wildlife agencies and tribes, consisting of a schedule for design and installation of a **surface bypass** ~~powerhouse collection and bypass~~ system at Ice Harbor and The Dalles projects. (Unless otherwise allowed by the Ten-Year Spill Agreement, use a 90-percent fish guidance efficiency standard as a design criterion ~~for turbine intake screens and~~ surface bypass systems. However, the standard need not be used if it is demonstrated to the Council's satisfaction, on the basis of hydraulic model studies or prototype testing of surface bypass systems and biological test results, that the 90-percent standard cannot be achieved.) The Corps should measure fish **passage** ~~guidance~~ efficiency and report results to the Council.

5.6A2 In coordination with the tribes and state and federal fishery agencies, investigate comparative and relative fish direct and delayed mortality through screens, turbines and spill at each dam. Until investigations are completed, spread- the - risk to juvenile migrants by removing half of the turbine intake screens from all Corps mainstem projects, and provide the necessary spill to achieve a 90% FPE. Report to the Council on progress through the Fish Operations Committee.

~~5.6A.2 Install and provide operational fish passage screens and bypass systems at all unscreened federal mainstem dams according to the following schedule:~~

- ~~**Ice Harbor:** Provide a completed and operational screening and low-velocity flume bypass system by March 1996.~~

- ~~**The Dalles:** Provide an operational screening and bypass system by March 1998. If a surface bypass system prototype is tested at The Dalles Dam, then complete engineering design for a screened bypass system, but defer screen procurement and construction contracts until testing is complete. Testing should take no longer than two years. In either case, install an operational powerhouse juvenile fish bypass system by March 2000.~~

5.6A.3 Ensure a 98-percent or greater salmon survival rate in all bypass and collection facilities from the deflector screens or surface bypass system entrances to the end of the bypass system outfall. Where possible, increase survival of smolts in the area below the bypass release points by removing fish predators, protecting migrants from predation by birds, providing alternative release ~~sites~~ **sites.** ~~or relocating bypass outfalls, particularly at Bonneville Dam by 1998~~, and/or modifying project operations to reduce predation**.**, ~~according to the schedule in Table 5-2.~~

~~5.6A.4 Complete evaluation, design and prototype testing of extended-length fish screens, and, if more effective than surface bypass systems, install them at all Snake and Columbia river dams.~~

5.6A.5 During design and preparation for installation of fish passage facilities, evaluate and report to the Council concerning modifications that may be needed to accommodate alternative flow and velocity measures outlined in Section 5.3 (Snake River Reservoir Drawdown Strategy).

5.6A.6 Expedite evaluation of fish passage efficiency at Bonneville Dam First Powerhouse and report to the Council modifications that may be needed to meet the standards in Section 5.6A.1. Expedite rehabilitation of old generating units. By ~~1996~~**April 2003 install**, **modifications to allow operation of the Second Powerhouse surface bypass sluiceway. By October 2004, complete design and environmental components to install a surface bypass system at the First Powerhouse.** ~~investigate project operating systems to provide independent operation of each powerhouse and modify an operating system by March 1998. Complete prototype testing of a surface flow juvenile bypass system by 1998~~.

5.6A.7 At The Dalles and Lower Granite, complete prototype testing of a surface flow juvenile bypass system by ~~1998~~**2003**.

5.6A.8 **By December 2004, construct a** ~~Investigate the feasibility of building a~~ fisheries engineering research facility in the Columbia River Basin to evaluate how fish respond to various fish passage design structures and new fish passage

technologies. ~~Report progress on this study by end of 1995.~~

5.6A.9 ~~Evaluate and modify, if necessary, the juvenile mechanical bypass system at John Day Dam, especially the collection channel and outfall~~. Complete prototype testing of a **John Day** surface flow juvenile bypass system by **2002**~~1998~~.

5.6A.10 Continue studies at McNary Dam to evaluate **fish spill efficiency and modification to meet temperature standards in fish passage facilities. Complete by 2003.**~~the expanded juvenile fish bypass and collection system and make necessary modifications by 1995.~~

~~5.6A.11 If initial testing at Ice Harbor and prototype testing of surface bypass systems at other mainstem dams indicate potential for improved fish passage at Ice Harbor Dam, complete prototype development and testing of a surface bypass system by 1998~~.

~~5.6A.12 Complete comprehensive evaluation of new mechanical bypass systems at Lower Monumental and Little Goose dams by 1995.~~

Corps of Engineers and Other Parties

5.6A.13 Explore promising new approaches to fish bypass technologies, including development and prototype testing of surface bypass systems, surface spill and behavioral guidance devices, such as the use of **curtains to divert fish from turbines**~~sound to guide fish~~. ~~If the results of this research indicate high efficiency at costs less than screen or other bypass system modifications and show no reason to preclude use of a new technique, propose to the Council incorporation into bypass strategies.~~ **Provide annual reports to the Council by October of each year.**

5.6A.14 Conduct laboratory studies, numerical analysis, hydraulic model studies and prototype testing to develop an improved understanding of the mechanisms of fish mortality in turbines. Use this information to develop biological design criteria to be used in advanced turbine designs or modified unit operations to increase fish survival. Report results of studies by **October of each year**~~September 2001~~. Based on results of studies, replace or rehabilitate existing turbines, or modify turbine operations at mainstem Columbia and Snake river dams.

5.6B Mid-Columbia River Salmon Passage

Mid-Columbia Public Utility Districts

5.6B.1 ~~Subject to Federal Energy Regulatory Commission approval, C~~coordinate and consult with the fish and wildlife agencies and tribes through the three coordinating committees (Wells, Rock Island and Mid-Columbia) on the design of prototype bypass system studies, research, evaluation and all other activities required in this section to achieve the most effective permanent solutions to juvenile fish passage problems in the mid-Columbia. By March 20 of each year, develop and submit to the Federal Energy Regulatory Commission, members of the coordinating committees and the Council an annual fish passage and project operational and maintenance plan. The annual fish

passage plan for the mid-Columbia public utility district projects should be coordinated with the various annual implementation plans developed under the auspices of the Fish Operations Executive Committee. At the request of the tribes, fish and wildlife agencies or public utility districts, the Fish Operations Executive Committee and/or the Council will help resolve any disputes related to achieving the objectives of this plan.

Douglas County Public Utility District

5.6B.2 Subject to Federal Energy Regulatory Commission approval, ensure that the installed juvenile fish bypass system tailored to the unique features of Wells Dam continues to operate effectively and in accordance with the terms and conditions of the 1990 Wells Settlement Agreement. **Continue to provide mitigation for unavoidable losses, including sockeye using the recommendations of the agencies and tribes in the Wells Coordinating Committee. Monitor and evaluate water quality parameters and implement operational and structural remedies to the Wells Coordinationg Committee by 2002.**

Chelan County Public Utility District

5.6B.3 ~~Evaluate, design and install a prototype surface collection and bypass system at Rocky Reach Dam by 1995. Review with the Mid-Columbia Coordinating Committee, the need for and, if needed,~~ **Rocky Reach.M**~~m~~ake structural repairs to the spillway so the spillbays closest to the powerhouse can operate independently. **Complete design and prototype investigations to install a sluiceway through Unit 1 by 2004. Implement recommended studies by the tribes and fishery agencies necessary for the relicensing proceeding, and incorporate them into the draft relicensing application to FERC. Provide interim spill to protect 95% of the juvenile migrations at an 90% FPE level. Seek and implement recommendations of the Mid-Columbia Coordinating Committee, including adult passage investigations and structural changes to bring the Project into compliance with water quality standards.** ~~If prototype testing indicates higher passage efficiency compared to screen modifications and shows no reason to preclude use of a surface bypass system, install a surface bypass system instead of turbine intake screens.~~

5.6B.4 ~~Subject to Federal Energy Regulatory Commission approval, complete installation at Rock Island Dam of a juvenile fish screening and bypass system, as set forth in Sections B and C of the Rock Island Settlement Agreement.~~ **Rock Island. Provide spill to protect 95% of the juvenile migrations at a 90% FPE level. Seek and implement recommendations of the Mid-Columbia Coordinating Committee, including adult passage investigations and passage modifications and structural changes to bring the Project into compliance with water quality standards**

5.6B.5 Subject to Federal Energy Regulatory Commission approval, develop plans for spills at Rocky Reach and Rock Island projects by March 1 of each year, as set forth in the stipulated agreement for Rocky Reach Dam and the 1986 Settlement Agreement for Rock Island Dam (Section C, “Fisheries Conservation Account,” or Section D, “Spill Program”).

Grant County Public Utility District

5.6B.6 ~~Subject to Federal Energy Regulatory Commission approval, complete testing and evaluation of prototype juvenile fish screening and bypass systems at Wanapum and Priest Rapids dams, and report the results of such tests and evaluation to the Council and the Federal Energy Regulatory Commission~~.

5.6B.7 ~~Subject to Federal Energy Regulatory Commission approval, complete installation at Wanapum Dam of a fully operational juvenile fish screening and bypass system by March 1, 1998, or inform the Council of the reasons why this date cannot be met.~~

5.6B.8 ~~Subject to Federal Energy Regulatory Commission approval, complete installation of a fully operational juvenile fish screening and bypass system at Priest Rapids Dam by March 1, 1997, or inform the Council of the reasons why this date cannot be met.~~

5.6B.9 ~~Subject to Federal Energy Regulatory Commission approval, p~~**Following the 2000 Spill Settlement Memorandum of Agreement, p**rovide an increased level of spill at both Wanapum and Priest Rapids dams to improve fish **passage and** survival for ~~80~~ **95** percent of both the spring and summer salmon migrants, **at an 90% FPE level** while avoiding dissolved gas supersaturation problems. The Mid-Columbia Coordinating Committee will have the responsibility to govern the timing and distribution of spill. ~~Implement such a plan for spill each year at Wanapum and Priest Rapids dams until juvenile fish screening and bypass systems are installed and operational at each project~~.

5.6B.10 ~~Subject to Federal Energy Regulatory Commission approval, e~~**E**xplore promising new approaches to juvenile fish bypass technology, including the use of surface bypass systems, by **2003**~~1996~~. ~~If prototype testing indicates higher passage efficiency compared to screen modifications and shows no reason to preclude use of a surface bypass system, install a surface bypass system instead of turbine intake screens.~~ **Seek and implement recommendations of the Mid-Columbia Coordinating Committee, including adult passage investigations and structural changes to bring the Project into compliance with water quality standards. Incorporate these changes into the draft relicensing application to FERC.**

5.6C Spill

Corps of Engineers, Bonneville and Other Parties

5.6C.1 Consistent with the experimental program developed under Section 5.0, and until better means are available to move juvenile migrants past dams, for mainstem projects operated by the Corps of Engineers on the Columbia and Snake rivers, provide spill to achieve 80-**90** percent fish passage efficiency at each Snake River project from approximately April 1**0**~~5~~ to ~~July 31~~**September 30**, and at each Columbia River project from approximately **April 10**~~May 1~~ to ~~August 31~~**September 30**, or as near as possible within the total dissolved gas guidelines established by federal and state water quality agencies. Manage the spill program in close cooperation with National Marine Fisheries Service and fish managers to ensure appropriate responses to monitoring information for gas bubble trauma. Exceptions to the state standards should be approved by the states on a showing, by the National Marine Fisheries Service and state and tribal fishery managers, that the risk of fish mortality from exposure to higher levels of dissolved gas is less than the risk of failure to provide the spill regime that may result in such levels.

~~Fish Managers, State Water Quality Agencies and Corps~~

5.6C~~.2 Prior to use of spill for fish passage in 1995, develop and implement a monitoring and spill management program for ambient nitrogen supersaturation levels, symptoms of gas bubble trauma, and systemwide effects of spill to ensure safe passage conditions for both adult and juvenile salmon.~~

~~Idaho, Oregon and Washington water quality agencies and~~ Corps

5.6C.3 **By March 30 2002, and in coordination with tribes, state water quality agencies and fishery agencies, d~~D~~**evelop and implement a network of **tri-level** water quality monitoring telemetry stations on the Snake and Columbia **rivers ~~rivers~~and in juvenile and adult fish bypass system~~s~~,- capable of instantaneous data retrieval** and evaluate data produced by the system.

5.6D Turbine Operating Efficiency

Corps of Engineers

5.6D.1 Operate turbine units within 1 percent of peak operating efficiency from April **10** through **September 30** August of each year, and especially during peak migration periods. Plan and coordinate deviations from the 1-percent peak efficiency criterion with the fishery agencies and tribes. Complete the turbine index testing program **for each individual turbine unit** at all mainstem dams by **April 10, 2003~~1996~~**. **Record deviations from the 1 percent criteria and provide the report to the agencies and tribes and the Council.**

5.6E Gas Supersaturation

Bonneville, National Marine Fisheries Service

5. ~~6E.1 Fund a study of dissolved gas supersaturation and its effects on salmon and steelhead passing through dam turbines, collection and bypass systems, spillways, adult ladders, reservoirs and other mechanisms, particularly in connection with possible reservoir drawdowns. The study should focus on the relationship between: a) spill levels at mainstem federal projects and the resulting total dissolved gas level; and b) the symptoms of gas bubble trauma related to both lethal and non-lethal effects on juvenile and adult salmon and other aquatic species. Report to the Council by January 1, 1997.~~

Corps of Engineers

5.6E.2 By **2002~~1997~~**, evaluate and modify mainstem projects to reduce dissolved gas levels during spill operations and increase spill efficiency. Include the following options in the evaluation:

a) Installation of spillway deflectors at each of the following dams~~: Lower Granite, Little Goose and Lower Monumental (two outer spillbays);~~ McNary (four outer

spillbays); ~~Ice Harbor, John Day and~~ The Dalles (all spillbays); and Bonneville (two outer spillbays) **Chief Joseph**;

b) Design and prototype test spillway and stilling basin modifications;

c) Design and prototype test structural and fish behavioral methods to increase fish passage efficiency of spillways and control nitrogen supersaturation, including the use of a slotted spillgate design; and;

d) Fund extensive hydroacoustic monitoring across the length of each dam to monitor smolt movement, determine spill efficiency and improve the effectiveness of spill passage.

Corps of Engineers

5.6E.3 Fund or install the following dissolved gas monitoring and abatement measures:

a) a more extensive dissolved gas monitoring system so physical aspects of gas plumes can be identified in the water column;
b) state water quality agencies and fishery agency and tribal entities to conduct physical and biological monitoring and evaluate data gathered by monitoring program;

c) supply additional gas monitoring equipment for backup installation and readiness for immediate use;

d) continued development and calibration of existing gas spill model to enable accurate prediction of dissolved gas levels under different riverine and spill conditions on a real-time basis;

e) gas abatement structures at all Corps dams by ~~1997~~**2003**; and

f) operational and structural measures to reduce high total dissolved gas levels caused by turbine discharges from headwater storage projects.

Reclamation

5.6E.4 Finish gas abatement structural designs that will reduce total dissolved gas from Grand Coulee Dam to meet water quality standards. Investigate alternative that can result in temperature control as well as gas abatement. Report to the tribes, fishery agencies and Council by December 2001. Seek funding to implement the alternative that best meets both temperature and gas standards by December 2005.

5.6F Develop and Implement Maintenance Plans

Federal Project Operators and Regulators

5.6F.1 Develop a plan for repair and maintenance of any part of each dam relating to the passage of juvenile salmon and steelhead, including: 1) measures to be followed in the event that any such facility breaks, is washed out or ceases to operate; and 2) designation of an individual responsible for carrying out the plan. If any dam operator fails to comply with the plan, the Council will ask the person responsible for carrying out the plan to explain at a Council meeting the reasons for the non-compliance. The Council will decide upon appropriate action at that time.

5.7 REDUCE PREDATION AND COMPETITION

Hydropower development in the Columbia Basin resulted in an environment that favors salmon predators. Additionally, introduction of non-native species, development of some hatchery programs, and greatly increased numbers of seals and sea lions as a result of protection of the Marine Mammal Protection Act, have resulted in an increase in the adverse effects of predation and competition on salmon. Conditions beneficial to predatory fish include increased predator spawning habitat, slightly warmer water temperatures, and the introduction of millions of hatchery fish that are diseased and ill-suited to escape predation. Other factors that improve predator success include concentrations of smolts at hydropower facilities and the incapacitation of smolts passing through generator turbines. Hydropower development also increased predation by birds. Predator vulnerability may also be increased for juvenile fish passing through existing bypasses and sluiceways. The introduction of non-native species, as well as certain hatchery management practices, have also resulted in increased competition for a number of the weak runs.

In this section, the Council calls for measures to reduce predation and competition, including a squawfish management program that employs targeted fisheries or other measures to achieve the removal of more than 20 percent of the squawfish population, with the expectation that this will result in more than a 50-percent reduction in the present consumption of juvenile salmonids. This is a modification to the current predator control effort and increases the rate of squawfish removal, which will progressively reduce predation on smolts. A comprehensive monitoring and evaluation program will evaluate the effectiveness of predator control efforts. These efforts will then be modified, if necessary.

5.7A Performance Standards for Reducing Predation

Bonneville, Corps of Engineers and Mid-Columbia Public Utility Districts

5.7A.1 **Pikeminnow~~Squawfish~~:** Reduce **pikeminnow**~~squawfish~~ population by more than 20 percent in the Snake and Columbia rivers with the expectation that this will result in more than a 50 percent reduction in the present consumption of juvenile salmonids.

5.7A.2 **Shad:** Explore the population ecology of shad to determine effective methods for control and develop programs to eliminate shad from the Columbia River system above Bonneville Dam and reduce the shad population below Bonneville Dam.

5.7A.3 **Other Non-Native Fishes:** Reduce numbers of non-native fish wherever they exist with listed species or weak runs, and curtail recruitment of non-native fish into the habitats of listed species and weak runs.

5.7A.4 ~~**Steelhead:** Evaluate the extent of residualism (precocious males) in hatchery steelhead populations. Determine the causes of residualism in hatchery steelhead populations and initiate actions, based upon the results of these determinations, to reduce the incidence of residualism by at least 50 percent to reduce the potential for residual hatchery steelhead to prey on or compete with natural salmon/steelhead populations~~.

5.7A.5 **Trout:** Use alternative planting strategies for release of hatchery trout which will reduce predation and competition to acceptable levels. Evaluate effect of native trout on survival of weak stocks.

5.7A.6 **Birds:** Monitor and assess predation by birds and identify non-lethal methods of control. **Continue with moving tern colonies out of the Columbia River estuary.**

5.7B Predation Control Actions and Evaluations

Bonneville and Other Parties

Pikeminnows ~~**Squawfish**~~

5.7B.1 ~~Continue implementation of the current squawfish project and increase the rate of squawfish removal thereby progressively reducing predation on smolts.~~

5.7B.2 Document current population dynamics, life history and behavioral attributes of **pikeminnows** ~~squawfish~~ throughout the migratory corridor to identify times and places where **pikeminnows** ~~squawfish~~ are vulnerable to control measures, to document sources of recruitment and to provide the data necessary to monitor responses of **pikeminnows** ~~squawfish~~ populations to control measures.

5.7B.3 Monitor the ~~squawfish~~ **pikeminnow** program effectiveness directly; i.e., measure total consumption by the predators, or rate of survival by the salmon, or both, if feasible. Other monitoring indices such as exploitation rates in the fisheries and age structures of the **pikeminnow**~~squawfish~~ populations, are ancillary and informative for analyzing the program operations. The control program will be implemented and evaluated in a phased process, beginning at one or two carefully selected locations and then expanding to more areas. Evaluations should quantify changes in predator populations and in the overall rate of predation. Provide an annual report to the Council on the effectiveness of this program.

5.7B.4 Expand the program that monitors fish communities and populations to measure and assess the effects of **pikeminnow**~~squawfish~~ control. Of particular interest would be other salmon predators and competitors, and any changes in their impacts on salmon concurrent with changes in squawfish population levels.

5.7B.5 Explore the development of methods to reduce **pikeminnow**~~squawfish~~ population numbers at all appropriate life stages. ~~Continue the present fisheries (sport reward fishery, dam angling and commercial harvest) as interim measures until more directly effective methods of squawfish control are found and implemented~~.

5. ~~7B.6 Explore the development of methods to capture squawfish by concentrating them through flow manipulation or other means into slack water areas where they would be more or less isolated from migratory salmonids and more vulnerable to capture.~~

~~5.7B.7 Examine potential conditions and feasibility for the use of Squoxin.~~

5.7B.8 Implement a formal process for annual peer review of the program performance.

Shad

5.7B.9 Explore population ecology of shad to determine the extent of adverse interactions with salmonids and identify effective methods for control.

5.7B.10 Concurrent with exploration of population ecology, develop programs to eliminate shad from the Columbia System above Bonneville Dam. Alternative upstream passage designs should be evaluated to find methods for preventing the upstream passage of shad while allowing salmon and steelhead to pass. The program will have to account for the very large biomass of adult shad that enter the system each year, and include components for separation of shad from salmon, their removal from the waterway, and their utilization in some responsible way.

5.7B.11 Managers should use whatever methods are available to reduce the numbers of shad that spawn below Bonneville Dam.

Other Non-Native Fishes

5.7B.12 Wherever non-indigenous species exist with listed species or other weak runs, use any measures practicable to reduce populations of non-indigenous species. In addition, recruitment of these species into habitats of the listed species should be curtailed.

5.7B.13 Sport harvest of non-indigenous species should be allowed anytime, with no bag limit or size restrictions.

5.7B.14 There should be no programs that would directly improve habitats, production, or survival of introduced species.

5.7B.15 Monitor populations of non-indigenous species as part of the program that monitors reservoir fish populations and communities that was recommended for squawfish control. These data and other information should be used to identify potential times and places that populations of these species are vulnerable to control measures.

5.7B.16 Application of the provisions and authority of the Non-indigenous Aquatic Nuisance Prevention and Control Act of 1990 should be evaluated and pursued as a vehicle to control and reduce the populations of non-native fishes in the area inhabited by the listed species.

~~Steelhead~~

5~~.7B.17 Assure that all hatchery steelhead are released at a time and in a physiological condition that will encourage rapid migration through the Columbia River system to reduce the extent of interactions with natural stocks of salmon and steelhead.~~

Trout

5.7B.18 No hatchery trout should be released into waters essential for spawning and rearing of the listed species or weak stocks unless alternate planting strategies can be used that will reduce predation-competition to acceptable levels.

5.7B.19 Evaluate the effect of native trout on survival of the listed species in areas where the listed species and other weak stocks cohabit.

Birds

5.7B.20 Add predation by birds in the Columbia and Snake river reservoirs as part of a continuing monitoring and assessment program, including examination of stomach contents.

5.7B.21 Initiate a comprehensive study immediately to evaluate salmonid consumption in the estuary. Emphasize Caspian tern and cormorant colonies utilizing manmade dredge-spoil islands in the lower river.

5.7B.22 Identify non-lethal methods of control. For example, netting or other materials can be employed to interfere with the ability of birds to reach the fish, or manmade habitats can be altered to limit population size.

Corps of Engineers, Bonneville and Federal Energy Regulatory Commission

5.7B.23 Evaluate and expeditiously implement measures to reduce smolt mortality due to fish and avian predation at bypass system release sites. Currently, the outfalls dump the fish into the river a short distance downstream from the dams, usually near the shore in an area likely to have high predation rates. Measures should be designed to disperse juvenile fish releases below dams and should include, but not be limited to, modifications to existing bypass system outfall structures, modification of project or bypass system operations.

National Marine Fisheries Service

Additional information is needed regarding the extent of marine mammal impacts on salmon populations.

Marine Mammals

5.7B.24 Investigate the relationship between the Endangered Species Act and the Marine Mammal Protection Act. Seek language in the Marine Mammal Protection Act that will permit the Secretary of Commerce the authority to allow the lethal removal of pinnipeds once all reasonable non-lethal means of deterrence have been exhausted. This type of control should be applied to pinnipeds affecting all weak stocks of salmon and steelhead, not only those that are listed.

5.7B.25 Develop a protocol for marine mammal predation control for immediate implementation in the event that evidence indicates control is needed to support listed species' recovery.

5.7B.26 Collect data on marine mammal distribution and abundance on a year round basis.

5.7B.27 Collect marine mammal food habit data, including the examination of fresh stomach contents from seals and sea lions in an area where they are assumed to be predatory on salmon.

5.7B.28 Observe and document the incidence and location of salmon predation. This should include the incidence of removal of salmon from fishing gear.

5.7B.29 Radio-tag chinook as they enter the mouth of the lower river so they can be tracked to ascertain their interactions with the marine mammal population.

5.7B.30 Radio-tag seals and sea lions.

5.7B.31 Radio-tag scarred fish at Bonneville Dam to determine their survival during the up-river migration.

5.7B.32 Conduct captive predation studies to validate the causes of scarring and determine size and species preference.

5.7B.33 Develop a computer model to simulate the effects of removing non-breeding male sea lions.

Mid-Columbia Public Utility Districts

Predators in Mid-Columbia

5.7B.34 Subject to Federal Energy Regulatory Commission approval, develop a coordinated study plan with the fishery managers to evaluate the extent of predation on juvenile salmon migrating through the five mid-Columbia River reservoirs. By October 1993, all five reservoirs should be indexed for predator populations. The public utility districts should prepare a comprehensive report on the extent of predation and predator indexing in the five mid-Columbia River reservoirs by January 1994. The three mid-Columbia coordinating committees should consult with the Council to determine the need for predator control programs. If the mid-Columbia coordinating committees and the Council jointly determine that predator control programs are warranted, then the public utility districts will implement, monitor and evaluate measures to alleviate juvenile salmonid predation in the appropriate reaches of the five mid-Columbia reservoirs beginning in June 1994.

5.8 TRANSPORTATION

In coordination with the region's fish and wildlife agencies and Indian tribes, the Corps of Engineers operates a large-scale program to collect and transport in barges juvenile salmon and steelhead to reduce predation and passage loss. This program has been an integral part of the region's fish passage enhancement measures since 1981.

The Council recognizes that despite considerable research and evaluation on the benefits of transportation, much disagreement remains. A similar degree of controversy surrounds other passage measures, such as the benefits derived from flow and water velocity augmentation. ~~These significant scientific uncertainties and their impacts on the region's abilities to develop an effective fish passage strategy are the basis for the mainstem passage experiment described in Section 5.0.~~

~~In the near term, especially in low-water conditions, transportation is one of the few tools the region has for improving salmon survival. In the longer term, depending on results of continuing evaluation, transportation may be useful in the mix of techniques the region will use to decrease salmon mortality associated with migration through the reservoirs.~~ However, transportation should not be regarded as a substitute for changes in the river ecosystem.

Generally, the Council encourages an interim strategy that substantially reduces**, leading to elimination of** the number of fish ~~transported~~ **transported.**~~and evaluates transportation survival versus inriver survival.~~ Transportation should not be used as a device to delay substantial improvements in inriver survival conditions. In-season transportation decisions should be made by the fish managers. In the case of stocks listed under the Endangered Species Act, these decisions will be made by the National Marine Fisheries Service in consultation with other fish managers). ~~Accordingly, the Council calls on the National Marine Fisheries Service, in collaboration with the tribes, state fishery managers and the Corps, to aggressively evaluate and implement transportation in keeping with the spread the risk concept and as part of an experimental design to evaluate inriver and transportation migration survival and returns to adult spawners. This approach will likely involve significant modification to the present operation of transportation, including the present policy of transporting all fish collected at Lower Granite, except fish collected for research purposes.~~ An essential component of this strategy is the comparison of survival to adult return under the two modes of passage, ideally back to the spawning ground or hatchery. Transportation required for the evaluation, or as a survival measure, should be in accordance with guidelines developed by the fish managers. The Council recommends guidelines consistent with the following:

- For Endangered Species Act sample groups: Because the fish will be placed at risk through handling and marking, the number of fish assigned to be transported and inriver sample groups in any year, should be limited to the minimum necessary for study design purposes and should be determined by the National Marine Fisheries Service in consultation with other fish managers. In years with very low expected numbers of migrating juveniles, prudence may dictate no sample groups for that year.

- For all other Endangered Species Act-listed migrants: Other juvenile migrants should be allowed to migrate inriver except as the National Marine Fisheries Service, in consultation with other fish managers, judges inriver conditions to be extremely adverse (for low water or other reasons). Except under such conditions, the Council expects significantly fewer than half the juveniles would be transported in any year.

- For other non Endangered Species Act-listed migrants: Other juvenile migrants should be allowed to migrate inriver except as the fish managers judge inriver conditions to be extremely adverse (for low water or other reasons). Except under such conditions, the Council expects significantly fewer than half the juveniles would be transported in any year.

~~The Council believes that transportation is likely to play a role in the region's salmon recovery plan. At the same time, it is apparent that additional information is needed about when and how transportation may benefit fish survival and how survival under transportation compares to the survival of fish migrating in the river. In addition, several innovative ideas for alternative transportation collection systems, techniques and management have been suggested during the amendment process. These should be investigated using the services of outside contractors and other available parties, as needed, to accelerate implementation of such improvements. The region would benefit from a regular infusion of creative ideas for the improvement of~~

transportation management and operations from a broad spectrum of interests. The Council encourages other parties to come forward with creative ideas for transportation, and calls on the transportation operators to take these ideas into full account.

5.8A Transportation Implementation and Evaluation

Corps of Engineers

5.8A.1 In consultation with National Marine Fisheries Service, continue transportation of Snake River fall chinook. Transportation may occur in the Snake River after subyearling fall chinook migrants compose 10 percent of the daily total chinook collection for three consecutive days at Lower Granite Dam. Transportation will not occur in the Columbia River until subyearling migrants compose 80 percent of the daily total chinook collection for three consecutive days at McNary Dam.

National Marine Fisheries Service

5.8A.2 Develop and ensure implementation of a program to compare the survival of transported juvenile spring chinook and, if possible, fall chinook, with fish that migrated through the river over a range of environmental conditions. This evaluation should be based on survival to adult return, ideally to the spawning grounds. The evaluation should minimize its impact on the migration through marking and handling. If possible, the evaluation should be based on collection from a single upriver project to avoid experimental conflicts.

Fishery Managers and Corps of Engineers

5.8A.3 Beginning in 1995, conduct smolt transportation in the Snake River according to the spread-the-risk concept and consistent with the guidelines described in measure 5.8A.1 above and with the experimental design developed by the National Marine Fisheries Service described in measure 5.8A.2. Consistent with the guidelines above, the proportion of the run to be transported in any year beyond evaluation needs will be determined by the fish managers.

5.8A.4 Manage the transportation program to minimize conflict with the evaluation program.

5.8A.5 Utilize the available barges to direct load collected fish into the transportation vehicle rather than holding collected fish in the raceways. Take steps to minimize migrational delay at the project by ensuring that barges are held at the projects for no more than 12 hours. It is expected that the spread-the-risk concept will result in a smaller proportion of the run being transported relative to the situation that has prevailed in the past several years. For this reason, it is hoped that direct loading under spread the risk can be accomplished with few additional barges. However, if this is not possible, then the Corps should immediately take steps to construct and acquire the additional barges necessary to permit direct loading.

Corps of Engineers

5.8A.6 On an expedited basis, improve salmon transportation by upgrading facilities and improving operations. Improvements should include direct loading of fish without

~~holding them in raceways after collection, enlarging transport barge exits, minimizing fish densities, reducing stress in holding areas through shading or other means, developing smolt release strategies, including dispersing fish to minimize predation and reducing noise levels in the barges and collection facilities. Immediately evaluate the feasibility of constructing and operating acclimation facilities below Bonneville Dam and alternative release sites farther downriver. Report to the Council annually by the end of each year on the status of these improvements and evaluations and on the feasibility of increasing transport benefits.~~

~~5.8A.7 Expedite funding for a preliminary evaluation of the feasibility and benefits of net pens to increase survival of transported fish by reducing mortality associated with bypass outfall areas. The evaluation will include preliminary engineering, as well as economic and biological parameters. Report results of the evaluation to the Council by December 31, 1995.~~

~~**Bonneville**~~

~~5.8A.8 Continue to conduct research on the survival of hatchery, wild and naturally spawning chinook salmon from headwater production areas to mainstem transport sites to determine the extent of mortality prior to transportation. Determine the cause (e.g., water quantity, water quality, food supply, disease, smolt quality, predation, etc.) of any high mortality rates prior to transport.~~

5.9 PURSUE MONITORING AND DISPUTE RESOLUTION

5.9A Monitoring

Bonneville

5.9A.1 Fund an annual smolt monitoring program to be conducted by the fish and wildlife agencies and tribes. The monitoring program will provide information on the migrating characteristics of the various stocks of salmon and steelhead within the Columbia River Basin. The program should include:

- field monitoring of smolt movement to determine the best timing for storage releases;
- coordination of runoff forecasts with water budget use and shaping;
- continuous monitoring of runoff conditions and fish movement at Lower Granite and Priest Rapids dams to give information for changes in water budget use if actual runoff conditions are inconsistent with runoff forecasts; and
- coordination of hatchery releases with water budget use.

- **Fund studies to investigate diseases that occur at fish passage facilities.**

5.9B Dispute Settlement

Fish Passage Manager and Fish Operations Executive Committee

5.9B.1 In the event that the fish and wildlife agencies and tribes are unable to agree on a flow schedule for the water budget, the fish passage manager**s** immediately will notify the Fish Operations Executive Committee, which will assist them in promptly resolving the

dispute. In the event the dispute cannot be resolved, the Council may establish and transmit to the Corps of Engineers a schedule for the water budget.

Fish Operations Executive Committee

5.9B.2 If federal project operators and regulators cannot resolve planning and operational disputes related to mainstem fish operations, the Fish Operations Executive Committee will meet with representatives of those entities to help resolve the dispute.

Section 6

ADULT SALMON MIGRATION

Mainstem Columbia and Snake river hydroelectric projects and some tributary projects are physical barriers to adult salmon and steelhead migrating from the ocean to spawning areas upstream. To solve this problem, adult fish passage facilities have been constructed at 13 mainstem dams on the Snake and Columbia rivers. Water flows and spill guidelines also have been adopted to provide unimpeded passage and maximum attraction of fish to the fishway entrances.

However, at some adult passage facilities, there are still problems that result in delayed passage and mortality. For example, flow and spill conditions intended to assist juvenile migrants at some dams tend to discourage upstream fish migration, mask the flows that attract fish to the fishway or induce fallback so that fish must relocate and re-ascend the ladder. These conditions may also increase total dissolved gas in the water to levels lethal to both fish and fish food organisms. **The ISAB (NWPPC 1999) noted that adult passage problems were many and that adult passage have been given limited attention in the Corps' capital construction program.**

In addition, inadequacies in certain mainstem adult passage facilities and in the operation and maintenance of these facilities create passage delays or otherwise reduce the success of adult fish passage. Losses and delays of returning adult salmon and steelhead at each dam due to upstream migration problems can be significant and have a cumulative effect. Reducing these passage mortalities could increase significantly the number of adult salmon available for harvest and escapement.

The Council has adopted a number of measures to improve adult migrant survival. The Council calls on the Corps of Engineers to implement all spill and operating criteria for mainstem adult fish passage facilities and to make needed improvements. In addition, the Council calls on the Corps to leave juvenile fish screens installed for a longer period to provide protection for adult salmon that fall back through the powerhouse. The Council also recommends adding project biologists to routinely inspect fish passage facilities at mainstem Corps dams. The Corps should conduct various evaluations and studies to improve the effectiveness of passage facilities and, ultimately, the survival of adult salmon and steelhead.

In addition, the fish and wildlife agencies and tribes pointed out that some disease problems in migrating salmon and steelhead may be caused or intensified by their concentration at fish ladders. The Council maintains that this problem warrants further research and calls for research on fish disease at passage facilities.

6.1 IMPROVE ADULT SALMON SURVIVAL

6.1A Mainstem Operations and Facilities

Corps of Engineers and National Marine Fisheries Service

6.1A.1 Adhere to all existing fishway operating and spill criteria. The fish passage committee (Section 5.3B.14) should evaluate and the Corps should implement needed improvements in criteria jointly with fishery managers:

- operate all fishways according to agreed-upon criteria;
- minimize power peaking, establish ramping rates for daily flow operations and eliminate zero-flow operations;
- operate spillways and turbines to enhance fish passage;
- reduce fish ladder water temperatures;
- install additional auxiliary water systems for attraction flow and improve entrances and exits of existing ladders.

6.1A.2 Complete the evaluation of all mainstem adult passage facilities, the need for new facilities, the effectiveness of entrance attraction flows and fishway hydraulics by December 1, **2001**~~1996~~. Make facility improvements as necessary. Provide and install, as necessary, back-up parts, attraction water pumps or fish turbines at each dam for use in the event of failure of these systems **by December 1, 2002**.

6.1A.3 ~~When adult fallback is a documented problem, keep fish screens in place at each dam beyond the juvenile migration period as indicated in the fishway operating criteria developed with the fishery managers. This is subject to the need for annual screen maintenance.~~

6.1A.4 As determined by the fish passage committee (Section 5.3B.14), the Corps should continue to upgrade existing adult fish passage facilities, including:

- automate control systems;
- place staff gauges (flow measuring devices) in areas that are accessible for both reading and cleaning;
- provide velocity meters in areas of known low velocity in the collection channels;
- ~~construct additional adult ladders at Lower Granite and Little Goose dams by 1999;~~
- provide increased attraction water for fish ladder collection channels and entrances by 1997;
- modify adult collection channel at McNary Dam ~~by 1996~~;
- construct adult collection channel extensions at Lower Granite and Little Goose dams by **2002**~~1998~~;

- complete adult fishway modifications and improvements at Bonneville Dam by **2002**~~1997~~, and
- investigate covering existing ladders.

6.1A.5 **Fund**~~Provide an adequate number of~~**two** trained staff **from the tribes and fishery agencies per dam** to regularly inspect both adult and juvenile fish passage facilities at each of the eight federal mainstem dams on a frequent basis throughout the fish passage season to ensure all fish facilities are operating according to agreed-upon criteria **between the fish managers and the Corps**.

6.1B Adult Salmon Research

Corps of Engineers

6.1B.1 Evaluate the effects of shad population increases on adult salmon passage at mainstem dams. Include in the evaluation the feasibility of selective shad removal in adult ladders. Report results to the Council by November 1994.

6.1B.2 Evaluate potential methods for decreasing water temperature in mainstem fish ladders and apply where appropriate **by December 2004**.

~~6.1B.3 Evaluate the effects on adult salmon passage of zero nighttime flow conditions in the lower Snake River. Report results to the Council.~~

6.1B.3 Conduct adult telemetry evaluations, capable of tracking individual fish to spawning areas for comparison of spawner success and distribution with the populations at large. Conduct temperature and hydraulic studies at each dam fishway. Note problem areas identified by telemetry and temperature and hydraulic studies and implement structural remedies at all dams by 2005.

National Marine Fisheries Service

6.1B.4 Evaluate the effects of increased spill for juvenile salmon on adult salmon passage, particularly in the early morning hours. Investigate modifications to adult fish facilities or project operations to improve adult passage during spill operations. Report results to Council by **2002**~~1997.~~ Upon Council approval, implement needed measures to reduce the impact of spill operations on adult passage.

Corps of Engineers and Bonneville

6.1B.5 To improve the accuracy of the present adult fish counting procedures, **implement**~~evaluate the feasibility and benefits of using~~ video-based or other automatic counting and species-recognition systems for monitoring adult fish passage at mainstem Columbia and Snake river dams **by 2003**. Report results to the Council. ~~If approved by the Council, institute video-based counting of adult fish at appropriate locations.~~

Bonneville, Corps of Engineers and National Marine Fisheries Service

6.1B.6 Continue research and development on the feasibility of installing adult fish PIT-tag detectors in the adult fish passage facilities of mainstem dams~~, including consideration of the capability of removing selected fish stocks for transport.~~ If feasible, develop

installation schedule and install adult fish PIT-tag detectors in adult fish passage facilities of mainstem dams as soon as possible. Report results of research, installation schedule and progress on installation to the Council by February **2002**~~1995~~ and annually thereafter.

6.1B.7 Fund studies to investigate diseases that occur at fish passage facilities. A number of diseases that affect adult **and juvenile** fish have been associated with fish ladders and attraction facilities at existing dams. Studies are needed to document the extent to which these disease problems cause losses of fish.

Corps of Engineers, Bonneville and Fishery Managers

6.1B.8 Evaluate the extent and identify the causes of interdam adult salmon losses, including non-dam losses, and take action to address these causes, as necessary. Report results to the Council by January 1996.

6.1C Improve Flows for Naturally Spawning Fall Chinook

Vernita Bar

The Vernita Bar section of the Columbia River immediately below Priest Rapids Dam in the Hanford Reach is extremely valuable for natural production of fall chinook salmon. Significant declines in production have occurred since the 1970s. The fish and wildlife agencies have shown that increasing flows above the present 36,000 cubic-feet per second minimum flow level would provide increased spawning habitat.

~~Fish and Wildlife Agencies, Tribes and~~ Grant County, Chelan County, Douglas County Public Utility Districts, Bonneville, Corps, Reclamation

6.1C.1 Comply with the **spawning and emergence** flow plan for Vernita Bar incorporated into the Federal Energy Regulatory Commission license for Priest Rapids Dam. **Annually implement a flow plan that reduces fluctuations to no more than plus or minus 10% of daily average flows for the previous 24 hour flow period from the time of emergence to the time that Hanford fry have migrated from shoreline areas. This time will be decided by the tribes and fishery agencies signators in the Vernita Bar Agreement. Consider amending the Vernita Bar Agreement to include the stranding flow plan.**

6.1C.2 Evaluate the effectiveness of the improved flows for fish production at the Vernita Bar and report the results of this evaluation to the Council and the Federal Energy Regulatory Commission.

6.1C.1 Bonneville and Grant County PUD
Countine to fund fishery agency and tribal monitoring of juvenile stranding in the Hanford Reach. Expand funding to increases the robustness of loss estimates.

Below Hells Canyon

The last remaining free-flowing stretch of the mid-Snake River is below Hells Canyon Dam. The fish and wildlife agencies and tribes believe that this stretch could be improved

for fall chinook salmon and steelhead spawning by establishing minimum flows and limits on river level fluctuations.

Bonneville and Idaho Power Company

6.1C.3 In consultation with the fish and wildlife agencies and tribes, fund studies to investigate the effects of establishing improved flows for fisheries production below Hells Canyon Dam, including a minimum flow for the spawning, incubation and rearing of salmon and steelhead, and of establishing limits on river level fluctuations. These studies shall also include estimates of power losses associated with improved flows.

6.1D Snake River Temperatures

Corps of Engineers, Bonneville, National Marine Fisheries Service and Other Parties

6.1D.1 If Dworshak Reservoir is above elevation 1,520 feet at the end of July, its use for temperature control evaluation will be addressed by the Fish Operations Executive Committee~~.~~ **Concurrance by the Nez Perce Tribe and the State of Idaho are necessary to use storage below elevation 1520 feet.**

Relevant Parties

6.1D.2 Seek funding assistance for necessary modifications to recreational and commercial facilities to allow Dworshak Reservoir to operate at reduced levels to improve survival of fall chinook consistent with the mitigation provisions of this program (See Section 9).

Idaho Power Company and Federal Energy Regulatory Commission

6.1D.3 Annually, during September, draft **at least** 100,000 acre-feet from Brownlee Reservoir to help reduce Snake River water temperatures for adult fish passage (See Section 5.2A.10). In addition, pass **at least** 100,000 acre-feet of water from the Snake River Basin through the Hells Canyon hydropower complex. (See Section 5.2D.2)

Bonneville and Corps of Engineers, in Cooperation with Idaho Power Company and Other Interested Parties

6.1D.4 Continue to evaluate whether releasing cool water from both Dworshak Dam and the Hells Canyon Complex during August and September improves adult fall chinook survival. This evaluation should be consistent with the guidelines specified in Sections 6.1D.1 and 6.1D.3. The objective of this evaluation is to reduce water temperatures at Ice Harbor Dam by September 1 of each year, and to determine the effectiveness of these operations on adult fish survival and passage through the lower Snake River. Report results of this evaluation to the Council annually by December 31. Policy and technical guidance for determining the magnitude and timing of Snake River temperature control releases from Dworshak and Brownlee should be provided in a July meeting of the Fish Operations Executive Committee.

6.1D.5 Upgrade the COLTEMP[30] **and EPA** water temperature prediction model**s** using the data and knowledge gained from all previous water temperature control operations and monitoring. **Expand predictive modeling to the Mid and Lower Columbia reaches.**

6.1D.6 Collect meteorological and hydrological data that will identify the effect of tributary watershed management and resulting inflow temperatures on mainstem Snake River water temperatures. Add to the existing water temperature data monitoring network. Include additional water temperature and velocity measurements from the lower Snake River.

6.1D.7 Conduct additional salmon and steelhead migration studies, and coordinate with ongoing fish migration and behavior studies, such as timing, movement, fallback, straying and other characteristics. Report results to the Council annually.

6.1D.8 Provide for coordinated data base management.

6.1E Mid-Columbia Dams

Mid-Columbia Public Utility Districts

6.1E.1 Subject to Federal Energy Regulatory Commission approval, evaluate adult fish passage**, including steelhead kelts,** at each mid-Columbia public utility district project to determine if losses are occurring at or between the dams. This study should include adult fish count evaluations and development of a coordinated, comprehensive study plan with fishery managers to evaluate existing adult fish passage at all five mid-Columbia dams and reservoirs, including determination of optimum flows and development of spill configuration guidelines to improve upstream migration conditions. To the extent possible, such evaluations should be coordinated with similar adult fish passage studies being planned by the Corps of Engineers for the federal Columbia River mainstem projects. These evaluations also should complement the terms of existing Federal Energy Regulatory Commission Wells and Rock Island Settlement Agreements between Douglas and Chelan County public utility districts and fishery managers. Compile the results of such evaluations into a comprehensive report on adult fish passage at the five mid-Columbia public utility districts projects and submit the report to the Federal Energy Regulatory Commission, the Council and members of the three mid-Columbia coordinating committees.

Douglas County Public Utility District

6.1E.2 Based on results of adult fish passage research and in consultation with the Wells Coordinating Committee, identify and correct all adult fishway deficiencies at Wells Dam, including hydraulic problems in the junction pools, by **2002**~~1996~~.

Chelan County Public Utility District

[30] COLTEMP is a Columbia River Basin water temperature model developed by the U.S. Army Corps of Engineers. It is used to predict water temperatures under alternative reservoir release strategies.

6.1E.3 Based on results of adult fish passage research and in consultation with the Mid-Columbia Coordinating Committee, identify and correct all adult fishway deficiencies at Rocky Reach Dam, including hydraulic problems in the junction pools, by **2003**~~1996~~.

6.1E.4 At Rock Island Project, implement the operating criteria and adult fishway modifications provided in Section F, "Adult Fish Ladders" of the Settlement Agreement dated April 24, 1987, filed in the relicensing proceeding for Project 943 and FERC Docket Nos. E-9569, et al. Based on results of adult fish passage research and in consultation with the Rock Island Coordinating Committee, identify and correct all adult fishway deficiencies, including hydraulic problems in the junction pools and installation of additional pumps, by **2003**~~1996~~.

Grant County Public Utility District

6.1E.5 Based on results of adult fish passage research and in consultation with the Mid-Columbia Coordinating Committee, identify and correct all adult fishway deficiencies by **2003**~~1995~~ at Priest Rapids Dam and by **2003**~~1996~~ at Wanapum Dam. **Install state-of-the-art fish counting facilities at both dams by April 2002. In consultation with the Mid-Columbia Coordinating Committee, design and prototype structural improvements to the Priest Rapids junction pool by April 2003.**

6.1F Maintenance Plans

Federal Project Operators and Regulators

6.1F.1 Develop a plan for repair and maintenance of any part of each dam relating to the passage of adult salmon and steelhead, including: 1) measures to be followed in the event that any such facility breaks, is washed out or ceases to operate; and 2) designation of an individual responsible for carrying out the plan. If any dam operator fails to comply with the plan, the Council will ask the person responsible for carrying out the plan to explain at a Council meeting the reasons for the non-compliance. The Council will decide upon appropriate action at that time.

6.1G Structural Modifications to Adult Fishways

Corps and Mid-Columbia Public Utility Districts

6.16.1 By ~~1996,~~**December 2002** in consultation with fish managers, complete a structural analysis of all mainstem fishways. Make any needed immediate corrections to structural elements such as diffuser gratings and orifices. Eliminate point and non-point pollution sources correctable by minor structural modifications. Undertake a comprehensive evaluation of the impact of juvenile bypass systems on adults that fall back downstream through them.

Projects Proposed as Measures under this Section

***Measures*:**

Short term recommendations (2001-2004).

- **The Corps shall implement necessary flood control flexibility to meet reservoir elevation objectives described in the next section and normative hydrograph index points described above to meet at least a 420 kcfs peak at The Dalles in early June for all runoff years. [31] The Corps shall seek flexibility in flood control in storage reservoirs basinwide, including the Hells Canyon Complex. Manage late fall and winter flood control releases of Bureau of Reclamation storage in upper Snake reservoirs during late August and September to augment flows for adult fall chinook and steelhead. Data from Reclamation indicates that many upper Snake Reservoir storage are near full during the late summer and fall months and must be excavated for flood control in the winter.**

- **BPA shall purchase of at least 0.5-1 MAF of flood control storage space from Canadian entities. This space will be used to store water to create the normative hydrograph and to assure that storage reservoirs meet IRC and other biological criteria.**

Long term recommendations (2004-2006)

- **The Corps shall implement a basin wide review of flood control focusing on additional flood control flexibility. This review shall be completed by the end of 2003.**

Reservoir Storage and Flow Augmentation

Reservoir storage should be managed to meet normative hydrograph objectives, IRCs and other biological criteria. Flood control flexibility and augmentation of flow from irrigation sources and flood control storage space are necessary to meet normative hydrograph and reservoir elevation objectives.

The normative river concept calls for stabilizing upper storage reservoirs by utilizing integrated rule curves and other biological curves established for Libby,

[31] In 1999 and in past years, summer salmon flows could have been much better if the Corps had implemented flexible flood control management in storage reservoirs. While CRITFC and state fishery agencies supported keeping storage reservoirs at higher elevations during the spring because weather forecasts indicated that the late spring runoff would be protracted, the Corps emptied storage reservoirs and they were never refilled. For example, Dworshak Reservoir remained about ten feet below full going into the summer migration period. Currently, the Corps manages flood control to extremely conservative levels without Congressional authorization. In an average water year with January-July runoff of 102 MAF, the Corps manages for control points (peak hydrograph) at The Dalles between 330-350 kcfs when they have authorization to manage for a flood control point of 550 kcfs at The Dalles (Corps 1997). The Corps should expedite a basin wide flood control review in a NEPA process.

Hungry Horse, Dworshak and Lake Roosevelt consistent with the findings of the ISAB in *Ecological impacts of the flow provisions of the Biological Opinion for endangered Snake River salmon on resident fishes in the Hungry Horse, and Libby system in Montana, Idaho and British Columbia* (Report 97-3; ISAB 1997).

Under current storage reservoir management by the federal operators, storage reservoir and flow objectives are not being met. For example, in 1998, the Grand Coulee storage elevation of 1280 mean sea level (msl) by April 10 was not met, as called for by RPA #1 (1995-1998 Opinion as modified by the FCRPS 1998 supplemental opinion). Flows during the spring chinook and summer chinook and steelhead migration were short nearly 1 million acre feet (maf) of storage because of this action.

The 1995-1998 FCRPS biological opinion also calls for Reclamation to take all reasonable steps to secure additional volumes of water in the upper Snake River beyond the 427 thousand acre feet (kaf) after 1998 (p. 100 Opinion). In 1997, operation of the Hells Canyon Complex prevented passing the full 427 kaf through the Complex to provide salmon flows. Further, NMFS was to conduct a study with the FERC licensee of the Complex to consider adjustments to project operations to assure that the 427 kaf would be passed through for salmon (p. 101 Opinion). NMFS consultation with FERC on this issue was to occur. To date, the study with the Hells Canyon Complex licensee has not been conducted, nor has consultation with FERC been concluded. To CRITFC's knowledge, NMFS has not issued a final biological opinion on Reclamation's 1998 biological assessment on the availability of acquiring additional upper Snake River water for listed juvenile and adult migrants.

RPA #1 (1995-1998 Opinion) that calls for consultation of the federal agencies to secure an additional 3.5 maf of Canadian storage (p. 101 Opinion) through flood control reallocations and summer drafting of Arrow Reservoir for average and below average runoff years. The Opinion states that if the Corps and BPA fail to make "significant progress' on obtaining these volumes, then consultation will take place. To CRITFC's knowledge this consultation has not occurred. Additionally, NMFS has not consulted with Reclamation to secure 0.5-1 maf of storage from the Columbia Basin Irrigation Project as recommended by CRITFC for the 1998 Supplemental Opinion for listed steelhead (CRITFC 1998).

CRITFC recommends operating Libby and Hungry Horse to integrated rule curves and if possible, stabilizing Lake Roosevelt to elevation 1283 during August and particularly September. In order to assure these criteria for Lake Roosevelt elevation, at least 500 kaf of water intended for Banks Lake should remain in Lake Roosevelt.

***Measures*:**

Short term (2001-2004)

- **The Bureau of Reclamation shall secure additional amounts of water to enhance flows and reservoir storage requirements including an additional 0.5 MAF from the upper Snake where irrigation currently appropriates about 7 MAF from the Snake River.**

- **The Bureau of Reclamation shall secure additional amounts of water to enhance flows and reservoir storage requirements including an additional 0.5 MAF from the Banks Lake and/or the Columbia Basin Irrigation Project which current appropriates 2.7 MAF from the Columbia River. Maintain Lake Roosevelt at elevation of at least 1283 during August and do not fill Lake Roosevelt above elevation 1283 during September, but pass all inflows thorough the storage reservoirs to the Lower Columbia**

- **The BPA shall purchase an additional 1 MAF from Canadian storage**

- **The Bureau of Reclamation and the Corps of Engineers shall operate Libby and Hungry Horse to integrated rule curves, stabilize Dworshak to elevation 1600 by August 1 and stabilize Lake Roosevelt to elevation 1283 during August and September.**

- **FERC should require Idaho Power Company to use the Upper Snake water to keep the Brownlee pool near elevation 2058 and pass all additional flow. Brownlee should remain near full pool, until storage is needed to augment fish flows.**

- **Dworshak Reservoir management. The federal operators shall follow the Nez Perce Tribe and State of Idaho Management Plan. Flexibility is needed in the timing of Dworshak flood control excavations. There should be water for a spring and August peak of 14 kcfs. During spring keep the reservoir near full in order to sustain the 14 kcfs flows. Then the pool should be filled to elevation 1600 by early June. Keep Dworshak full until August 1 unless water quality concerns force earlier excavation.[32] Flows for the first half of September should be 12 kcfs to support adult passage in the Clearwater and flush remaining juveniles. Studies indicate that increased flow with temperature control promotes better spawner distribution, and facilitates adult passage (Bjornn 1999 unpublished data; Heinith 1992 unpublished data; Cramer et al. 1985; McGie 1992; Mundy et al. 1998).[33] The Independent Scientific Advisory Board (1999) estimates that one adult fall chinook escaping to the spawning grounds represents 1500 fall chinook smolts successfully passing eight mainstem dams. Bjornn (1999, unpublished data) has demonstrated that adult steelhead passage is substantially benefited from cool water augmentation. Lichatowich and**

[32] The decision to implement an earlier excavation will be made in-season consistent with the Nez Perce Tribe and State of Idaho's 2000 Dworshak operations plan.

[33] In a comprehensive study of factors that influence salmon production, Lichatowich and Cramer (1979) found that timing of spawning and spawner distribution had low coefficients of var

Cramer (1979) found that the low coefficient of variation (high sensitivity) for measurements of spawner distribution to upper river areas was an influential parameter for salmonid productivity. Geist et al. (1997) suggest that adult fall chinook that are delayed more that five days by dams may have insufficient energy reserves to complete spawning.

……..

- **Implement Seasonal Drawdowns. Implement an experimental drawdown of Lower Granite Reservoir to elevation 723 by June 20 to augment the declining Snake hydrograph and to improve critical rearing habitat and passage for subyearling fall chinook. Do not fill the reservoir until October 31, after adult migrants have passed upstream of the reservoir. Drawdown and maintain John Day and McNary reservoirs to plus or minus 1.5 feet of minimum operating pool from March 20-October 31. Operate the remaining Lower Snake reservoirs at Minimum Operating Pool until November 1.**

Biological rationale: **Drawing down these reservoirs will improve critical rearing habitat and expedite water particle travel time and passage survival. Operating pools at MOP will reduce water particle travel time, facilitating juvenile and adult passage. Heat transfer analyses indicate that Lower Granite drawdown will make limited cool water releases from Dworshak more effective, and better meet temperature water quality standards. Radio telemetry studies indicate that Lower Snake River adult passage does not appear to be impacted when fishway entrances are at MOP (Bjornn, 1997,unpublished data).**

Power Peaking and Ramp Flows. To prevent stranding of juvenile migrants and to maintain riparian community integrity, Dworshak releases should be ramped at a rate of 6 inches per hour as measured at the Clearwater gage below Dworshak Dam. Adjust Dworshak release temperatures to meet the 68 degree water quality standard as measured in the scrollcase at Lower Granite Dam. At the Hells Canyon Complex, limit all flow reductions by ramping rates of no more than 6 inches per hour as measured at Lime Point. Such impacts have caused fishery managers to invoke ramping rate criteria to limit power peaking activities in tributaries to less than a two inch per hour change to shoreline areas (Hunter 1992). In the Hanford Reach, reduce power peaking from federal projects upstream to ramp flows a rate of no more than 2 inches per hour during the early emergence of Hanford fry (March 20- April 20).

Biological Rationale: **The NMFS' 1995 FCRPS biological opinion does not call for any provisions that restrict daily flow fluctuations. Extreme flow fluctuations that routinely occur in a 24 hour period from power peaking makes it difficult, if not impossible, for adult fishways and juvenile bypass systems to consistently remain in hydraulic criteria. These criteria are essential to meet fish facility performance standards established by the state and federal fisheries agencies and tribes (DFOP**

1993). Studies have shown that adult passage is significantly delayed by power peaking activities (DFOP 1993).

Power peaking can impact critical riparian habitat by limiting invertebrate production and diversity (Gislasen 1985) and is contrary to the normative river concept (ISG 1996). Dramatic flow fluctuations from power peaking can strand juvenile salmon in shallow littoral areas causing direct mortality of many fish (Hunter 1992; Wagner et al. 1998).

Spill Operations: CRITFC recommends the following spill operations be implemented at all federal and FERC licensed mainstem hydro projects. Spill has been consistently shown to provide the best route of juvenile and adult passage through mainstem dams.

Spill levels can be modified based upon real-time monitoring of physical and biological parameters at the discretion of the tribes and fish and wildlife management agencies.

> ***Measure*: Spill to the total dissolved gas waiver level at each mainstem dam for 24 hours a day from April 10 – September 30.[34] Limited spill (about 3-5 kcfs per dam) for adult downstream passage should continue until adult salmon and steelhead cease to pass the dams.**

Other Spill actions:

1. ~~1.~~**11. Relax and seek flexibility in rigid flood control rule curves to recreate normative hydrographs and reclaim floodplain habitat;**
2. ~~2.~~**12. Spill and/or surface bypass to achieve 80% Fish Passage Efficiency (FPE) or better through non-powerhouse routes;**
3. ~~3.~~**13. Turbine operation within 1% of peak efficiency;**
4. ~~4.~~**14. Reduced water level fluctuations from power peaking operations;**
5. ~~5.~~**15. New and/or improved turbine technology and efficiency;**
6. ~~6.~~**16. Predator reduction and abatement;**
7. ~~7.~~**17. Water temperature and total dissolved gas reduction and abatement to comply with the federal Clean Water Act;**
8. ~~8.~~**18. Additional adult fish ladders, new designs and structural improvements to existing ladders and improved maintenance of existing ladders;**
9. ~~9.~~**19. Restrict new dredging and improve existing dredging management practices and;**
10. ~~10.~~**20. 24-hour video fish counting**

[34] The initiation of spill should be determined by the tribes and fishery management agencies by the presence of migrating juvenile and adult salmonids using passage systems, hydroacoustic methods and in-river sampling. The dates provided are general planning dates. Spill at Bonneville Dam for the passage of Spring Creek Hatchery migrants should be provided for at least 10 days in March at the levels and times recommended for the general anadromous fish populations.

Modify Snake River Dams to Natural River Conditions: Restore natural river levels, conditions and habitat in the Lower Snake River by removing the earthen embankments at Ice Harbor, Lower Monumental, Little Goose and Lower Granite dams, and mitigate for the economic and other short-term impacts that will occur; draw down Lower Granite reservoir to 710 feet (spillway crest) until embankment removal is accomplished. Complete removal by 2006. This action will restore approximately 9,000 acres of spawning habitat for Snake River fall chinook. It will also improve migration survival for juvenile and adult salmon and steelhead and lower water temperatures.

John Day Drawdown: Draw down the reservoir behind John Day Dam to Minimum Operating Pool (MOP) immediately, and to spillway crest or natural river level, on a year-round basis, in the near-term. Complete the drawdown by 2008. This action will restore approximately 40 miles of spawning habitat for Columbia River fall chinook. It will also improve migration survival for juvenile and adult salmon and steelhead and reduce water temperatures.

Water Management: Manage water resources to more closely mimic the natural, historic river hydrograph (for example, through improved utilization of water from Canadian storage, Banks Lake and various irrigation projects) but maintain, to the maximum extent practicable, full, stable water levels in Lake Roosevelt and in Libby, Dworshak and Hungry Horse reservoirs according to their Integrated Rule Curves and consistent with the Northwest Power Planning Council's Fish and Wildlife Program

Improve Passage: Develop juvenile and adult anadromous fish passage capabilities, employing any and all possible biological, engineering/technological, legal, political and societal means, to circumvent the current artificial barriers to anadromous fish migration at Chief Joseph and Grand Coulee dams, Dworshak Dam and the Hells Canyon Complex (Hells Canyon, Oxbow and Brownlee dams)

Protect and restore estuary habitat: Protect critical estuary habitat and restore former estuary habitat

Improve Water Quality: Improve water quality in the mainstem Columbia and Snake Rivers by reducing or eliminating toxic pollution sources and other contaminant discharges in compliance with applicable water quality criteria (at a minimum)

Protect the Hanford Reach: Designate the Hanford Reach of the Columbia River under the federal Wild and Scenic Rivers Act, and re-establish normative river conditions there

Specific Measures and Implementation Dates

Item	Project	Compl Date	RefYr Cap Cost
Juvenile			
Surface bypass	LWG	2001	44730
Juv bypass system	LWG	2001	1305
Natural river drawdown	LWG	2006	225000
Adult			
Fish ladder temperature control: study	LWG	2002	730
AWS and emergency AWS	LWG	2002	5000
Adult Pit-tag detectors	LWG	2002	1000
Picketed lead fences	LWG	1997	68
Adult fishway temperature control/add pumps	LWG	2002	1000
Juvenile			
Natural river drawdown	LGS	2006	225000
Adult			
Adult fishway temperature control/add pumps	LGS	2003	1000
AWS and emergency AWS	LGS	2002	5000
Juvenile			
Natural river drawdown	LMN	2007	225000
Gas abatement-fast track end bay deflectors/spillway modifications	LMN	2004	10000

Adult			
Adult fishway temperature control/add pumps	LMN	2001	2000
AWS and emergency AWS	LMN	2003	5000
Juvenile			
Surface bypass	IHR	2001	1580
Natural river drawdown	IHR	2007	225000
Adult			
Adult fishway temperature control/add pumps	IHR	2003	2000
Adult PIT-tag detectors	IHR	2003	2000
AWS and emergency AWS	IHR	2003	3500
Juvenile			
Gas abatement- fast track end bay defectors and spillway modifications	MCN	2004	20000
Gas abatement/side channel spillway	MCN	2012	740000
Adult			
Fishway temp.control/structural modifications	MCN	2006	5000
Auxillary water supply	MCN	2003	450
Adult PIT-tag detectors	MCN	2004	2000
Juvenile			
Surface bypass- skeleton bay	JDA	2004	40000

Surface bypass studies	JDA	2003	10122
Surf.bypass-spillway/gate mods for juv/adult passage	JDA	2002	10000
Surface bypass -prototype channel	JDA	2004	12000
Adult			
Reduce Jumping in Pool/Weir Adult Lad.	JDA	2002	8700
Fishway exit modifications	JDA	2002	5000
Reconfigure conduit	JDA	2002	15000
Restrain pollution	JDA	2002	500
Emerg. aux. water supply	JDA	2004	30000
Fishway temp. control/structural modifications	JDA	2004	5000
Other			
Phase II Drawdown study	JDA	2003	7000
Juvenile			
Surface bypass	TDA	2003	10277
Sluiceway outfall relocation	TDA	2002	10000
Spillway mods./weirs/notched alternate gates	TDA	2002	12000
Spillway mods./weirs/notched remaining gates	TDA	2004	6000
Juv. screen bypass system-studies/prototypes	TDA	2004	21513
Juv. screened bypass system w/ barging mods/implemented	TDA	2005	160000
Gas abatement-fast track endbay deflectors/modify spillway	TDA	2008	12000
Adult			
Emerg. water supply study	TDA	2002	1108
Emergency auxillary water supply	TDA	2002	40000
Adult channel dewatering	TDA	2002	6000
Install bulkheads, reduce collection channel leaks	TDA	2002	6000
Automate S. Shore Exit Weir	TDA	2002	2000

New fishway designs-increase attraction flows	TDA	2006	12000
Fishway/east ladder sluiceway for adult fallback	TDA	2006	10000
Temperature control- structural modifications	TDA	2006	5000
Juvenile			
Surface bypass prototype	BON1	2004	54114
PH2 guidance device	BON2	2001	30000
Surface bypass B 2	BON2	2008	81000
Gas abatement/fast track endbay deflectors-spillway mods	BON	2003	24000
Gas abatement/baffled spillway/raised tailrace	BON	2010	706000
Adult			
Auxillary water supply (powerhouse 2)	BON2	2003	10000
Modify B 2 trashracks/ Emerg. AWS	BON2	2002	15000
Adult lamprey passage study	BON	2003	500
PH2 Mod. Shad Removal	BON2	2002	1000
PH1 Entrance Weir Mod. (Criteria)	BON1	2002	4500
Adult flat plate PIT-tag detector	BON2	2002	293
Adult PIT-tag detectors	BON	2002	2000
Fishway Redesign; Increase Attraction Flow	BON	2005	25000
Temp Control-structural modifications	BON	2005	5000
Other			
Lamprey passage improvement mods.	BON	2005	3500
System Improvements			

Completed mitigation analysis	SYS	2002	28450
Drawdown test	SYS	2002	3050
Gas abatement program	SYS	2002	24554
Adult passage L. Columbia	SYS	2002	2738
L Snake feasibility study	SYS	2002	19716
Aux water supply Snake	SYS	2002	466
Fishway temp control evaluation	SYS	2002	673
NPD review	SYS	2002	374
Turbine model study	SYS	2002	1047
Turbine passage survival PH1	SYS	2002	11323
Completed acoustic technology	SYS	2002	1942
Separator evaluation	SYS	2002	4654
Dispersed release	SYS	2002	2420
Dispersed release	SYS	2002	1880
Regional research facility	SYS	2003	20000
FGE at Little Goose	SYS	2002	200
Chief Joseph temperature control/multiport outlet	CHJ	2011	40000
Chief Joseph gas abatement-extended deflectors	CHJ	2004	40000
Dworshak gas abatement	DWR	2010	10000
Libby gas abatement: 3 turbines or flow deflectors	LBY	2007	20000
G.Coulee gas abatement	BUR	2008	300000
Willamette River temperature control	COU	2007	70000
Adult Passage Middle F. Willamette	DEX, LOP	2007	15000
S. Santiam fishery restoration	GPR	2007	9000
COE-Lower Snake Compens.	LSRP	2002	14700
COE-Lower Snake Compens.	LSRP	2006	73500
COE-Lower Snake Compens.	LSRP	2012	35000

total	166821

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